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Power

Ref: APL/MEL/EMD/EC/MoEFCC/391/11/24
Date: 27.11.2024.

To,
Additional Principal Chief Conservator of Forest
Ministry of Environment, Forest and Climate Change
Integrated Regional Office, Bhopal
Kendriya Paryavaran Bhavan,
Link Road No- 3, E-5, Ravi Shankar Nagar
Bhopal - 462 016 (M.P)

Sub: Six Monthly Compliance Status report of Environment Clearances for Phase I & II by Mahan Energen Ltd. at Village Bandhaura, District Singrauli, Madhya Pradesh.

Ref: 1. Environmental clearance letter no. **J-13011/56/2006-IA.II (T)** Dated- 20.04.2007 & Its subsequent amendment vide letter dated 10.02.2009, 23.08.2013 and 08.04.2016 & EC transfer dated 15.09.2022

2. Environment Clearance F. No. **J-13011/56/2006-IA.II (T)**, EC Identification No. EC23A004MP195224 dated 02.08.2023.

Dear Sir,

With reference to above subject, please find enclosed herewith Six-Monthly Environment Clearances (EC) compliance status report **(Phase I & II)** along with Environmental monitoring reports, Fly ash & CSR Report etc. for the period of **April'2024 to September'2024** in soft (**e-mail**).

This is for your kind information & record please.

Thanking You,
Yours faithfully,
for **Mahan Energen Limited**

(R N Shukla)
Head Environment & Forest

Encl: as above

CC:

Member Secretary
Central Pollution Control Board
Parivesh Bhavan, East Arjun Nagar
Kendriya Paryavaran Bhawan
New Delhi- 110 032.

Member Secretary,
Madhya Pradesh Pollution Control Board
Paryavaran Parisar, E-5, Arera Colony,
Bhopal, MP

The Regional Officer
Madhya Pradesh Pollution Control Board
Waidhan, Navgarh, Singrauli, MP-486887

SIX MONTHLY COMPLIANCE REPORT
OF
ENVIRONMENTAL CLEARANCE (EC's)

For

2800 (Phase-I 2x600 and Phase-II 2x800) MW

Thermal Power Plant

At

Village Bandhaura, Tehsil Mada,
District Singrauli, Madhya Pradesh

Submitted to:

Integrated Regional Office, Bhopal
Ministry of Environment & Forest & Climate Change
Central Pollution Control Board, New Delhi &
Madhya Pradesh Pollution Control Board, Bhopal

adani
Power

Submitted By:

Environment Management Department
Mahan Energen Limited
Bandhaura Village, Mada Tehsil, Singrauli
District, Madhya Pradesh-486 886

Period: April'2024 to September'2024

CONTENTS

Mahan Energen Limited

Introduction:

Mahan Energen Limited a wholly owned subsidiary of Adani Power Limited is Coal based Thermal Power Plant situated at Village Bandhaura, Khairahi, Karsualal and Nagwa in Singrauli District of Madhya Pradesh. The Plant has total capacity of 2800 MW (Phase I: 2x600 MW – Operational and Phase II: 2x800 MW Construction started).

Adani Power Limited has implemented the Approved Resolution Plan and acquired 100% of paid-up share capital and management control of EPMPL on 16.03.2022. "Mahan Energen Limited" is wholly owned subsidiary of Adani Power Limited and incorporated under Companies (Incorporation) Rules, 2014 date 25.03.2022.

The Environmental Clearance for **Phase I** was granted by MoEFCC vide No. J-13011/56/2006-IA. II(T) dated 20.04.2007 and its subsequent amendment vide letter dated 10.02.2009, 23.08.2013, 08.04.2016 and 16.07.2023 and transferred EC from Essar Power MP Limited **to Mahan Energen Limited** was granted on 15.09.2022.

Consent to Establish (CTE) and Consent to Operate (CTO) for Phase I already obtained from MPPCB and both Units are operational.

Status of the Expansion Project - Phase- II (2x800 MW):

Environmental Clearance (EC) granted for Expansion of Bandhaura Thermal Power Plant of capacity 2x800 MW vide F. No. J-13011/56/2006-IA. II (T), EC Identification No. EC23A004MP195224 on dated: 02.08.2023 from MoEFCC, New Delhi

Consent to Establish (CTE): Consent to Establish granted vide CTE no. 58920 dated 27.09.2023 from Madhya Pradesh Pollution Control Board valid up to 31.08.2028.

Construction work of Thermal Power Plant is started & under progress and financial closure achieved.

Mahan Energen Ltd. has also proposed the expansion by addition of 2x800 MW under Phase-III, Terms of Reference (ToR) has been granted by MoEFCC vide file no. File No: J-13011/56/2006-IA.II(T) dated: 02.07.2024.

Mahan Energen Limited

COMPLIANCE STATUS ON ENVIRONMENTAL CLEARANCE
Phase-I
1200 (2×600) MW Coal Based Thermal Power Plant
Vide letter No. J-13011/56/2006-IA.II (T) dated 20.04.2007 and
its subsequent amendment dated 10.02.2009: 23.08.2013, 08.04.2016.
and EC transferred from Essar Power to Mahan Energen Ltd. on 15.09.2022.
Amendment in EC dated 16.07.2023.

A	Specific Condition	Compliance Status
(i)	The total land requirement shall not exceed 700 ha for all activities/ facilities of the power project put together.	Complied. Project activities/Facilities of the Power Project have been developed within 700 ha.
(ii)	Forestry clearance for diversion of 70 ha forest land involved in the project shall be obtained before starting construction on the forest land.	Compiled The forest area is optimised to 34.98 ha now. Stage-1 FC has been obtained from MoEFCC vide letter no.6-MPC 043/2008-BHO/822 dated. 02.04.2009 and final diversion of land does not proceed. **No construction activities have been taken place in the forest land and No Forest land is involved.**
(iii)	R&R in sufficient detail shall be finalized before award of the project and a copy of the detailed R&R shall be submitted to MoEF within three months of the issue of this letter or before the award of the project whichever is earlier.	Complied As previous, R&R Benefits are being provided as per Madhya Pradesh R&R policy 2002 and in line with agreement executed on 18.10.2008 between Collector, Singrauli and EPMPL. Copy of the agreement with MP Govt. has been forwarded to MoEFCC vide our letter no. EPMPL/ MoEF/ 07.07.2010. Adani Power Limited has implemented the Approved Resolution Plan and acquired 100% of paid-up share capital and management control of EPMPL on 16.03.2022. "Mahan Energen Limited" is wholly owned subsidiary of Adani Power Limited
(iv)	The PAFs/ PAPs losing their homesteads, or a major portion of the land shall not be ousted from the land till they are settled at the alternate sites.	Complied R&R implementation as per the agreement dated; 05.09.2007 has been done. All payments as per the demand received from the state government & local administration have been made, plots allotted to all the homesteads. Supporting documents already submitted with EC compliance report.
(v)	Ash and sulphur content in the coal to be used in the project shall not exceed 35% and 0.5% respectively.	Complied. Ash and Sulphur content in the coal is being maintained below 35% & 0.5% respectively. MEL Power Plant is based on Pit head TPP

		and all parameters are being achieved as per notification.
(vi)	Two bi-flue stacks of 275m height each shall be provided with continuous online monitoring equipment. Exit velocity of at least 25m/sec shall be maintained.	Complied One bi-flue stack of 275 M height has been installed. Also, CEMS (Continuous emission monitoring system) has been provided for both units. Exit velocity is maintained > 25m/s. Stack emission monitoring Report is enclosed as **Annexure-I.**
(vii)	High efficiency electrostatic precipitators (ESPs) with efficiency not less than 99.9% shall be installed to ensure that particulate emission does not exceed 100 mg/Nm3.	Complied ESP (9 Fields) with efficiency of 99.9% installed in both the units to meet permissible norm for particulate emissions less than 50 mg/Nm3. Stack Emission Monitoring Report has been provided as **Annexure – I.**
(viii)	Space provision shall be made for Flue Gas De-sulphurisation (FGD) unit, if required at a later stage.	Complied Space for FGD has been provided in the adjacent to chimney. As per MoEFCC Notification dated 5th Sep 2022, Mahan TPP fall under Category "C" Non-retiring TPPs and the timelines for compliance of SO2 emission is up to December'2026.
(ix)	Low NOx burners shall be provided.	Complied Low NOx burners have already been provided in each boiler.
(x)	Adequate dust extraction system such as bag filters and water spray system in dusty areas such as coal and ash handling areas, transfer areas and other vulnerable areas shall be provided.	Compiled Dust extraction systems over fly ash silo, coal bunkers and conveyor junction points have been installed. Dry fog diffusion systems have already been provided in coal crusher house and conveyor transfer points. Water sprinkling system & Mobile Fog Cannon has been provided in coal yard area.
(xi)	Fly ash shall be collected in dry form and ash generated shall be used in a phased manner as per provisions of the notification on Fly Ash Utilization issued by the Ministry in September 1999 and its amendments. By the end of 9th year full fly ash utilization should be ensured. Unutilized ash shall be disposed of in the ash pond in the form of High Concentration Slurry.	Complied. MoUs/Agreements have been signed with Cement Industries as M/s Prism Johnson Limited Cement and M/s Birla Corporation India Limited (BCIL) to lift the fly ash generated from the power plant. We have also signed a MOU with "Ashtech (India) Private Ltd." for lifting the Ash being generated from the Power Plant. Only unutilized Ash is being sent to Ash dyke /pond. Ash generation and utilization report is enclosed as **Annexure- IV.**
(xii)	Ash pond shall be lined with HDPE geo-synthetic membrane to avoid leaching. Adequate safety	Complied

	measures shall be implanted to protect the ash pond bund from getting breached.	HDPE lining has been provided in the ash pond. The ash pond operates with HCSD system. Adequate safety measures such as proper bund slope, toe drain around the dyke, etc., have been taken to protect the bund.
(xiii)	A conservation plan for Schedule-1 animals reported in the study area of the project shall be prepared in consultation with an expert organization like Wildlife Institute of India at Dehradun and duly approved by State Wildlife Department of Madhya Pradesh. A copy of the same shall be submitted to the ministry and Regional Office at Bhopal within six months of the date of issue of this letter. The plan so prepared shall be implemented effectively. Necessary allocation of funds for the same shall be made and will be included as project cost.	Complied Ecological Assessment and Flora & Fauna Wildlife Conservation & Management Plan has been prepared by M/s. Good Earth Enviro Care in Association with Department of Environment Management, Indian Institute of Social Welfare & Business Management, Kolkata and report is submitted to PCCF – WL, Bhopal vide **letter no APL/MEL/Env/ PCCF/407/23 dated; 03.04.2023, copy is eclosed as Annexure IV.** We have also reiterated PCCF-WL, Bhopal vide letter no. APL/MEL/Env/PCCF/409/24 dated: 19.10.2024 for necessary action. The plan will be implemented with due approval of CWLW.
(xiv)	Rain water harvesting shall be practiced. A detailed scheme for rain water harvesting to recharge the ground water aquifer shall be prepared in consultation with Central Ground Water Authority/ State Ground Water Board and a copy of the same shall be submitted within 3 months to the Ministry.	Complied Rainwater Harvesting study carried out & report is submitted to Regional Director, Central Ground Water Board, Bhopal & Member Secretary, Central Ground Water Authority, New Delhi. vide letter no. APL/MEL/ENV/CGWA/404/23 dated; 03.04.2023. Rainwater harvesting within the plant premises has been constructed/ implemented to harvest the rainwater. Acknowledged copy submitted in previous compliance. Pond deepening work is being carried out in Five-Six ponds in villages falling under the area. More than 400 farmers availed benefits from pond deepening for irrigation in their agricultural land.
(xv)	The treated effluents conforming to the prescribed standards only shall be discharged in the Bhalea nallah.	Complied. Effluent is being treated suitably and analysis results are well within the stipulated MPPCB/CPCB standard by the process of neutralizing and treated water being used for gardening. We are maintaining zero discharge of treated effluent. Effluent analysis results are provided as Annexure–I.

(xvi)	Regular monitoring of ground water in and around the ash pond area shall be carried out, records maintained, and periodic reports shall be furnished to the Regional Office of the Ministry.	Complied Regular monitoring of ground water is being carried out in and around the ash pond area. Record is maintained and enclosed as **Annexure – I.**
(xvii)	A 100 m wide green belt shall be developed all around the plant area and 20 m wide green belt shall be developed all around the ash pond and township covering a total area of 100 ha.	Being Complied Greenbelt is developed is about 122.21 ha area.
(xviii)	First aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.	Complied
(xix)	Leq of Noise Level should be limited to 75 dBA and regular maintenance of equipment to be undertaken. For people working in high noise areas, personal protection devices should be provided.	Complied Leq of noise level at project boundary is being monitored and observed less than 75 dB (A). People working in high noise area are provided with PPEs like ear- muff and ear plug. Monitoring report is enclosed as **Annexure–I.**
(xx)	Regular monitoring of the ambient air quality shall be carried out in and around the power plant and records maintained. 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.	Complied. Online CAAQ monitoring system for Ambient air quality is already established. Ambient Air Quality Monitoring is also being carried out by third party consultant. Monitoring reports is enclosed as **Annexure-I.** Records of the same are being maintained and report is being sent to the Regional Office of the MoEFCC, CPCB & MPPCB. Online ambient air quality system also connected with MPPCB & CPCB portal.
(xxi)	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, informing that the project has been accorded environmental clearance and copies of clearance letters are available with the State Pollution Control Board/ Committee and may also be seen at website of the Ministry of Environment and Forests at http://www.envfor.nic.in.	Complied.
(xxii)	A separate environment monitoring cell (EMC) with suitable qualified staff should be set up for implementation of the stipulated environmental safeguards.	Complied We have established separate environmental monitoring cell with well qualified staff and Sr. management to carry out regular surveillance for implementation of stipulated environmental safeguards.

(xxiii)	A half yearly report on the status of implantation of the stipulated conditions and environmental safeguards should be submitted to this Ministry, its Regional Office at Bhopal, CPCB and SPCB.	Complied Six monthly compliance reports is being submitted regularly. Last compliance report for the period of October' 2023- March '2024 submitted vide letter no. APL/MEL/EMD/ EC/ MoEFCC /287/05/24 dated 24.05.2024.
(xxiv)	Regional Office of the Ministry of Environment & Forests located at Bhopal will monitor the implementation of the stipulated conditions. A complete set of documents including 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.	Complied. All necessary information forwarded to the MoEFCC Regional Office, Bhopal on regular basis.
(xxv)	Separate funds should be allocated for implementation of environmental protection measures along with item-wise break-up. This cost should be included as part of the project cost. The funds earmarked for the environment protection measures should not be diverted for other purposes and year-wise expenditure should be reported to the Ministry.	Complied Separate Budget has been allocated for the Environmental Protection Measures by Mahan Energen Limited the details of expenditure on Environmental protection for April'24 to Sept'24 is enclosed as **Annexure-VI**.
(xxvi)	Full cooperation should be extended to the scientists/ officers from the Ministry/ Regional Office of the Ministry at Bhopal/ the CPCB/ the SPCB who would be monitoring the compliance of environmental status.	Full co-operation & support is being extended to all the Govt visiting officials always.
	EC Amendment vide letter no. J-13011/56/2006 -IA. II (T) dated: 23.08.2013	
(xxvii)	The project proponent shall upload the status of compliance of the conditions stipulated in the environmental clearance issued vide this Ministry's letter of even no. dated 20.04.2007. in its website and updated periodically and also simultaneously send the same by e-mail to the Regional Office of the Ministry of Environment and Forests.	Complied. EC compliance report of Mahan Energen Limited is being uploaded on Adani Power website and soft copy is being sent to Regional Office of MoEFCC, CPCB and MPPCB.
(xxviii)	Criteria pollutants levels including NOx, RSPM (PM-10 & PM-2.5) SO2, NOx (from stack & ambient air) shall be regularly monitored and results displayed in your website and also at the main gate of the power plant.	Complied. Criteria pollutants levels including NOx, RSPM (PM-10 & PM-2.5) SO2, NOx (from stack & ambient air) being regularly monitored, and results are displayed at the main gate of the Power Plant & same being submitted to concern authorities. Monthly Env. Monitoring are being done by third party also and report is being sent to pollution control board on monthly basis.

		Environmental monitoring report is enclosed as **Annexure-I.**
(xxix)	Avenue plantation along the route (both sides of the road) of imported coal transportation from railway siding at Mahadiya /Singrauli Railway Siding to Rajmilan-Bandhoura- Power Plant site, over a distance of 63 kms shall be raised by the project proponent at its own cost. The status of implementation shall be submitted to the Regional Office of the Ministry.	Being Complied Plantation is being done on the roadside. Domestic Coal is being used for the operation of Power Plant and Coal is procured through Forward e-auction from the nearby Coal mines of SECL/NCL. At present transportation of the coal is not being done through **Mahadiya Coal siding.**
(xxx)	It shall be ensured that only mechanized covered trucks are used for imported coal transportation.	Complied The transportation by road is done through mechanically covered trucks to the extent possible, else through tarpaulin covered trucks to prevent coal dust dispersion in the atmosphere.
(xxxi)	A long-term study of radioactivity and heavy metals contents on coal to be used shall be carried out through a reputed institute once the power plant becomes operational. Thereafter mechanism for all in-built continuous monitoring for radioactivity and heavy metals in coal and fly ash (including bottom ash) shall be put in place.	Complied Domestic Coal are being used for power generation for Mahan TPP. Periodical coal and ash analysis are being carried out through a reputed institute. M/s Bhabha Atomic Research Centre (BARC), Department of Atomic Energy, Govt. of India for Radioactivity and heavy metal contents and reports is being submitted periodically with Six monthly EC compliance report to Ministry, CPCB and MPPCB. For provision of In-built mechanism continuous monitoring for radio activity and heavy metals in coal and fly ash (including bottom ash), the technology and monitoring instrument is not available with the suppliers in the country and is not feasible to monitor in this mechanism. Analysis Report of Radioactivity in Coal Sample is enclosed as **Annexure-II.** MoEFCC has already been amended in Environmental Clearance (EC) in CONDITION NO. (xxxi) vide F. No. J-13011/56/2006-IAII (T) dated; 16th July' 2023.
(xxxii)	The recommendation of the Central Electricity Authority issued vide it's letter no. 159/100ITP&I/CEA/2011, dated 01.02.2013, on the feasibility of transportation of coal from Mahadiya Railway Siding to Mahan TPP site shall be implemented.	Currently transportation of the coal is not being done through Mahadiya Railway siding. Coal is procured through e-auction from the nearby Coal mines of Northern coal Field and APMDCL-Suliyari Coal mine.

(xxxiii)	The project proponent shall maintain a log book of imported coal and Bill of Imports for coal to establish that the coal used for the power project are additional coal coming to the country. These documents shall be submitted to the Regional Office of the Ministry from time to time.	MEL is not using Imported Coal for Power plant. We are mostly procuring the Coal through Forward e-auction from the nearby Coal mines as NCL/SECL.
	EC Amendment vide letter no. J-13011/56/2006 -IA.II (T) dated 08.04.2016	
(xxxiv)	The Sulphur and ash contents of domestic coal shall not exceed 0.5% and 35 % respectively. The coal shall be sourced through e-auction only in case of emergency and non-viability of imported coal. In case of variation of quality at any point of time, fresh reference shall be made to the Ministry for suitable amendments to the environmental clearance. However, for the imported coal, the ash and sulphur contents will be as specified in the earlier order.	Complied Mahan Energen Limited currently procuring coal through domestic sources only. Ash and Sulphur and ash content in the coal is being maintained below 35% & 0.5% respectively and also being complied as per notification of **Pit head based TPP.** Ash content in Coal report is enclosed as **Annexure III.**
(xxxv)	The road transportation shall be restricted to the route as approved earlier vide amendment dated 23.08.2013.	Compiled Road transportation is being done as per the local administration instruction/approved route only and with mechanically covered truck and with instruction of Local Administration. Transportation of Coal through Conveyor Belt is under progress and Stage-I in Principle approval granted by IRO, MoEFCC, Bhopal vide letter FP/MP/Others/405152/2022 dated: 04.02.2024 for Coal conveyor belt area & project work will be completed by December'2026.
(xxxvi)	The transportation by road shall be through mechanically covered trucks to the extent feasible, else through tarpaulin covered trucks so as to prevent coal dust dispersion in the atmosphere.	Compiled & followed. Transporting of the coal is being done through trucks covered with tarpaulin with proper sealing arrangement as per the MoEFCC and local authority direction.
(xxxvii)	Harnessing solar power within the premises of the plant particularly at available roof tops shall be carried out and status of implementation including actual generation of solar power shall be submitted along with half yearly monitoring report.	Being Complied 100 Nos. Solar Power streetlights has been installed within the plant premises. We have already installed Solar power panels in Township.
(xxxviii)	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	Complied Regular monitoring of surface water quality is being carried out on regular basis.

	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.	Record are maintained & also report are sent to the Regional Office of the Ministry, CPCB & MPPCB on regular basis. Analysis Report of Surface Water Quality is enclosed as **Annexure-I.**
(xxxix)	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	Complied There is no disturbance caused to any water body including natural drainage system in the area due to operation of the plant.
(xl)	CSR 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 CSR 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.	Compiled & being followed. CSR activities / programs are totally based on the need of the community having special focus on livelihood generation, health and education. Separate budget is allocated for CSR programs. For livelihood restoration of displaced people monthly sustenance allowance (Bhatta) is being given to PAPs. Local youths are also engaged under different contractors working inside the plant to provide them relevant training, exposure & livelihood. CSR progress report is enclosed as **Annexure-V.**
(xli)	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.	Being Complied & compliance assured on regular basis. CSR activities are implemented in consultation and collaboration with nearby community & Panchayats leader as well as District Administration. Regular community meetings are organized in all the villages to understand the issues of community. Social development activities have been carried out for Need Based under the CSR activities by Adani Foundation.
(xlii)	An Environmental Cell comprising of at least one expert in environmental science/ engineering, ecology, occupational health and social science, shall be created preferably at the project site itself and shall be headed by an officer of appropriate superiority and qualification. It shall be ensured that the Head of the Cell shall directly report to the Head of the Plant who would be accountable for implementation of environmental regulations and social impact improvement/mitigation measures.	Complied We have established separate environmental monitoring cell with well qualified staff to carry out regular surveillance for implementation of stipulated environmental safeguards.
EC Transferred from Essar to Mahan Energen Limited on dated 15th September 2022		

Mahan Energen Limited

1.	2X600 MW Mahan Super Thermal Power Project at Tehsil Mada, District- Singrauli (Madhya Pradesh)- Transfer of environmental clearance from M/s Essar Power (M.P.) Ltd. to M/s Mahan Energen Limited-reg This has reference to your online proposal no. IA/MP/THE/269676/2022 dated 26th April 2022 regarding transfer of the Environmental clearance (EC) for the above said project from M/s Essar Power (M.P.) Ltd to M/s **Mahan Energen Limited**.	Noted
2.	The ministry had earlier issued EC for 4x200 MW Mahan super thermal power project at tehsil Mada, District- Singrauli (Madhya Pradesh) in favour of M/s Essar Power (M.P.) Limited vide letter dated 20th April 2007, the said EC was further amended vide letter 10th Feb 2009, 23rd August'2013 and 18th April'2016 for reducing the power generation capacity to 3 x 600 MW, changing the fuel source and extending the validity of EC.	Noted.
3.	As per details submitted by the PP the M/s Essar Power (M.P.) Limited (earlier owner) could achieve the capacity of 2 x 600 = 1200 MW only within the validity period of EC i.e.,19.04.2017 against the EC generated (reduced the capacity 3x 600 MW) by the Ministry to the aforesaid plant. Accordingly, CTO was obtained from SPCB vide letter dated 30.08.2016 from commissioned capacity i.e. 2 x 600 MW.	Noted
4.	M/s Mahan Energen Limited has informed that the unit of M/s Essar power M P Limited was admitted into the corporate Insolvency Resolution process (CIRP) vide order dated 29.09.2020 passed by National Company Law Tribunal New Delhi and M/s Adani Power Ltd has acquired 100% paid share capital and Management control of M/s Essar power (M.P.) Ltd, and thus necessitating transfer of al requisite approvals in the name of M/s Mahan Energen Limited.	Noted & agreed.
5.	M/s Mahan Energen Limited has submitted and affidavit to abide by the terms and conditions stipulated in the environmental clearance 20th April 2007 and its subsequent amendments dated 10th February 2009, 23rd August 2013 and 08th April, 2016 issued in the name of M/s Mahan Energen Limited.	Noted and being complied. Environment clearance 20th April 2007 and its subsequent amendments dated 10th February 2009, 23rd August 2013 and 08th April 2016.

6.	As per the relevant provision of the EIA Notification 2006, the environmental clearance granted by the ministry vide letter No. J-13011/56/2006-IA-II(T) dated 20th April 2007 and its subsequent amendments dated 10th February, 2009, 23rd August, 2013 and 8th April, 2016 to the project 4 x200 MW (3X600 MW reduced capacity) MW Mahan Super Thermal Power Project at Tehsil- Mada, Village-Bandhaura, Nagwa, Karsualal and Khairahi, District- Singrauli, Madhya Pradesh is hereby transferred from M/s Essar power (M.P) Limited to M/s Mahan Energen Limited, with the condition that the aforesaid power plant will be operated on the power generation capacity 2 x600 MW Further expansion shall be taken up only after prior Environmental Clearance under the vision of the EIA Notification, 2006, as amended. The other terms and condition as mentioned in the initial Environmental Clearance and its further amendments shall remaining unchanged.	Noted & agreed
7.	This issued with approval of the competent authority.	Noted.

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Mahan Energen Limited

Compliance Status of Environmental Clearance (Phase-II)

1600 MW (2×800 MW) Expansion of Bandhaura Thermal Power Plant

Environment Clearance F. No. J-13011/56/2006-IA. II(T)

EC Identification No. EC23A004MP195224 dated 02.08.2023

Sl. No.	Specific Conditions	Compliance Status
(i)	As already committed by the project proponent, Zero Liquid Discharge shall be ensured, and no waste/treated water shall be discharged outside the premises.	Noted & agreed Compliance assured during operation phase. Plant design is based on Zero Liquid Discharge (ZLD). Generated wastewater will be treated in ETP & STP, and treated water will be recycled/reused with in the plant premises.
(ii)	Peripheral Green belt (Three row plantation) with Miyawaki plantation technique of 15 m thickness along the plant boundary shall be developed with more than 90% survival rate of the plant species. It would be ensured that total 33% area of total project cover area is under green cover focusing on Ash Dyke area.	Being Complied.
(iii)	Make a plan for pollution control with the consultation of State Pollution Control Board and submit implementation report with compliance report.	Noted & compliance assured. MEL has already submitted details of pollution control system (Air & Water) along with EIA & EMP report same will be implemented during construction and operation.
(iv)	No Coal shall be transported through the villages and no coal shall be transported through road beyond 2026 and no extension shall be granted in this regard.	Compliance assured. The Transportation of Coal will be done through Conveyor Belt. Forest Clearance/approval obtained from MoEFCC. Stage-I in Principle approval granted by IRO, MoEFCC, Bhopal vide letter FP/MP/ Others/405152/2022 dated: 04.02.2024 for Coal conveyor belt area & construction will be completed by December 2026.
(v)	Extensive green cover within 2 km range of the plant boundary shall be developed. An action plan in this regard to be prepared in consultation with CPCB/expert institution and submitted before Regional Office of the Ministry within 3 months.	Being followed The study is already conducted by the Reputed Government institute, Indian Institute of Social Welfare and Business Management (IISWBM, Kolkata) Environment Management Department. The study report is enclosed as **Annexure – X.**
(vi)	24x7 online monitoring system for ambient air quality shall be established with its connectivity with SPCB and CPCB server.	Compliance assured during operation phase. MEL has already installed 4 no. of CAAQMS for existing operational plant.

	Stack monitoring shall be done through 24X7 online monitoring system. The emission Standards for Municipal Solid Waste based Thermal Power Plants as per Municipal Solid Waste Rules, 2016 dated 8.4.2016 (S.O. 1357 (E)) shall be complied (Refer Part C of Schedule II of Municipal Solid Waste Rules, 2016 dated 8.4.2016 (S.O. 1357 (E)).	Online Continuous Emission Monitoring System (CEMS) in both units will be installed and data transmission to CPCB and MPPCB portal before commissioning of Plant.
(vii)	Adequate dust extraction system such as cyclones/bag filters and water spray system in dusty areas such as waste delivery points, transfer areas and other vulnerable dusty areas shall be provided along with an environment friendly sludge disposal system. Water Sprinkling on roads shall be done in every 6 hours in winter season and 3 hours in summer season of roads within 1 km range approaching the plant. A logbook shall be maintained for the activity and be in Six-monthly compliance report.	Compliance assured. Adequate dust extraction system will be installed to control the fugitive emission during plant operation. Water Sprinkling on roads is being carried out for dust suppression in around the plant premises.
(viii)	LED display of air quality (Continuous Online monitoring) shall be installed on the roadside (within 1 km range) and nearby hotspots viz. residential colony, Schools Hospitals; maintenance of devices shall be done on regular basis.	Complied LED display board at the main gate of Plant is already installed and operational.
(ix)	Everyday cleaning of Road/Paved roads within 1 km range of plant site shall be ensured throughout the year through vacuum-based vehicle.	Being Complied For Regular cleaning of roads, road sweeping machine has been deployed, water sprinkling system also has been installed for dust suppression.
(x)	Environment Audit of plant shall be done annually, and report shall be submitted to Regional Office of the Ministry.	Compliance assured during plant operation.
(xi)	Project proponent shall explore the use of treated sewage water from the Sewage Treatment Plant of Municipality / local bodies/ similar organization located within 50km radius of the proposed power project to minimize the water drawl from surface water bodies.	Noted As on date there is no STP located within 50 Km radius of plant, feasibility and availability shall be explored.
(xii)	A detailed action plan regarding leachate handling shall be prepared and implemented in consultation with SPCB and the same shall be submitted to the Regional Office of the Ministry. Zero liquid	Noted and compliance assured during plant operation.

	discharge shall be adopted. Leachate shall be treated and reused. No treated leachate shall be discharged in any circumstances. Characteristics of Leachate and the treated leachate shall be monitored once in quarter and records shall be maintained.	
(xiii)	Oil and grease recovered from the treatment plant should be disposed only through authorized recyclers.	Compliance assured during operation phase. Used Oil and grease will be collected and stored properly in designated cover shed and will be disposed off only through authorized recyclers.
(xiv)	Harnessing solar power within the premises of the plant particularly at available roof tops shall be carried out and status of implementation including actual generation of solar power shall be submitted along with half yearly monitoring report.	Being Complied 100 Nos. Solar Power Streetlights already has been installed within the plant premises. Further, Feasibility for harnessing Solar Power is being explored.
(xv)	Fly ash handling shall be done strictly as per extent rules/regulations of the Ministry/CPCB issued from time to time including Ministry's Notification No. S.O.548I(E) dated 31st December 2021.	Noted and Compliance assured during operation phase.
(xvi)	Monitoring of surface water quality and Ground Water 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.	Being Complied.
(xvii)	A well-designed rainwater 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.	Being Complied Rainwater harvesting within the plant premises has been constructed/ implemented to harvest the rainwater. 10 No. storm water recharge pit has been developed. Pond deepening work is being carried out in 5-6 ponds in villages falling under the area. More than 400 farmers availed benefits from pond deepening for irrigation in their agricultural land.

(xviii)	Watershed development plan shall be prepared and implemented focusing on micro watershed development within 10 km radius of the project. Action taken report in this regard be submitted before regional office of the Ministry in 6 monthly compliance report.	Being Complied The study is already conducted by the reputed Government Institute, Indian Institute of Social Welfare and Business Management (IISWBM, Kolkata)–Environment Management Department. The study report is enclosed as **Annexure XI**
(xix)	A detailed ecological monitoring and survey covering forestry, fisheries, wildlife, and its habitat shall be done once in two years to assess the impacts of projects on the local environment and ecology. Monitoring report shall be uploaded on the Parivesh Portal and a copy of the same be submitted to the regional office of MoEF&CC.	Ecological assessment and wildlife conservation & management plan / study" is conducted by the reputed Government Institute, Indian Institute of Social Welfare and Business Management (IISWBM, Kolkata)–Environment Management Department. The study report is enclosed as Annexure XV.
(xx)	For the DG sets, emission limits and the stack height shall be in conformity with the extant regulations and the CPCB guidelines. Acoustic enclosure shall be provided to DG set for controlling the noise pollution.	Compliance assured during plant operation.
(xxi)	An Environmental Cell headed by the Environment Manger with postgraduate qualification in environmental science /environmental engineering, shall be created. It shall be ensured that the Head of the Cell shall directly report to the Head of the Plant who would be accountable for implementation of environmental regulations and social impact improvement/mitigation measures.	Complied We have already established separate environmental monitoring cell with well qualified Environment Manager/staff to carry out regular surveillance for implementation of stipulated environmental safeguards.
(xxii)	The unit shall make the arrangement for protection of possible fire hazards during the manufacturing process in material handling. The firefighting system shall be as per the norms.	Compliance Assured.
(xxiii)	The energy sources for lighting purposes shall preferably be LED based.	Being Complied MEL has already installed LED based lights.
(xxiv)	Public grievance redressal system shall be established under supervision of project head. The functioning of the system shall be reviewed every month.	Being Complied

(xxv)	Epidemiological Study among population within 5 km radius of project cover area shall be carried out on regular interval (Once in two year) through independent agency. Necessary measures shall be taken as per findings of study in consultation with district administration. Action taken report shall be submitted to the Regional Office of the Ministry.	Compliance assured, once in a two years.
(xxvi)	The Project Proponent shall submit the time- bound action plan to the concerned regional office of the Ministry within 6 months from the date of issuance of Environmental Clearance for undertaking the CER activities, committed during public consultation by the project proponent and as discussed by the EAC, in terms of the provisions of the MoEF&CC Office Memorandum No.22-65/2017-IA.III dated 30 September 2020. The action plan shall be implemented within three years of commencement of the project.	Compliance assured. The time- bound action plan for CER activities is already submitted to Ministry, same is enclosed as **Annexure –XII.**
(xxvii)	Occupational health surveillance of the workers shall be done on a regular basis and records maintained as per the Factories Act.	Compliance assured as per the Factories Act.
(xxviii)	A multi-specialty Hospital of 100 beds shall be established and maintained to cater the need of population living within 10 km.	Compliance assured. MEL is already considered to provide multi-specialty hospital along with construction stage (within Five Years).
Miscellaneous		
(xxix)	Consent to Establish/Operate for the project shall be obtained from the State Pollution Control Board as required under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.	Complied Consent to Establish (CTE) has already been obtained from MPPCB vide **CTE no. 58920 dated 27.09.2023 valid up to 31.08.2028.** Copy of CTO submitted in previous compliance report. Consent to Operate (CTO) will be obtained before commissioning of the Plant.
(xxx)	All necessary clearance from the Authority concerned, as may be applicable should be obtained prior to commencement of project or activity.	Noted & already obtained.
B. **I.**	**Standard EC Conditions for Thermal Power Plants:** **Statutory Compliance**	
(i)	Emission Standards for Thermal Power Plants as per Ministry's Notification S.O.	Compliance assured during operation of Plant.

	3305(E) dated 7.12.2015, G.S.R.593 (E) dated 28.6.2018 and as amended from time to time shall be complied.	
(ii)	Part C of Schedule II of Municipal Solid Wastes Rules, 2016 dated 08.04.2016 as amended from time to time shall be complied for power plants based on Municipal Solid Waste.	Not Applicable. The Plant is Coal based Thermal Power Plant.
(iii)	MoEF&CC Notification G.S.R 02(E) dated 2.1.2014 as amended time to time regarding use of raw or blended or beneficiated/washed coal with ash content not exceeding 34% shall be complied with, as applicable.	Compliance assured during operation of Plant
(iv)	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 as amended from time to time shall be complied.	Compliance assured. Fly ash will be utilized as per the MoEFCC notification and its amendments.
(v)	Thermal Power Plants other than the power plants located on coast and using sea water for cooling purposes, shall achieve specific water consumption of 2.5 m3/MWh and Zero effluent discharge.	Compliance assured during Plant operation. Specific Water consumption will be within the standard norms and plant designed is based on Zero Liquid Discharge (ZLD).
(vi)	The recommendation from Standing Committee of NBWL under the Wildlife (Protection) Act, 1972 should be obtained, if applicable.	Not Applicable for MEL TPP.
(vii)	No Objection Certificate from Ministry of Civil Aviation be obtained for installation of requisite chimney height and its siting criteria for height clearance.	Not Applicable as Chimney height is less than 150 meters. The proposed Stack height is 120 meters**,** therefore NOC not required for installation of Stacks as per AAI and MoD rules.
(viii)	Groundwater shall not be drawn during construction of the project. In case, groundwater is drawn during construction, necessary permission be obtained from CGWA.	Compliance assured. No ground water is proposed. Surface water will be used for construction as well as in plant operation. We have allocated 36 MCM river water (Rihand Dam) from Water Resource Department, Bhopal Madhya Pradesh.
II	**Ash Content / mode of transportation of Coal:**	
(i)	EC is given on the basis of assumption of_% of ash content and_km distance of transportation in rail/road/conveyor/any other mode. Any increase of % ash content by more than 1 percent, and/ or any change in transportation mode or increase in the	Compliance assured once during operation phase.

	transport distance (except for rail) require application for modifications of EC conditions after conducting the 'incremental impact assessment' and proposal for mitigation measures.	
III	**Air quality monitoring and Management:**	
(i)	Flue Gas Desulphurization System shall be installed based on Lime/ Ammonia dosing to capture Sulphur in the flue gases to meet the SO2 emissions standard of 100 mg/Nm3.	Compliance assured. FGD will be installed during the construction of Thermal Power Plant.
(ii)	Selective Catalytic Reduction (SCR) system or the Selective Non-Catalytic Reduction (SNCR) system or Low NOX Burners with Over Fire Air (OFA) system shall be installed. To achieve NOX emission standard of 100 mg/Nm3.	Compliance assured. Low Nox burner will be installed during the construction of Thermal Power Plant.
(iii)	High efficiency Electrostatic Precipitators (ESPs) shall be installed in each unit to ensure that particulate matter (PM) emission to meet the stipulated standards of 30 mg/Nm3.	Compliance assured. High efficiency Electrostatic Precipitators (ESPs) will be installed during construction of Thermal Power Plant.
(iv)	Stacks of prescribed height m shall be provided with continuous online monitoring instruments for SOX, Nox, and Particulate Matter as per extant rules.	Compliance assured. Stack height of 120m will be provided with continuous emission monitoring system (CEMS) as per guidelines of CPCB/MoEFCC.
(v)	Exit velocity of flue gases shall not be less than 20-25 m/ s. Mercury emissions from stack shall also be monitored periodically.	Compliance assured & will be maintained during plant operation.
(vi)	Continuous Ambient Air Quality monitoring system shall be set up to monitor common/criteria pollutants from the flue gases such as PM10, PM2.5, SO2, NOX within the plant area at least at one location. The monitoring of other locations (at least three locations outside the plant area covering upwind and downwind directions at an angle of 120° each) shall be carried out manually.	Complied MEL has already installed & operational 4 no. of CAAQMS for existing operational plant.
(vii)	Adequate dust extraction/suppression systems shall be installed in coal handling, ash handling areas and material transfer points to control fugitive emission.	Compliance assured. Adequate dust extraction/suppression system will be installed during construction of plant.
(viii)	Appropriate Air Pollution Control measures (Des/DSs) be provided at all the dust generating sources including sufficient water sprinkling arrangements	Compliance assured. Adequate Air Pollution Control measures will be provided during construction of plant.

	at various locations viz., roads, excavation sites, crusher plants, transfer points, loading and unloading areas, etc.	
IV	**Noise Pollution and its control measures:**	
(i)	The Ambient Noise levels shall meet the standards prescribed as per the Noise Pollution (Regulation and Control) Rules, 2000.	Being Complied
(ii)	Persons exposed to high noise generating equipment shall use Personal Protective Equipment (PPE) like earplugs/earmuffs, etc.	Being Complied Suitable PPEs are being provided, and people are using suitable PPEs like earplugs/earmuffs, etc. while working near high noise generating equipment.
(iii)	Periodical medical examination on hearing loss shall be carried out for all the \workers and maintain audiometric record and for treatment of any hearing loss including rotating to non- noisy/less noisy areas.	Noted and being complied.
V.	**Human Health Environment:**	
(i)	Bi-annual Health check-up of all the workers is to be conducted. The study shall take into account of chronic exposure to noise which may lead to adverse effects like increase in heart rate and blood pressure, hypertension and peripheral vasoconstriction and thus increased peripheral vascular resistance. Similarly, the study shall also assess the 20ealthh impacts due to air polluting agents.	Agreed and being complied.
(ii)	Baseline health status within the study area shall be assessed and report be prepared. Mitigation measures should be taken to address the endemic diseases.	Complied. The study is conducted by the reputed Government Institute, Indian Institute of Social Welfare and Business Management (IISWBM, Kolkata)–Environment Management Department. The Baseline health status report is enclosed as **Annexure-VIII.**
(iii)	Impact of operation of power plant on agricultural crops, large water bodies (as applicable) once in two years by engaging an institute of repute. The study shall also include impact due to heavy metals associated with emission from power plant.	Compliance assured during Plant operation.
(iv)	Sewage Treatment Plant shall be provided for domestic wastewater.	Noted and Compliance assured. STP will be established during construction of plant.
Vi	**Water quality monitoring and Management:**	

(i)	Induced/Natural draft closed cycle wet cooling system including cooling towers shall be set up with minimum Cycles of Concentration (COC) of 5.0 or above for power plants using fresh water to achieve specific water consumption of 2.5 m3/MW hr. (Or) Induced/Natural draft open cycle cooling system shall be set up with minimum Cycles of Concentration (COC) of 1.5 or above for power plants using sea water.	Noted and Compliance assured during operational phase of the plant.
(ii)	In case of water withdrawal from river, a minimum flow 15% of the average flow of 120 consecutive leanest days should be maintained for environmental flow whichever is higher, to be released during the lean season after water withdrawal for proposed power plant.	Noted and Compliance assured once the Plant is operational.
(iii)	Records pertaining to measurements of daily water withdrawal and river flows (obtained from Irrigation Department/Water Resources Department) immediately upstream and downstream of withdrawal site shall be maintained.	Noted and Compliance assured during operation of Plant.
(iv)	Rainwater harvesting in and around the plant area be taken up to reduce drawl of fresh water. If possible, recharge of groundwater to be undertaken to improve the ground water table in the area.	Being Complied Rainwater harvesting within the plant premises has been constructed/ implemented to harvest the rainwater. 10 No. storm water recharge pit has been developed. Pond deepening work being carried out in 5-6 ponds in villages falling under the area. More than 400 farmers availed benefits from pond deepening for irrigation in their agricultural land.
(v)	Regular (at least once in six months) monitoring of groundwater quality in and around the ash pond area including presence of heavy metals (Hg, Cr, As, Pb, etc.) shall be carried out as per CPCB guidelines. Surface water quality monitoring shall be undertaken for major surface water bodies as per the EMP. The data obtained should be compared with the baseline data so as to ensure that the groundwater and surface water quality is not adversely impacted due to the project & its activities.	Being Complied Ground water and Surface water quality monitoring is being carried out by NABL accredited consultant, report is attached as **Annexure I.**

(vi)	The treated effluents emanating from the different processes such as DM plant, boiler blow down, ash pond/dyke, sewage, etc. conforming to the prescribed standards shall be re- circulated and reused. Sludge/ rejects will be disposed in accordance with the Hazardous Waste Management Rules.	Compliance assured once the Plant is operational. Treated water will be used in CHP/AHP Ash handling system and development of greenbelt.
(vii)	Hot water dispensed from the condenser should be adequately cooled to ensure the temperature of the released surface water is not more than 5 degrees Celsius above the temperature of the intake water.	Noted and agreed. Compliance assured during operation of plant.
(viii)	Based on the commitment made by the Project Proponent, Sewage Treatment Plants within the radius of 50 km from proposed project, the treated sewage of ……..KLD from STP …. (name) shall be used as an alternative to the fresh water source to minimize the freshwater drawl from surface water bodies.	Noted As on date there is no STP located within 50 Km radius of plant, feasibility and availability shall be explored.
(ix)	Wastewater generation of …. KLD from various sources (viz. cooling tower blowdown, boiler blow down, wastewater from ash handling, etc.) shall be treated to meet the standards of Ph: 6.5-8.5; Total Suspended Solids: 100 mg/l; Oil & Grease: 20 mg/1; Copper: 1 mg/l; Iron:1 mg/1; Free Chlorine: 0.5; Zinc: 1.0 mg/1; Total Chromium: 0.2 mg/1; Phosphate: 5.0 mg/1;	Noted & Compliance assured during operation of plant. ETP will be installed to treat the wastewater and meet the standards norms.
(x)	Sewage generation of …….KLD will be treated by setting up Sewage Treatment plant to maintain the treated sewage characteristics of Ph: 6.5-9.0; Bio-Chemical Oxygen Demand (BOD): 30 mg/1; Total Suspended Solids: 100 mg/1; Fecal Coliforms (Most Probable Number) :< 1000 per 100 ml.	Noted & Compliance assured during operation of plant. STP will be installed to treat the domestic wastewater and meet the standards norms.
VII	**Risk Mitigation and Disaster Management:**	
(i)	Adequate safety measures and environmental safeguards shall be provided in the plant area to control spontaneous fires in coal yard, especially during *dry* and humid season.	Being Complied Onsite emergency plan prepared and being followed.
(ii)	Storage facilities for auxiliary liquid fuel such as LOO and HFO/LSHS shall be made as per the extant rules in the plant area in accordance with the directives of	Compliance assured. Storage facilities for auxiliary liquid fuel such as LOO and HFO/LSHS will be provided.

	Petroleum & Explosives Safety Organization (PESO). Sulphur Content in the liquid fuel should not exceed 0.5%.	
(iii)	Ergonomic working conditions with First Aid and sanitation arrangements shall be made for the drivers and other contract workers during the construction phase.	Being complied & followed all required action.
(iv)	Safety management plan based on Risk Assessment shall be prepared to limit the risk exposure to the workers within the plant boundary.	Being complied
(v)	Regular mock drills for on-site emergency management plan and Integrated Emergency Response System shall be developed for all kind of possible disaster situations.	Being complied.
VIII	**Green belt and Biodiversity conservation:**	
(i)	Green belt shall be developed in an area of 33% of the total project with indigenous native tree species in accordance with CPCB guidelines. The green belt shall inter-alia cover an entire periphery of the plant.	Being Complied.
(ii)	In-situ/ex-situ Conservation Plan for the conservation of flora and fauna should be prepared and implemented.	Complied Conservation Plan for the conservation of flora and fauna is already prepared and submitted along with EIA-EMP report.
(iii)	Suitable screens shall be placed across the intake channel to prevent entrainment of life forms including eggs, larvae, juvenile fish, etc., during extraction of seawater.	Water will be drawn from existing intake well & water pipeline from Rihand Reservoir.
IX	**Waste Management:**	
(i)	Solid waste management should be planned in accordance with extant Solid Waste Management Rules, 2016.	Compliance assured. Solid waste management is being done as per the Solid Waste Management Rules, 2016.
(ii)	Toxicity Characteristic Leachate Procedure (TCLP) test shall be conducted for any substance, potential of leaching heavy metals into the surrounding areas as well as into the groundwater.	Compliance assured during plant operation.
(iii)	Ash pond shall be lined with impervious liner as per the soil conditions. Adequate dam/ dyke safety measures shall also be implemented to protect the ash dyke from getting breached.	Compliance assured. Ash Pond will be developed as per guidelines of CPCB/MoEFCC during the construction.
(iv)	Fly ash shall be collected in dry form and ash generated shall be used in phased	Compliance assured.

	manner as per provisions of the Notification on Fly Ash Utilization issued by the Ministry and amendment thereto. By the end of 4th year, 100% fly ash utilization should be ensured. Unutilized ash shall be disposed off in the ash pond in the form of High Concentration Slurry. Mercury and other heavy metals (As, Hg, Cr, Pb, etc.) will be monitored in the bottom ash as also in the effluents emanating from the existing ash pond. Fly ash utilization details shall be submitted to concerned Regional Office along with the six- monthly compliance reports and utilization data shall be published on company's website.	Fly Ash will be utilized as per the MoEFCC Ash notification and its amendments.
(v)	Unutilized ash shall be disposed off in the Ash Pond in the form of High Concentration Slurry/Medium Concentration Slurry/Lean Concentration Slurry method. Ash water recycling systems shall be set up to recover supernatant water.	Noted & Compliance assured during plant operation. High Concentration Slurry Disposal System (HCSD) will be installed.
(vi)	In case of waste-to-energy plant, major problems related with environment are fire smog in MSW dump site, foul smell and impacts to the surrounding populations. Therefore, the following measures are required to be taken up: A. Water hydrants at all the dumpsites of MSW area to be provided so that the fire and smog could be controlled. B. Sprayer like microbial consortia may be provided for arresting the foul smell emanating from MSW area.	Not Applicable. The Plant is Coal based Thermal Power Plant.
x.	**Monitoring Compliances:**	
(i)	Environmental Audit of the project be taken up by the third party for preparation of Environmental Statement as per Form-V & Conditions stipulated in the EC and report be submitted to the Ministry.	Noted, Compliance assured once the Plant is operational with Govt. reputed institute.
(ii)	Resettlement & Rehabilitation Plan as per the extant rules of Govt. of India and respective State Govt. shall be followed, if applicable.	Not Applicable R&R is not required as land for expansion project is already in possession with Mahan Energen Limited.
(iii)	Energy Conservation Plan to be implemented as envisaged in the EIA / EMP report. Renewable Energy Purchase	Noted and Being Complied 100 Nos. Solar Power Streetlights already has been installed within the plant premises.

	Obligation as set by MoP/State Government shall be met either by establishing renewable energy power plant (such as solar, wind, etc.) or by purchasing Renewable Energy Certificates.	Further, Feasibility for harnessing Solar Power will be explored. Adani group already establish more than 10,000 MW renewable energy power plant (such as solar, wind & hybrid etc.)
(iv)	Monitoring of Carbon Emissions from the existing power plant as well as for the proposed power project shall be carried out annually from a reputed institute and report be submitted to the Ministry's Regional Office.	Complied. The study is conducted by the reputed Government Institute, Indian Institute of Social Welfare and Business Management, IISWBM, Kolkata Environment Management Department. The Carbon Emissions Monitoring / study report is enclosed as **Annexure- IX.**
(v)	Energy and Water Audit shall be conducted at least once in two years and recommendations arising out of the Report should be followed. A report in this regard shall be submitted to Ministry's Regional Office.	Compliance assured during the Plant operation.
(vi)	Environment Cell (EC) shall be constituted by taking members from different divisions, headed by a qualified person on the subject, who shall be reporting directly to the Head of the Project.	Complied We have established separate environmental monitoring cell with well qualified staff to carry out regular surveillance for implementation of stipulated environmental safeguards.
(vii)	The project proponent shall (Post-EC Monitoring): a. Send a copy of environmental clearance letter to the heads of Local Bodies, Panchayat, Municipal bodies, and relevant offices of the Government. b. Upload the clearance letter on the web site of the company as a part of information to the general public. c. Inform the public through advertisement within seven days from the date of issue of the clearance letter, at least in two local newspapers that are widely circulated in the region of which one shall be in the vernacular language that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the SPCB and may also be seen at Website of the Ministry of	Complied a. Copy of environmental clearance letter submitted to Dist. Development Officer, Block Development Officer, Panchayats, Zilla Parishad and relevant offices of the Government. Copy of same is enclosed as Annexure XIII. b. Environment clearance letter uploaded on the web site of the company. https://www.adanipower.com/Downloads c. Information through advertisement has been published in two local newspapers **(Dainik Bhaskar & Times of India)** in Hindi & English. A copy of the same is enclosed as **Annexure XIV.**

	Environment, Forest and Climate Change (MoEF&CC) at http://parviesh.nic.in. d. Upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same periodically. e. Monitor the criteria pollutants level namely, PM (PM10& PM2.5 incase of ambient MQ), SO2, NOx (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the projects and display the same at a convenient location for disclosure to the public and put on the website of the company; f. Submit six monthly reports on the status of the compliance of the stipulated environmental conditions including results of monitored data (both in hard copies as well as by e-mail) to the Regional Office of MoEF&CC, the respective Zonal Office of CPCB and the SPCB. g. submit the environmental statement for each financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company. h. Inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project and the date of commencement of the land development work.	d. Status of compliance of the stipulated environment clearance conditions, including results of monitored data will be submit half yearly and upload the same on company website. e. Monitoring of the pollutants level PM (PM10& PM2.5), SO2, NOx is being displayed at the main gate of the plant. f. Six monthly status of the compliance report of the stipulated environmental conditions including results of monitored data is being submitted to the Regional Office of MoEFCC, the respective Zonal Office of CPCB and SPCB. g. Environmental statement for each financial year in Form-V will be submitted to the State Pollution Control Board during operation phase. h. The date of **financial closure is 20.06.2023**.
XI.	**Corporate Environmental Responsibility (CER) activities:**	
(i)	CER activities will be carried out as per OM No. 22-65/2017-IA.III dated 30.09.2020 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.	Noted and being complied. The time- bound action plan for CER activities is already submitted to Ministry and same is under implementation, copy of same is enclosed as **Annexure XII.**
C.	**General Condition:**	

(i)	The EC granted to the project is strictly under the provisions of the EIA Notification 2006 and its amendments. It does not tantamount/ construe to approvals/ consent/ permissions, etc. required to be obtained under any other Acts/ Rules/ Subordinate legislations, etc., as may be applicable to the project.	Noted & agreed.
(ii)	The project proponent shall prepare a site-specific conservation plan and wildlife management plan in case of the presence of Schedule-1 species in the study area, as applicable to the project, and submit to Chief Wildlife Warden for approval. The recommendations shall be implemented in consultation with the State Forest/Wildlife Department in a time bound manner.	Complied Ecological Assessment and Flora & Fauna Wildlife Conservation & Management Plan has been prepared by M/s. Good Earth Enviro Care in Association with Department of Environment Management, Indian Institute of Social Welfare & Business Management, Kolkata and report is submitted to PCCF – WL, Bhopal vide letter no APL/MEL/Env/ PCCF/407/23 dated; 03.04.2023. We have also reiterated PCCF-WL, Bhopal vide letter no. APL/MEL/Env/PCCF/409/24 dated: 19.10.2024. Copy of letter is enclosed as Annexure VII. The plan will be implemented with due approval from CWLW.
(iii)	No further expansion or modifications in the plant, other than mentioned in the EIA Notification, 2006 and its amendments, shall be carried out without prior approval of the Ministry of Environment, Forest and Climate Change. In case of deviations or alterations in the project proposal from those submitted to this Ministry for clearance, a fresh reference shall be made to the Ministry to assess the adequacy of conditions imposed and to add additional environmental protection measures required, if any.	Noted and agreed.
(iv)	The energy source for lighting purpose shall be preferably LED based, or advance having preference in energy conservation and environment betterment.	Being Complied. MEL has already installed LED based lights.
(v)	The locations of ambient air quality monitoring stations shall be decided in consultation with the State Pollution Control Board (SPCB) and it shall be ensured that at least one station each is installed in the upwind and downwind direction as well as where maximum	Complied MEL has already installed 4 no. of CAAQMS in consultation with State Pollution Control Board (SPCB).

	ground level concentrations are anticipated.	
(vi)	The overall noise levels in and around the plant area shall be kept well within the standards by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels shall conform to the standards prescribed under Environment (Protection) Act, 1986 Rules, 1989 viz. 75 dBA (daytime) and 70 dBA (nighttime).	Noted & Compliance assured. Necessary noise control measures like acoustic hoods, silencers, enclosures etc. will be provided at all sources of noise generation.
(vii)	The Company shall harvest rainwater from the roof tops of the buildings and storm water drains to recharge the ground water and to utilize the same for process requirements.	Being Complied Rainwater harvesting within the plant premises has been constructed/ implemented to harvest the rainwater. 10 No. storm water recharge pit has been developed. Pond deepening work is being carried out in 5-6 ponds in villages falling under the area. More than 400 farmers availed benefits from pond deepening for irrigation in their agricultural land.
(viii)	Training shall be imparted to all employees on safety and health aspects of chemicals handling. Pre-employment and routine periodical medical examinations for all employees shall be undertaken on regular basis. Training to all employees on handling of chemicals shall be imparted.	Being Complied Training is being imparted to all employees on safety and health aspects on regular basis.
(ix)	The company shall also comply with all the environmental protection measures and safeguards proposed in the documents submitted to the Ministry. All the recommendations made in the EIA/EMP in respect of environmental management, and risk mitigation measures relating to the project shall be implemented.	Noted and Compliance assured.
(x)	The company shall undertake all relevant measures for improving the socio-economic conditions of the surrounding area. CER activities shall be undertaken by involving local villages and administration and shall be implemented.	Being complied. The time- bound action plan for CER activities is already submitted to Ministry and same is under implementation, copy is enclosed as Annexure XII.
(xi)	The company shall undertake eco-developmental measures including community welfare measures in the project area for the overall improvement of the environment.	Noted and Compliance assured.

(xii)	A separate Environmental Management Cell (having qualified person with Environmental Science/Environmental Engineering/ specialization in the project area) equipped with full-fledged laboratory facilities shall be set up to carry out the Environmental Management and Monitoring functions.	Complied We have established separate environmental monitoring cell with well qualified staff to carry out regular surveillance for implementation of stipulated environmental safeguards.
(xiii)	The company shall earmark sufficient funds towards capital cost and recurring cost per annum to implement the conditions stipulated by the Ministry of Environment, Forest and Climate Change as well as the State Government along with the implementation schedule for all the conditions stipulated herein. The funds so earmarked for environment management/ pollution control measures shall not be diverted for any other purpose.	Being Complied Separate budgets have been already allocated for Environmental protection measures.
(xiv)	A copy of the clearance letter shall be sent by the project proponent to concerned Panchayat, Zilla Parishad/Municipal Corporation, Urban local Body and the local NGO, if any, from whom suggestions/ representations, if any, were received while processing the proposal.	Complied Copy of environmental clearance letter submitted to IRO, MoEFCC, RO, MPPCB, Dist. Development Officer, Singrauli, Block Development Officer, Singaruli, Panchayats and Zilla Parishad. Copy of same is enclosed as Annexure XIII.
(xv)	The project proponent shall also submit six monthly reports on the status of compliance of the stipulated Environmental Clearance conditions including results of monitored data (both in hard copies as well as by e-mail) to the respective Regional Office of MoEF&CC, the respective Zonal Office of CPCB and SPCB. A copy of Environmental Clearance and six-monthly compliance status report shall be posted on the website of the company.	Being Complied Six monthly reports on the status of compliance of the stipulated Environmental Clearance conditions including results of monitored data is being submitted to the respective Regional Office of MoEFCC, Zonal Office of CPCB and SPCB. Copy of Environmental Clearance and six-monthly compliance status report is already uploaded on website of the company. https://www.adanipower.com/Downloads
(xvi)	The environmental statement for each financial year ending 31st March in Form-V as is mandated shall be submitted 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	Compliance assured during operation phase. Will be submitted in operation phase, every year before 30th September.

	to the respective Regional Offices of MoEF&CC by e- mail.	
(xvii)	The project proponent shall inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the SPCB/Committee and may also be seen at Website of the Ministry and at https:/ /parivesh.nic.in/. This shall be advertised within seven days from the date of issue of the clearance letter, at least in two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned and a copy of the same shall be forwarded to the concerned Regional Office of the Ministry.	Complied Copy of environmental clearance letter submitted to IRO, MoEFCC, RO, MPPCB, Dist. Development Officer, Singrauli, Block Development Officer, Singaruli, Panchayats and Zilla Parishad. Copy of same is enclosed as **Annexure XIII.** Environment clearance letter already uploaded on the web site of the company https://www.adanipower.com/Downloads Information through advertisement has been published in two local newspapers in Hindi & English. Copy of News Paper cutting is enclosed as **Annexure- XIV.**
(xviii)	The project authorities shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of the project.	Complied Financial closure and final approval of the project achieved.
(xix)	This Environmental clearance is granted subject to outcome of Hon'ble Supreme Court of India, Hon'ble High Court, Hon'ble NGT and any other Court of Law, if any, as may be applicable to this project.	Noted.

*****

Annexure I

SUMMARY SHEET OF AMBIENT AIR QUALITY MONITORING : APRIL – 2024

Name & Address of the Party: M/s Mahan Energen Limited
Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli,
Madhya Pradesh - 486886

Reporting Date: 07/05/2024

S. No.	Date of Saupling	Near Admin Buliding				Near Gate No. – 2				Near Gate No. – 3			
		Parameters & Results				Parameters & Results				Parameters & Results			
		PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)
1.	01/04/2024 To 02/04/2024	64.32	41.45	14.86	24.43	75.73	42.64	13.72	25.05	79.32	39.12	14.08	23.76
2.	05/04/2023 To 06/04/2024	66.34	36.84	15.42	23.62	72.88	40.32	12.82	23.54	81.43	44.31	13.87	19.65
3.	08/04/2024 To 09/04/2024	63.78	38.52	13.34	22.32	76.84	39.87	11.89	22.56	77.54	43.56	12.56	22.54
4.	12/04/2024 To 13/04/2024	65.56	37.56	12.67	23.54	75.93	37.98	14.23	24.43	80.64	40.87	14.45	24.43
5.	15/04/2024 To 16/04/2024	64.45	35.89	13.56	20.78	74.67	43.76	13.24	21.52	78.42	42.43	15.76	21.89
6.	19/04/2024 To 20/04/2024	62.89	37.65	14.43	24.32	69.56	44.89	14.54	25.12	77.67	39.59	14.41	23.67
7.	22/04/2024 To 23/04/2024	67.43	40.23	15.32	25.64	78.45	40.43	16.23	24.66	76.42	40.12	12.23	22.06
8.	26/04/2024 To 27/04/2024	64.34	39.95	13.89	23.46	74.83	43.22	14.67	26.34	79.34	43.87	14.46	20.32
9.	29/04/2024 To 30/04/2024	65.89	36.54	14.32	25.67	76.54	42.54	16.35	25.84	78.21	42.53	15.87	25.53
10.	Maximum	67.43	41.45	15.42	25.67	78.45	44.89	16.35	26.34	81.43	44.31	15.87	25.53
11.	Minimum	62.89	35.89	12.67	20.78	69.56	37.98	11.89	21.52	76.42	39.12	12.23	19.65
12.	Average	65.00	38.29	14.20	23.75	75.05	41.74	14.19	24.34	78.78	41.82	14.19	22.65
13.	Limits As Per NAAQS	100	60	80	80	100	60	80	80	100	60	80	80

Note:- NAAQS: National Ambient Air Quality Standards.

Vardan Envirolab LLP
(Formerly known as Vardan Envirolab)
Approvals & Certifications
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Approvals & Certifications

SUMMARY SHEET OF AMBIENT AIR QUALITY MONITORING, JUNE – 2024

Name & Address of the Party: M/s Mahan Energen Limited
Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli,
Madhya Pradesh - 486886

Reporting Date: 08/07/2024

S. No.	Date of Sampling	Near Admin Buliding				Near Gate No. – 2				Near Gate No. – 3			
		Parameters & Results				Parameters & Results				Parameters & Results			
		PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)
1	03-06-2024 to 04-06-2024	75.41	33.72	19.19	25.75	82.16	38.46	21.64	27.12	78.27	37.49	20.31	25.64
2	07-06-2024 to 08-06-2024	73.75	37.18	16.24	22.79	83.37	40.91	15.33	23.28	84.11	39.24	16.18	22.75
3	12-06-2024 to 13-06-2024	72.21	46.15	11.8	28.14	77.61	36.66	12.91	25.82	75.88	36.38	13.22	24.36
4	14-06-2024 to 15-06-2024	64.12	21.54	5.21	9.18	73.33	32.57	6.74	11.07	74.54	33.12	6.47	10.28
5	17-06-2024 to 18-06-2024	58.08	39.37	10.36	5.28	70.26	30.11	11.22	6.95	71.07	31.48	10.29	7.08
6	21-06-2024 to 22-06-2024	63.51	14.92	14.4	11.41	71.51	32.25	15.95	13.64	72.16	31.79	16.14	12.57
7	24-06-2024 to 25-06-2024	61.55	36.81	11.46	13.26	72.85	33.14	12.25	15.72	74.24	35.27	11.35	16.11
8	28-06-2024 to 29-06-2024	66.52	32.24	15.98	20.11	76.52	35.47	16.49	21.73	78.52	36.84	14.46	20.72
9	Minimum	58.08	14.92	5.21	5.28	70.26	30.11	6.74	6.95	71.07	31.48	6.47	7.08
10	Maximum	75.41	46.15	19.19	28.14	83.37	40.91	21.64	27.12	84.11	39.24	20.31	25.64
11	Average	66.89	32.74	13.08	16.99	75.95	34.95	14.07	18.17	76.10	35.20	13.55	17.44
12	Limits As Per CPCB	100	60	80	80	100	60	80	80	100	60	80	80

Note:- CPCB: Centr l Pollution Control Board.

Vardan Envirolab ®

SUMMARY SHEET OF QUARTERLY AMBIENT AIR QUALITY MONITORING, JUNE– 2024

Name & Address of the Party: M/s Mahan Energen Limited
Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli,
Madhya Pradesh - 486886

Reporting Date: 08/07/2023

S. No.	Date of Sampling	Locations	Parameters & Results								
			CO (mg/m³)	NH_3 (µg/m³)	Pb (µg/m³)	C_6H_6 (µg/m³)	B(a)P (ng/m³)	O_3 (µg/m³)	As (ng/m³)	Ni (ng/m³)	Hg (ng/m³)
1.	28/06/2024 To 29/06/2024	Near Admin Buliding	0.52	15.27	BLQ(LOQ-0.1)	BLQ(LOQ-0.5)	BLQ(LOQ-0.5)	25.92	BLQ(LOQ-0.1)	BLQ(LOQ-5.0)	BLQ(LOQ-1.0)
2.	28/06/2024 To 29/06/2024	Near Gate No. – 2	0.67	16.14	BLQ(LOQ-0.1)	BLQ(LOQ-0.5)	BLQ(LOQ-0.5)	26.55	BLQ(LOQ-0.1)	BLQ(LOQ-5.0)	BLQ(LOQ-1.0)
3.	28/06/2024 To 29/06/2024	Near Gate No. – 3	0.61	17.13	BLQ(LOQ-0.1)	BLQ(LOQ-0.5)	BLQ(LOQ-0.5)	28.61	BLQ(LOQ-0.1)	BLQ(LOQ-5.0)	BLQ(LOQ-1.0)
4.	Limits As Per CPCB		4	400	1	5	1	180	6	20	-

Note:- CPCB: Central Pollution Control Board.

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Approvals & Certifications

Vardan Envirolab

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SUMMARY SHEET OF AMBIENT AIR QUALITY MONITORING – JULY - 2024

Name & Address of the Party: M/s Mahan Energen Limited
Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886

Reporting Date: 08/08/2024

S. No.	Date of Sampling	Near Admin Building – Parameters & Results					Near Gate No. – 2 – Parameters & Results					Near Gate No. – 3 – Parameters & Results				
		PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)
1.	10-07-2024 To 11-07-2024	82.89	50.41	14.31	22.41	0.68	77.55	49.16	13.96	19.09	0.73	84.19	51.66	15.92	20.78	0.71
2.	13-07-2024 To 14-07-2024	80.44	49.58	15.63	21.93	0.69	84.17	50.21	14.05	23.64	0.67	80.38	52.16	13.75	22.89	0.74
3.	16-07-2024 To 17-07-2024	71.98	42.5	18.06	24.23	0.66	74.96	45.83	17.88	22.84	0.63	84.86	53.9	20.54	27.25	0.74
4.	19-07-2024 To 20-07-2024	77.84	40.82	16.5	21.57	0.66	78.59	45.34	17.13	23.2	0.72	84.61	45.32	21.29	26.04	0.68
5.	22-07-2024 To 23-07-2024	73.32	37.91	18.98	22.54	0.73	71.06	41.66	16.79	23.44	0.69	75.11	35.41	15.69	21.51	0.73
6.	26-07-2024 To 27-07-2024	81.71	51.25	14.48	20.6	0.62	83.27	48.33	16.5	22.6	0.66	75.6	52.5	13.5	21.21	0.71
7.	29-07-2024 To 30-07-2024	81.53	48.75	13.9	20.96	0.69	83.39	52.5	14.25	20.6	0.64	77.81	49.16	14.54	16.11	0.73
8.	Maximum	71.98	37.91	13.90	20.60	0.62	71.06	41.66	13.96	19.09	0.63	75.11	35.41	13.50	16.11	0.68
9.	Minimum	82.89	51.25	18.98	24.23	0.73	84.17	52.50	17.88	23.64	0.73	84.86	53.90	21.29	27.25	0.74
10.	Average	78.53	45.89	15.98	22.03	0.68	79.00	47.58	15.79	22.20	0.68	80.37	48.59	16.46	22.26	0.72
11.	Limits As Per CPCB	100	60	80	80	4	100	60	80	80	4	100	60	80	80	4

S. No.	Date of Sampling	Gajara Bahara Railway Siding – Parameters & Results				
		PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)
1.	27/07/2023 To 28/07/2023	79.67	50	12.4	22.23	0.72
2.	Limits As Per CPCB	100	60	80	80	4

Note:- CPCB: Central Pollution Control Board.

Authorised Signatory

SUMMARY SHEET OF AMBIENT AIR QUALITY MONITORING – AUGUST - 2024

Name & Address of the Party: M/s Mahan Energen Limited
Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli,
Madhya Pradesh - 486886

Reporting Date: 07/09/2024

S. No.	Date of Sampling	Near Admin Building					Near Gate No. – 2					Near Gate No. – 3				
		Parameters & Results					Parameters & Results					Parameters & Results				
		PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)
1.	01-08-2024 To 02-08-2024	69.38	38.33	11.94	19.27	0.59	82.66	46.66	16.56	22.72	0.69	52.63	25.41	10.26	16.37	0.52
2.	05-08-2024 To 06-08-2024	60.93	25.41	10.04	17.82	0.64	70.94	30.83	13.9	19.39	0.68	55.83	21.66	9.69	16.13	0.55
3.	09-08-2024 To 10-08-2024	62.46	27.91	12.86	15.65	0.62	72.89	32.50	13.90	21.93	0.67	53.98	23.75	9.34	13.53	0.59
4.	12-08-2024 To 13-08-2024	58.03	29.95	10.21	17.04	0.53	73.39	39.10	11.71	18.85	0.55	51.55	27.45	15.06	18.49	0.58
5.	16-08-2024 To 17-08-2024	56.11	30.36	11.59	18.97	0.59	71.29	38.68	12.29	20.18	0.55	50.52	25.79	13.09	17.58	0.61
6.	20-08-2024 To 21-08-2024	64.67	27.5	13.21	22.72	0.52	69.32	35.83	16.79	22.05	0.57	58.47	26.66	10.46	18.10	0.59
7.	23-08-2024 To 24-08-2024	67.76	26.24	13.50	21.39	0.53	67.18	34.58	14.88	21.39	0.58	56.12	27.08	11.77	17.22	0.53
8.	26-08-2024 To 27-08-2024	58.49	31.24	11.42	19.94	0.61	67.78	29.16	11.94	16.92	0.62	55.11	22.07	9.52	14.87	0.65
9.	29-08-2024 To 30-08-2024	66.80	29.16	13.96	21.02	0.55	68.42	36.24	17.54	21.21	0.51	54.18	27.07	10.38	17.48	0.62
10.	Maximum	69.38	38.33	13.96	22.72	0.64	82.66	46.66	17.54	22.72	0.69	58.47	27.45	15.06	18.49	0.65
11.	Minimum	56.11	25.41	10.04	15.65	0.52	67.18	29.16	11.71	16.92	0.51	50.52	21.66	9.34	13.53	0.53
12.	Average	62.74	29.57	12.08	19.31	0.58	71.54	35.95	14.39	20.52	0.60	54.27	25.22	11.06	16.64	0.58
13.	Limits As Per CPCB	100	60	80	80	4	100	60	80	80	4	100	60	80	80	4

Note:- CPCB: Central Pollution Control Board.

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SUMMARY SHEET OF AMBIENT AIR QUALITY MONITORING – May- 2024

Name & Address of the Party: M/s Mahan Energen Limited
Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli,
Madhya Pradesh - 486886

Reporting Date: 08/06/2024

S. No.	Date of Sampling	Near Admin Building				Near Gate No. – 02				Near Gate No. – 03			
		Parameters & Results				Parameters & Results				Parameters & Results			
		PM10 (μg/m³)	PM2.5 (μg/m³)	SO_2 (μg/m³)	NO_2 (μg/m³)	PM10 (μg/m³)	PM2.5 (μg/m³)	SO_2 (μg/m³)	NO_2 (μg/m³)	PM10 (μg/m³)	PM2.5 (μg/m³)	SO_2 (μg/m³)	NO_2 (μg/m³)
1.	03-05-2024 To 04-05-2024	62.54	44.36	12.18	26.52	77.85	40.76	15.49	27.65	76.45	37.64	16.17	21.38
2.	06-05-2024 To 07-05-2024	68.56	34.56	17.13	24.85	74.29	42.46	14.21	25.45	83.47	41.24	15.97	22.73
3.	10-05-2024 To 11-05-2024	66.43	41.27	11.52	24.19	80.18	42.54	11.89	20.31	75.27	42.96	13.88	23.36
4.	13-05-2024 To 14-05-2024	67.38	40.34	13.72	24.68	77.61	35.47	12.54	25.87	82.87	39.14	16.34	25.65
5.	17-05-2024 To 18-05-2024	66.67	37.54	14.93	22.78	76.95	45.18	15.83	23.74	80.52	44.66	17.47	24.94
6.	20-05-2024 To 21-05-2024	64.63	39.89	16.56	25.56	73.86	46.74	12.69	26.36	79.84	42.68	15.76	25.91
7.	24-05-2024 To 25-05-2024	68.46	43.35	16.98	23.57	75.72	38.85	18.36	26.93	78.62	40.68	13.32	24.15
8.	27-05-2024 To 28-05-2024	66.84	41.82	13.63	22.75	76.28	41.17	16.69	24.68	81.87	45.63	15.88	19.29
9.	30-05-2024 To 31-05-2024	67.87	38.92	15.85	26.74	78.84	46.89	14.67	23.46	79.57	44.57	15.95	26.37
10.	Maximum	68.56	44.36	17.13	26.74	80.18	46.89	18.36	27.65	83.47	45.63	17.47	26.37
11.	Minimum	62.54	34.56	11.52	22.75	73.86	35.47	11.89	20.31	75.27	37.64	13.32	19.29
12.	Average	66.59	40.22	14.72	24.62	76.84	42.22	14.70	24.93	79.83	42.14	15.63	23.75
13.	Limits As Per CPCB	100	60	80	80	100	60	80	80	100	60	80	80

Note:- CPCB: Central Pollution Control Board.

Laboratory: Plot No. 82A, Sector -5, IMT Manesar, Gurugram - 122051, Haryana
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E-mail: lab@vardan.co.in, bd@vardan.co.in
www.vardan.co.in

SUMMARY SHEET OF AMBIENT AIR QUALITY MONITORING, SEPTEMBER– 2024

Name & Address of the Party: M/s Mahan Energen Limited
Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886

Reporting Date: 07/10/2024

S. No.	Date of Sampling	Near Admin Buliding					Near Gate No. – 2					Near Gate No. – 3				
		Parameters & Results					Parameters & Results					Parameters & Results				
		PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	PM10 (µg/m³)	PM2.5 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)
1	02-09-2024 to 03-09-2024	69.38	38.33	11.94	19.27	0.59	82.66	46.66	16.56	22.72	0.69	52.63	25.41	10.26	16.37	0.52
2	07-09-2024 to 08-09-2024	60.93	25.41	10.04	17.82	0.64	70.94	30.83	13.9	19.39	0.68	55.83	21.66	9.69	16.13	0.55
3	09-09-2024 to 10-09-2024	62.46	27.91	12.86	15.65	0.62	72.89	32.5	13.9	21.93	0.67	53.98	23.75	9.34	13.53	0.59
4	13-09-2024 to 14-09-2024	58.03	29.95	10.21	17.04	0.53	73.39	39.1	11.71	18.85	0.55	51.55	27.45	15.06	18.49	0.58
5	16-09-2024 to 17-09-2024	56.11	30.36	11.59	18.97	0.59	71.29	38.68	12.29	20.18	0.55	50.52	25.79	13.09	17.58	0.61
6	21-09-2024 to 22-09-2024	64.67	27.5	13.21	22.72	0.52	69.32	35.83	16.79	22.05	0.57	58.47	26.66	10.46	18.1	0.59
7	23-09-2024 to 24-09-2024	67.76	26.24	13.50	21.39	0.53	67.18	34.58	14.88	21.39	0.58	56.12	27.08	11.77	17.22	0.53
8	26-09-2024 to 27-09-2024	58.49	31.24	11.42	19.94	0.61	67.78	29.16	11.94	16.92	0.62	55.11	22.07	9.52	14.87	0.65
9	Minimum	56.11	25.41	10.04	15.65	0.52	67.18	29.16	11.71	16.92	0.55	50.52	21.66	9.34	13.53	0.53
10	Maximum	69.38	38.33	13.50	22.72	0.64	82.66	46.66	16.79	22.72	0.69	58.47	27.45	15.06	18.49	0.65
11	Average	62.23	29.62	11.85	19.10	0.58	71.93	35.92	14.00	20.43	0.61	54.28	24.98	11.15	16.54	0.58
12	Limits As Per CPCB	100	60	80	80	4	100	60	80	80	4	100	60	80	80	4

Note:- CPCB: Central Pollution Control Board.

VARDAN ENVIROLAB LLP
Authorised Signatory

Vardan Envirolab LLP
(Formerly known as Vardan Envirolab)

Test Reports of Stack Emission Monitoring

Vardan EnviroLab
Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Hr)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/AP/01	Report No.:	VEL/AP/2404260007
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	30/04/2024
		Period of Analysis:	26/04/2024 - 30/04/2024
		Receipt Date:	26/04/2024
		Page No.:	1 of 1

Sample Description: STACK EMISSION MONITORING

General Information

Sampling Location	: Boiler Unit - 01
Sample Collected By	: VEL Representative
Sampling Instrument Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/04
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 22/04/2024
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: Boiler Unit - 01
Stack Diameter (m)	: 6.9
Stack Height (m)	: 275
Plant Load (MW/h)	: 580
Make of Stack	: MS
Sampling Duration (Minutes)	: 38.26
Ambient Temperature - Ta (°C)	: 30.0
Temperature of Stack Gases - Ts (°C)	: 129.0
Velocity of Stack Gases (m/sec.)	: 26.09
Flow Rate of PM (LPM)	: 30.0
Flow Rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Sampling & Analysis Protocol	: CPCB Guidelines & IS: 11255
Parameter Required	: As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits As Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1)	43.78	mg/Nm^3	50
2.	Sulphur Dioxide (as SO_2)	IS: 11255 (P-2)	797.23	mg/Nm^3	200
3.	Oxides of Nitrogen (as NO_X)	IS: 11255 (P-7)	264.75	mg/Nm^3	450
4.	Mercury (as Hg)	VEL/ENV/STP/144, Issue No.- 01, Issue Date : 01/11/2021	BLQ(LOQ-0.005)	mg/Nm^3	0.03

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

End of Report

Amitesh
(Reviewed By)

Dr Shiv
(Authorized Signatory)
30/04/2024

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Vardan EnviroLab
Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Hr)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/AP/02	Report No.:	VEL/AP/2404260008
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	30/04/2024
		Period of Analysis:	26/04/2024 - 30/04/2024
		Receipt Date:	26/04/2024
		Page No.:	1 of 1
Sample Description:	STACK EMISSION MONITORING		

General Information

Sampling Location	: Boiler Unit - 02
Sample Collected By	: VEL Representative
Sampling Instrument Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/04
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 22/04/2024
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: Boiler Unit - 02
Stack Diameter (m)	: 6.9
Stack Height (m)	: 275
Plant Load (MW/h)	: 590
Make of Stack	: MS
Sampling Duration (Minutes)	: 55.64
Ambient Temperature - Ta (°C)	: 30.0
Temperature of Stack Gases - Ts (°C)	: 131.0
Velocity of Stack Gases (m/sec.)	: 26.12
Flow Rate of PM (LPM)	: 29.0
Flow Rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Sampling & Analysis Protocol	: CPCB Guidelines & IS: 11255
Parameter Required	: As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits As Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1)	45.74	mg/Nm^3	50
2.	Sulphur Dioxide (as SO_2)	IS: 11255 (P-2)	818.32	mg/Nm^3	200
3.	Oxides of Nitrogen (as NO_X)	IS: 11255 (P-7)	274.81	mg/Nm^3	450
4.	Mercury (as Hg)	VEL/ENV/STP/144, Issue No.- 01, Issue Date : 01/11/2021	BLQ(LOQ-0.005)	mg/Nm^3	0.03

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

End of Report

(Reviewed By) (Authorized Signatory)

30/04/2024

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ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/AP/01	Report No.:	VEL/AP/2405270007
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	31/05/2024
		Period of Analysis:	27/05/2024 - 31/05/2024
		Receipt Date:	27/05/2024
		Page No.:	1 of 1

Sample Description: STACK EMISSION MONITORING

General Information

Sampling Location	: Boiler Unit - 01
Sample Collected By	: VEL Representative
Sampling Instrument Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/04
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 23/05/2024
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: Boiler Unit - 01
Stack Diameter (m)	: 6.9
Stack Height (m)	: 275
Plant Load (MW/h)	: 580
Make of Stack	: MS
Sampling Duration (Minutes)	: 38.26
Ambient Temperature - Ta (°C)	: 30.0
Temperature of Stack Gases - Ts (°C)	: 129.0
Velocity of Stack Gases (m/sec.)	: 26.09
Flow Rate of PM (LPM)	: 30.0
Flow Rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Sampling & Analysis Protocol	: CPCB Guidelines & IS: 11255
Parameter Required	: As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits As Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1)	45.57	mg/Nm^3	50
2.	Sulphur Dioxide (as SO_2)	IS: 11255 (P-2)	781.75	mg/Nm^3	200
3.	Oxides of Nitrogen (as NO_X)	IS: 11255 (P-7)	278.64	mg/Nm^3	450
4.	Mercury (as Hg)	VEL/ENV/STP/144, Issue No.- 01, Issue Date : 01/11/2021	BLQ(LOQ-0.005)	mg/Nm^3	0.03

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

End of Report

(Authorized Signatory)

31/05/2024

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Test Report

Sample Number:	VEL/AP/02	Report No.:	VEL/AP/2405270008
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	31/05/2024
		Period of Analysis:	27/05/2024 - 31/05/2024
		Receipt Date:	27/05/2024
		Page No.:	1 of 1
Sample Description:	STACK EMISSION MONITORING		

General Information

Sampling Location	: Boiler Unit - 02
Sample Collected By	: VEL Representative
Sampling Instrument Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/04
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 23/05/2024
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: Boiler Unit - 02
Stack Diameter (m)	: 6.9
Stack Height (m)	: 275
Plant Load (MW/h)	: 590
Make of Stack	: MS
Sampling Duration (Minutes)	: 55.64
Ambient Temperature - Ta (°C)	: 30.0
Temperature of Stack Gases - Ts (°C)	: 131.0
Velocity of Stack Gases (m/sec.)	: 26.12
Flow Rate of PM (LPM)	: 29.0
Flow Rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Sampling & Analysis Protocol	: CPCB Guidelines & IS: 11255
Parameter Required	: As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits As Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1)	47.53	mg/Nm^3	50
2.	Sulphur Dioxide (as SO_2)	IS: 11255 (P-2)	829.76	mg/Nm^3	200
3.	Oxides of Nitrogen (as NO_X)	IS: 11255 (P-7)	286.78	mg/Nm^3	450
4.	Mercury (as Hg)	VEL/ENV/STP/144, Issue No.- 01, Issue Date : 01/11/2021	BLQ(LOQ-0.005)	mg/Nm^3	0.03

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

End of Report

(Reviewed by) (Authorized Signatory)
31/05/2024

Vardan Envirolab LLP

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (HR)
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Test Report

Sample Number:	VEL/AP/02	Report No.:	VEL/AP/2406200002
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	24/06/2024
		Period of Analysis:	20/06/2024 - 24/06/2024
		Receipt Date:	20/06/2024
		Page No.:	1 of 1
Sample Description:	STACK EMISSION MONITORING		

General Information

Sampling Location	: Boiler Unit - 02
Sample Collected By	: VEL Representative
Sampling Instrument Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/04
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 17/06/2024
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: Boiler Unit - 02
Stack Diameter (m)	: 6.9
Stack Height (m)	: 275
Plant Load (MW/h)	: 494
Make of Stack	: MS
Sampling Duration (Minutes)	: 59.00
Ambient Temperature - Ta (°C)	: 37.0
Temperature of Stack Gases - Ts (°C)	: 135.0
Velocity of Stack Gases (m/sec.)	: 25.76
Flow Rate of PM (LPM)	: 29.34
Flow Rate of Gas (LPM)	: 2.0
Volumetric Flow Rate (Nm^3/hr)	: 2464849.61
Sampling Condition	: Isokinetic
Sampling & Analysis Protocol	: CPCB Guidelines & IS: 11255
Parameter Required	: As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits As Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1)	47.23	mg/Nm^3	50
2.	Sulphur Dioxide (as SO_2)	IS: 11255 (P-2)	833.35	mg/Nm^3	200
3.	Oxides of Nitrogen (as NO_X)	IS: 11255 (P-7)	291.82	mg/Nm^3	450
4.	Mercury (as Hg)	VEL/ENV/STP/144, Issue No.- 01, Issue Date : 01/11/2021	BLQ(LOQ-0.005)	mg/Nm^3	0.03

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

End of Report

Amitabh Kumar
(Reviewed By)

Dr Shiv ... Singh
(Authorized Signatory)
24/06/24

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Test Report

Sample Number:	VEL/AP/01	Report No.:	VEL/AP/2406200001
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	24/06/2024
		Period of Analysis:	20/06/2024 - 24/06/2024
		Receipt Date:	20/06/2024
		Page No.:	1 of 1
Sample Description:	STACK EMISSION MONITORING		

General Information	
Sampling Location	: Boiler Unit - 01
Sample Collected By	: VEL Representative
Sampling Instrument Used	: Stack Monitoring Kit
Instrument Code	: VEL/INS/ENV/SMK/04
Instrument Calibration Status	: Calibrated
Date of Monitoring	: 17/06/2024
Meteorological Condition During Monitoring	: Clear Sky
Stack Attached To	: Boiler Unit - 01
Stack Diameter (m)	: 6.9
Stack Height (m)	: 275
Plant Load (MW/h)	: 485
Make of Stack	: MS
Sampling Duration (Minutes)	: 58.00
Ambient Temperature - Ta (°C)	: 37.0
Temperature of Stack Gases - Ts (°C)	: 128.0
Velocity of Stack Gases (m/sec.)	: 25.54
Flow Rate of PM (LPM)	: 29.60
Flow Rate of Gas (LPM)	: 2.0
Volumetric Flow Rate (Nm^3/hr)	: 2486458.70
Sampling Condition	: Isokinetic
Sampling & Analysis Protocol	: CPCB Guidelines & IS: 11255
Parameter Required	: As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits as Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1)	46.12	mg/Nm^3	50
2.	Sulphur Dioxide (as SO_2)	IS: 11255 (P-2)	784.26	mg/Nm^3	200
3.	Oxides of Nitrogen (as NO_X)	IS: 11255 (P-7)	282.57	mg/Nm^3	450
4.	Mercury (as Hg)	VEL/ENV/STP/144, Issue No.- 01, Issue Date : 01/11/2021	BLQ(LOQ-0.005)	mg/Nm^3	0.03

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

End of Report

VARDAN ENVIROLAB Amitabh Kumar Manager

(Reviewed By)

VARDAN ENVIROLAB Dr. Shiv Prakash Singh Authorised Signatory

(Authorized Signatory)

24/06/24

Vardan Envirolab LLP
Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (HR)
ISO 9001 | ISO 14001 | ISO 45001
TC-6299

Test Report

Sample Number : VEL/AP/01

Name & Address of the Party : M/s Mahan Energen Ltd.
Village-Bandhaura, Post- Karsualal, Tehsil- Waidhan, Distt- Singrauli, Madhya Pradesh.

Report No. : VEL/AP/2408071001
Format No : 7.8 F-03
Party Reference No : 5703016500
Reporting Date : 08/08/2024
Period of Analysis : 07/08/2024-08/08/2024
Receipt Date : 07/08/2024
ULR No. : TC629924200004852F

Name of Sample : **Stack Emission Monitoring**
Sample Group : Atmospheric Pollution

General Information

Sampling Location	:	Unit-1
Sample Collected By	:	VEL Representative (Mr. Mithilesh)
Date of Sampling	:	30/07/2024
Sampling duration (Minutes)	:	34.0
Stack attached to	:	Boiler Unit-01
Make of stack	:	MS
Type of Fuel Used	:	Coal
Diameter of stack(m)	:	6.9 Mtr.
Height of stack(m)	:	205 Mtr.
Instrument calibration status	:	Calibrated
Meteorological Condition	:	Clear Sky
Ambient Temperature - Ta (°C)	:	40.0
Temperature of Stack Gases - Ts (°C)	:	134.0
Velocity of Stack Gases (m/sec.)	:	23.71
Flow rate of PM (LPM)	:	27.0
Flow rate of Gas (LPM)	:	2.0
Sampling condition	:	Isokinetic
Protocol used	:	IS 11255 & EPA

S.No.	Test Parameters	Test Method	Results	Units	Limits as per CPCB
Discipline : Chemical					
1	Particulate Matter (as PM)	IS:11255 (P-1)	46.16	mg/Nm3	50.0
2	Sulphur Dioxide (as SO2)	IS:11255 (P-2)	788.61	mg/Nm3	200.0
3	Oxide of Nitrogen (as NOX)	VEL/ENV/STP/ST/FGA/01, Issue No.- 01, Issue date 01/11/2021	307.52	mg/Nm3	450.0
4	Mercury (as Hg)	VEL/ENV/STP/144, Issue No.01, Issue Date - 01/11/2021	BLQ(LOQ-0.005)	mg/Nm3	0.03

Volumetric Flow Rate-2276338.63 Nm3/hr.

BLQ-Below Limit of Quantification,LOQ-Limit of Quantification.

End of Report

Reviewed By 08/08/2024

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TC-6299

Test Report

Sample Number :	VEL/AP/02	**Report No.**	: VEL/AP/2408071002
Name & Address of the Party	: M/s Mahan Energen Ltd. Village-Bandhaura, Post- Karsualal, Tehsil- Waidhan, Distt- Singrauli, Madhya Pradesh.	**Format No**	: 7.8 F-03
		Party Reference No	: 5703016500
		Reporting Date	: 08/08/2024
		Period of Analysis	: 07/08/2024-08/08/2024
		Receipt Date	: 07/08/2024
Name of Sample	: **Stack Emission Monitoring**	**ULR No.**	: TC629924200004853F
Sample Group	: Atmospheric Pollution		

General Information

Sampling Location	: Unit-2
Sample Collected By	: VEL Representative (Mr. Mithilesh)
Date of Sampling	: 30/07/2024
Sampling duration (Minutes)	: 36.0
Stack attached to	: Boiler Unit -02
Make of stack	: MS
Type of Fuel Used	: Coal
Diameter of stack(m)	: 6.9 Mtr.
Height of stack(m)	: 205.0 Mtr.
Instrument calibration status	: Calibrated
Meteorological Condition	: Clear Sky
Ambient Temperature - Ta (°C)	: 41.0
Temperature of Stack Gases - Ts (°C)	: 121.0
Velocity of Stack Gases (m/sec.)	: 26.63
Flow rate of PM (LPM)	: 26.0
Flow rate of Gas (LPM)	: 2.0
Sampling condition	: Isokinetic
Protocol used	: IS 11255 & EPA

S.No.	Test Parameters	Test Method	Results	Units	Limits as per CPCB
Discipline : Chemical					
1	Particulate Matter (as PM)	IS:11255 (P-1)	42.97	mg/Nm3	50.0
2	Sulphur Dioxide (as SO2)	IS:11255 (P-2)	747.45	mg/Nm3	200.0
3	Oxide of Nitrogen (as NOX)	VEL/ENV/STP/ST/FGA/01, Issue No.- 01, Issue date 01/11/2021	286.31	mg/Nm3	450.0
4	Mercury (as Hg)	VEL/ENV/STP/144, Issue No.01, Issue Date - 01/11/2021	BLQ(LOQ-0.005)	mg/Nm3	0.03

Volumetric Flow Rate-2641038.11 Nm3/hr.

BLQ-Below Limit of Quantification,LOQ-Limit of Quantification.

End of Report

Reviewed By 08/08/2024

Authorized Signatory

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Test Report

Sample Number : VEL/AP/04

Name & Address of the Party : M/s Mahan Energen Ltd.
Village-Bandhaura, Post- Karsualal, Tehsil- Waidhan, Distt- Singrauli, Madhya Pradesh.

Report No. : VEL/AP/2408301004
Format No : 7.8 F-03
Party Reference No : 5703016500
Reporting Date : 05/09/2024
Period of Analysis : 30/08/2024-04/09/2024
Receipt Date : 30/08/2024
ULR No. : TC629924200005440F

Name of Sample : **Stack Emission Monitoring**
Sample Group : Atmospheric Pollution

General Information

Sampling Location	:	Unit-1
Sample Collected By	:	VEL Representative (Mr. Mithilesh)
Date of Sampling	:	27/08/2024
Sampling duration (Minutes)	:	34.0
Stack attached to	:	Boiler Unit-01
Make of stack	:	MS
Type of Fuel Used	:	Coal
Diameter of stack(m)	:	6.9 Mtr.
Height of stack(m)	:	275.0 Mtr.
Instrument calibration status	:	Calibrated
Meteorological Condition	:	Clear Sky
Ambient Temperature - Ta (°C)	:	36.0
Temperature of Stack Gases - Ts (°C)	:	221.0
Velocity of Stack Gases (m/sec.)	:	25.48
Flow rate of PM (LPM)	:	28.0
Flow rate of Gas (LPM)	:	2.0
Sampling condition	:	Isokinetic
Protocol used	:	IS 11255 & EPA

S.No.	Test Parameters	Test Method	Results	Units	Limits as per CPCB
Discipline : Chemical					
1	Particulate Matter (as PM)	**IS:11255 (P-1)**	47.23	mg/Nm3	**50.0**
2	Sulphur Dioxide (as SO2)	**IS:11255 (P-2)**	772.40	mg/Nm3	**200.0**
3	Oxide of Nitrogen (as NOX)	**VEL/EN/STP/146, Issue No.01, Issue Date - 01/11/2023**	301.31	mg/Nm3	**450.0**
4	Mercury (as Hg)	**VEL/EN/STP/144, Issue No.01, Issue Date - 01/11/2023**	BLQ(LOQ-0.005)	mg/Nm3	**0.03**

Volumetric Flow Rate-2015450.70 Nm3/hr.

BLQ-Below Limit of Quantification,LOQ-Limit of Quantification.

End of Report

Reviewed By

Kumar 05/09/2024

VARDAN ENVIROLAB

Dr Shiv Prakash Singh
Authorized Signatory

Test Report

Sample Number : VEL/AP/05

Name & Address of the Party : M/s Mahan Energen Ltd.
Village-Bandhaura, Post- Karsualal, Tehsil- Waidhan, Distt- Singrauli, Madhya Pradesh.

Report No. : VEL/AP/2408301005
Format No : 7.8 F-03
Party Reference No : 5703016500
Reporting Date : 05/09/2024
Period of Analysis : 30/08/2024-04/09/2024
Receipt Date : 30/08/2024
ULR No. : TC629924200005441F

Name of Sample : **Stack Emission Monitoring**
Sample Group : Atmospheric Pollution

General Information

Sampling Location	:	Unit-2
Sample Collected By	:	VEL Representative (Mr. Mithilesh)
Date of Sampling	:	27/08/2024
Sampling duration (Minutes)	:	33.0
Stack attached to	:	Boiler Unit-02
Make of stack	:	MS
Type of Fuel Used	:	Coal
Diameter of stack(m)	:	6.9 Mtr.
Height of stack(m)	:	275.0 Mtr.
Instrument calibration status	:	Calibrated
Meteorological Condition	:	Clear Sky
Ambient Temperature - Ta (°C)	:	36.0
Temperature of Stack Gases - Ts (°C)	:	219.0
Velocity of Stack Gases (m/sec.)	:	26.05
Flow rate of PM (LPM)	:	28.0
Flow rate of Gas (LPM)	:	2.0
Sampling condition	:	Isokinetic
Protocol used	:	IS 11255 & EPA

S.No.	Test Parameters	Test Method	Results	Units	Limits as per CPCB
Discipline : Chemical					
1	Particulate Matter (as PM)	IS:11255 (P-1)	44.53	mg/Nm3	50.0
2	Sulphur Dioxide (as SO2)	IS:11255 (P-2)	742.37	mg/Nm3	200.0
3	Oxide of Nitrogen (as NOX)	VEL/EN/STP/146, Issue No.01, Issue Date - 01/11/2023	280.52	mg/Nm3	450.0
4	Mercury (as Hg)	VEL/EN/STP/144, Issue No.01, Issue Date - 01/11/2023	BLQ(LOQ-0.005)	mg/Nm3	0.03

Volumetric Flow Rate-2041116.20 Nm3/hr.

BLQ-Below Limit of Quantification,LOQ-Limit of Quantification.

End of Report

Reviewed By

Kumar 05/09/2024

VARDAN ENVIROLAB GURUGRAM

VARDAN ENVIROLAB Dr. Shiv Prakash Singh Authorised Signatory

Authorized Signatory

Test Report

Sample Number:	VEL/AP/01	Report No.:	VEL/AP/2409170001
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Waidhan, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	21/09/2024
		Period of Analysis:	17/09/2024 - 21/09/2024
		Receipt Date:	13/09/2024
		Page No.:	1 of 1

Sample Description: STACK EMISSION MONITORING

General Information	
Sampling Location	: Unit -01
Sample Collected By	: VEL Representative (Mr. Mithilesh)
Date of Monitoring	: 13/09/2024
Sampling Duration (Minutes)	: 40.0
Stack Attached To	: Boiler Unit -01
Make of Stack	: MS
Type of Fuel Used	: Coal
Stack Diameter (m)	: 6.9 Mtr.
Stack Height (m)	: 275 Mtr.
Instrument calibration status	: Calibrated
Meteorological Condition During Monitoring	: Clear Sky
Ambient Temperature - Ta (°C)	: 35.0
Temperature of Stack Gases - Ts (°C)	: 189.0
Velocity of Stack Gases (m/sec.)	: 26.17
Flow Rate of PM (LPM)	: 27.0
Flow Rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Sampling & Analysis Protocol	: IS 11255 & EPA

S. No.	Parameters	Test Method	Results	Units	Limits As Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1)	43.67	mg/Nm^3	50
2.	Sulphur Dioxide (as SO_2)	IS: 11255 (P-2)	776.11	mg/Nm^3	200
3.	Oxides of Nitrogen (as NO_X)	IS: 11255 (P-7)	298.17	mg/Nm^3	450
4.	Mercury (as Hg)	VEL/ENV/STP/144, Issue No.- 01, Issue Date : 01/11/2021	BLQ(LOQ-0.005)	mg/Nm^3	0.03

Volumetric Flow Rate-1854201.16 Nm^3/hr
Note: STP-Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

End of Report

(Reviewed By) (Authorized Signatory)

21/09/2024

Terms & Conditions

Vardan Envirolab LLP
Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (HR)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/AP/02	Report No.:	VEL/AP/2409170002
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	21/09/2024
		Period of Analysis:	17/09/2024 - 21/09/2024
		Receipt Date:	13/09/2024
		Page No.:	1 of 1
Sample Description:	STACK EMISSION MONITORING		

General Information

Sampling Location	: Unit -02
Sample Collected By	: VEL Representative (Mr. Mithilesh)
Date of Monitoring	: 13/09/2024
Sampling Duration (Minutes)	: 42.0
Stack Attached To	: Boiler Unit -02
Make of Stack	: MS
Type of Fuel Used	: Coal
Stack Diameter (m)	: 6.9 Mtr.
Stack Height (m)	: 275 Mtr.
Instrument calibration status	: Calibrated
Meteorological Condition During Monitoring	: Clear Sky
Ambient Temperature - Ta (°C)	: 40.0
Temperature of Stack Gases - Ts (°C)	: 197.0
Velocity of Stack Gases (m/sec.)	: 25.95
Flow Rate of PM (LPM)	: 27.0
Flow Rate of Gas (LPM)	: 2.0
Sampling Condition	: Isokinetic
Sampling & Analysis Protocol	: IS 11255 & EPA

S. No.	Parameters	Test Method	Results	Units	Limits As Per CPCB
1.	Particulate Matter (as PM)	IS: 11255 (P-1)	40.78	mg/Nm^3	50
2.	Sulphur Dioxide (as SO_2)	IS: 11255 (P-2)	753.74	mg/Nm^3	200
3.	Oxides of Nitrogen (as NO_X)	IS: 11255 (P-7)	277.63	mg/Nm^3	450
4.	Mercury (as Hg)	VEL/ENV/STP/144, Issue No.- 01, Issue Date : 01/11/2021	BLQ(LOQ-0.005)	mg/Nm^3	0.03

Volumetric Flow Rate-1812300.31 Nm^3/hr

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

End of Report

(Reviewed By)

(Authorized Signatory)
21/09/2024

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Test Reports of Ground Water Sample

Vardan Envirolab LLP

Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (HR)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/W/01	Report No.:	VEL/W/2409210001
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli. Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	28/09/2024
		Period of Analysis:	21/09/2024 - 28/09/2024
		Receipt Date:	21/09/2024
		Sampling Date:	10/09/2024
Sample Description:	Ground Water	Sampling Quantity:	10 Ltrs. + 250 ml
Location:	Bandhaura Village	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh Kumar)	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025, APHA 23rd Edition 2017 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	Colour	IS: 3025 (P-4)	*BLQ(**LOQ-1.0)	Hazen	5	15
2.	Odour	IS: 3025 (P-5)	Agreeable	--	Agreeable	Agreeable
3.	pH (at 25°C)	IS: 3025 (P-11)	7.16	--	6.5 to 8.5	No Relaxation
4.	Taste	IS: 3025 (P-8)	Not Performed	--	Agreeable	Agreeable
5.	Turbidity	IS: 3025 (P-10)	10.00	NTU	1	5
6.	Total Dissolved Solids	IS: 3025 (P-16)	436.00	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Aluminium (as Al)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
8.	Ammonia (as Total Ammonia - N)	IS: 3025 (P-34)	*BLQ(**LOQ-0.1)	mg/L	0.5	No Relaxation
9.	Anionic Detergents (as MBAS)	IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
10.	Barium (as Ba)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.7	No Relaxation
11.	Boron (as B)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
12.	Calcium (as Ca)	IS: 3025 (P-40)	59.92	mg/L	75	200

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Test Report

Sample Number: VEL/W/01			Report No.: VEL/W/2409210001			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
13.	Chloramines (as Cl_2)	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	4.0	No Relaxation
14.	Chloride (as Cl)	IS: 3025 (P-32)	63.14	mg/L	250	1000
15.	Copper (as Cu)	VEL/STP/ICP/W-01. Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
16.	Fluoride (as F)	APHA, 4500 F D, SPADNS Method	0.26	mg/L	1.0	1.5
17.	Residual Free Chlorine	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	0.2	1
18.	Iron (as Fe)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	1.0	No Relaxation
19.	Magnesium (as Mg)	APHA, 3500 Mg B, Calculation Method	20.34	mg/L	30	100
20.	Manganese (as Mn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
21.	Mineral Oil	IS: 3025 (P-39)	*BLQ(**LOQ-0.5)	mg/L	1.0	No Relaxation
22.	Nitrate (as NO_3)	IS: 3025 (P-34)	5.94	mg/L	45	No Relaxation
23.	Phenolic Compounds (as C_6H_5OH)	IS: 3025 (P-43)	*BLQ(**LOQ-0.001)	mg/L	0.001	0.002
24.	Selenium (as Se)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
25.	Silver (as Ag)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.1	No Relaxation
26.	Sulphate (as SO_4)	IS: 3025 (P-24)	25.69	mg/L	200	400
27.	Sulphide (as H_2S)	IS: 3025 (P-29)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
28.	Total Alkalinity (as $CaCO_3$)	IS: 3025 (P-23)	116.05	mg/L	200	600
29.	Total Hardness (as $CaCO_3$)	IS: 3025 (P-21)	231.00	mg/L	200	600
30.	Zinc (as Zn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0

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28/09/2024

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Test Report

Sample Number: VEL/W/01			Report No.: VEL/W/2409210001			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 3 Parameters Concerning Toxic Substances						
31.	Cadmium (as Cd)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
32.	Cyanide (as CN)	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
33.	Lead (as Pb)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
34.	Mercury (as Hg)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
35.	Molybdenum (as Mo)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.07	No Relaxation
36.	Nickel (as Ni)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.02	No Relaxation
37.	Polychlorinated Biphenyls (PCB)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0005	No Relaxation
38.	Polynuclear Aromatic Hydrocarbons (PAH)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0001	No Relaxation
39.	Total Arsenic (as As)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
40.	Total Chromium (as Cr)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	No Relaxation
41.	Trihalomethanes:					
(A)	Bromoform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(B)	Dibromochloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(C)	Bromodichloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.06	No Relaxation
(D)	Chloroform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.2	No Relaxation

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Test Report

Sample Number: VEL/W/01			Report No.: VEL/W/2409210001			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 5 Pesticide Residues Limits and Test Method						
42.	Alachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	20	No Relaxation
43.	Atrazine	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
44.	Aldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
45.	Dieldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
46.	Alpha HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.01	No Relaxation
47.	Beta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
48.	Butachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	125	No Relaxation
49.	Chlorpyriphos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
50.	Delta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
51.	2,4- Dichlorophenoxyacetic Acid	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
52.	DDT (o, p and p, p – Isomers of DDT, DDE and DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
53.	Endosulfan (Alpha, Beta & Sulphate)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.4	No Relaxation
54.	Ethion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	3	No Relaxation
55.	Gamma-HCH (Lindane)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
56.	Isoproturon	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	9	No Relaxation
57.	Malathion (Malathion and its Oxygen Analogue that is Malaoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	190	No Relaxation

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28/09/2024

Vardan Envirolab LLP
Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (HR)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number: VEL/W/01			Report No.: VEL/W/2409210001			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
58.	Methyl Parathion (Methyl Parathion and its Oxygen Analogue that is Methyl-Paraoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.3	No Relaxation
59.	Monocrotophos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
60.	Phorate (Phorate and its Oxygen Analogue that is Phorate Sulphoxide and Phorate Sulphone)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
Table 5 Bacteriological Quality of Drinking Water						
61.	E. coli	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--
62.	Total Coliform	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

Amendment No.1 in June 2015 (Limits of Iron & Arsenic) and Amendment No.2 in September 2018 (Limit of Boron & IS Method of E. coli & Total Coliform) & Amendment No.3 in February 2021 (Limit of Mineral Oil).

Reviewed By

End of Report

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Test Report

Sample Number:	VEL/W/02	**Report No.:**	VEL/W/2409210002
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	**Format No.:**	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	28/09/2024
		Period of Analysis:	21/09/2024 - 28/09/2024
		Receipt Date:	21/09/2024
		Sampling Date:	10/09/2024
Sample Description:	Ground Water	**Sampling Quantity:**	10 Ltrs. + 250 ml
Location:	Karsualal Village	**Sampling Type:**	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh Kumar)	**Preservation:**	Ice Box
Sampling and Analysis Protocol:	IS: 3025, APHA 23rd Edition 2017 & STP	**Parameter Required:**	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	Colour	IS: 3025 (P-4)	*BLQ(**LOQ-1.0)	Hazen	5	15
2.	Odour	IS: 3025 (P-5)	Agreeable	--	Agreeable	Agreeable
3.	pH (at 25°C)	IS: 3025 (P-11)	7.81	--	6.5 to 8.5	No Relaxation
4.	Taste	IS: 3025 (P-8)	Agreeable	--	Agreeable	Agreeable
5.	Turbidity	IS: 3025 (P-10)	*BLQ(**LOQ-1.0)	NTU	1	5
6.	Total Dissolved Solids	IS: 3025 (P-16)	511.00	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Aluminium (as Al)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
8.	Ammonia (as Total Ammonia - N)	IS: 3025 (P-34)	*BLQ(**LOQ-0.1)	mg/L	0.5	No Relaxation
9.	Anionic Detergents (as MBAS)	IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
10.	Barium (as Ba)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.7	No Relaxation
11.	Boron (as B)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
12.	Calcium (as Ca)	IS: 3025 (P-40)	79.96	mg/L	75	200

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Test Report

Sample Number: VEL/W/02			Report No.: VEL/W/2409210002			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
13.	Chloramines (as Cl_2)	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	4.0	No Relaxation
14.	Chloride (as Cl)	IS: 3025 (P-32)	70.42	mg/L	250	1000
15.	Copper (as Cu)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
16.	Fluoride (as F)	APHA, 4500 F D, SPADNS Method	0.30	mg/L	1.0	1.5
17.	Residual Free Chlorine	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	0.2	1
18.	Iron (as Fe)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	1.0	No Relaxation
19.	Magnesium (as Mg)	APHA, 3500 Mg B, Calculation Method	27.97	mg/L	30	100
20.	Manganese (as Mn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
21.	Mineral Oil	IS: 3025 (P-39)	*BLQ(**LOQ-0.5)	mg/L	1.0	No Relaxation
22.	Nitrate (as NO_3)	IS: 3025 (P-34)	5.08	mg/L	45	No Relaxation
23.	Phenolic Compounds (as C_6H_5OH)	IS: 3025 (P-43)	*BLQ(**LOQ-0.001)	mg/L	0.001	0.002
24.	Selenium (as Se)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
25.	Silver (as Ag)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.1	No Relaxation
26.	Sulphate (as SO_4)	IS: 3025 (P-24)	31.49	mg/L	200	400
27.	Sulphide (as H_2S)	IS: 3025 (P-29)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
28.	Total Alkalinity (as $CaCO_3$)	IS: 3025 (P-23)	137.15	mg/L	200	600
29.	Total Hardness (as $CaCO_3$)	IS: 3025 (P-21)	315.00	mg/L	200	600
30.	Zinc (as Zn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0

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Test Report

Sample Number: VEL/W/02			Report No.: VEL/W/2409210002			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
Table 3 Parameters Concerning Toxic Substances						
31.	Cadmium (as Cd)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
32.	Cyanide (as CN)	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
33.	Lead (as Pb)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
34.	Mercury (as Hg)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
35.	Molybdenum (as Mo)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.07	No Relaxation
36.	Nickel (as Ni)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.02	No Relaxation
37.	Polychlorinated Biphenyls (PCB)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0005	No Relaxation
38.	Polynuclear Aromatic Hydrocarbons (PAH)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0001	No Relaxation
39.	Total Arsenic (as As)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
40.	Total Chromium (as Cr)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	No Relaxation
41.	**Trihalomethanes:**					
(A)	Bromoform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(B)	Dibromochloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(C)	Bromodichloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.06	No Relaxation
(D)	Chloroform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.2	No Relaxation

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S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Sample Number: VEL/W/02			Report No.: VEL/W/2409210002			
Table 4 Pesticide Residues Limits and Test Method						
42.	Alachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	20	No Relaxation
43.	Atrazine	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
44.	Aldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
45.	Dieldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
46.	Alpha HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.01	No Relaxation
47.	Beta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
48.	Butachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	125	No Relaxation
49.	Chlorpyriphos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
50.	Delta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
51.	2,4- Dichlorophenoxyacetic Acid	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
52.	DDT (o, p and p, p – Isomers of DDT, DDE and DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
53.	Endosulfan (Alpha, Beta & Sulphate)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.4	No Relaxation
54.	Ethion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	3	No Relaxation
55.	Gamma-HCH (Lindane)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
56.	Isoproturon	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	9	No Relaxation
57.	Malathion (Malathion and its Oxygen Analogue that is Malaoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	190	No Relaxation

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Test Report

Sample Number: VEL/W/02			Report No.: VEL/W/2409210002			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
58.	Methyl Parathion (Methyl Parathion and its Oxygen Analogue that is Methyl-Paraoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.3	No Relaxation
59.	Monocrotophos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
60.	Phorate (Phorate and its Oxygen Analogue that is Phorate Sulphoxide and Phorate Sulphone)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
Table 5 Bacteriological Quality of Drinking Water						
61.	E. coli	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--
62.	Total Coliform	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

Amendment No.1 in June 2015 (Limits of Iron & Arsenic) and Amendment No.2 in September 2018 (Limit of Boron & IS Method of E. coli & Total Coliform) & Amendment No.3 in February 2021 (Limit of Mineral Oil).

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End of Report

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Test Report

Sample Number:	VEL/W/03	**Report No.:**	VEL/W/2409210003
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	**Format No.:**	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	28/09/2024
		Period of Analysis:	21/09/2024 - 28/09/2024
		Receipt Date:	21/09/2024
		Sampling Date:	10/09/2024
Sample Description:	Ground Water	**Sampling Quantity:**	10 Ltrs. + 250 ml
Location:	Raila Village	**Sampling Type:**	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh Kumar)	**Preservation:**	Ice Box
Sampling and Analysis Protocol:	IS: 3025, APHA [illegible] Edition 2017 & STP	**Parameter Required:**	As Per W[illegible] Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	Colour	IS: 3025 (P-4)	*BLQ(**LOQ-1.0)	Hazen	5	15
2.	Odour	IS: 3025 (P-5)	Agreeable	--	Agreeable	Agreeable
3.	pH (at 25°C)	IS: 3025 (P-11)	7.32	--	6.5 to 8.5	No Relaxation
4.	Taste	IS: 3025 (P-8)	Agreeable	--	Agreeable	Agreeable
5.	Turbidity	IS: 3025 (P-10)	1.09	NTU	1	5
6.	Total Dissolved Solids	IS: 3025 (P-16)	454.00	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Aluminium (as Al)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
8.	Ammonia (as Total Ammonia - N)	IS: 3025 (P-34)	*BLQ(**LOQ-0.1)	mg/L	0.5	No Relaxation
9.	Anionic Detergents (as MBAS)	IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
10.	Barium (as Ba)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.7	No Relaxation
11.	Boron (as B)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
12.	Calcium (as Ca)	IS: 3025 (P-40)	75.75	mg/L	75	200

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S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
13.	Chloramines (as Cl_2)	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	4.0	No Relaxation
14.	Chloride (as Cl)	IS: 3025 (P-32)	75.28	mg/L	250	1000
15.	Copper (as Cu)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
16.	Fluoride (as F)	APHA, 4500 F D, SPADNS Method	0.35	mg/L	1.0	1.5
17.	Residual Free Chlorine	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	0.2	1
18.	Iron (as Fe)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	1.0	No Relaxation
19.	Magnesium (as Mg)	APHA, 3500 Mg B, Calculation Method	22.87	mg/L	30	100
20.	Manganese (as Mn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
21.	Mineral Oil	IS: 3025 (P-39)	*BLQ(**LOQ-0.5)	mg/L	1.0	No Relaxation
22.	Nitrate (as NO_3)	IS: 3025 (P-34)	5.63	mg/L	45	No Relaxation
23.	Phenolic Compounds (as C_6H_5OH)	IS: 3025 (P-43)	*BLQ(**LOQ-0.001)	mg/L	0.001	0.002
24.	Selenium (as Se)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
25.	Silver (as Ag)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.1	No Relaxation
26.	Sulphate (as SO_4)	IS: 3025 (P-24)	28.41	mg/L	200	400
27.	Sulphide (as H_2S)	IS: 3025 (P-29)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
28.	Total Alkalinity (as $CaCO_3$)	IS: 3025 (P-23)	126.60	mg/L	200	600
29.	Total Hardness (as $CaCO_3$)	IS: 3025 (P-21)	283.50	mg/L	200	600
30.	Zinc (as Zn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0

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Test Report

Sample Number: VEL/W/03 | Report No.: VEL/W/2409210003

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 3 Parameters Concerning Toxic Substances						
31.	Cadmium (as Cd)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
32.	Cyanide (as CN)	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
33.	Lead (as Pb)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/l	0.01	No Relaxation
34.	Mercury (as Hg)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
35.	Molybdenum (as Mo)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.07	No Relaxation
36.	Nickel (as Ni)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.02	No Relaxation
37.	Polychlorinated Biphenyls (PCB)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0005	No Relaxation
38.	Polynuclear Aromatic Hydrocarbons (PAH)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0001	No Relaxation
39.	Total Arsenic (as As)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
40.	Total Chromium (as Cr)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	No Relaxation
41.	**Trihalomethanes:**					
(A)	Bromoform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(B)	Dibromochloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(C)	Bromodichloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.06	No Relaxation
(D)	Chloroform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.2	No Relaxation

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Test Report

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Sample Number: VEL/W/03			Report No.: VEL/W/2409210003			
Table 4 Pesticide Residues Limits and Test Method						
42.	Alachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	20	No Relaxation
43.	Atrazine	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
44.	Aldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
45.	Dieldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
46.	Alpha HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.01	No Relaxation
47.	Beta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
48.	Butachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	125	No Relaxation
49.	Chlorpyriphos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
50.	Delta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
51.	2,4- Dichlorophenoxyacetic Acid	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
52.	DDT (o, p and p, p -- Isomers of DDT, DDE and DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
53.	Endosulfan (Alpha, Beta & Sulphate)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.4	No Relaxation
54.	Ethion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	3	No Relaxation
55.	Gamma-HCH (Lindane)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
56.	Isoproturon	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	9	No Relaxation
57.	Malathion (Malathion and its Oxygen Analogue that is Malaoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	190	No Relaxation

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Test Report

Sample Number: VEL/W/03			Report No.: VEL/W/2409210003			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
58.	Methyl Parathion (Methyl Parathion and its Oxygen Analogue that is Methyl-Paraoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.3	No Relaxation
59.	Monocrotophos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
60.	Phorate (Phorate and its Oxygen Analogue that is Phorate Sulphoxide and Phorate Sulphone)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
Table 5 Bacteriological Quality of Drinking Water						
61.	E. coli	IS: 15185:2016	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--
62.	Total Coliform	IS: 15185:2016	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

Amendment No.1 in June 2015 (Limits of Iron & Arsenic) and Amendment No.2 in September 2018 (Limit of Boron & IS Method of E. coli & Total Coliform) & Amendment No.3 in Febrnary 2021 (Limit of Mineral Oil).

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End of Report

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Test Reports of Piezometer Water Sample

Test Report

Sample Number:	VEL/W/04	**Report No.:**	VEL/W/2409210004
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	**Format No.:**	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	28/09/2024
		Period of Analysis:	21/09/2024 - 28/09/2024
		Receipt Date:	21/09/2024
		Sampling Date:	10/09/2024
Sample Description:	Ground Water (Pizometer)	**Sampling Quantity:**	10 Ltrs. + 250 ml
Location:	Piezo Well No. 01	**Sampling Type:**	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh Kumar)	**Preservation:**	Ice Box
Sampling and Analysis Protocol:	IS: 3025, APHA 23rd Edition 2017 & STP	**Parameter Required:**	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	Colour	IS: 3025 (P-4)	*BLQ(**LOQ-1.0)	Hazen	5	15
2.	Odour	IS: 3025 (P-5)	Agreeable	--	Agreeable	Agreeable
3.	pH (at 25°C)	IS: 3025 (P-11)	7.34	--	6.5 to 8.5	No Relaxation
4.	Taste	IS: 3025 (P-8)	Agreeable	--	Agreeable	Agreeable
5.	Turbidity	IS: 3025 (P-10)	1.91	NTU	1	5
6.	Total Dissolved Solids	IS: 3025 (P-16)	481	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Aluminium (as Al)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L	0.03	0.2
8.	Ammonia (as Total Ammonia - N)	IS: 3025 (P-34)	*BLQ(**LOQ-0.1)	mg/L	0.5	No Relaxation
9.	Anionic Detergents (as MBAS)	IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
10.	Barium (as Ba)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.7	No Relaxation
11.	Boron (as B)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
12.	Calcium (as Ca)	IS: 3025 (P-40)	87.53	mg/L	75	200

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Test Report

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Sample Number: VEL/W/04			Report No.: VEL/W/2409210004			
13.	Chloramines (as Cl_2)	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	4.0	No Relaxation
14.	Chloride (as Cl)	IS: 3025 (P-32)	99.56	mg/L	250	1000
15.	Copper (as Cu)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
16.	Fluoride (as F)	APHA, 4500 F D, SPADNS Method	0.31	mg/L	1.0	1.5
17.	Residual Free Chlorine	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	0.2	1
18.	Iron (as Fe)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	1.0	No Relaxation
19.	Magnesium (as Mg)	APHA, 3500 Mg B, Calculation Method	27.45	mg/L	30	100
20.	Manganese (as Mn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
21.	Mineral Oil	IS: 3025 (P-39)	*BLQ(**LOQ-0.5)	mg/L	1.0	No Relaxation
22.	Nitrate (as NO_3)	IS: 3025 (P-34)	6.42	mg/L	45	No Relaxation
23.	Phenolic Compounds (as C_6H_5OH)	IS: 3025 (P-43)	*BLQ(**LOQ-0.001)	mg/L	0.001	0.002
24.	Selenium (as Se)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
25.	Silver (as Ag)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.1	No Relaxation
26.	Sulphate (as SO_4)	IS: 3025 (P-24)	35.42	mg/L	200	400
27.	Sulphide (as H_2S)	IS: 3025 (P-29)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
28.	Total Alkalinity (as $CaCO_3$)	IS: 3025 (P-23)	211.00	mg/L	200	600
29.	Total Hardness (as $CaCO_3$)	IS: 3025 (P-21)	331.80	mg/L	200	600
30.	Zinc (as Zn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0

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Test Report

Sample Number: VEL/W/04			Report No.: VEL/W/2409210004			
					Limits of IS: 10500-2012	
S. No.	Parameters	Test Method	Results	Units	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 3 Parameters Concerning Toxic Substances						
31.	Cadmium (as Cd)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
32.	Cyanide (as CN)	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
33.	Lead (as Pb)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
34.	Mercury (as Hg)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
35.	Molybdenum (as Mo)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.07	No Relaxation
36.	Nickel (as Ni)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.02	No Relaxation
37.	Polychlorinated Biphenyls (PCB)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0005	No Relaxation
38.	Polynuclear Aromatic Hydrocarbons (PAH)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0001	No Relaxation
39.	Total Arsenic (as As)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
40.	Total Chromium (as Cr)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	No Relaxation
41.	**Trihalomethanes:**					
(A)	Bromoform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(B)	Dibromochloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(C)	Bromodichloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.06	No Relaxation
(D)	Chloroform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.2	No Relaxation

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28/09/24

Test Report

Sample Number: VEL/W/04			Report No.: VEL/W/2409210004			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
Table 5 Pesticide Residues Limits and Test Method						
42.	Alachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	20	No Relaxation
43.	Atrazine	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
44.	Aldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
45.	Dieldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
46.	Alpha HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.01	No Relaxation
47.	Beta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
48.	Butachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	125	No Relaxation
49.	Chlorpyriphos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
50.	Delta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
51.	2,4- Dichlorophenoxyacetic Acid	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
52.	DDT (o, p and p, p – Isomers of DDT, DDE and DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
53.	Endosulfan (Alpha, Beta & Sulphate)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.4	No Relaxation
54.	Ethion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	3	No Relaxation
55.	Gamma-HCH (Lindane)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
56.	Isoproturon	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	9	No Relaxation
57.	Malathion (Malathion and its Oxygen Analogue that is Malaoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	190	No Relaxation

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Test Report

Sample Number: VEL/W/04			Report No.: VEL/W/2409210004			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
58.	Methyl Parathion (Methyl Parathion and its Oxygen Analogue that is Methyl-Paraoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.3	No Relaxation
59.	Monocrotophos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
60.	Phorate (Phorate and its Oxygen Analogue that is Phorate Sulphoxide and Phorate Sulphone)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
Table 5 Bacteriological Quality of Drinking Water						
61.	E. coli	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--
62.	Total Coliform	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

Amendment No.1 in June 2015 (Limits of Iron & Arsenic) and Amendment No.2 in September 2018 (Limit of Boron & IS Method of E. coli & Total Coliform) & Amendment No.3 in February 2021 (Limit of Mineral Oil).

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End of Report

28/09/2024

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28/09/2024

Test Report

Sample Number:	VEL/W/05	Report No.:	VEL/W/2409210005
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	28/09/2024
		Period of Analysis:	21/09/2024 - 28/09/2024
		Receipt Date:	21/09/2024
		Sampling Date:	10/09/2024
Sample Description:	Ground Water (Pizometer)	Sampling Quantity:	10 Ltrs. + 250 ml
Location:	Piezo Well No. 02	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh Kumar)	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025, APHA 23rd Edition 2017 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	Colour	IS: 3025 (P-4)	*BLQ(**LOQ-1.0)	Hazen	5	15
2.	Odour	IS: 3025 (P-5)	Agreeable	--	Agreeable	Agreeable
3.	pH (at 25°C)	IS: 3025 (P-11)	7.55	--	6.5 to 8.5	No Relaxation
4.	Taste	IS: 3025 (P-8)	Agreeable	--	Agreeable	Agreeable
5.	Turbidity	IS: 3025 (P-10)	1.55	NTU	1	5
6.	Total Dissolved Solids	IS: 3025 (P-16)	675	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Aluminium (as Al)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L	0.03	0.2
8.	Ammonia (as Total Ammonia - N)	IS: 3025 (P-34)	*BLQ(**LOQ-0.1)	mg/L	0.5	No Relaxation
9.	Anionic Detergents (as MBAS)	IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
10.	Barium (as Ba)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.7	No Relaxation
11.	Boron (as B)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
12.	Calcium (as Ca)	IS: 3025 (P-40)	117.84	mg/L	75	200

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Amitabh Kumar Dubey
Technical Manager
Reviewed By

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Dr. Shiv
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Test Report

Sample Number: VEL/W/02			Report No.: VEL/W/2409210002			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
13.	Chloramines (as Cl_2)	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	4.0	No Relaxation
14.	Chloride (as Cl)	IS: 3025 (P-32)	123.84	mg/L	250	1000
15.	Copper (as Cu)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
16.	Fluoride (as F)	APHA, 4500 F D, SPADNS Method	0.35	mg/L	1.0	1.5
17.	Residual Free Chlorine	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	0.2	1
18.	Iron (as Fe)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	1.0	No Relaxation
19.	Magnesium (as Mg)	APHA, 3500 Mg B, Calculation Method	50.88	mg/L	30	100
20.	Manganese (as Mn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
21.	Mineral Oil	IS: 3025 (P-39)	*BLQ(**LOQ-0.5)	mg/L	1.0	No Relaxation
22.	Nitrate (as NO_3)	IS: 3025 (P-34)	8.94	mg/L	45	No Relaxation
23.	Phenolic Compounds (as C_6H_5OH)	IS: 3025 (P-43)	*BLQ(**LOQ-0.001)	mg/L	0.001	0.002
24.	Selenium (as Se)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
25.	Silver (as Ag)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.1	No Relaxation
26.	Sulphate (as SO_4)	IS: 3025 (P-24)	42.92	mg/L	200	400
27.	Sulphide (as H_2S)	IS: 3025 (P-29)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
28.	Total Alkalinity (as $CaCO_3$)	IS: 3025 (P-23)	226.83	mg/L	200	600
29.	Total Hardness (as $CaCO_3$)	IS: 3025 (P-21)	504.00	mg/L	200	600
30.	Zinc (as Zn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0

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Test Report

Sample Number: VEL/W/05			Report No.: VEL/W/2409210005			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 3 Parameters Concerning Toxic Substances						
31.	Cadmium (as Cd)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
32.	Cyanide (as CN)	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
33.	Lead (as Pb)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
34.	Mercury (as Hg)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
35.	Molybdenum (as Mo)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.07	No Relaxation
36.	Nickel (as Ni)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.02	No Relaxation
37.	Polychlorinated Biphenyls (PCB)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0005	No Relaxation
38.	Polynuclear Aromatic Hydrocarbons (PAH)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0001	No Relaxation
39.	Total Arsenic (as As)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
40.	Total Chromium (as Cr)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	No Relaxation
41.	**Trihalomethanes:**					
(A)	Bromoform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(B)	Dibromochloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(C)	Bromodichloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.06	No Relaxation
(D)	Chloroform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.2	No Relaxation

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Dr. Shiv Prakash Singh
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Test Report

Sample Number: VEL/W/05			Report No.: VEL/W/2409210005			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
Table 4 Pesticide Residues Limits and Test Method						
42.	Alachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	20	No Relaxation
43.	Atrazine	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
44.	Aldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
45.	Di[illegible]	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*B[illegible]**LOQ-0.01)	µg/L	0.03	No Relaxation
46.	Alpha HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.01	No Relaxation
47.	Beta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
48.	Butachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	125	No Relaxation
49.	Chlorpyriphos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
50.	Delta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
51.	2,4- Dichlorophenoxyacetic Acid	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
52.	DDT (o, p and p, p – Isomers of DDT, DDE and DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
53.	Endosulfan (Alpha, Beta & Sulphate)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.4	No Relaxation
54.	Ethion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	3	No Relaxation
55.	Gamma-HCH (Lindane)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
56.	Isoproturon	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	9	No Relaxation
57.	Malathion (Malathion and its Oxygen Analogue that is Malaoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	190	No Relaxation

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Test Report

Sample Number: VEL/W/05			Report No.: VEL/W/2409210005			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
58.	Methyl Parathion (Methyl Parathion and its Oxygen Analogue that is Methyl-Paraoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.3	No Relaxation
59.	Monocrotophos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
60.	Phorate (Phorate and its Oxygen Analogue that is Phorate Sulphoxide and Phorate Sulphone)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
Table 5 Bacteriological Quality of Drinking Water						
61.	E. coli	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--
62.	Total Coliform	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

Amendment No.1 in June 2015 (Limits of Iron & Arsenic) and Amendment No.2 in September 2018 (Limit of Boron & IS Method of E. coli & Total Coliform) & Amendment No.3 in February 2021 (Limit of Mineral Oil).

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End of Report

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Test Report

Sample Number:	VEL/W/06	Report No.:	VEL/W/2409210006
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	28/09/2024
		Period of Analysis:	21/09/2024 - 28/09/2024
		Receipt Date:	21/09/2024
		Sampling Date:	10/09/2024
Sample Description:	Ground Water (Pizometer)	Sampling Quantity:	10 Ltrs. + 250 ml
Location:	Piezo Well No. 03	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh Kumar)	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025, APHA 23rd Edition 2017 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012	
					Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	Colour	IS: 3025 (P-4)	*BLQ(**LOQ-1.0)	Hazen	5	15
2.	Odour	IS: 3025 (P-5)	Agreeable	--	Agreeable	Agreeable
3.	pH (at 25°C)	IS: 3025 (P-11)	7.90	--	6.5 to 8.5	No Relaxation
4.	Taste	IS: 3025 (P-8)	Not Performed	--	Agreeable	Agreeable
5.	Turbidity	IS: 3025 (P-10)	7.5	NTU	1	5
6.	Total Dissolved Solids	IS: 3025 (P-16)	697.00	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Aluminium (as Al)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
8.	Ammonia (as Total Ammonia - N)	IS: 3025 (P-34)	*BLQ(**LOQ-0.1)	mg/L	0.5	No Relaxation
9.	Anionic Detergents (as MBAS)	IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
10.	Barium (as Ba)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.7	No Relaxation
11.	Boron (as B)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
12.	Calcium (as Ca)	IS: 3025 (P-40)	130.40	mg/L	75	200

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Test Report

Sample Number: VEL/W/06			Report No.: VEL/W/2409210006			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
13.	Chloramines (as Cl_2)	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	4.0	No Relaxation
14.	Chloride (as Cl)	IS: 3025 (P-32)	135.99	mg/L	250	1000
15.	Copper (as Cu)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
16.	Fluoride (as F)	APHA, 4500 F D, SPADNS Method	0.38	mg/L	1.0	1.5
17.	Residual Free Chlorine	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	0.2	1
18.	Ir[illegible]s Fe)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*[illegible]Q(**LOQ-0.01)	mg/L	1.0	No Relaxation
19.	Magnesium (as Mg)	APHA, 3500 Mg B, Calculation Method	48.54	mg/L	30	100
20.	Manganese (as Mn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
21.	Mineral Oil	IS: 3025 (P-39)	*BLQ(**LOQ-0.5)	mg/L	1.0	No Relaxation
22.	Nitrate (as NO_3)	IS: 3025 (P-34)	9.56	mg/L	45	No Relaxation
23.	Phenolic Compounds (as C_6H_5OH)	IS: 3025 (P-43)	*BLQ(**LOQ-0.001)	mg/L	0.001	0.002
24.	Selenium (as Se)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
25.	Silver (as Ag)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.1	No Relaxation
26.	Sulphate (as SO_4)	IS: 3025 (P-24)	44.40	mg/L	200	400
27.	Sulphide (as H_2S)	IS: 3025 (P-29)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
28.	Total Alkalinity (as $CaCO_3$)	IS: 3025 (P-23)	257.42	mg/L	200	600
29.	Total Hardness (as $CaCO_3$)	IS: 3025 (P-21)	525.00	mg/L	200	600
30.	Zinc (as Zn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0

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Test Report

Sample Number: VEL/W/06			Report No.: VEL/W/2409210006			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 3 Parameters Concerning Toxic Substances						
31.	Cadmium (as Cd)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
32.	Cyanide (as CN)	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
33.	Lead (as Pb)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
34.	Mercury (as Hg)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.0005)	mg/L	0.001	No Relaxation
35.	Molybdenum (as Mo)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.07	No Relaxation
36.	Nickel (as Ni)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.02	No Relaxation
37.	Polychlorinated Biphenyls (PCB)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0005	No Relaxation
38.	Polynuclear Aromatic Hydrocarbons (PAH)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0001	No Relaxation
39.	Total Arsenic (as As)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
40.	Total Chromium (as Cr)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	No Relaxation
41.	**Trihalomethanes:**					
(A)	Bromoform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(B)	Dibromochloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(C)	Bromodichloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.06	No Relaxation
(D)	Chloroform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.2	No Relaxation

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Test Report

Sample Number: VEL/W/06			Report No.: VEL/W/2409210006			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
Table 4 Pesticide Residues Limits and Test Method						
42.	Alachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	20	No Relaxation
43.	Atrazine	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
44.	Aldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
45.	Dieldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
46.	Alpha HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.01	No Relaxation
47.	Beta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
48.	Butachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	125	No Relaxation
49.	Chlorpyriphos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
50.	Delta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
51.	2,4- Dichlorophenoxyacetic Acid	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
52.	DDT (o, p and p, p – Isomers of DDT, DDE and DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
53.	Endosulfan (Alpha, Beta & Sulphate)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.4	No Relaxation
54.	Ethion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	3	No Relaxation
55.	Gamma-HCH (Lindane)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
56.	Isoproturon	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	9	No Relaxation
57.	Malathion (Malathion and its Oxygen Analogue that is Malaoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	190	No Relaxation

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Test Report

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Sample Number: VEL/W/06			Report No.: VEL/W/2409210006			
58.	Methyl Parathion (Methyl Parathion and its Oxygen Analogue that is Methyl-Paraoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.3	No Relaxation
59.	Monocrotophos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
60.	Phorate (Phorate and its Oxygen Analogue that is Phorate Sulphoxide and Phorate Sulphone)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
Table 5 Bacteriological Quality of Drinking Water						
61.	E. coli	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--
62.	Total Coliform	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification. #The parameter not performed because sample not found suitable for testing.

Amendment No.1 in June 2015 (Limits of Iron & Arsenic) and Amendment No.2 in September 2018 (Limit of Boron & IS Method of E. coli & Total Coliform) & Amendment No.3 in February 2021 (Limit of Mineral Oil).

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End of Report

Dhan 28/09/2024

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Test Report

Sample Number:	VEL/W/07	Report No.:	VEL/W/2409210007
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	28/09/2024
		Period of Analysis:	21/09/2024 - 28/09/2024
		Receipt Date:	21/09/2024
		Sampling Date:	10/09/2024
Sample Description:	Ground Water (Pizometer)	Sampling Quantity:	10 Ltrs. + 250 ml
Location:	Piezo Well No. 04	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh Kumar)	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025, APHA 23rd Edition 2017 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1 Organoleptic and Physical Parameters						
1.	Colour	IS: 3025 (P-4)	*BLQ(**LOQ-1.0)	Hazen	5	15
2.	Odour	IS: 3025 (P-5)	Agreeable	--	Agreeable	Agreeable
3.	pH (at 25°C)	IS: 3025 (P-11)	7.46	--	6.5 to 8.5	No Relaxation
4.	Taste	IS: 3025 (P-8)	Agreeable	--	Agreeable	Agreeable
5.	Turbidity	IS: 3025 (P-10)	*BLQ(**LOQ-1.0)	NTU	1	5
6.	Total Dissolved Solids	IS: 3025 (P-16)	482.00	mg/L	500	2000
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts						
7.	Aluminium (as Al)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.03	0.2
8.	Ammonia (as Total Ammonia - N)	IS: 3025 (P-34)	*BLQ(**LOQ-0.1)	mg/L	0.5	No Relaxation
9.	Anionic Detergents (as MBAS)	IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L	0.2	1.0
10.	Barium (as Ba)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.7	No Relaxation
11.	Boron (as B)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.5	2.4
12.	Calcium (as Ca)	IS: 3025 (P-40)	63.13	mg/L	75	200

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Test Report

Sample Number: VEL/W/07			Report No.: VEL/W/2409210007			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
13.	Chloramines (as Cl_2)	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	4.0	No Relaxation
14.	Chloride (as Cl)	IS: 3025 (P-32)	67.99	mg/L	250	1000
15.	Copper (as Cu)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	1.5
16.	Fluoride (as F)	APHA, 4500 F D, SPADNS Method	0.28	mg/L	1.0	1.5
17.	Residual Free Chlorine	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L	0.2	1
18.	Iron (as Fe)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	1.0	No Relaxation
19.	Magnesium (as Mg)	APHA, 3500 Mg B, Calculation Method	25.44	mg/L	30	100
20.	Manganese (as Mn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	0.1	0.3
21.	Mineral Oil	IS: 3025 (P-39)	*BLQ(**LOQ-0.5)	mg/L	1.0	No Relaxation
22.	Nitrate (as NO_3)	IS: 3025 (P-34)	6.49	mg/L	45	No Relaxation
23.	Phenolic Compounds (as C_6H_5OH)	IS: 3025 (P-43)	*BLQ(**LOQ-0.001)	mg/L	0.001	0.002
24.	Selenium (as Se)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.001)	mg/L	0.01	No Relaxation
25.	Silver (as Ag)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.1	No Relaxation
26.	Sulphate (as SO_4)	IS: 3025 (P-24)	30.42	mg/L	200	400
27.	Sulphide (as H_2S)	IS: 3025 (P-29)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
28.	Total Alkalinity (as $CaCO_3$)	IS: 3025 (P-23)	131.88	mg/L	200	600
29.	Total Hardness (as $CaCO_3$)	IS: 3025 (P-21)	262.50	mg/L	200	600
30.	Zinc (as Zn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L	5.0	15.0

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Test Report

Sample Number: VEL/W/07			Report No.: VEL/W/2409210007			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 3 Parameters Concerning Toxic Substances						
31.	Cadmium (as Cd)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.003	No Relaxation
32.	Cyanide (as CN)	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L	0.05	No Relaxation
33.	Lead (as Pb)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.01	No Relaxation
34.	[illegible]cury (as Hg)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*[illegible]Q(**LOQ-0.0005)	mg/L	0.001	No Relaxation
35.	Molybdenum (as Mo)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.07	No Relaxation
36.	Nickel (as Ni)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.02	No Relaxation
37.	Polychlorinated Biphenyls (PCB)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0005	No Relaxation
38.	Polynuclear Aromatic Hydrocarbons (PAH)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L	0.0001	No Relaxation
39.	Total Arsenic (as As)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L	0.01	No Relaxation
40.	Total Chromium (as Cr)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L	0.05	No Relaxation
41.	Trihalomethanes:					
(A)	Bromoform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(B)	Dibromochloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.1	No Relaxation
(C)	Bromodichloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.06	No Relaxation
(D)	Chloroform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L	0.2	No Relaxation

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Test Report

Sample Number: VEL/W/07			Report No.: VEL/W/2409210007			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
Table 4 Pesticide Residues Limits and Test Method						
42.	Alachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	20	No Relaxation
43.	Atrazine	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
44.	Aldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
45.	Endrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.03	No Relaxation
46.	Alpha HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.01	No Relaxation
47.	Beta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
48.	Butachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	125	No Relaxation
49.	Chlorpyriphos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
50.	Delta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.04	No Relaxation
51.	2,4- Dichlorophenoxyacetic Acid	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	30	No Relaxation
52.	DDT (o, p and p, p – Isomers of DDT, DDE and DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
53.	Endosulfan (Alpha, Beta & Sulphate)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.4	No Relaxation
54.	Ethion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	3	No Relaxation
55.	Gamma-HCH (Lindane)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
56.	Isoproturon	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	9	No Relaxation
57.	Malathion (Malathion and its Oxygen Analogue that is Malaoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	190	No Relaxation

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Test Report

Sample Number: VEL/W/07			Report No.: VEL/W/2409210007			
S. No.	Parameters	Test Method	Results	Units	Limits of IS: 10500-2012 Requirement (Acceptable Limit)	Limits of IS: 10500-2012 Permissible Limit in the Absence of Alternate Source
58.	Methyl Parathion (Methyl Parathion and its Oxygen Analogue that is Methyl-Paraoxon)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	0.3	No Relaxation
59.	Monocrotophos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	1	No Relaxation
60.	Phorate (Phorate and its Oxygen Analogue that is Phorate Sulphoxide and Phorate Sulphone)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L	2	No Relaxation
Table 5 Bacteriological Quality of Drinking Water						
61.	E. coli	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--
62.	Total Coliform	IS: 15185	Absent	Per 100 ml	Shall not be detectable in any 100 ml sample	--

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

Amendment No.1 in June 2015 (Limits of Iron & Arsenic) and Amendment No.2 in September 2018 (Limit of Boron & IS Method of E. coli & Total Coliform) & Amendment No.3 in February 2021 (Limit of Mineral Oil).

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End of Report

Page No. 5 of 5

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Dr. Shiv Prakash
20/09/2024

Test Reports of Surface Water Quality

Test Report

Sample Number:	VEL/W/04	**Report No.:**	VEL/W/2405130022
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	**Format No.:**	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	18/05/2024
		Period of Analysis:	13/05/2024 - 18/05/2024
		Receipt Date:	13/05/2024
		Sampling Date:	10/05/2024
Sample Description:	Surface Water Sample	**Sampling Quantity:**	10 Ltrs. + 250 ml
Location:	Near Main Gate No. – 01	**Sampling Type:**	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh)	**Preservation:**	Ice Box
Sampling and Analysis Protocol:	IS: 3025, APHA 23rd Edition 2017 & STP	**Parameter Required:**	As Per Work Order

S. No.	Parameters	Test Method	Results	Units
Table 1 Organoleptic and Physical Parameters				
1.	Colour	IS: 3025 (P-4)	*BLQ(**LOQ-1.0)	Hazen
2.	Odour	IS: 3025 (P-5)	Unobjectionable	--
3.	pH (at 25°C)	IS: 3025 (P-11)	7.11	--
4.	Taste	IS: 3025 (P-8)	Unobjectionable	--
5.	Turbidity	IS: 3025 (P-10)	*BLQ(**LOQ-1.0)	NTU
6.	Total Dissolved Solids	IS: 3025 (P-16)	256.00	mg/L
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts				
7.	Aluminium (as Al)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
8.	Ammonia (as Total Ammonia - N)	IS: 3025 (P-34)	*BLQ(**LOQ-0.3)	mg/L
9.	Anionic Detergents (as MBAS)	IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L
10.	Barium (as Ba)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L
11.	Boron (as B)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L
12.	Calcium (as Ca)	IS: 3025 (P-40)	64.00	mg/L
13.	Chloramines (as Cl_2)	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L
14.	Chloride (as Cl)	IS: 3025 (P-32)	58.00	mg/L
15.	Copper (as Cu)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
16.	Fluoride (as F)	APHA, 4500 F D, SPADNS Method	0.37	mg/L

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Test Report

Sample Number: VEL/W/04			Report No.: VEL/W/2405130022	
S. No.	**Parameters**	**Test Method**	**Results**	**Units**
17.	Residual Free Chlorine	IS: 3025 (P-26)	*BLQ(**LOQ-0.15)	mg/L
18.	Iron (as Fe)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	0.031	mg/L
19.	Magnesium (as Mg)	APHA, 3500 Mg B, Calculation Method	12.45	mg/L
20.	Manganese (as Mn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L
21.	Mineral Oil	IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L
22.	Nitrate (as NO_3)	IS: 3025 (P-34)	14.34	mg/L
23.	Phenolic Compounds (as C_6H_5OH)	IS: 3025 (P-43)	*BLQ(**LOQ-0.0005)	mg/L
24.	Selenium (as Se)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.001)	mg/L
25.	Silver (as Ag)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
26.	Sulphate (as SO_4)	IS: 3025 (P-24)	40.00	mg/L
27.	Sulphide (as H_2S)	IS: 3025 (P-29)	*BLQ(**LOQ-0.02)	mg/L
28.	Total Alkalinity (as $CaCO_3$)	IS: 3025 (P-23)	162.24	mg/L
29.	Total Hardness (as $CaCO_3$)	IS: 3025 (P-21)	179.00	mg/L
30.	Zinc (as Zn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L
Table 3 Parameters Concerning Toxic Substances				
31.	Cadmium (as Cd)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
32.	Cyanide (as CN)	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L
33.	Lead (as Pb)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
34.	Mercury (as Hg)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.0005)	mg/L
35.	Molybdenum (as Mo)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
36.	Nickel (as Ni)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L

VARDAN ENVIROLAB • Amitabh Kumar • Technical Manager

Reviewed By

VARDAN ENVIROLAB

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18/05/2024

Test Report

Sample Number: VEL/W/04			Report No.: VEL/W/2405130022	
S. No.	**Parameters**	**Test Method**	**Results**	**Units**
37.	**Polychlorinated Biphenyls (PCB):**			
(A)	2,4,4' Trichlorobiphenyl (PCB-28)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(B)	2,4,5'Trichlorobiphenyl (PCB-31)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(C)	2,2',5,5' Tetrachlorobiphenyl (PCB-52)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(D)	2,2,4,5,5' Pentachlorobiphenyl (PCB-101)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(E)	2,2',3,4,4'5' Hexachlorobiphenyl (PCB-138)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(F)	2,2,4,4',5,5' Hexachlorobiphenyl (PCB-153)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(G)	2,2',3,4,4'5,5' Heptachlorobiphenyl (PCB-180)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
38.	**Polynuclear Aromatic Hydrocarbons (PAH):**			
(A)	PAH (Chrysene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(B)	PAH (Fluoranthene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(C)	PAH (Benzo (b) Flouranthene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(D)	PAH (Ace- Napthylene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(E)	PAH (Benzo (a) Anthracene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(F)	PAH (Benzo (a) Pyrene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(G)	PAH (Benzo (g,h,i.) Perylene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(H)	PAH (Benzo (k) Fluoranthene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(I)	PAH (Anthracene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(J)	PAH (Di-benzo(a.h) Anthracene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(K)	PAH (Fluorene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(L)	PAH (Indeno 1,2,3 (c,d) Pyrene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(M)	PAH (Naphthalene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(N)	PAH (Phenanthrene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(O)	PAH (Pyrene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L

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18/05/2024

Test Report

Sample Number: VEL/W/04			Report No.: VEL/W/2405130022	
S. No.	**Parameters**	**Test Method**	**Results**	**Units**
(P)	PAH (1-Methylnaphthalene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(Q)	PAH (2-Methylnaphthalene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(R)	PAH (Acenaphthene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
39.	Total Arsenic (as As)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L
40.	Total Chromium (as Cr)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
41.	**Trihalomethanes:**			
(A)	Bromoform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L
(B)	Dibromochloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L
(C)	Bromodichloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L
(D)	Chloroform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L
Table 5 Pesticide Residues Limits and Test Method				
42.	Alachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
43.	Atrazine	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
44.	Aldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
45.	Dieldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
46.	Alpha HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
47.	Beta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
48.	Butachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
49.	Chlorpyriphos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
50.	Delta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L

VARDAN ENVIROLAB
Amitabh Kumar Dubey
Technical Manager

Reviewed By

VARDAN ENVIROLAB
Dr. Shiv
Authorised S...

Authorized Signatory
18/05/2024

Test Report

S. No.	Parameters	Test Method	Results	Units
Sample Number: VEL/W/04			Report No.: VEL/W/2405130022	
51.	2,4- Dichlorophenoxyacetic Acid	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
52.	DDT (o, p DDE)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
53.	DDT (o, p DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
54.	DDT (o, p DDT)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
55.	DDT (p, p DDE)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
56.	DDT (p, p DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
57.	DDT (p, p DDT)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
58.	Endosulfan (Alpha)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
59.	Endosulfan (Beta)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
60.	Endosulfan (Sulphate)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
61.	Ethion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
62.	Gamma-HCH (Lindane)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
63.	Isoproturon	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
64.	Malathion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
65.	Methyl Parathion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
66.	Monocrotophos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
67.	Phorate	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
Table 6 Bacteriological Quality				
68.	E. coli	IS: 15185:2016	Absent	Per 100 ml
69.	Total Coliform	IS: 15185:2016	Absent	Per 100 ml

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

End of Report

VARDAN ENVIROLAB Amitabh Kumar Technical Manager

Reviewed By

VARDAN ENVIROLAB Dr. Shiv ... Singh

Authorized Signatory

18/05/2024

Test Report

Sample Number:	VEL/W/05	Report No.:	VEL/W/2405130023
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	18/05/2024
		Period of Analysis:	13/05/2024 - 18/05/2024
		Receipt Date:	13/05/2024
		Sampling Date:	10/05/2024
Sample Description:	Surface Water Sample	Sampling Quantity:	10 Ltrs. + 250 ml
Location:	Near Main Gate No. – 03	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh)	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025, APHA 23rd Edition 2017 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units
Table 1 Organoleptic and Physical Parameters				
1.	Colour	IS: 3025 (P-4)	*BLQ(**LOQ-1.0)	Hazen
2.	Odour	IS: 3025 (P-5)	Unobjectionable	--
3.	pH (at 25°C)	IS: 3025 (P-11)	7.94	--
4.	Taste	IS: 3025 (P-8)	Unobjectionable	--
5.	Turbidity	IS: 3025 (P-10)	*BLQ(**LOQ-1.0)	NTU
6.	Total Dissolved Solids	IS: 3025 (P-16)	157.00	mg/L
Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts				
7.	Aluminium (as Al)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
8.	Ammonia (as Total Ammonia - N)	IS: 3025 (P-34)	*BLQ(**LOQ-0.3)	mg/L
9.	Anionic Detergents (as MBAS)	IS: 3025 (P-68)	*BLQ(**LOQ-0.05)	mg/L
10.	Barium (as Ba)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L
11.	Boron (as B)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L
12.	Calcium (as Ca)	IS: 3025 (P-40)	11.38	mg/L
13.	Chloramines (as Cl_2)	IS: 3025 (P-26)	*BLQ(**LOQ-0.1)	mg/L
14.	Chloride (as Cl)	IS: 3025 (P-32)	19.72	mg/L
15.	Copper (as Cu)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
16.	Fluoride (as F)	APHA, 4500 F D, SPADNS Method	0.25	mg/L

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18/05/2024

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Test Report

Sample Number: VEL/W/05			Report No.: VEL/W/2405130023	
S. No.	**Parameters**	**Test Method**	**Results**	**Units**
17.	Residual Free Chlorine	IS: 3025 (P-26)	*BLQ(**LOQ-0.15)	mg/L
18.	Iron (as Fe)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	0.019	mg/L
19.	Magnesium (as Mg)	APHA, 3500 Mg B, Calculation Method	17.62	mg/L
20.	Manganese (as Mn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L
21.	Mineral Oil	IS: 3025 (P-39)	*BLQ(**LOQ-0.1)	mg/L
22.	Nitrate (as NO_3)	IS: 3025 (P-34)	*BLQ(**LOQ-1.0)	mg/L
23.	Phenolic Compounds (as C_6H_5OH)	IS: 3025 (P-43)	*BLQ(**LOQ-0.0005)	mg/L
24.	Selenium (as Se)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.001)	mg/L
25.	Silver (as Ag)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
26.	Sulphate (as SO_4)	IS: 3025 (P-24)	9.75	mg/L
27.	Sulphide (as H_2S)	IS: 3025 (P-29)	*BLQ(**LOQ-0.02)	mg/L
28.	Total Alkalinity (as $CaCO_3$)	IS: 3025 (P-23)	64.68	mg/L
29.	Total Hardness (as $CaCO_3$)	IS: 3025 (P-21)	92.00	mg/L
30.	Zinc (as Zn)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	mg/L
Table 3 Parameters Concerning Toxic Substances				
31.	Cadmium (as Cd)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
32.	Cyanide (as CN)	IS: 3025 (P-27)	*BLQ(**LOQ-0.02)	mg/L
33.	Lead (as Pb)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
34.	Mercury (as Hg)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.0005)	mg/L
35.	Molybdenum (as Mo)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
36.	Nickel (as Ni)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L

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18/05/2024

Test Report

Sample Number: VEL/W/05			Report No.: VEL/W/2405130023	
S. No.	Parameters	Test Method	Results	Units
37.	**Polychlorinated Biphenyls (PCB):**			
(A)	2,4,4' Trichlorobiphenyl (PCB-28)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(B)	2,4,5'Trichlorobiphenyl (PCB-31)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(C)	2,2',5,5' Tetrachlorobiphenyl (PCB-52)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(D)	2,2,4,5,5' Pentachlorobiphenyl (PCB-101)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(E)	2,2',3,4,4'5' Hexachlorobiphenyl (PCB-138)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(F)	2,2,4,4',5,5' Hexachlorobiphenyl (PCB-153)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(G)	2,2',3,4,4'5,5' Heptachlorobiphenyl (PCB-180)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
38.	**Polynuclear Aromatic Hydrocarbons (PAH):**			
(A)	PAH (Chrysene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(B)	PAH (Fluoranthene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(C)	PAH (Benzo (b) Flouranthene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(D)	PAH (Ace- Napthylene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(E)	PAH (Benzo (a) Anthracene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(F)	PAH (Benzo (a) Pyrene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(G)	PAH (Benzo (g,h,i.) Perylene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(H)	PAH (Benzo (k) Fluoranthene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(I)	PAH (Anthracene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(J)	PAH (Di-benzo(a,h) Anthracene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(K)	PAH (Fluorene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(L)	PAH (Indeno 1,2,3 (c,d) Pyrene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(M)	PAH (Naphthalene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(N)	PAH (Phenanthrene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(O)	PAH (Pyrene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L

Reviewed By

Authorized Signatory

18/05/2024

Test Report

Sample Number: VEL/W/05			Report No.: VEL/W/2405130023	
S. No.	**Parameters**	**Test Method**	**Results**	**Units**
(P)	PAH (1-Methylnaphthalene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(Q)	PAH (2-Methylnaphthalene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
(R)	PAH (Acenaphthene)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.00005)	mg/L
39.	Total Arsenic (as As)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.005)	mg/L
40.	Total Chromium (as Cr)	VEL/STP/ICP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.002)	mg/L
41.	**Trihalomethanes:**			
(A)	Bromoform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L
(B)	Dibromochloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L
(C)	Bromodichloromethane	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L
(D)	Chloroform	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.05)	mg/L
Table 5 Pesticide Residues Limits and Test Method				
42.	Alachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
43.	Atrazine	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
44.	Aldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
45.	Dieldrin	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
46.	Alpha HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
47.	Beta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
48.	Butachlor	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
49.	Chlorpyriphos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
50.	Delta HCH	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L

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Reviewed By

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18/05/2024

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Test Report

Sample Number: VEL/W/05			Report No.: VEL/W/2405130023	
S. No.	**Parameters**	**Test Method**	**Results**	**Units**
51.	2,4- Dichlorophenoxyacetic Acid	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
52.	DDT (o, p DDE)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
53.	DDT (o, p DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
54.	DDT (o, p DDT)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
55.	DDT (p, p DDE)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
56.	DDT (p, p DDD)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
57.	DDT (p, p DDT)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
58.	Endosulfan (Alpha)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
59.	Endosulfan (Beta)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
60.	Endosulfan (Sulphate)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
61.	Ethion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
62.	Gamma-HCH (Lindane)	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
63.	Isoproturon	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
64.	Malathion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
65.	Methyl Parathion	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
66.	Monocrotophos	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
67.	Phorate	VEL/STP/W-01, Issue No.- 01, Issue Date : 01/11/2021	*BLQ(**LOQ-0.01)	µg/L
Table 6 Bacteriological Quality				
68.	E. coli	IS: 15185:2016	Absent	Per 100 ml
69.	Total Coliform	IS: 15185:2016	Absent	Per 100 ml

Note: STP- Standard Testing Procedure, *BLQ- Below Limit of Quantification, **LOQ- Limit of Quantification.

End of Report

VARDAN ENVIROLAB * Dy. Technical Manager *

Reviewed By

VARDAN ENVIROLAB Dr. Shiv ... Authorised

Authorized Signatory

18/05/2024

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TEST REPORT

TC-11227

VIBRANT
"Experience the unimaginable"

Sample Number :	VTL/SW/01	**ULR No.**	: TC1122724000002013F
		Report No.	: VTL/W/2409160004/A
Name & Address of the Party	: M/s Mahan Energen Limited, 2×800 MW, Village-: Bandhaura, Tehsil: Mada, Singraulli Madhya Pradesh	**Format No**	: 7.8 F-01
		Party Reference No	: NIL
		Report Date	: 21/09/2024
		Period of Analysis	: 16/09/2024-21/09/2024
Sample Description	: SURFACE WATER	**Receipt Date**	: 16/09/2024
Sampling Location	: Rampa Mayar River	**Sampling Date**	: 12/09/2024
Sample Collected By	: VTL Team	**Sampling Type**	: Grab
Preservation	: Suitable Preservation	**Sample Quantity**	: 2 Ltr.
Method of sampling	: IS :3025	**Coordinates**	: NA

S.No.	Test Parameters	Test Method	Results	Unit
1	pH (at 25°C)	IS : 3025 (P-11) : 2022	7.26	--
2	Turbidity	IS : 3025: (P-10)1984, RA 2017	5.2	NTU
3	Total Hardness (as CaCO3)	IS: 3025 (P-21): 2009, RA 2019	92.31	mg/l
4	Calcium (as Ca)	IS: 3025 (P- 40): 1991 RA 2019	21.40	mg/l
5	Total Alkalinity (as CaCO3)	IS: 3025 (P-23): 1986, RA 2019	115.0	mg/l
6	Chloride (as Cl)	IS: 3025 (P-32): 1988, RA 2019	58.0	mg/l
7	Magnesium (as Mg)	IS: 3025 (P-46): 1994, RA 2019	9.46	mg/l
8	Total Dissolved Solids	IS :3025 (P-16): 1984, RA 2017	492.0	mg/l
9	Sulphate (as SO4)	IS: 3025 (P-24): Sec.1 2022	19.63	mg/l
10	Fluoride (as F)	APHA 23rd Edition ,4500FD :2017	0.26	mg/l
11	Nitrate (as NO3)	IS: 3025 (P-34): 1988	8.26	mg/l
12	Iron (as Fe)	APHA 23rd Edition , 3111B,2017	0.24	mg/l
13	Aluminium (as Al)	IS 3025 (P-55): 2003, RA 2019	*BLQ(**LOQ-0.03)	mg/l
14	Boron (as B)	APHA 23rd Edition, 4500B,2017	*BLQ(**LOQ-0.2)	mg/l
15	Total Chromium (as Cr)	APHA 23rd Edition 2017 3113 B, 2017	*BLQ(**LOQ-0.02)	mg/l
16	Phenolic Compounds (C6H5OH)	APHA 23rd Edition 5530C: 2017	*BLQ(**LOQ-0.001)	mg/l
17	Zinc (as Zn)	APHA 23rd Edition,3030D, 3113 B , 2017	0.36	mg/l
18	Copper (as Cu)	APHA 23rd Edition 3111B 2017	*BLQ(**LOQ-0.02)	mg/l
19	Manganese (as Mn)	APHA 23rd Edition, 3030D, 3111 B, 2017	*BLQ(**LOQ-0.05)	mg/l
20	Cadmium (as Cd)	APHA 23rd Edition, 3030D, 3113 B, 2017	*BLQ(**LOQ-0.002)	mg/l
21	Lead (as Pb)	APHA 23rd Edition, 3030D, 3113 B,2017	*BLQ(**LOQ-0.005)	mg/l
22	Selenium (as Se)	APHA 23rd Edition, 3114C, 2017	*BLQ(**LOQ-0.005)	mg/l

Checked by

VIBRANT TECHNO LAB PRIVATE LIMITED JAIPUR

RK Yadav
Lab Incharge
Authorized Signatory

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TC-11227

VIBRANT
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Sample Number : VTL/SW/01

ULR No. : TC1122724000002013F
Report No. : VTL/W/2409160004/A

S.No.	Test Parameters	Test Method	Results	Unit
23	Arsenic (as As)	APHA 23rd Edition, 3114C, 2017	*BLQ(**LOQ-0.005)	mg/l
24	Mercury (as Hg)	APHA 23rd edition, 3112B 2017	*BLQ(**LOQ-0.001)	mg/l
25	Fecal Coliform	IS:1622 :2009	11	MPN
26	Dissolved oxygen (DO)	IS : 3025 (P -38) : 1989, RA 2019	5.40	mg/l
27	Biochemical Oxygen Demand (BOD) (3 days at 27°C)	IS: 3025 (P-44) : 1993, RA : 2019	6.96	mg/l
28	Chemical Oxygen Demand (COD)	IS : 3025 (P- 58) : 2006 RA 2017	28.45	mg/l

*BLQ-Below Limit Of Quantification, **LOQ- Limit of Quantification

End of Report

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Approved & Certified EPA 1986 Recognised, ISO:9001 and OHSAS:45001 Certified

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bd@vibranttechnolab.com
www.vibranttechnolab.com

TEST REPORT

VIBRANT
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Sample Number : VTL/SW/01		**Report No.**	: VTL/W/2409160004/B
Name & Address of the Party	: M/s Mahan Energen Limited, 2×800 MW, Village-: Bandhaura, Tehsil: Mada, Singraulli Madhya Pradesh	**Format No**	: 7.8 F-01
		Party Reference No	: NIL
		Report Date	: 21/09/2024
		Period of Analysis	: 16/09/2024-21/09/2024
Sample Description	: **SURFACE WATER**	**Receipt Date**	: 16/09/2024
Sampling Location	: Rampa Mayar River	**Sampling Date**	: 12/09/2024
Sample Collected By	: VTL Team	**Sampling Type**	: Grab
Preservation	: Suitable Preservation	**Sample Quantity**	: 2 Ltr.
Method of sampling	: IS :3025	**Coordinates**	: NA

S.No.	Test Parameters	Test Method	Results	Unit
1	Colour	IS : 3025:(P-4)1983, :RA 2017	*BLQ(**LOQ-5.0)	Hazen
2	Odour	IS : 3025 (P-5) : RA 2018	Agreeable	--
3	Taste	IS :3025 (P-8): 1984 RA 2017	Agreeable	--
4	Anionic Detergents (as MBAS)	IS 3025 (P-68) 2019	*BLQ(**LOQ-0.05)	mg/l
5	Total Coliform	IS:1622 :2009	42	per 100 ml
6	Phosphate (as PO4)	APHA 23rd Edition, 4500D, 2017	0.72	mg/l
7	Ammonia (as NH3)	IS : 3025 (P-34) 1988, Sec.4 RA 2019	1.02	mg/l

*BLQ-Below Limit Of Quantification, **LOQ- Limit of Quantification

End of Report

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Test Reports of Waste Water Quality

Test Report

Sample Number:	VEL/PE/01	Report No.:	VEL/PE/2405020001
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	07/05/2024
		Period of Analysis:	02/05/2024 - 07/05/2024
		Receipt Date:	02/05/2024
		Sampling Date:	29/04/2024
Sample Description:	Waste Water Sample	Sampling Quantity:	2 Ltrs.
Sample Location:	STP Outlet (STP Plant)	Sampling Type:	Grab
Sample Collected By:	VEL Representative	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards As Per The Environment (Protection) Rules, 1986		
					Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)
1.	pH (at 25°C)	IS: 3025 (P-11)	7.62	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	IS: 3025 (P-17)	96.00	mg/L	100	600	200
3.	B.O.D. (3 Days @27°C)	IS: 3025 (P-44)	10.54	mg/L	30	350	100
4.	Chemical Oxygen Demand (C.O.D.)	IS: 3025 (P-58)	66.74	mg/L	250	--	--
5.	Oil & Grease	Clause No. 5 of IS: 3025 (P-39)	0.71	mg/L	10	20	10
6.	Faecal Coliform	IS: 1622:1981	<2	MPN/100 ml	--	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS
As Per The Environment (Protection) Rules, 1986 [SCHEDULE – VI] (See Rule 3A)

End of Report

(Reviewed By)

07/05/2024

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07/05/2024

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Test Report

Sample Number:	VEL/PE/02	Report No.:	VEL/PE/2405020002
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	07/05/2024
		Period of Analysis:	02/05/2024 - 07/05/2024
		Receipt Date:	02/05/2024
		Sampling Date:	29/04/2024
Sample Description:	Waste Water Sample	Sampling Quantity:	2 Ltrs.
Sample Location:	STP Outlet (STP Plant - Township)	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Amit Pandey)	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards As Per The Environment (Protection) Rules, 1986		
					Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)
1.	pH (at 25°C)	IS: 3025 (P-11)	8.05	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	IS: 3025 (P-17)	43.00	mg/L	100	600	200
3.	B.O.D. (3 Days @27°C)	IS: 3025 (P-44)	13.96	mg/L	30	350	100
4.	Chemical Oxygen Demand (C.O.D.)	IS: 3025 (P-58)	64.27	mg/L	250	--	--
5.	Oil & Grease	Clause No. 5 of IS: 3025 (P-39)	0.86	mg/L	10	20	10
6.	Faecal Coliform	IS: 1622:1981	<2	MPN/100 ml	--	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS
As Per The Environment (Protection) Rules, 1986 [SCHEDULE – VI] (See Rule 3A)

End of Report

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07/05/2024

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Test Report

Sample Number:	VEL/PE/03	Report No.:	VEL/PE/2405020003
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	07/05/2024
		Period of Analysis:	02/05/2024 - 07/05/2024
		Receipt Date:	02/05/2024
		Sampling Date:	29/04/2024
Sample Description:	Waste Water Sample	Sampling Quantity:	2 Ltrs.
Sample Location:	ETP Outlet (ETP Plant)	Sampling Type:	Grab
Sample Collected By:	VEL Representative	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards As Per The Environment (Protection) Rules, 1986		
					Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)
1.	pH (at 25°C)	IS: 3025 (P-11)	6.63	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	IS: 3025 (P-17)	34.00	mg/L	100	600	200
3.	B.O.D. (3 Days @27°C)	IS: 3025 (P-44)	16.05	mg/L	30	350	100
4.	Chemical Oxygen Demand (C.O.D.)	IS: 3025 (P-58)	89.55	mg/L	250	--	--
5.	Oil & Grease	Clause No. 5 of IS: 3025 (P-39)	0.63	mg/L	10	20	10
6.	Total Dissolved Solids	IS: 3025 (P-16)	412.00	mg/L	--	--	--
7.	Chloride (as Cl)	IS: 3025 (P-23)	29.53	mg/L	--	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS
As Per The Environment (Protection) Rules, 1986 [SCHEDULE – VI] (See Rule 3A)

End of Report

VARDAN ENVIROLAB · Dy. Technical Manager
(Reviewed By)

Page No. 1 of 1

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07/05/2024

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Test Report

Sample Number:	VEL/PE/01	Report No.:	VEL/PE/2406180001
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	22/06/2024
		Period of Analysis:	18/06/2024 - 22/06/2024
		Receipt Date:	18/06/2024
		Sampling Date:	15/06/2024
Sample Description:	Waste Water Sample	Sampling Quantity:	2 Ltrs.
Sample Location:	STP Outlet (STP Plant)	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh)	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards As Per The Environment (Protection) Rules, 1986		
					Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)
1.	pH (at 25°C)	IS: 3025 (P-11)	7.36	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	IS: 3025 (P-17)	61	mg/L	100	600	200
3.	B.O.D. (3 Days @27°C)	IS: 3025 (P-44)	10.78	mg/L	30	350	100
4.	Chemical Oxygen Demand (C.O.D.)	IS: 3025 (P-58)	65.17	mg/L	250	--	--
5.	Oil & Grease	Clause No. 5 of IS: 3025 (P-39)	0.58	mg/L	10	20	10
6.	Faecal Coliform	IS: 1622:1981	<2	MPN/100 ml	--	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS As Per The Environment (Protection) Rules, 1986 [SCHEDULE – VI] (See Rule 3A)

*****End of Report*****

VARDAN ENVIROLAB Dy. Technical Manager

(Reviewed By)

VARDAN ENVIROLAB Satya Dev Authorized Signatory 22/06/2024

VARDAN ENVIROLAB Dr. Shiv Prakash Authorised Signatory

(Authorized Signatory)

22/06/2024

Vardan Envirolab LLP
Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (HR)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/PE/02	**Report No.:**	VEL/PE/2406180002
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	**Format No.:**	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	22/06/2024
		Period of Analysis:	18/06/2024 - 22/06/2024
		Receipt Date:	18/06/2024
		Sampling Date:	15/06/2024
Sample Description:	Waste Water Sample	**Sampling Quantity:**	2 Ltrs.
Sample Location:	STP Outlet (STP Plant - Township)	**Sampling Type:**	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh)	**Preservation:**	Ice Box
Sampling and Analysis Protocol:	IS: 3025 & STP	**Parameter Required:**	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards As Per The Environment (Protection) Rules, 1986		
					Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)
1.	pH (at 25°C)	IS: 3025 (P-11)	7.22	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	IS: 3025 (P-17)	48	mg/L	100	600	200
3.	B.O.D. (3 Days @27°C)	IS: 3025 (P-44)	11.72	mg/L	30	350	100
4.	Chemical Oxygen Demand (C.O.D.)	IS: 3025 (P-58)	58.96	mg/L	250	--	--
5.	Oil & Grease	Clause No. 5 of IS: 3025 (P-39)	0.66	mg/L	10	20	10
6.	Faecal Coliform	IS: 1622:1981	<2	MPN/100 ml	--	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS As Per The Environment (Protection) Rules, 1986 [SCHEDULE – VI] (See Rule 3A)

End of Report

VARDAN ENVIROLAB * Dy. Technical Manager
Amitabh
(Reviewed By)

VARDAN ENVIROLAB * Satya Dev * Authorized Signatory
22/06/2024

VARDAN ENVIROLAB * Dr. Shiv Prakash * Authorised Signatory
(Authorized Signatory)
22/06/2024

Ph: 0124-4343750 | E-mail: lab@vardan.co.in, bd@vardan.co.in | www.vardan.co.in

Vardan Envirolab LLP
Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (HR)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/PE/03	**Report No.:**	VEL/PE/2406180003
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	**Format No.:**	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	22/06/2024
		Period of Analysis:	18/06/2024 - 22/06/2024
		Receipt Date:	18/06/2024
		Sampling Date:	15/06/2024
Sample Description:	Waste Water Sample	**Sampling Quantity:**	2 Ltrs.
Sample Location:	ETP Outlet (ETP Plant)	**Sampling Type:**	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh)	**Preservation:**	Ice Box
Sampling and Analysis Protocol:	IS: 3025 & STP	**Parameter Required:**	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards As Per The Environment (Protection) Rules, 1986		
					Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)
1.	pH (at 25°C)	IS: 3025 (P-11)	7.72	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	IS: 3025 (P-17)	39	mg/L	100	600	200
3.	B.O.D. (3 Days @27°C)	IS: 3025 (P-44)	13.78	mg/L	30	350	100
4.	Chemical Oxygen Demand (C.O.D.)	IS: 3025 (P-58)	87.46	mg/L	250	--	--
5.	Oil & Grease	Clause No. 5 of IS: 3025 (P-39)	0.68	mg/L	10	20	10
6.	Total Dissolved Solids	IS: 3025 (P-16)	418	mg/L	--	--	--
7.	Chloride (as Cl)	IS: 3025 (P-23)	30.34	mg/L	--	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS As Per The Environment (Protection) Rules, 1986 [SCHEDULE – VI] (See Rule 3A)

End of Report

(Reviewed By)

(Authorized Signatory)
22/06/2024

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Test Report

Sample Number	VEL/PE/02	Report No.	VEL/PE/2407251002
Name & Address of the Party	M/s Mahan Energen Ltd. Village-Bandhaura, Post- Karsualal, Tehsil- Waidhan, Distt- Singrauli, Madhya Pradesh.	Format No	7.8 F-03
		Party Reference No	5703016500
		Reporting Date	03/08/2024
		Period of Analysis	25/07/2024-01/08/2024
		Receipt Date	25/07/2024
Name of Sample	Waste Water (STP Outlet)	Sampling Date	18/07/2024
Sample Group	Pollution & Environment	Sampling Quantity	2.0 Ltrs.+250 ml
Location	STP Plant	Sampling Type	Garb
Sample Collected By	VEL Representative (Mr. Mithilesh)		
Environmental Condition	25±2°C	ULR No.	TC629924200004816F
Parameter Required	As per work order		
Analysis Protocol	APHA & IS		

S.No.	Test Parameters	Test Method	Result	Unit	General Standards as per the Environment(Protection)Rules,1986		
					Inland Surface Water	Public Sewers	Land for Irrigation
Discipline : Chemical							
1	pH at 25°C	IS:3025:P-11: 2022 (Electrode Method)	6.87	--	5.5 - 9.0	5.5 - 9.0	5.5 - 9.0
2	Total Suspended Solid at 105°C (TSS) , max.	IS: 3025 (P-17): 2022 (Gravimetric Method)	55.60	mg/L	100.0	600.0	200.0
3	Oil & Grease, Max.	Clause No-5 of IS:3025 (P-39) : 2021:(Gravimetric Method)	BLQ(LOQ-4.0)	mg/L	10.0	20.0	10.0
4	Biological Oxygen Demand at 27°C, Max.	IS 3025:Part-44: 1993	28.00	mg/L	30.0	350.0	100.0
5	Chemical Oxygen Demand at 150°C, Max.	IS:3025 (P-58) 2006 Open reflux method	182.00	mg/L	250.0	--	--

02/08/2024

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Authorized Signatory

Test Report

Sample Number : VEL/PE/02 Report No. : VEL/PE/2407251002

S.No.	Test Parameters	Test Method	Result	Unit	General Standards as per the Environment(Protection)Rules,1986		
					Inland Surface Water	Public Sewers	Land for Irrigation
Discipline : Biological							
6	Faecal coliform	APHA,23rd Edition,9221 E	94	MPN/100 ml	--	--	--

BLQ-Below Limit of Quantification,LOQ-Limit of Quantification.

End of Report

8/08/2024
Reviewed By

Dhamendra Kumar Dixit
Technical Manager-Micro
08/08/2024
Authorized Signatory

Vardan Envirolab LLP
Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (HR)
ISO 9001 | ISO 14001 | ISO 45001

TC-6299

Test Report

Sample Number : VEL/PE/03
Name & Address of the Party : M/s Mahan Energen Ltd.
Village-Bandhaura, Post- Karsualal, Tehsil- Waidhan, Distt- Singrauli, Madhya Pradesh.

Report No. : VEL/PE/2407251003
Format No : 7.8 F-03
Party Reference No : 5703016500
Reporting Date : 03/08/2024
Period of Analysis : 25/07/2024-01/08/2024
Receipt Date : 25/07/2024
Sampling Date : 18/07/2024
Sampling Quantity : 2.0 Ltrs.
Sampling Type : Grab
ULR No. : TC629924200004817F

Name of Sample : **Waste water (ETP Outlet)**
Sample Group : Pollution & Environment
Location : ETP Plant
Sample Collected By : VEL Representative (Mr. Mithilesh)
Environmental Condition : 25±2°C
Parameter Required : As per work order
Analysis Protocol : APHA & IS

S.No.	Test Parameters	Test Method	Result	Unit	General Standards as per the Environment(Protection)Rules,1986		
					Inland Surface Water	Public Sewers	Land for Irrigation
Discipline : Chemical							
1	pH at 25°C	IS:3025:P-11: 2022 (Electrode Method)	6.78	--	5.5 - 9.0	5.5 - 9.0	5.5 - 9.0
2	Total Suspended Solid at 105°C (TSS) , max.	IS: 3025 (P-17): 2022 (Gravimetric Method)	34.40	mg/L	100.0	600.0	200.0
3	Total Dissolved Solid at 180°C, max.	IS: 3025 (P-16): 2023(Gravimetric Method)	904.00	mg/L	--	--	--
4	Oil & Grease, Max.	Clause No-5 of IS:3025 (P-39) : 2021:(Gravimetric Method)	BLQ(LOQ-4.0)	mg/L	10.0	20.0	10.0
5	Biological Oxygen Demand at 27°C, Max.	IS 3025:Part-44: 1993	20.00	mg/L	30.0	350.0	100.0
6	Chemical Oxygen Demand at 150°C, Max.	IS:3025 (P-58) 2006 Open reflux method	149.00	mg/L	250.0	--	--
7	Chloride. max.	IS 3025 :(Part- 32): 1998(Argentometric Method)	323.00	mg/L	--	--	--

BLQ-Below Limit of Quantification,LOQ-Limit of Quantification.

End of Report

Reviewed By 03/08/2024

Authorized Signatory

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Vardan Envirolab LLP
Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (HR)
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Test Report

Sample Number:	VEL/PE/01	Report No.:	VEL/PE/240814001
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	21/08/2024
		Period of Analysis:	14/08/2024 - 21/08/2024
		Receipt Date:	14/08/2024
		Sampling Date:	06/08/2024
Sample Description:	Waste Water Sample	Sampling Quantity:	2 Ltrs.
Sample Location:	STP Outlet (STP Plant)	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh)	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards As Per The Environment (Protection) Rules, 1986		
					Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)
1.	pH (at 25°C)	IS: 3025 (P-11)	7.45	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	IS: 3025 (P-17)	65	mg/L	100	600	200
3.	B.O.D. (3 Days @27°C)	IS: 3025 (P-44)	9.25	mg/L	30	350	100
4.	Chemical Oxygen Demand (C.O.D.)	IS: 3025 (P-58)	54.81	mg/L	250	--	--
5.	Oil & Grease	Clause No. 5 of IS: 3025 (P-39)	0.51	mg/L	10	20	10
6.	Faecal Coliform	IS: 1622:1981	<2	MPN/100 ml	--	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS
As Per The Environment (Protection) Rules, 1986 [SCHEDULE – VI] (See Rule 3A)

End of Report

(Reviewed By)
VARDAN ENVIROLAB Technical Manager

(Authorized Signatory)
2/8/2024
VARDAN ENVIROLAB LLP Authorised Signatory

Test Report

Sample Number:	VEL/PE/03	Report No.:	VEL/PE/240814003
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	21/08/2024
		Period of Analysis:	14/08/2024 - 21/08/2024
		Receipt Date:	14/08/2024
		Sampling Date:	06/08/2024
Sample Description:	Waste Water Sample	Sampling Quantity:	2 Ltrs.
Sample Location:	ETP Outlet (ETP Plant)	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh)	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards As Per The Environment (Protection) Rules, 1986		
					Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)
1.	pH (at 25°C)	IS: 3025 (P-11)	7.83	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	IS: 3025 (P-17)	42	mg/L	100	600	200
3.	B.O.D. (3 Days @27°C)	IS: 3025 (P-44)	14.37	mg/L	30	350	100
4.	Chemical Oxygen Demand (C.O.D.)	IS: 3025 (P-58)	83.55	mg/L	250	--	--
5.	Oil & Grease	Clause No. 5 of IS: 3025 (P-39)	0.66	mg/L	10	20	10
6.	Total Dissolved Solids	IS: 3025 (P-16)	432	mg/L	--	--	--
7.	Chloride (as Cl)	IS: 3025 (P-23)	27.19	mg/L	--	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS As Per The Environment (Protection) Rules, 1986 [SCHEDULE – VI] (See Rule 3A)

End of Report

VARDAN ENVIROLAB · Technical Manager

(Reviewed By)

VARDAN ENVIROLAB LLP · Authorised Signatory

Dr. Shiv Prakash Singh 21/08/2024

(Authorized Signatory)

Test Report

Sample Number:	VEL/PE/17	Report No.:	VEL/PE/24092100017
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh – 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	28/09/2024
		Period of Analysis:	21/09/2024 - 28/09/2024
		Receipt Date:	21/09/2024
		Sampling Date:	10/09/2024
Sample Description:	Waste Water Sample	Sampling Quantity:	2 Ltrs.
Sample Location:	STP Outlet (STP Plant)	Sampling Type:	Grab
Sample Collected By:	VEL Representative (Mr. Mithilesh)	Preservation:	Ice Box
Sampling and Analysis Protocol:	IS: 3025 & STP	Parameter Required:	As Per Work Order

S. No.	Parameters	Test Method	Results	Units	General Standards As Per The Environment (Protection) Rules, 1986		
					Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)
1.	pH (at 25°C)	IS: 3025 (P-11)	7.21	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	IS: 3025 (P-17)	66.8	mg/L	100	600	200
3.	B.O.D. (3 Days @27°C)	IS: 3025 (P-44)	8.46	mg/L	30	350	100
4.	Chemical Oxygen Demand (C.O.D.)	IS: 3025 (P-58)	62	mg/L	250	--	--
5.	Oil & Grease	Clause No. 5 of IS: 3025 (P-39)	BLQ(LOQ-4.0)	mg/L	10	20	10
6.	Faecal Coliform	IS: 1622:1981	<2.0	MPN/100 ml	--	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS
As Per The Environment (Protection) Rules, 1986 [SCHEDULE – VI] (See Rule 3A)

End of Report

VARDAN ENVIROLAB LLP GURUGRAM
(Reviewed By)

VARDAN ENVIROLAB LLP Dr. Shiv Prakash Authorised Signatory
(Authorized Signatory)
28/09/2024

Test Report

Sample Number:	VEL/PE/19	**Report No.:**	VEL/PE/24092100019
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	**Format No.:**	7.8 F-03
		Party Reference No.:	5703016500 Date : 09/06/2024
		Reporting Date:	28/09/2024
		Period of Analysis:	21/09/2024 - 28/09/2024
		Receipt Date:	21/09/2024
		Sampling Date:	10/09/2024
Sample Description:	Waste Water Sample	**Sampling Quantity:**	2 Ltrs.
Sample Location:	ETP Outlet (ETP Plant)	**Sampling Type:**	Grab
Sample Collected By:	VEL Representative (M· Mithilesh)	**Preservation:**	Ice Box
Sampling and Analysis Protocol:	IS: 3025 & STP	**Parameter Required:**	As Per Work Ord

S. No.	Parameters	Test Method	Results	Units	General Standards As Per The Environment (Protection) Rules, 1986		
					Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)
1	pH (at 25°C)	IS: 3025 (P-11)	7.39	--	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2.	Total Suspended Solids	IS: 3025 (P-17)	18.4	mg/L	100	600	200
3.	B.O.D. (3 Days @27°C)	IS: 3025 (P-44)	12	mg/L	30	350	100
4.	Chemical Oxygen Demand (C.O.D.)	IS: 3025 (P-58)	83.55	mg/L	250	--	--
5.	Oil & Grease	Clause No. 5 of IS: 3025 (P-39)	BLQ(LOQ-4.0)	mg/L	10	20	10
6.	Total Dissolved Solids	IS: 3025 (P-16)	76	mg/L	--	--	--
7.	Chloride (as Cl)	IS: 3025 (P-23)	22.65	mg/L	--	--	--

Note:- GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS As Per The Environment (Protection) Rules, 1986 [SCHEDULE – VI] (See Rule 3A)

End of Report

(Reviewed By)

(Authorized Signatory)
28/09/2024

Test Reports
of
Ambient Noise
Quality

Vardan EnviroLab
Laboratory: Plot No. 82A, Sector - 5, IMT Manesar, Gurugram - 122051 (Hr)
ISO 9001 | ISO 14001 | ISO 45001

Test Report

Sample Number:	VEL/AP/01	**Report No.:**	VEL/AP/2404110001
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	**Format No.:**	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	13/04/2024
		Period of Analysis:	11/04/2024- 13/04/2024
		Receipt Date:	11/04/2024
		Page No.:	1 of 1

Sample Description: AMBIENT NOISE LEVEL MONITORING

General Information

Sampling Location	:	Near Admin Building
Sample Collected By	:	VEL Representative
Sampling Instrument Used	:	Sound Level Meter
Instrument Code	:	VEL/INS/ENV/SLM/10
Instrument Calibration Status	:	Calibrated
Meteorological Condition During Monitoring	:	Clear Sky
Date of Monitoring	:	08/04/2024 To 09/04/2024
Time of Monitoring	:	06:00 A.M. To 06:00 A.M.
Ambient Temperature (°C)	:	Min.25°C, Max.40°C
Surrounding Activity	:	Human & Vehicular Activities
Scope of Monitoring	:	Regulatory Requirement
Sampling & Analysis Protocol	:	IS: 9989
Sampling Duration	:	24 Hours
Parameter Required	:	As Per Work Order

S. No.	Test Parameters	Test Method	Test Results		Units
			Day Time (06:00 A.M. To 10:00 P.M.)	Night Time (10:00 P.M. To 06:00 A.M.)	
1.	$L_{Max.}$	IS: 9989	64.2	60.1	dB (A)
2.	$L_{Min.}$	IS: 9989	42.6	39.4	dB (A)
3.	$L_{Eq.}$	IS: 9989	57.50	52.40	dB (A)
4.	CPCB Limits In dB (A*) $L_{Eq.}$ (Industrial Area)	-	75.00	70.00	dB (A)

Note:-*A "decibel" is a unit in which noise is measured.

End of Report

(Reviewed By)

(Authorized Signatory)
13/04/2024

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Test Report

Sample Number:	VEL/AP/02	Report No.:	VEL/AP/2404180001
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	20/04/2024
		Period of Analysis:	18/04/2024- 20/04/2024
		Receipt Date:	18/04/2024
		Page No.:	1 of 1

Sample Description: AMBIENT NOISE LEVEL MONITORING

General Information

Sampling Location	:	Near Gate No. – 1
Sample Collected By	:	VEL Representative
Sampling Instrument Used	:	Sound Level Meter
Instrument Code	:	VEL/INS/ENV/SLM/10
Instrument Calibration Status	:	Calibrated
Meteorological Condition During Monitoring	:	Clear Sky
Date of Monitoring	:	15/04/2024 To 16/04/2024
Time of Monitoring	:	06:00 A.M. To 06:00 A.M.
Ambient Temperature (°C)	:	Min.25°C, Max.40°C
Surrounding Activity	:	Human & Vehicular Activities
Scope of Monitoring	:	Regulatory Requirement
Sampling & Analysis Protocol	:	IS: 9989
Sampling Duration	:	24 Hours
Parameter Required	:	As Per Work Order

S. No.	Test Parameters	Test Method	Test Results		Units
			Day Time (06:00 A.M. To 10:00 P.M.)	Night Time (10:00 P.M. To 06:00 A.M.)	
1.	$L_{Max.}$	IS: 9989	68.2	62.5	dB (A)
2.	$L_{Min.}$	IS: 9989	45.5	43.3	dB (A)
3.	$L_{Eq.}$	IS: 9989	60.80	51.90	dB (A)
4.	CPCB Limits In dB (A*) $L_{Eq.}$ (Industrial Area)	-	75.00	70.00	dB (A)

Note:-*A "decibel" is a unit in which noise is measured.

End of Report

(Reviewed By)

(Authorized Signatory)
20/04/2024

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Test Report

Sample Number:	VEL/AP/03	Report No.:	VEL/AP/2404250001
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	27/04/2024
		Period of Analysis:	25/04/2024 - 27/04/2024
		Receipt Date:	25/04/2024
		Page No.:	1 of 1

Sample Description: AMBIENT NOISE LEVEL MONITORING

General Information

Sampling Location	:	Near Gate No. - 2
Sample Collected By	:	VEL Representative
Sampling Instrument Used	:	Sound Level Meter
Instrument Code	:	VEL/INS/ENV/SLM/10
Instrument Calibration Status	:	Calibrated
Meteorological Condition During Monitoring	:	Clear Sky
Date of Monitoring	:	22/04/2024 To 23/04/2024
Time of Monitoring	:	06:00 A.M. To 06:00 A.M.
Ambient Temperature (°C)	:	Min.26°C, Max.41°C
Surrounding Activity	:	Human & Vehicular Activities
Scope of Monitoring	:	Regulatory Requirement
Sampling & Analysis Protocol	:	IS: 9989
Sampling Duration	:	24 Hours
Parameter Required	:	As Per Work Order

S. No.	Test Parameters	Test Method	Test Results		Units
			Day Time (06:00 A.M. To 10:00 P.M.)	Night Time (10:00 P.M. To 06:00 A.M.)	
1.	$L_{Max.}$	IS: 9989	70.8	62.5	dB (A)
2.	$L_{Min.}$	IS: 9989	46.4	46.4	dB (A)
3.	$L_{Eq.}$	IS: 9989	68.21	56.32	dB (A)
4.	CPCB Limits In dB (A*) $L_{Eq.}$ (Industrial Area)	-	75.00	70.00	dB (A)

Note:-*A "decibel" is a unit in which noise is measured.

End of Report

VARDAN ENVIROLAB Amitabh Dy. Technical Manager
(Reviewed By)

VARDAN ENVIROLAB Prakash Singh Authorised Signatory
(Authorized Signatory)
27/04/2024

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- Giving opinions does not imply endorsement of the tested sample by the lab. Under no circumstances, the lab accepts any liability caused by the use or misuse of the test report.

Test Report

Sample Number:	VEL/AP/04	Report No.:	VEL/AP/2405020001
Name & Address of the Party:	M/s Mahan Energen Limited Village: Bandhora, Post: Karsualal, Tehsil: Mada, Distt.: Singrauli, Madhya Pradesh - 486886	Format No.:	7.8 F-03
		Party Reference No.:	5703009832 Date : 14/06/2023
		Reporting Date:	04/05/2024
		Period of Analysis:	02/05/2024 - 04/05/2024
		Receipt Date:	02/05/2024
		Page No.:	1 of 1

Sample Description: AMBIENT NOISE LEVEL MONITORING

General Information	
Sampling Location	: Near Gate No. - 3
Sample Collected By	: VEL Representative
Sampling Instrument Used	: Sound Level Meter
Instrument Code	: VEL/INS/ENV/SLM/10
Instrument Calibration Status	: Calibrated
Meteorological Condition During Monitoring	: Clear Sky
Date of Monitoring	: 29/04/2024 To 30/04/2024
Time of Monitoring	: 06:00 A.M. To 06:00 A.M.
Ambient Temperature (°C)	: Min.25°C, Max.41°C
Surrounding Activity	: Human & Vehicular Activities
Scope of Monitoring	: Regulatory Requirement
Sampling & Analysis Protocol	: IS: 9989
Sampling Duration	: 24 Hours
Parameter Required	: As Per Work Order

S. No.	Test Parameters	Test Method	Test Results		Units
			Day Time (06:00 A.M. To 10:00 P.M.)	Night Time (10:00 P.M. To 06:00 A.M.)	
1.	$L_{Max.}$	IS: 9989	62.4	55.6	dB (A)
2.	$L_{Min.}$	IS: 9989	40.6	38.9	dB (A)
3.	$L_{Eq.}$	IS: 9989	57.46	44.74	dB (A)
4.	CPCB Limits In dB (A*) $L_{Eq.}$ (Industrial Area)	-	75.00	70.00	dB (A)

Note:-*A "decibel" is a unit in which noise is measured.

End of Report

VARDAN ENVIROLAB (Reviewed By) Manager

VARDAN ENVIROLAB (Authorized Signatory) 04/05/2024 Authorised Signatory

Terms & Conditions

- The results reported relate only to the samples tested. In case sample is not drawn the results apply to the sample as received.
- This test report in full or in part, shall not be reproduced in any court of law without prior written approval of the laboratory.
- To confirm the authenticity of this certificate of analysis, please contact us through email at lab@vardan.co.in
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Annexure-I

Mahan Energen Limited

Location			Admin	Gate No.1	Gate No. 2	Gate No. 3
Month	**Date**	**Duration**	**Leq dB(A)**	**Leq dB(A)**	**Leq dB(A)**	**Leq dB(A)**
April-2024	06.10.2023	Day	57.5	60.8	68.2	57.5
		Night	52.4	51.9	56.3	44.7
May-2024	07.11.2023	Day	60.6	62.7	70.3	56.5
		Night	54.7	54.7	64.4	46.8
June-2024	15.2.2023	Day	55.24	64.22	68.61	58.63
		Night	53.46	63.91	62.37	47.68
July-2024	02.01.2024	Day	64.29	64.27	66.29	63.96
		Night	51.71	52.47	53.37	53.49
August-2024	05.02.2024	Day	61.47	62.81	65.37	60.24
		Night	48.72	48.91	51.85	46.27
September-2024	11.03.2024	Day	60.45	62.45	61.27	58.91
		Night	49.27	48.29	51.29	49.19

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Government of India
Department of Atomic Energy
Board of Radiation & Isotope Technology

çek.ki= Vªfdx vkbZMh/Certificate Tracking ID : 2403788
tkjh djus dh frfFk/Date of Issue : 02-Nov-2024
çek.ki= Øekad/Certificate Sr.No.: ULR-TC1170324000003667F

TC-11703

Radioanalytical Laboratory

RADIOACTIVITY TEST CERTIFICATE

Ref : BRIT/RAL/DOM/868-871/MISC/663-666/24-25

To :
M/S. MAHAN ENERGEN LIMITED
VILLAGE : BANDHAURA, POST KARSUARAJA,
TEHSIL MADA, DIST. SINGRAULI, M.P. PIN 486 886

This is regarding the sample of "COAL" sent for radioactivity analysis vide your letter ref. : MEL/ENV/BRIT/169/24 dated 16.09.2024 with the following markings, as shown in italics:

NAME & ADDRESS OF THE CUSTOMER	:	***MAHAN ENERGEN LIMITED, VILLAGE : BANDHAURA, POST KARSUARAJA, TEHSIL MADA, DIST. SINGRAULI, M.P. PIN 486 886***
SAMPLE NAME	:	***COAL SAMPLE***

DATE OF RECEIPT OF SAMPLE: 26.09.2024 **DATE OF COMPLETION OF TEST: 30.10.2024**

The samples were analysed for U-238 , Ra-226, Th-232 & K-40 radioactivity content and the values obtained are as follows:

Sr. No	SAMPLE	U-238 (Bq/Kg)	Ra-226 (Bq/Kg)	Th-232 (Bq/Kg)	K-40 (Bq/Kg)
1	COAL SAMPLE	41.8 ± 2.7	38.1 ± 5.5	81.2 ± 5	89.1 ± 6.6

Opinion: The measurement values are below the clearance level for radionuclides of natural origin in bulk solid materials, as per AERB directive 01/2010 (table-3) dated 26/11/2010.

Note: (i) The report pertains to the given sample only. (ii) The sample will be retained in this laboratory for a period of 1 month from certificate date and thereafter it will be disposed off. (iii) This report shall not be reproduced except in full, without written approval of the laboratory. (iv) The sampling is not done by this laboratory.

Checked by:
GANPAT B NAKTI
Assistant

Authorized Signatory:
AJAY NANA THAMKE
OIC, RAL

**************** End of Report ******************

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BRIT/ BARC Vashi Complex, Sector 20, Navi Mumbai – 400 703 (Maharashtra)
osclkbV@ Website: www.britatom.gov.in; njHkk"k@ 022 2788 7002/ 7006

adani

Power

Ref: MEL/ENV/FLYASH/165/24
Date: 15.07.2024

To,
Additional Principal Chief Conservator of Forest
Ministry of Environment, Forest & Climate Change
Integrated Regional Office Western Region
Kendriya Paryavaran Bhawan, Link Road No. -3
E-5, Ravi Shankar Nagar, Bhopal- 462 016 (MP)

Sub: Advisory regarding implementation of Notification No. G.S.R. 02 (E) dated 2nd January 2014 and subsequent amendment in 21.05.2020 for supply and use of coal with ash content-regarding.

Ref: File No. L-11011/21/2014-IA, I (T), dated: 13.04.2015.

Dear Sir,

With reference to above subject matter, we are submitting herewith the compliance of said Notification.

The half yearly compliance reports of Fly Ash management for environmental safeguards stipulated in the EC and Consent are being regularly submitted to both the regional office of MoEF&CC, Bhopal as well as Madhya Pradesh Pollution Control Board (MPPCB). We are also submitting the half yearly & annual reports of Fly ash utilization & Ash content of Coal to Central Electricity Authority (CEA).

We are enclosing herewith the monthly as well as **Quarterly Average Ash Content** in the Coal for the period of **April'2024 to June'2024** as Annexure - I

Total Capacity of TPP: 1200 (2x600) MW

This is for your kind information and record please.

Thanking You,

Yours faithfully,
for **Mahan Energen Limited**

(R N Shukla)
Head – Environment & Forest
Encl.: As above

Mahan Energen Limited
Adani Corporate House
Shantigram, S G Highway
Ahmedabad 382 421
Gujarat, India
CIN: U40100GJ2005PLC147690

Tel +91 79 2656 4444
Fax +91 79 2555 7177
www.adani.com

Registered Office: Adani Corporate House, Shantigram, Vaishnodevi Circle, SG Highway, Khodiyar 382421, Gujarat, India

MAHAN ENERGEN LIMITED

Annexure – 1

ASH PERCENTAGE IN COAL

(From April'2024 to June'2024)

Month	Coal Consumption (MT)	Ash % in Coal
April'2024	470075.40	34.91
May'2024	459,710.48	34.36
June'2024	454479.10	33.17
Quarterly Average (%)	....	**34.14**

MT-Metric Tone

- Mahan Energen Limited is based on Pit head Thermal Power Plant

adani

Power

Ref: MEL/ENV/FLYASH/209/24
Date: 17.10.2024

To,
Additional Principal Chief Conservator of Forest
Ministry of Environment, Forest & Climate Change
Integrated Regional Office Western Region
Kendriya Paryavaran Bhawan, Link Road No. -3
E-5, Ravi Shankar Nagar, Bhopal- 462 016 (MP)

Sub: Advisory regarding implementation of Notification No. G.S.R. 02 (E) dated 2nd January 2014 and subsequent amendment in 21.05.2020 for supply and use of coal with ash content-regarding.

Ref: File No. L-11011/21/2014-IA, I (T), dated: 13.04.2015.

Dear Sir,

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The half yearly compliance reports of Fly Ash management for environmental safeguards stipulated in the EC and Consent are being regularly submitted to both the regional office of MoEF&CC, Bhopal as well as Madhya Pradesh Pollution Control Board (MPPCB). We are also submitting the half yearly & annual reports of Fly ash utilization & Ash content of Coal to Central Electricity Authority (CEA).

We are enclosing herewith the Monthly as well as **Quarterly Average Ash Content** in the Coal for the period of **July'2024 to September'2024** as Annexure - I

Total Capacity of TPP: 1200 (2x600) MW

This is for your kind information and record please.

Thanking You,

Yours faithfully,
for **Mahan Energen Limited**

(R N Shukla)
Head Environment & Forest
Encl.: As above

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Mahan Energen Limited

Annexure – 1

ASH PERCENTAGE IN COAL

(From July '2024 to September '2024)

Month	Coal Consumption (MT)	Ash % in Coal
July'2024	381910.25	30.73
August'2024	416818.00	30.01
September'2024	421497.00	30.37
Quarterly Average (%)		30.37

MT-Metric Tone

- Mahan Energen Limited is based on Pit head Thermal Power Plant

Ash Generation and Utilization Details
(April'2024 to September'2024)

Month	Ash Generation (MT)	Ash Utilization				Total Ash Utilization (MT)	Utilization (%)
		Cement Industries (MT)	Filling of mine voids/ stone quarries	Fly ash-based products bricks, blocks, tiles, (MT)	Filling up of low lying area; (For Construction 2x800 MW TPP project within the Plant boundary)		
April'2024	164104.32	30636.20	15976.71	35.00	44157.00	90804.91	55.30
May'2024	157951.75	37707.56	51353.96	0.00	32130.00	121191.52	76.70
June'2024	150772.96	54697.90	58047.68	172.00	28635.39	141553.48	93.90
July'2024	117363.80	6332.86	41768.22	99.35	20277.28	68477.71	58.30
August'2024	125097.45	7723.30	24806.82	14.92	8562.00	41106.20	32.90
Sept'2024	128027.07	11830.08	83305.54	78.43	876.00	96090.05	75.10
Total	843317.35	148927.90	275258.93	399.70	134637.67	559223.87	66.31

Annexure V

Foundation

Half Yearly Report 2024-25

We are currently operating in 20 villages across 15 panchayats, positively impacting 64 thousands lives.

Preface

It is with immense pleasure and pride that I present the half-yearly report of the Adani Foundation's CSR activities in Singrauli district. At Adani Foundation, we firmly believe in the power of responsible corporate citizenship to transform lives and uplift communities. Singrauli, with its rich cultural heritage and vibrant communities, has been a focal point of our efforts to make a meaningful and sustainable impact.

Over the past six months, our CSR initiatives in Singrauli have gained momentum, thanks to the relentless dedication of our team, the support of our partners, and the active participation of the local community. Through our various projects and programs, we have strived to address pressing challenges, promote education, enhance healthcare facilities, and foster economic empowerment.

This report serves as a testament to the progress we have achieved, the hurdles we have overcome, and the lives we have touched. It highlights the stories of resilience, hope, and positive change that have emerged from our initiatives. We have endeavored to create a holistic approach, focusing not only on immediate needs but also on building a sustainable future for the residents of Singrauli.

We are deeply grateful for the trust and collaboration extended to us by the people of Singrauli, the local authorities, and our esteemed partners.

As we move forward, we remain committed to our mission of empowering communities, nurturing talent, and creating pathways to prosperity. The challenges ahead are significant, but so is our determination to overcome them. With your continued support, we are confident that we can make a lasting difference in the lives of the people of Singrauli.

I extend my heartfelt gratitude to everyone who has contributed to our initiatives in Singrauli. Your support fuels our passion and propels us toward achieving greater milestones in the future.

Manoj Prabhakar
Program Manager
Adani Foundation Singrauli

Journey of Goodness – Since
June 2022 at Singrauli

Vision

"To accomplish a passionate commitment to social obligations towards communities, fostering sustainable and integrated development, thus improving quality of life"

Mission

"To play the role of a facilitator for the benefit of the people without distinction of caste or community, sector, religion, class or creed, in the fields of education, community health, and promotion of social and economic welfare and upliftment of the people in general."

Philosophy

"Taking inspiration from the Gandhian philosophy of trusteeship, the Adani Foundation strives to create sustainable opportunities. It does so by facilitating quality education, enabling the youth with income-generating skills, promoting a healthy society and supporting infrastructure development."

Journey of Adani Foundation

20	villages
15	Panchayat
25	Tola/Ward
64 K	Beneficiaries

20k	Youth
1.5k	Farmers
18	Acres of land

24	Schools
4.4k	Students
2.4k	Utthan Students

Health outreach	11K
Hospital, clinic footfall	35K
Women, child nutrition	414

Improved cattle	11.1k
Artificial inseminations	100

Women SHGs	61
Community outreach	500

Green Energy Biogas, Plantation, Solar Light, Vermicompost	3.7K

Thematic Areas

- Education
- Community Health
- Sustainable Livelihood
- Community Development
- Climate Action

CSR Singrauli

DEMOGRAPGIC DETAILS

Tehsil - 3
Development Block -3
Gram Panchayat - 328
Revenue Village - 814
Household - 243925
Population - 1510000
Scheduled Tribes (ST) - 32.59 %
Scheduled Caste (SC) - 12.79%

Thermal Plant/ Project Core Village:-

Bandhaura , Nagwa, Khairahi & Karsualal

Thermal Plant/ Project Peripheral Villages

Semua, Suhira, Amilia, Railla, Chaura, Malga Ghuni, Karsuaraja

Coal Transport Area Village:-

Jamgadi, Khanua Khas, Gajra Bahra, Bhalia Tola Phatpani, Gorbani, Suliyari, Jhalri

 # Adani Foundation's outreach in 2 blocks name Devsar & Waidhan. Total 20 villages of 17 Gram Panchayats; 5432 households; Population; 26957

adani Foundation

Community Health

MEL, Singrauli Health Care Unit regularly running Hospital in Nagwa Village , Health care Unit provided Health Care Services to all age group at R&R Colony and other peripheral village. Also organized specialized health camp.

Health Facility

No. of Direct Beneficiaries FY-23-24	
Activity	**Beneficiary**
Nagwa Hospital	7407 Patients
Ambulance	233 Patients
Lab Facility	637 Patients
IPD Patients	3711 Patients
Mobile Med. Camp	85 Camps
Health Awareness	23 no's- 563 Person
Mega Health Camp	431 Patients

Education

The AF provide Free education to all R&R family village Nagwa, children encourage underprivileged students with promising academic records to complete school and pursue higher education. Children, especially girls, being raised by single mothers and women headed families find special mention within this framework. So far, This academic year 2024-25, 1206 students have benefited, with this program. In certain cases, the Foundation also facilitates sponsorships for deserving students pursuing higher education.

Utthan: **Transforming Govt. Schools into Model Institutions**

Enhancing Government primary schools

Appointing an Utthan Sahayak in Each School as a Catalyst and Facilitator

Ensuring Resources and Facilities

Enhancing Literacy, Numeracy, and Life Skills

Empowering Government School Teachers through Capacity Building

Special Emphasis on 'Priya' Vidyarthis'

Preparing Students for NMMS & JNV Entrance Examinations

4839 Students
20 Schools

Education Support Service

- **Infrastructure & Related Support in School**
  - a) Drinking water facility – **09 Schools**
  - b) Toilet construction **03 Schools**
  - c) Bala painting **09 Schools**
  - d) TLM & Stationary **20 Schools**
  - e) Bag Distribution **3700 students**
  - f) Sports Kit Support **20 Schools**
  - g) Anganwadi & School building Painting & Repairing **03 no's**





Sustainable Livelihood Development Program

Skill Development Training Program

Adani Foundation, in its relentless pursuit of empowering communities, proudly conducted batches of a comprehensive sewing training program and Electric motor winding training program. This initiative aimed at enhancing the skill and independence of women & youth from diverse background.
By empowering these women & youth, the foundation continues its mission to make a positive impact on communities and promote sustainable livelihood.

Annapurna Program

Under the Adani Annapurna program, the Adani Foundation actively promotes organic farming practices, striving to reduce fertilizer costs and enhance the overall health and well-being of villagers. By advocating sustainable agricultural methods, the Foundation aims to create a healthier environment, empower local communities, and foster a future rooted in ecological harmony.

Program name	No. of Beneficiary	Remark
Sewing Training	40	Women & Youth Generating their livelihood after Training
Handicraft Trg and Production	30	Engage 12 no's youths in different organization.
Annapurna kit distribution	200	Provide Quality seeds to women farmer
Homecare Cleaning & Detergent Pdr.	15	Total Earning 1.72 Lakh in 6 Months
Organic pesticide	45	300 Liters Pesticide produced
Vegetable Cultivation	80	Vegetables worth Rs 57K were earned

Sathwaro (Sikki Art)

Understanding Sathwaro

Empowering Artisans and Preserving Culture

Sathwaro initiative aims to **safeguard India's heritage arts and crafts,** striving for sustainable cultural heritage preservation. The Sathwaro logo symbolizes unity, while valuing and supporting artisans for **better market access**.

Needs for Projects Sathwaro:

Sathwaro addresses artisans' economic struggles, preserves national cultural identities, promotes handicrafts globally, and inspires younger generations to continue cultural legacies, aligning with SDGs for **economic growth, livelihood, and cultural preservation.**

Sustainable Livelihood Development Program

adani Foundation

Adani Kamdhenu Program

Adani Foundation recently made history in village areas by organizing the first-ever series of Animal Health Camps. In a groundbreaking initiative, six camps were conducted, addressing the vital need for animal welfare in rural communities. These camps, a testament to the Foundation's commitment, provided essential veterinary care and expertise, ensuring the well-being of livestock. By focusing on animal health, the Foundation not only uplifted rural economies but also strengthened the bond between communities and their animals, fostering a healthier, more sustainable future for all.

Total Village Covered	Total Camp	No. of Beneficiary	Total Animal					
			Cow	Ox	Buffalo	Goat	Hen	Other
8	9	768	326	210	110	543	10	9

Bio-Gas Plant

Adani Foundation proudly constructed **9** bio-gas plants in **4** villages which Name is Khairahi, Raila, Karsuaraja and Bandhaura, ushering in a new era of sustainable energy. These eco-friendly initiatives not only promote clean energy but also empower rural communities, contributing significantly to environmental conservation and improved living standards.

Vruksh Se Vikash

S.No.	Name of Tree	Total Tree Plated	Remark
1	Mango	1696	Plantation in FY 2024-25 is till Sept'24 in 10 Village – Nagwa, Khairahi, Karsualal, Karsuaraja, Bandhaura, Raila, Amiliya, Suhira, Jamgadi, Khanua
2	Pomegranate	300	
3	Guava	500	
4	Jack Fruit	500	
5	Anwala	200	
6	Pipal	15	
7	Lemon	686	
8	Neem	300	
9	Jamun	400	
10	Sagwan	500	
11	Kadam	100	
12	Bamboo	100	
13	Seasam	100	
14	Ashok	300	
15	Bel	200	
16	Bargad	15	
17	Karanj	40	
18	Karaunda	130	
		6082	

In alignment with our Chairman's visionary goal of planting 1 trillion trees by 2030, Adani Foundation took a significant step forward by planting 6082 saplings. This initiative exemplifies our dedication to realizing this ambitious vision, fostering a greener planet and sustainable future for generations to come.

Community Development

Objective

To developed need-based public infrastructure | To encourage sports | To enhance reach of social schemes | To ensure access to potable drinking water | To preserve, protect and promote national heritage and art | To provide quick relief (food supply, medicines etc.) in case of natural calamities

Climate Action

Objective

To increase availability of water | To increase green cover | To promote clean villages | To enhance sustainable green energy solutions.

Key programmes

Water Conservation
Enhancing green cover and promotion of biodiversity
Waste management and sanitation
Promotion of green energy

Water Conservation
10 Nos ponds Restored nearby 8 villages & **11000 Cum** water Cap. increased

Promotion of green energy
40 Nos Solar streetlight installed nearby village area

Waste management and sanitation
20 Nos Biogas unit installed & rest 15 nos Bio-gas construction is going on at nearby 8 village area.

Enhancing green cover and promotion of biodiversity
600 Saplings planted nearby 14 villages

Biogas

Organic Waste – Biogas

Adani Foundation proudly constructed Nonconventional Energy sources for Villagers at nearby village area. These eco-friendly initiatives not only promote clean energy but also empower rural communities, contributing significantly to environmental conservation and improved living standards.

Adani foundation An awareness program on biogas was organized, attracting the participation of 45 villagers. The event aimed to educate the community about the benefits of biogas as a sustainable and eco-friendly energy source.

Total Biogas unit Installed – 20 Nos.

Coverage area - 8 villages which Name is Nagwa, Khairahi, Bandhaura, Raila, Karsuaraja and Karsualal

Total Beneficiary count- 90 no's members

FY 24-25 Target- 25 nos Biogas unit

Organic Farming

13 Nos. farmer awareness programs were organized at Bandhaura, Khairahi, Karsua, Raila and Amiliya villages, focusing on sustainable agricultural practices and soil health. As part of these programs, soil testing was conducted to provide farmers with detailed insights into their land's fertility and nutrient requirements. A total of **80** farmers participated, gaining valuable knowledge to enhance their farming techniques and productivity.

Media highlights

अदाणी फाउंडेशन का एनीमिया मुक्त समाज बनाने की विशेष पहल

116 किशोरियों की निःशुल्क रक्त जांच हुई

स्टार समाचार | सिंगरौली

कुपोषण दूर करने पर जोर : अदाणी फाउंडेशन का पोषण वाटिका पर एक दिवसीय प्रशिक्षण

अदाणी फाउंडेशन के बारे में

अदाणी फाउंडेशन ने लगाया शिविर 150 लोगों ने कराई जांच

स्टार समाचार | सिंगरौली

सुदूर ग्रामीण क्षेत्रों में जरूरतमंदों के बीच स्वास्थ्य सम्बन्धी समस्याओं के समाधान के लिए सिंगरौली जिला स्थित अदाणी समूह के महान इनर्जेन लिमिटेड के सहयोग से बंधौरा गांव में अदाणी फाउंडेशन द्वारा गुरुवार को निःशुल्क बृहद स्वास्थ्य शिविर का आयोजन किया गया। बंधौरा गांव के शासकीय मध्य विद्यालय में आयोजित इस कैंप में मेडिकल टीमए आशा कार्यकर्ता और आंगबाड़ी कार्यकर्ता के मदद से 150 स्थानीय रोगियों का इलाज कर उन्हें निःशुल्क दवाइयां दी गई। इस शिविर में सामान्य रोगी के अलावा 22 गर्भवती महिलाओं को स्वास्थ्य परीक्षण कर उनका हीमोग्लोबिन जांच किया गया और आवश्यक दवाइयां दी गयी। इसके साथ ही इस शिविर में नेत्र रोग विशेषज्ञ द्वारा 68 नेत्र रोगियों की भी जांच की गयी जिसमें 22 मरीज मोतियाबिंद के पाए गए। इस स्वास्थ्य जांच शिविर में पहुंचे सभी मरीजों का इलाज कर उन्हें निःशुल्क दवाइयां बांटी गयी। इस स्वास्थ्य परीक्षण शिविर में अमोलिया स्वास्थ्य केंद्र की प्रमुख डॉ अचला, नेत्र रोग विशेषज्ञ डॉ हरीश कुमार और डॉ कौशल राठौर की मौजूदगी में आशा कार्यकर्ता और आंगनबाड़ी कार्यकर्ताओं की टीम ने मरीजों की जांच और दवाइयों के वितरण में सक्रिय भूमिका निभाई। कार्यक्रम का आयोजन सीएसआर के मनोज प्रभाकर के नेतृत्व में किया गया।

बंधौरा में आयोजित हुए अदाणी फाउंडेशन के स्वास्थ्य शिविर में 39 लोगों की निःशुल्क जांच

- गांववासियों को बेहतर स्वास्थ्य सेवा के साथ अच्छी सुविधाएं उपलब्ध कराने का दिया गया भरोसा

विशेष संवाददाता | सिंगरौली (बैढ़न)

सामाजिक दायित्वों के निर्वहन के क्रम में अदाणी विद्युत परियोजना महान इनर्जेन लिमिटेड के सीएसआर विभाग की ओर से बुधवार को प्लांट के समीपवर्ती गांव बंधौरा में स्वास्थ्य शिविर का आयोजन किया गया। इस दौरान 39 ग्रामीणों की निःशुल्क स्वास्थ्य जांच करने के साथ उनमें दवा वितरित की गई। इसके पहले बंधौरा पंचायत भवन में आयोजित हेल्थ कैम्प का पूर्व सरपंच समाजसेवी आशीष शुक्ला ने फीता काटकर शुभारंभ किया। इस दौरान अदाणी फाउंडेशन के अधिकारी मनोज प्रभाकर ने ग्रामीणों को विश्वास दिलाया कि कंपनी सभी गांववासियों को बेहतर स्वास्थ्य सेवा एवं अच्छी सुविधा उपलब्ध कराएगी। ग्रामीण बच्चों, महिलाओं युवाओं और अन्य सभी आयु वर्ग के लोगों के सर्वांगीण विकास में कंपनी महत्वपूर्ण भूमिका निभाते हुए सकारात्मक सहयोग देगी। ऐसी ही अपेक्षा उन्होंने ग्रामीणों से भी की। उन्होंने कहा कि शिक्षा व स्वास्थ्य पर ध्यान देते हुए कंपनी विकासपरक कई अच्छे व सफल कार्यक्रम भी आयोजित करेगी, जिससे अधिक संख्या में ग्रामीणजन लाभान्वित हो सकेंगे। कैंप में आए 39 मरीजों को मुफ्त जांच संग दवा दी गई। साथ ही उन्हें आगे भी स्वास्थ्य सेवा देने का भरोसा दिया गया। अदाणी फाउंडेशन के हेल्थ कैम्प को सफल बनाने में कंपनी की स्वास्थ्य टीम से अभिषेक सिंह, फार्मासिस्ट कमलेश कुमार, नर्स पल्लवी और वीरेंद्र कुमार के साथ-साथ ग्रामीण के रूप में उमेश कुमार का महत्वपूर्ण योगदान रहा।

Media highlights

महिलाओं के जीवन में यह प्रयास लायेगा सकारात्मक परिवर्तन

अदाणी फाउंडेशन के सहयोग से करसुआराजा में डिटर्जेंट पाउडर उत्पादन केंद्र का उद्घाटन

जरूरतमंद महिलाओं को बनायेगा आत्मनिर्भर

महिला सशक्तीकरण के बिना समग्र विकास संभव नहीं

बाला पेंटिंग से बुनियादी शिक्षा को बढ़ावा दे रहा अदाणी फाउंडेशन का 'प्रोजेक्ट उत्थान'

रीवा, 16 मई 2024

सिंगरौली जागरण

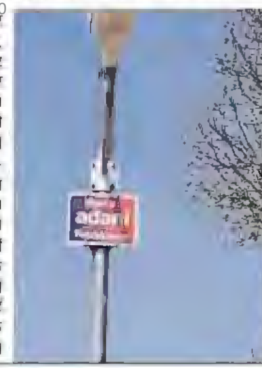
अदाणी फाउंडेशन ने कैरियर मार्गदर्शन और परामर्श कार्यशाला का किया आयोजन

अलग-अलग विद्यालयों के 100 से ज्यादा छात्रों ने लिया हिस्सा

अदाणी फाउंडेशन के सोलर लाइट अभियान से जगमग होने लगी गांव की गलियां

हीगवर्ती सिंगरौली। माडा तहसील अंतर्गत बंधौरा स्थित महान इनर्जेन लिमिटेड के पड़ोस के गांवों में ऊर्जा एवं पर्यावरण संरक्षण को बढ़ावा देने के उद्देश्य से अदाणी फाउंडेशन ने पहले चरण के तहत दस सोलर लाइटें लगाई है। अंधेरे में स्थानीय ग्रामीणों को काफी परेशानी होती थी। ऐसे में सोलर स्ट्रीट लाइट लगने के बाद गांव के लोगों को काफी फायदा हुआ है। रोशनी पर्याप्त हो इसके लिए हर पोल पर 24 वाट के ट्यूब लगाए गए हैं। इन लाइटों की खासियत यह है कि यदि किसी कारण से 72 घंटे अगर खराब मौसम के कारण सूर्य की रोशनी नहीं मिलती है, तब भी ये गांवों की गलियों को रोशन करेंगे।

प्रथम चरण के अंतर्गत सुहीरा, रैला, कर्सुआलाल, नगवा, खैराही और बंधौरा गांवों में सामुदायिक भवन, प्राथमिक स्वास्थ्य केंद्र, मार्केट कॉम्प्लेक्स एवं चौक-चौराहे पर दस सोलर लाइट लगाई गई है। गांव की सड़कें और गलियां भी अब शहर की तरह जगमग हो रही है। अदाणी फाउंडेशन द्वारा गांव-गांव में सोलर लाइट लगाए जाने पर ग्रामीणों ने खुशी जाहिर की है। रात के समय हो रही दिक्कतों से ग्रामीणों को निजात मिली है, वहीं सोलर लाइट लग जाने से इलाके में आवागमन बढ़ा है और लोगों में सुरक्षा की भावना भी मजबूत हुई है। अब स्थानीय निवासी रात के वक्त भी अपने रोजमर्रा की



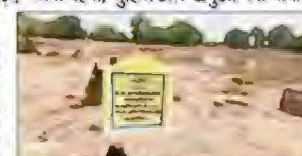
आर्थिक गतिविधियों को जारी रख सकते हैं, जिससे सामाजिक और आर्थिक विकास को बल मिलेगा।

आनेवाले कुछ दिनों में अदाणी फाउंडेशन द्वारा आसपास के गांवों के स्कूलों, आंगनबाड़ी केंद्रों और पंचायत भवनों जैसे सार्वजनिक स्थलों एवं अन्य स्थानों पर कई सोलर लाइट लगाने की योजना है। गांवों में सोलर लाइट लगने से बिजली की बचत होगी एवं कार्बन के उत्सर्जन में भी कमी आएगी, जिससे ग्लोबल वार्मिंग की समस्या से निपटने में मदद मिलेगी। खास बात यह है कि

अदाणी फाउंडेशन ने कराया नौ तालाबों का जीर्णोद्धार

करसुआराजा, जमगड़ी, गजरा बहरा, सुहिरा और खनुआ नवा गांवों में हुआ तालाबों का जीर्णोद्धार

सिंगरौली 9 जुलाई। जिले के बंधौरा स्थित महान एनर्जेन लिमिटेड के परियोजना क्षेत्र में जल संरक्षण के लिए स्थानीय लोगों को सक्षम बनाने एवं म.प्र. सरकार की जल गंगा संवर्धन अभियान को प्रोत्साहन देने के लिए अदाणी फाउंडेशन ने 9 तालाबों के जीर्णोद्धार का कार्य पूरा किया गया।



Thank You!

Mahan Energen Limited

Phase-I 2x600 MW

Expenditure incurred towards the implementation of Environmental Protection: FY 2024- 2025

Capital Expenditure (Establishment & Strengthening of Environment Management System)		
Sr. No.	**Expense Details**	**Expense Incurred (Rs. in Lakhs) April'24- Septmeber'24**
1	Cost incurred on procurement of spares, flanges and fittings of Ash Handling System	54.0
2	Cost incurred on ESP Overhauling work (Internal repair and TR maintenance)	12.0
3	Cost incurred on overhauling of DE / DSS system at Coal Bunker and Filter replacement in Ventilation System at Coal Handling Plant.	6.0
4	Civil Works Structure / Supply and installation of closed PEB store for Fly Ash Bricks Plant.	33.52
5	Cost incurred on Purchase for Organic waste Composter System (Disposal of food waste).	6.38
6	Ash Dyke Strengthening / Repairing Cost	24.43
7	Cost incurred on Ash utilization/disposal system:	1200.0
8	Purchase / Running cost of Water Fog Cannon / Mist Gun (Purchase of Fogger-66L)	7.1
9	Installation cost of New Manual Ambient Air Quality Monitoring Stations.	3.79
10	Environmental Lab Setup	12.0
(A) Total Capital Expenditure (Rs. in Lakhs)		**1359.22**
Recuring Expenditure (Waste disposal, emissions treatment, and remediation costs)		
11	Maintenance Services of OEM agency for repairing & maintenance of CAAQMS and CEMS systems and acquisition and transfer of real time monitoring data to CPCB portal	18.71
12	Cost incurred on procurement of analyzers & sensors, and other consumable items for Continuous Ambient Air Quality / Effluent Monitoring System (CAAQMS / EQMS).	21.0
13	Cost incurred on chemical treatment of Effluent at Water Treatment Plant.	0.7
14	Cost incurred on Operation of Sewage Treatment Plant.	0.6
15	environmental monitoring by SPCB / MoEFCC authorized Environmental Monitoring agency as per compliance requirement.	6.97
16	Tree Plantation cost	22.30
17	Operation & Maintenance cost of Fly Ash Brick Plant	4.25
18	Water tankers hiring charges for dust suppression	16.99
19	World Environment Day Celebration	1.10
20	Legal & Consent Fee	100
21	CSR Expenses	201.45
(B) Total Recurring Expenditure		**394.07**
Grand Total (A+B) ((Rs. In lakhs)		**1753.29**

adani
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Ref- APL/MEL/Env/PCCF/409/24
Date: 19.10.2024

To,
The Principal Chief Conservator of Forest (Wildlife),
Pragati Bhawan, Bhopal Vikas Pradhikaran,
3rd Floor, M.P Nagar, Bhopal
Madhya Pradesh - 462011

Sub: Submission of Ecological Assessment and Flora Fauna Wildlife Conservation and management Plan for Bandhaura Thermal Power Plant at Village Bandhaura, Tehsil Mada, District Singrauli, Madhya Pradesh by Mahan Energen Limited.

Ref:
1. APL vide Letter no. APL/MEL/Env/PCCF/407/23 dated 03.04.2023.
2. EC for 1200 (2x600) MW, vide letter no. J-13011/56/2006.IA.II (T) dated: 20.04.2007, Amended EC dated; 10.02.2009, 23.08.2013, 08.04.2016 & EC for 1600 (2x800) MW, vide letter no. J-13011/56/2006-IA.II (T), dated: 02.08.2023.
3. Certified EC compliance by MoEFCC, IRO, Bhopal vide File no. 4(0)1/2022 (Env.)1/10563/2022 (2) dated; 02.09.2022.

Dear Sir,

With reference to the above subject and APL Letters vide APL/MEL/Env/PCCF/407/23 dated 03.04.2023, and APL/MEL/Env/PCCF/157/24 dated 15.07.2024 (through post), we have already submitted Ecological Assessment and Flora & Fauna Wildlife Conservation & Management Plan which is prepared by M/s Good Earth Enviro Care in Association with Department of Environment Management, Indian Institute of Social Welfare & Business Management, Kolkata (Kolkata University & NABET Members)

We are regularly following up with the concern office on the subject matter and response is awaited.

Kindly solicit your suggestions and recommendation on the submitted Wildlife Conservation Plan.

Thanking You

Yours faithfully,
for **Mahan Energen Limited**

(R N Shukla)
Head Environment & Forest

22/X/24

Mahan Energen Limited
Adani Corporate House
Shantigram, S G Highway
Ahmedabad 382 421
Gujarat, India
CIN: U40100GJ2005PLC147690

Tel +91 79 2656 4444
Fax +91 79 2555 7177
www.adani.com

Encl.: 1. Copy of Acknowledged Letter of submission of Ecological assessment and flora fauna & Wildlife Conservation and management plan for Mahan Energen Limited.

CC:

1. **Integrated Regional Office**
   Ministry of Environment, Forest & Climate Change, Kendriya Paryavaran Bhavan, Link Road No. 3, Ravi Shankar Nagar, Bhopal (M.P)-462016

2. **The District Forest Officer**
   Majan Road, Waidhan, Singrauli. Madhya Pradesh-486889

3. **The Regional Officer**
   Madhya Pradesh Pollution Control Board, Regional Office, Waidhan, Singrauli, M.P.

adani
Power

Ref: APL/MEL/Env/PCCF/407/23
Date: 03.04.2023

To,
The Principal Chief Conservator of Forest (Wildlife),
Pragati Bhawan, Bhopal Vikas Pradhikaran,
3rd Floor, M.P Nagar, Bhopal
Madhya Pradesh - 462011

Sub.: **Submission of Ecological Assessment and Flora Fauna Wildlife Conservation and Management Plan for Operational 1200 (2x600) MW Thermal Power Plant** with proposed Expansion of Bandhaura Ultra Super Critical Thermal Power Plant at Village Bandhaura, Tehsil Mada, District Singraulli, Madhya Pradesh by Mahan Energen Limited.

Ref.: **1. Environmental Clearance (EC) vide File no. J-13011/56/2006. IA. II(T) dated 20.04.2007 and amendments on 10.02.2009, 23.08.2013 and 08.04.2016.**
2. Certified EC compliance by MoEFCC, IRO, Bhopal vide File no. 4(0)1/2022(Env.) I/10563/2022 (2) dated; 02.09.2022.

Dear Sir,

With reference to above mentioned subject, the Ministry of Environment, Forest & Climate Change (MoEFCC) has granted Environmental Clearance vide letter no **J-13011/56/2006-IA.II** (T) dated: 20.04.2007 and its subsequent amendments dated 10.02.2009. 23.08.2013, 08.04.2016. Subsequently transfer of EC to **Mahan Energen Limited (MEL) on 15.09.2022**.

In compliance of the **Specific Condition no: xiii of EC**; "A conservation Plan for Schedule -I animals reported in the study area of the project shall be prepared in consultation with an expert organization and duly approved by state wildlife department of Madhya Pradesh". during the plant site visit by **MoEF&CC, Integrated Regional Officer, Bhopal** for certification of EC Compliance status vide letter / File no. 4(0)1/2022(Env.) I/10563/2022 (2) dated; 02.09.2022.

MEL has also proposed to undertake expansion of the existing plant of Bandhaura Ultra Super Critical Thermal Power Plant by adding 1600 (2x800) MW to existing 1200 (2x600) MW **within the existing plant boundary / areas** at Village Bandhura, Tehsil Mada, District Singraulli, Madhya Pradesh.

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Power

We are submitting herewith the Ecological Assessment and Flora & Fauna Wildlife Conservation & Management Plan, which is prepared by M/s Good Earth Enviro Care in Association with Department of Environment Management, Indian Institute of Social Welfare & Business Management, Kolkata (Kolkata University & NABET Members).

The Wildlife Conservation Plan prepared by consultant is hereby submitted for your kind Pursual.

Solicit your suggestion and recommendation.

Thanking You,

Your's faithfully
for **Mahan Energen Limited**

(Authorized Signatory)
Head - Environment & Forest

Encl: Ecological assessment and flora fauna & Wildlife Conservation and Management Plan for Mahan Energen Limited

CC:
1. **Integrated Regional Office,** Ministry of Environment, Forest & Climate Change, Kendriya Paryavaran Bhavan, Link Road No. 3, Ravi Shankar Nagar, Bhopal (M.P) – 462016
2. **The District Forest Officer,** Majan Road, Waidhan, Singrauli, Madhya Pradesh – 486889.
3. **The Regional Officer,** Madhya Pradesh Pollution Control Board, Regional Office, Waidhan, Singrauli, M.P. -

Mahan Energen Ltd
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Annexure VIII

BASELINE HEALTH STATUS AROUND MAHAN TPP

Document No: IISWBM/IRP/BHS-APL/2024-25/03 V1.1 Dated 25/06/2024

IISWBM

June 2024

BASELINE HEALTH STATUS AROUND MAHAN TPP

Document No: IISWBM/IRP/BHS-APL/2024-25/03 V1.1 Dated 25/06/2024

Submitted By

Mahan Energen Limited

Vill-Bandhuara, Block-Baidhan
Singrauli (MP)

Executed By

DEPARMENT OF ENVIRONMENT MANAGEMENT
INDIAN INSTITUTE OF SOCIAL WELFARE
& BUSINESS MANAGEMENT
(A Constituent Institute of University of Calcutta)
KOLKATA – 700 073

JUNE, 2024

CONTENTS

EXECUTIVE SUMMARY

Adani Power Limited (APL), a member of the Adani Group, has taken up the implementation of large Thermal Power Projects at various locations in India in view of the growing needs of power requirements in the country. APL is also actively planning to implement Thermal Power Stations at various locations in India, totalling to about 20,000 MW in the coming years.

In accordance with its mission of being enviro-socially responsible corporate entity with thrust on sustainable development, MEL aims to focus on minimizing health impact of thermal power plant if any as well as emphasis on improving the health status of local community within 10 km radius of Mahan TPP. To accomplish this mission, it is imperative to carry out comprehensive community health status assessment study that can facilitate in formulating a cost-effective short as well as long-term community health management plan.

The objectives of the study are as follows:

- To assess the status of environmental pollution (viz. air, noise, water etc.) within the study area.
- To assess the health status along with the perception of different stakeholders regarding the health status of the people surrounding MEL.
- To study the prevalence of non-communicable diseases among the study population.
- To study the likely changes in health status of the local people.
- To validate the health data collected and to compare the available health data with National& Regional data.
- To study if any correlation exists between Environment quality and health status or/ and any other factors affecting the health status.
- To formulate cost effective health management plan.

The detail scope of work for the present study is as follows:

1) The study need to cover and collect the Primary data from the field and Secondary data. Study shall be conducted by the team occupational health & environmental experts

2) The detailed health assessment study would be conducted for the study area (core and buffer zone) i.e. 10.0 km radius of MEL's TPP.

3) Collection and trend (long-term) analysis of Environment (air and water) quality data of the study area.

4) Perceptions study of different stakeholders regarding the health status of the people surrounding Mahan TPP using developed questionnaire for the purpose.

5) Study of the prevalence of non-communicable diseases among the local community around Mahan TPP using the standard tools developed for the purpose.

6) Assessment of the change in health status of the local population.

7) Collection and validation of the health data to compare the available health data with National& Regional data trend.

8) Study to assess if any correlation exists between Environment quality and health status or/ and anyother factors affecting the health status.

9) Recommendation on institutional mechanism for implementation of health management plan, Suggestions / recommendation for improving health status of local community.

Despite their pivotal role in meeting energy demands, coal-based thermal power plants pose significant challenges and risks to both human health and the environment. The combustion of coal releases a plethora of pollutants into the atmosphere, contributing to air pollution and its associated health impacts. These pollutants include particulate matter (PM_{10}), sulfur dioxide (SO_2), nitrogen oxides (NOx), polyaromatic hydrocarbons (PAHs), heavy metals, and more. Their emissions have far-reaching consequences, ranging from respiratory and cardiovascular diseases in human populations to ecological degradation and climate change.

The combustion of coal in thermal power plants releases a significant amount of particulate matter (PM) and carbon dioxide (CO2) into the atmosphere. Particulate matter, including PM10 and PM2.5, consists of tiny particles of ash, soot, metals, and other substances that can penetrate deep into the lungs when inhaled. PM exposure has been linked to respiratory diseases such as asthma, bronchitis, and lung cancer, as well as cardiovascular problems including heart attacks and strokes.

Sulfur dioxide (SO_2) is a colorless gas with a pungent odor produced during the combustion of coal containing sulfur compounds. Coal-based power plants are one of the major sources of SO_2 emissions globally. When SO_2 is released into the atmosphere, it reacts with moisture and other gases to form sulfate aerosols and sulfuric acid, which can contribute to the formation of acid rain. Exposure to SO_2 can irritate the respiratory system, exacerbate respiratory conditions such as asthma and chronic bronchitis, and increase the risk of cardiovascular diseases.

Nitrogen oxides (NO_x), including nitrogen dioxide (NO_2) and nitric oxide (NO), are produced during the combustion process when nitrogen in the air reacts with oxygen at high temperatures. Coal-based power plants are significant contributors to NO_x emissions due to the combustion of coal in high-temperature boilers. NO_x emissions can lead to the formation of ground-level ozone (smog) and secondary particulate matter, which can worsen air quality and contribute to respiratory and cardiovascular problems. NO_2, in particular, can irritate the respiratory system, exacerbate asthma symptoms, and increase the risk of respiratory infections.

Exposure to the pollutants due to the operation of coal-based thermal power plants has been linked to a range of diseases and health conditions, impacting respiratory, cardiovascular, neurological, and developmental health. The hazards caused due to the operation of coal fire thermal power plants are broadly categorized into two parts: i) short term and ii) long term.

The short term health hazards include respiratory illness, asthma attacks and chronic bronchitis.

The long term health hazards include premature deaths, cardiovascular diseases, lung cancer, low birth weights and higher infant mortality.

The analysis of ambient air quality in the vicinity of Mahan TPP reveals that pollutant levels, including PM_{10}, $PM_{2.5}$, SO_2, and NO_x, are well within the respective permissible limits.

The analysis of ambient noise level reveals that the noise levels recorded at all four monitoring stations in the Mahan TPP remain well within the regulatory thresholds.

The state-of-the-art method was employed for the health status assessment study of the Mahan Thermal Power Plant (TPP). This advanced approach ensured a comprehensive and accurate evaluation of the health impacts on the local community. The study was explanatory in nature, utilizing both primary and secondary data to provide a detailed understanding of the health status and associated factors.

For the comprehensive assessment of health impacts within the buffer zone of the Mahan TPP, a mixed methods approach was meticulously adopted, employing a sequential explanatory design. This robust methodological approach commenced with the collection and analysis of quantitative data, which provided a foundational understanding of the health-related variables and prevalence of health issues within the community. Following the quantitative analysis, a qualitative data collection phase was undertaken to delve deeper into the contextual and experiential aspects of the health impacts observed. By integrating the quantitative findings with qualitative insights, the mixed methods approach enabled a comprehensive and nuanced understanding of the health impacts within the buffer zone of Mahan TPP.

The reconnaissance survey was undertaken by a team led by Dr. Priyanka Roy, Dr. K. M. Agrawal and Ms Asmita Basu from IISWBM along with MEL Team from 8th - 9nd March, 2024. The team had a kick-off meeting at the MEL TPP on 7th March, 2024 to finalise the modalities for commencing the field study as well as collection of secondary data.

Initially, MEL Team appraised the objective of proposed study and the required coverage of the same as per MoEF&CC Environmental Clearance condition. MEL Team also shared the detailed information regarding the existing health status of the area. They also shared the detail of the availability of healthcare infrastructure as well as healthcare services within the study area. During the meeting, detail plan for undertaking field study was also discussed and resolved that all the required primary data need to be collected within stipulated time frame.

The survey was undertaken to primarily examine the existing healthcare facilities as well as interact with various stakeholders such as healthcare professionals, workers, local community etc. within the buffer zone of Mahan TPP for the formulation of cost effective health management plan.

The baseline health status in the buffer zone of the Mahan TPP has been thoroughly assessed through an extensive field survey. This assessment involved visits to various healthcare facilities, including rural health clinic, Primary Health Centres (PHC), Sub-Health Centre (SHC), and Community Health Centres (CHC). During these visits, in-depth interviews were conducted with a range of healthcare professionals, such as doctors, Auxiliary Nurse Midwives (ANMs), Anganwadi workers, and other health staff. These interviews provided valuable insights into the healthcare infrastructure and services available in the region.

The primary health center in Nagwa is operated by MEL and is staffed by one doctor, Dr. K.K. Tiwari, two pharmacists, two Auxiliary Nurse Midwives (ANMs), one health worker, one lab technician, two ambulance drivers, and one housekeeping staff member. During an interaction with Dr. Tiwari, it was revealed that the clinic provides medical services free of cost to the local community, including facilities such as Day IPD, Pathology Services, Free Medicine Services, Ambulance Services, and OPD. Patients are initially treated with empirical medicines, and if these are inadequate, they are referred to the nearest district hospital, located about 40-45 km away, or to Nehru Hospital, about 50 km from the center. A comprehensive data analysis of diseases recorded at the Primary Health Center in R&R Colony Nagwa was undertaken to assess the overall disease patterns within the study area.

The gender wise distribution of disease patterns recorded in the center revealed notable differences in the distribution of diseases between males and females. For general ailments, males reported a higher percentage at 51.75%, compared to 48.25% for females. Skin-related issues were more prevalent among males at 58.81%, whereas females accounted for 41.19%. Conversely, ENT, mouth, and dental conditions were slightly higher in females at 52.41%, with males at 47.59%. Cardiovascular conditions exhibited a significant disparity, with females representing 74.65% of cases, in contrast to 25.35% for males. Ophthalmic issues were more common in males at 54.47% compared to 45.53% in females. Similarly, gastrointestinal problems were slightly more prevalent in males at 54.12%, whereas females accounted for 45.88%. Upper respiratory infections (URI) showed a significant difference, with males at 73.68% and females at 26.32%.

Interaction with the Anganwadi workers at the Sub Health Center in Nagwa revealed several critical gaps in healthcare services. Notably, there is no Auxiliary Nurse Midwife (ANM) available at the center, and there are no facilities for conducting child deliveries or vaccination drives. Despite these limitations, a Community Health Officer (CHO) visits the center regularly to prescribe medicines to patients. The CHO faces a significant workload, attending to 300-400 patients on a regular basis, especially during seasonal changes.

At the Sub Health Center in Chauda, a detailed discussion took place with Ladies Health Visitor (LHV) Maya Vishwakarma, who currently oversees healthcare services across 28 villages. Highly experienced in child delivery, LHV Vishwakarma plays a pivotal role in maternal and child health in the region. The center also employs an ASHA worker responsible for sample collection for various diagnostic tests. The Community Health Officer (CHO) at Chauda is tasked with managing Non-Communicable Diseases (NCDs) in the area.

LHV Vishwakarma reported that the region commonly faces diseases such as malaria, diarrhea, and typhoid. Additionally, there have been notable cases of sexually transmitted diseases (STDs) like HIV and AIDS, which are primarily attributed to the influx of migrant workers. Recently, the center documented 25 cases of leprosy, as well as instances of hypo-pigmentation and filariasis. These observations underscore the diverse health challenges faced by the community and highlight the critical need for comprehensive healthcare services and preventive measures in the area.

During the visit in Community Health Center (CHC) located in Khutar, it was observed that the most commonly reported diseases include fever, diarrhea, and cough and cold. However, a notable concern is the significant number of upper respiratory infections (URI) being reported. This pattern highlights the need for enhanced respiratory care services and possibly more robust public health interventions to address these issues effectively. Overall, while the CHC in Khutar provides essential healthcare services to the community, there are critical gaps that need to be addressed to improve health outcomes.

The Occupational Health Center (OHC) within the Mahan Thermal Power Plant (TPP) is staffed by a dedicated team of 2 doctors, 4 pharmacists, 4 nursing staff, and 4 ambulance drivers. The OHC has been providing essential healthcare services, attending to an average of 20-25 patients per day. The center has established ties with Misra Polyclinic and Nehru Hospital to enhance its healthcare services and has conducted pre-medical examinations for 1,400 workers to date.

The injury patterns commonly reported at the OHC include cuts and scratches, slips, trips, and falls, often resulting from slippery conditions within the plant. To mitigate these risks, the OHC regularly conducts first aid training sessions for the workers, emphasizing the importance of immediate and effective responses to workplace injuries.

Strategies for minimization of health impacts associated with coal based TPP operations include:

1. Air Quality Management: Strengthening of advanced pollution control technologies and stringent emission monitoring systems to ensure compliance with air quality standards. This includes regular maintenance of pollution control equipment and periodic air quality assessments.

2. Noise Pollution Control: Deploying sound insulation measures and strengthening noise reduction technologies to minimize noise pollution generated by plant operations. Additionally, ensuring regular monitoring of noise levels and promptly implementing corrective actions as deemed necessary to address any deviations from acceptable thresholds.

3. Water Quality Monitoring: Strengthening of comprehensive water quality monitoring programs to assess the impact of plant operations on local water bodies. Implementing measures to prevent water contamination and ensuring compliance with water quality standards.

4. Health Education and Awareness: Conducting health education and awareness programs for workers within the TPP and the local community to raise awareness about potential health risks associated with plant operations. Providing information on preventive measures and promoting healthy lifestyle practices.

Measures for mitigation of health risks of workers working in coal based TPP include:

1. Occupational Health Programs: Implementing comprehensive occupational health programs is essential for promoting the health and safety of workers within the TPP premises. These programs should include regular health screenings, periodical medical examinations, ergonomic assessments, and training on workplace safety measures.

2. Healthcare Facilities Strengthening: Enhancing healthcare facilities within the TPP premises involves a multifaceted approach to significantly improve the well-being of the workforce. This includes upgrading medical infrastructure to modern standards, which ensures that all healthcare services are delivered efficiently and effectively.

Measures for mitigation of health risks of the local community include:

1. Mobile Health Care Unit Operationalization: Establishing and operationalizing a mobile healthcare unit in collaboration with Mahan Energy Limited (MEL) is a strategic initiative to extend vital healthcare services to the local community. This mobile unit will facilitate regular health camps, providing medical consultations and screenings to address a wide range of health issues.

2. Community Health Initiatives: Launching community health initiatives focused on preventive healthcare, disease awareness, and promoting healthy living practices is essential for improving the overall health and well-being of the local population. These initiatives will include organizing regular health camps that offer free medical check-ups, vaccinations, and screenings for common diseases, ensuring early detection and timely intervention.

1.0 INTRODUCTION

1.1 BACKGROUND

The Adani Group (1988) has grown from being a trading house to a diversified business group with interests from infrastructural development to FMCGs. The Adani Group has made foray into high growth sector like Power, Infrastructure, Global Trading, Logistics and Energy.

Adani Power Limited (APL), a member of the Adani Group, has taken up implementation of large Thermal Power Projects at various locations in India in view of the growing needs of power requirements in the country. APL is also actively planning to implement Thermal Power Stations at various locations in India, totaling to about 20,000 MW in the coming years.

Mahan Energen Limited (MEL) under Adani Power Limited is proposing to set up Mahan Thermal Power Plant (2X800 MW) in the villages of Bandhuara, Nagwa, Karsualal and Khairahi under Singrauli District of Madhya Pradesh. The detail of location of the project is presented in Table 1.1 :

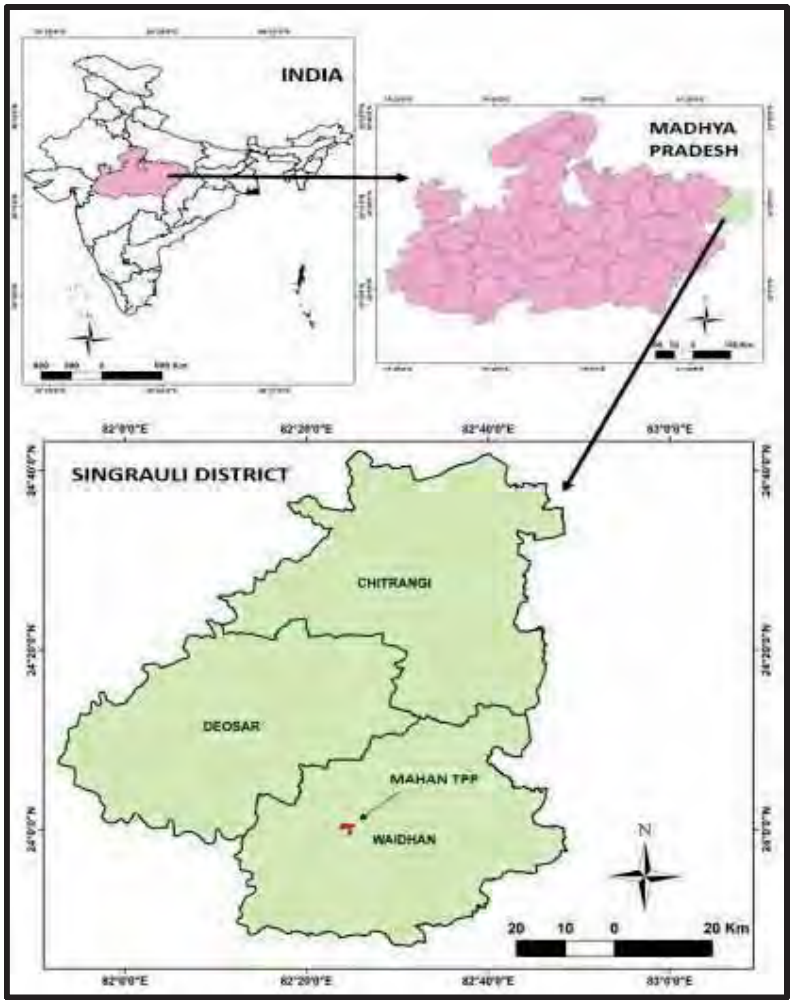
TABLE 1.1: LOCATION OF PROJECT

State	Madhya Pradesh
District	Singrauli
Villages	Bandhuara, Nagwa, Karsualal and Khairahi
Geographical Coordinates	$24^0 0' 5.22''$ N $82^0 23' 35.46''$ E $24^0 0' 22.42''$ N $82^0 25' 21.39''$ E

The expansion ie. 2x800 MW of existing 2x600 MW Mahan at Singrauli District of Madhya Pradesh State may result in changes of health status of surrounding community of project area due to likely environmental pollution (air, noise, water, etc). A thorough understanding of issues, related to community health as well as relationship with various environmental factors, are absolutely important for inclusive growth and sustainable development.

In accordance with its mission of being enviro-socially responsible corporate entity with thrust on sustainable development, MEL aims to focus on minimizing health impact of thermal power plant if any as well as emphasis on improving the health status of local community within 10 km radius of Mahan TPP. To accomplish this mission, it is imperative to carry out comprehensive community health status assessment study that can facilitate in formulating a cost-effective short as well as long-term community health management plan.

FIGURE 1.1: LOCATION OF MAHAN TPP



1.2 OBJECTIVES OF THE STUDY

The objectives of the proposed study are as follows:

- To assess the status of environmental pollution (viz. air, noise, water etc.) within the study area.
- To assess the health status along with the perception of different stakeholders regarding the health status of the people surrounding MEL.
- To study the prevalence of non-communicable diseases among the study population.
- To study the likely changes in health status of the local people.
- To validate the health data collected and to compare the available health data with

National& Regional data.

- To study if any correlation exists between Environment quality and health status or/ and any other factors affecting the health status.

- To formulate cost effective health management plan.

1.3 SCOPE OF THE STUDY

The scope of the study includes the undertaking of a reconnaissance survey. On the basis of the reconnaissance survey a framework would be evolved for undertaking time bound detailed field survey within the influence zone of the MEL's TPP (i.e. 10.0 km radius) for assessment of health status of local community and establish relationship with environmental quality and health status. The detail scope of work for proposed study is as follows:

1) The study need to cover and collect the Primary data from the field and Secondary data. Study shall be conducted by the team occupational health & environmental experts

2) The detailed health assessment study would be conducted for the study area (core and buffer zone) i.e. 10.0 km radius of MEL's TPP.

3) Collection and trend (long-term) analysis of Environment (air and water) quality data of the study area.

4) Perceptions study of different stakeholders regarding the health status of the people surrounding Mahan TPP using developed questionnaire for the purpose.

5) Study of the prevalence of non-communicable diseases among the local community around Mahan TPP using the standard tools developed for the purpose.

6) Assessment of the change in health status of the local population.

7) Collection and validation of the health data to compare the available health data with National& Regional data trend.

8) Study to assess if any correlation exists between Environment quality and health

status or/ and anyother factors affecting the health status.

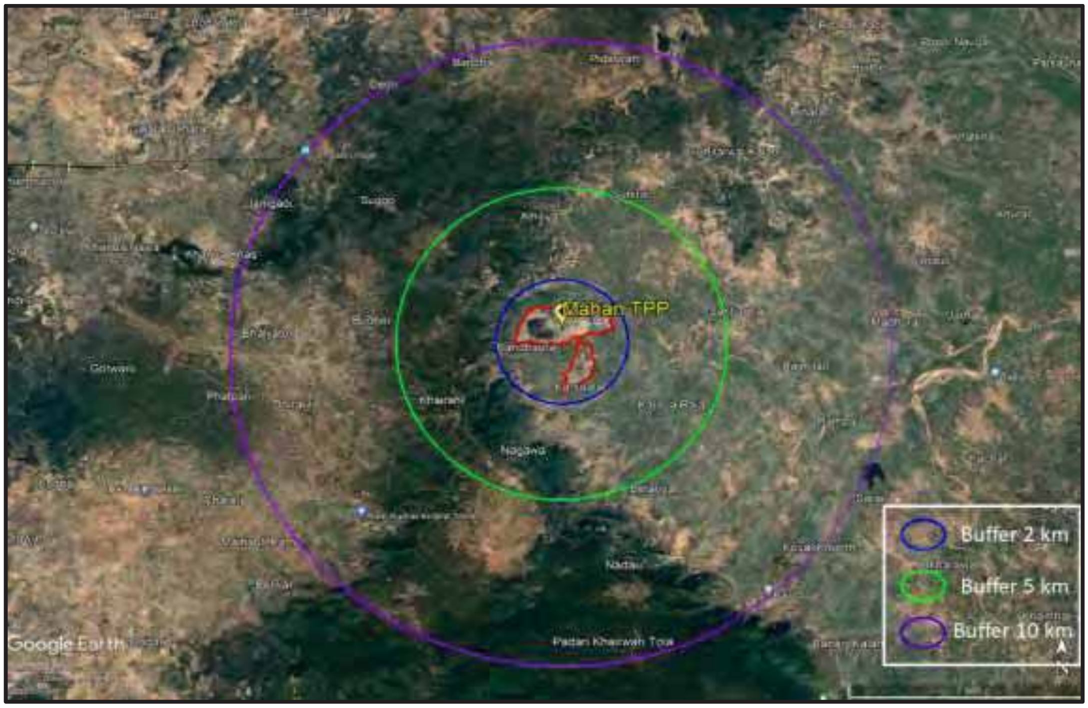
9) Recommendation on institutional mechanism for implementation of health management plan, Suggestions / recommendation for improving health status of local community.

The Scope of Work would also include presentation of the study report before the Expert Appraisal Committee of MoEF&CC and subsequent preparation of replies to the clarifications asked, if any.

The layout map of Mahan TPP has been presented in Figure 1.2. The buffer zone identified around Mahan TPP for health assessment study has been presented in Figure 1.3.

FIGURE 1.2: LAYOUT MAP OF MAHAN TPP

FIGURE 1.3: BUFFER ZONE FOR HEALTH ASSESSMENT STUDY AROUND MAHAN TPP



1.4 PROJECT AT A GLANCE

General:

Project Authority (SPV)	:	Mahan Energen Ltd.
Project	:	2x800 MW Ultra Super-Critical ThermalPower Project.
Selected Location	:	Bandhaura, Nagwa, Karsualal and Khairahi village, Singrauli District, M.P.
Latitude and Longitude of the site	:	24°0'28.90"N latitude / 82°24'49.94"E longitude
Altitude	:	320 to 340 m.
Average RL	:	335 m.
Annual average rain fall	:	1132.7 mm

Nearest Major Town	:	Waidhan and Singrauli
Seismic Zone	:	Zone-III as per IS 1893
Access by Road	:	State Highway (SH14) is passing about 16km from the site.
Access by Rail	:	Singrauli Station is located at 52 km fromProject Site.
Access by Air	:	Nearest Airport is at Varanasi at a distanceof 280 km.
Access by Sea	:	Nearest Seaport is at Dhamra at a distanceof 770 km.

Preliminary Project Particulars:

Main Fuel	:	Coal from Commercial Coal Mines (GCV 3000-4200 Kcal/Kg)
Fuel Transportation	:	Through Long Belt conveyor (LBC) system.
Water	:	From the Rihand Reservoir at 36 km fromSite.
Land	:	920 Acres of land is available for the PowerProject.
Layout Features	:	2 X 800 MW Ultra Super-Critical Units

Technical Features:

Power Generating Unit sets	:	Two units of 800 MW turbine generator fed by steam from coal fired P.F. boiler operating at Ultra Super-critical range.
Cooling System	:	Closed recirculating condenser cooling system with induced draft cooling tower.
Coal Handling System	:	Coal handling facility, which comprises

		receipt of coal from Mines through LBC system, with on-line existing & new crushing and stacking by existing & new stacker-cum-reclaimer in the existing & new coal yard and finally feeding the bunker level conveyors.
Ash Disposal System	:	Provision will be made for disposal of fly ash in dry form to adjacent Cement Plants/ Mineback filling. Provision will be made for disposal of ash in high concentration slurry form.
Power Evacuation	:	At 400 kV level to State Transmission Unit (STU)
Environmental Aspects	:	Elaborate arrangements for Flue gas desulphurization (FGD) and Selective Catalytic Reduction (SCR) systems complying with emission norms as per latest MoEF & CC. Independent steel wet flue foreach unit, down- stream of FGD of suitable height as per MoEF & CC guidelines and an adequately designed electrostatic precipitator with more than 99.99% efficiency are envisaged. Waste water quality to be maintained as per MoEF & CC notification. Zero Plant Discharge facility shall be present since the cooling water, blow down water, waste water and ash water would be recycled back to the systemafter suitable treatment for reuse. For coal transportation from mines, pipe conveyor technology will be adopted to mitigate environmental concerns.
Rehabilitation Requirement	:	Nil

Other Facilities:

Township	:	Township with civic amenities would be developed.

Mode of Implementation	:	The Project would be implemented on EPCconcept.
Project Time Frame	:	54 months from Zero Date i.e. the date of 'Financial Closure' for Commercial Operation of Unit#3 and 60 months for Unit#4

2.0 HEALTH RISK OF COAL BASED TPP

Despite their pivotal role in meeting energy demands, coal-based thermal power plants pose significant challenges and risks to both human health and the environment. The combustion of coal releases a plethora of pollutants into the atmosphere, contributing to air pollution and its associated health impacts. These pollutants include particulate matter (PM_{10}), sulfur dioxide (SO_2), nitrogen oxides (NOx), polyaromatic hydrocarbons (PAHs), heavy metals, and more. Their emissions have far-reaching consequences, ranging from respiratory and cardiovascular diseases in human populations to ecological degradation and climate change.

The health impacts of coal usage, from mining to consumption in power plants, are profound and multifaceted. Coal dust, which is stirred up during the mining process and released during coal transport, poses severe respiratory risks. Chronic exposure to coal dust can lead to serious conditions such as black lung disease, or pneumoconiosis.

Coal inherently contains numerous heavy metals, as it is formed from compressed organic matter rich in carbon but also heavy metals. These metals, including lead, mercury, nickel, tin, cadmium, antimony, and arsenic, along with radioactive isotopes of thorium and strontium, are released during coal mining and combustion. The presence of these heavy metals can result in both acute and chronic toxicity, posing significant environmental and biological hazards.

Particulates emitted from coal-burning power plants, such as tiny particles of fly ash and dust, have substantial health implications. Coal also contains trace amounts of radioactive elements like uranium and thorium, further contributing to its health risks.

Coal-fired power plants are the largest human-caused source of sulfur dioxide, a pollutant gas that contributes to acid rain formation and causes significant health problems, including respiratory issues and cardiovascular diseases.

Exposure to coal pollutants, such as ozone and particulate matter (PM), is linked to the development and increased mortality rates from lung cancer, which is the leading cause of cancer deaths in both men and women. Additionally, water pollution from coal operations can leach toxins into the environment and drinking water, causing negative health and environmental impacts.

Coal combustion pollutants are also associated with chronic obstructive pulmonary disease (COPD), a condition characterized by permanent narrowing of the airways. Furthermore, these pollutants can lead to cardiovascular diseases, including artery blockages that cause heart attacks, tissue death, and heart damage due to oxygen deprivation.

Studies have demonstrated a correlation between air pollutants from coal and an increased risk of stroke. Coal also contains trace amounts of mercury, which, when released into the environment through burning, can affect the nervous system and result in a loss of intellectual capacity. Notably, coal-fired power plants are responsible for approximately one-third of all human-related mercury emissions.

2.1 EMISSIONS FROM COAL-BASED THERMAL POWER PLANTS

The subsequent section presents a detailed examination of major air pollutants emitted from coal-based thermal power plants.

2.1.1 Particulate Matter (PM):

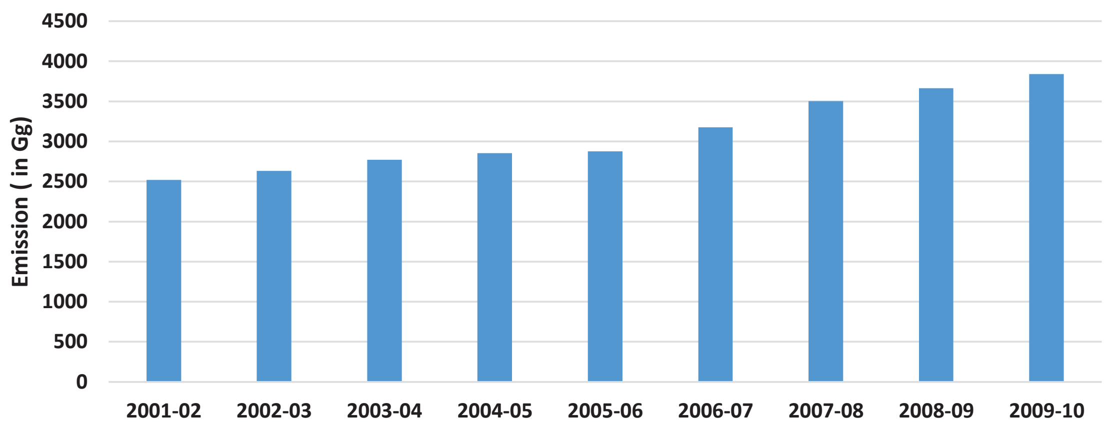
The combustion of coal in thermal power plants releases a significant amount of particulate matter (PM) and carbon dioxide (CO2) into the atmosphere. Particulate matter, including PM10 and PM2.5, consists of tiny particles of ash, soot, metals, and other substances that can penetrate deep into the lungs when inhaled. PM exposure has been linked to respiratory diseases such as asthma, bronchitis, and lung cancer, as well as cardiovascular problems including heart attacks and strokes. Additionally, carbon dioxide, a greenhouse gas emitted in large quantities by coal-based power plants, contributes to global warming and climate change, which in turn can exacerbate health issues such as heat-related illnesses, infectious diseases, and food and water insecurity. The status of variation in the emission of CO2 from 2001-2002 and 2009-2010 has been depicted in figure 2.1.

FIGURE 2.1 :STATUS OF VARIATION IN CO2 EMISSION FROM THERMAL POWER PLANTS IN INDIA

2.1.2 Sulfur Dioxide (SO2):

Sulfur dioxide (SO2) is a colorless gas with a pungent odor produced during the combustion of coal containing sulfur compounds. Coal-based power plants are one of the major sources of SO2 emissions globally. When SO2 is released into the atmosphere, it reacts with moisture and other gases to form sulfate aerosols and sulfuric acid, which can contribute to the formation of acid rain. Exposure to SO2 can irritate the respiratory system, exacerbate respiratory conditions such as asthma and chronic bronchitis, and increase the risk of cardiovascular diseases. Prolonged exposure to high levels of SO2 can lead to respiratory inflammation, reduced lung function, and respiratory-related mortality. Additionally, SO2 emissions can have environmental impacts such as acidification of soil and water bodies, which can harm aquatic ecosystems and vegetation. The status of variation in the emission of SO2 from 2001-2002 and 2009-2010 has been depicted in figure 2.2.

FIGURE 2.2 : STATUS OF VARIATION IN SO2 EMISSION FROM THERMAL POWER PLANTS IN INDIA



2.1.3 Nitrogen Oxides (NOx):

Nitrogen oxides (NOx), including nitrogen dioxide (NO2) and nitric oxide (NO), are produced during the combustion process when nitrogen in the air reacts with oxygen at high temperatures. Coal-based power plants are significant contributors to NOx emissions due to the combustion of coal in high-temperature boilers. NOx emissions can lead to the formation of ground-level ozone (smog) and secondary particulate matter, which can worsen air quality and contribute to respiratory and cardiovascular problems. NO2, in particular, can irritate the respiratory system, exacerbate asthma symptoms, and increase the risk of respiratory infections. Prolonged exposure to NOx can also lead to decreased lung function, increased susceptibility to respiratory illnesses, and cardiovascular diseases such as heart attacks and strokes. Additionally, NOx emissions contribute to the formation of acid rain and atmospheric deposition of nitrogen, which can have adverse effects on ecosystems and water quality. The status of variation in the emission of NOx from 2001-2002 and 2009-2010 has been depicted in figure 2.3.

FIG 2.3: STATUS OF VARIATION IN NOx EMISSION FROM THERMAL POWER PLANTS IN INDIA

2.1.4 Polyaromatic Hydrocarbons (PAHs):

Polyaromatic hydrocarbons (PAHs) are organic compounds formed during the incomplete combustion of coal and other fossil fuels. Coal-based power plants emit PAHs through the combustion of coal and release them into the atmosphere, where they can undergo chemical reactions and become attached to particulate matter. PAHs are known carcinogens and have been associated with various health effects, including cancer, developmental disorders, and reproductive problems. Inhalation or ingestion of PAHs can lead to DNA damage, oxidative stress, and inflammation, increasing the risk of lung, bladder, and other cancers. Additionally, PAH exposure has been linked to developmental delays, behavioral problems, and reduced IQ in children. PAHs can also accumulate in soil and water bodies, posing risks to ecosystems and wildlife.

2.1.5 Heavy Metals:

Coal combustion releases a variety of heavy metals, including mercury, arsenic, lead, cadmium, chromium, nickel, and others, into the atmosphere. These metals are naturally present in coal and are released into the air when coal is burned. Heavy metals can have toxic effects on human health and the environment, even at low concentrations. Mercury, for example, is a neurotoxin that can impair cognitive development and cause neurological disorders, especially in children and fetuses. Arsenic is a known carcinogen and can cause skin lesions, respiratory problems, and cardiovascular diseases. Lead exposure can lead to neurological and developmental disorders, especially in children as WHO declared there is no safe limit of lead for children for their delayed development and neurological diseases. Cadmium, chromium, nickel, and other heavy metals have been associated with various health effects, including cancer, respiratory problems, and kidney damage, neurological manifestations. Additionally, heavy metals can accumulate in soil, water, and food chains, posing risks to ecosystems and human health through bioaccumulation and biomagnification.

2.2 HEALTH IMPACTS OF COAL-BASED POWER PLANTS

Exposure to the pollutants due to the operation of coal-based thermal power plants has been linked to a range of diseases and health conditions, impacting respiratory, cardiovascular, neurological, and developmental health. The hazards caused due to the operation of coal fire thermal power plants are broadly categorized into two parts: i) short term and ii) long term.

The short term health hazards include respiratory illness, asthma attacks and chronic bronchitis.

The long term health hazards include premature deaths, cardiovascular diseases, lung cancer, low birth weights and higher infant mortality.

The detail of the various diseases has been presented in the subsequent section.

2.2.1 Respiratory Diseases:

Exposure to pollutants emitted from coal-based power plants, such as particulate matter (PM), sulfur dioxide (SO2), and nitrogen oxides (NOx), can significantly impact respiratory health. PM, especially fine particles like PM2.5, can penetrate deep into the lungs, causing irritation, inflammation, and exacerbating respiratory conditions such as asthma, bronchitis, and chronic obstructive pulmonary disease (COPD). SO2 and NOx can also irritate the respiratory tract, leading to coughing, wheezing, shortness of breath, and worsening symptoms in individuals with pre-existing respiratory conditions. Prolonged exposure to these pollutants can increase the risk of cardiovascular diseases and respiratory infections, reduce lung function, and contribute to the development of respiratory diseases.

2.2.2 Cardiovascular Diseases:

Coal-based power plants emit pollutants that not only affect the respiratory system but also pose significant risks to cardiovascular health. Fine particles (PM2.5) and gaseous pollutants like SO_2 and NOx can enter the bloodstream through the lungs, triggering systemic inflammation, oxidative stress, and endothelial dysfunction. These mechanisms can lead to the development and progression of cardiovascular diseases such as hypertension, coronary artery disease, stroke, and heart failure. Long-term exposure to air pollution from the power plants has been associated with increased cardiovascular morbidity and mortality, posing a significant public health burden.

2.2.3 Neurological Diseases:

Exposure to pollutants from power plants, particularly heavy metals like mercury, lead, and arsenic, can have adverse effects on neurological health. Mercury is a potent neurotoxin that can impair cognitive function, memory, and motor skills, especially in children and developing fetuses. Lead exposure has been linked to neurodevelopmental disorders, learning disabilities, and behavioral problems in children. Arsenic exposure has been associated with neurological disorders, peripheral neuropathy, and cognitive impairment. These heavy metals can accumulate in the brain and nervous system over time, leading to chronic neurological diseases and impairments. The symptoms are mimics with the Parkinsonism Diseases and lack of awareness makes it worse.

2.2.4 Developmental Disorders:

Prenatal exposure to pollutants from coal-based power plants, including PAHs and heavy metals, can have detrimental effects on fetal development and lead to various developmental disorders. PAHs are known to cross the placental barrier and interfere with fetal growth and development, increasing the risk of low birth weight, preterm birth, and developmental delays. Heavy metals like lead and mercury can also cross the placenta and affect fetal neurodevelopment, leading to cognitive deficits, behavioral problems, and developmental disorders later in life. Early-life exposure to these pollutants can have lifelong consequences for physical, cognitive, and socioemotional development, highlighting the importance of addressing environmental exposures during pregnancy.

2.2.5 Noise induced hearing loss and other secondary effects of noise

Noise-induced hearing loss (NIHL) is a significant occupational health concern associated with coal-based thermal power plants (TPPs). Workers exposed to high levels of noise generated by machinery, equipment, and operations within TPPs are at risk of experiencing permanent hearing damage over time. In addition to NIHL, other secondary effects of coal-based TPPs on human health include stress-related disorders, respiratory issues due to air pollution from coal combustion, and potential long-term impacts on cardiovascular health. These secondary effects highlight the importance of implementing effective noise control measures, stringent emission standards, and comprehensive occupational health and safety protocols within coal-based TPPs to mitigate health risks and safeguard the well-being of workers and nearby communities.

2.3 STATUS OF POLLUTION AROUND MAHAN TPP

2.3.1 Air Quality

The comprehensive assessment of ambient air quality surrounding the Mahan Thermal Power Plant (TPP), has been presented in Tables 2.1-2.4 and illustrated in Figures 2.4-2.7. The analysis reveals that pollutant levels, including PM10, PM2.5, SO2, and NOx, are well within the respective permissible limits.

TABLE 2.1 (A): MONTHLY VARIATION IN AMBIENT AIR QUALITY AROUND MAHAN TPP (2022-23) - PM 10 CONCENTRATION

PM10 (µg/Nm³)												
Month	Station 1				Station 2				Station 3			
	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD
Apr-22	54.2	58.60	56.40	1.25	56.80	61.10	59.01	1.40	55.20	60.80	57.99	1.93
May-22	53.70	57.20	55.70	1.33	57.20	63.10	60.39	1.92	55.90	62.30	58.78	1.88
Jun-22	51.50	58.60	54.83	1.98	50.80	58.30	55.75	2.31	54.60	57.20	55.96	0.94
Jul-22	53.50	56.30	54.69	0.98	56.30	60.60	58.63	1.39	54.50	57.30	55.89	1.00
Aug-22	55.00	58.60	56.84	1.38	63.40	65.80	64.46	0.81	57.20	62.40	60.38	1.57
Sep-22	58.7	65.30	61.91	2.00	59.80	65.90	62.66	1.81	59.80	66.50	63.56	1.92
Oct-22	65.80	71.20	68.06	1.80	58.50	64.60	61.80	1.76	55.00	59.10	56.63	1.32
Nov-22	61.50	69.10	64.81	2.27	68.70	76.10	72.24	2.25	50.60	57.00	53.60	2.05
Dec-22	61.30	70.60	66.23	3.02	64.30	74.90	69.86	3.82	43.60	57.90	50.40	4.36
Jan-23	63.59	73.97	68.35	3.47	63.50	77.60	70.88	4.60	47.80	57.90	52.64	3.41
Feb-23	60.20	73.10	68.20	3.92	64.90	74.60	70.11	2.89	49.70	59.50	54.76	3.42
Mar-23	63.90	74.40	69.13	3.24	64.90	75.50	69.92	3.36	49.40	62.90	56.59	3.76
NAAQS	100											

Station 1: Admin
Station 2: Gate no. 2
Station 3: Gate no. 3

FIGURE 2.4 (A): PM10 CONCENTRATION AROUND MAHAN TPP (2022-23)

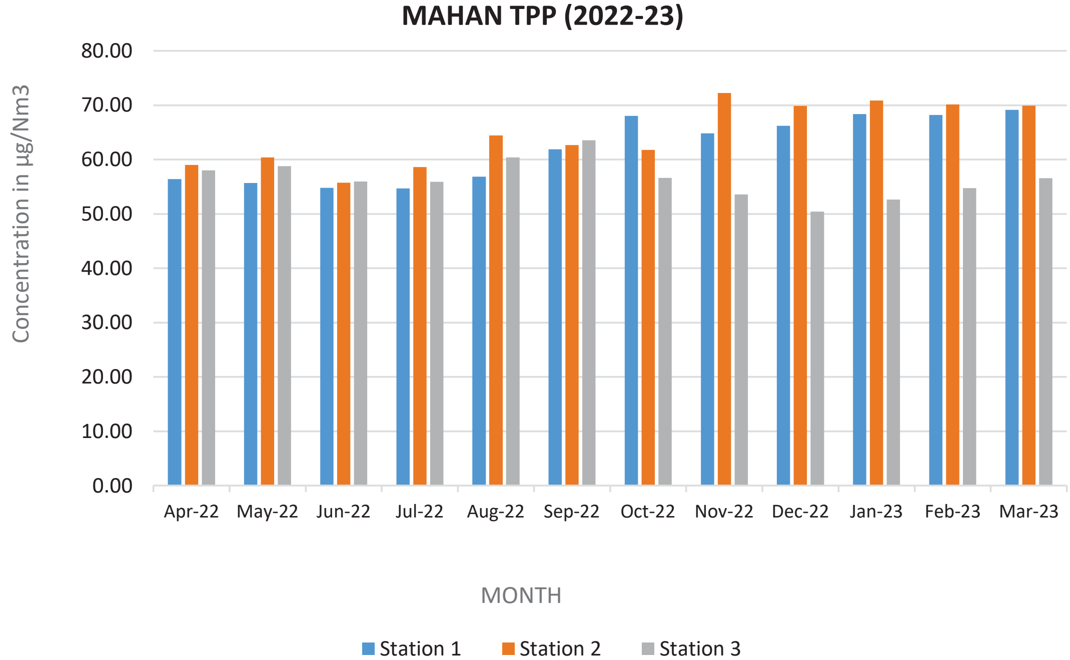


TABLE 2.1 (B): MONTHLY VARIATION IN AMBIENT AIR QUALITY AROUND MAHAN TPP (2023-24) - PM 10 CONCENTRATION

PM10 (µg/Nm3)												
Month	Station 1				Station 2				Station 3			
	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD
Apr-23	61.50	67.90	65.14	2.28	64.00	74.10	68.89	3.24	52.00	61.80	57.29	3.51
May-23	62.50	69.50	66.27	1.98	65.40	73.40	69.66	2.38	53.10	64.00	59.09	3.58
Jun-23	60.40	67.20	64.73	2.20	63.70	70.30	67.24	2.15	61.50	67.50	64.41	1.91
Jul-23	33.89	61.12	47.35	8.70	43.29	70.49	54.76	8.70	44.62	71.00	55.54	8.14
Aug-23	33.62	54.62	45.00	6.43	38.94	60.47	50.56	5.59	39.40	49.20	44.79	3.08
Sep-23	41.97	55.34	47.39	4.61	46.89	57.15	52.31	3.20	39.46	44.53	41.96	1.79
Oct-23	54.23	69.24	61.94	4.46	61.23	71.05	67.09	3.54	48.63	57.25	53.30	2.94
Nov-23	65.78	76.98	71.60	3.25	68.16	79.03	73.94	3.92	59.34	69.12	63.07	3.32
Dec-23	67.58	81.54	73.63	4.24	66.91	73.76	69.33	2.61	53.97	68.94	61.97	4.79
Jan-24	68.32	76.45	72.58	2.70	64.27	75.59	69.25	3.32	58.24	66.79	62.50	2.82
Feb-24	67.98	79.36	73.31	3.61	66.48	76.81	72.05	3.15	58.87	71.56	63.83	3.70
Mar-24	61.78	70.43	65.92	2.49	68.17	79.65	74.72	3.97	75.23	81.39	78.27	1.95
NAAQS	100 (µg/Nm3)											

Station 1: Admin
Station 2: Gate no. 2
Station 3: Gate no. 3

FIGURE 2.4 (B): PM10 CONCENTRATION AROUND MAHAN TPP (2023-24)

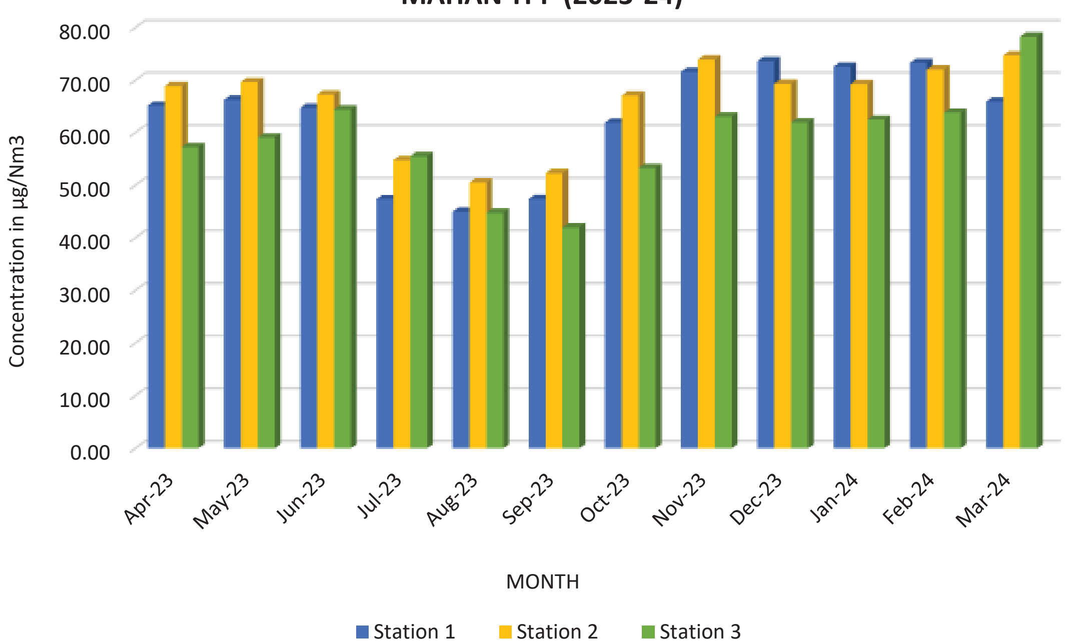


TABLE 2.2 (A): MONTHLY VARIATION IN AMBIENT AIR QUALITY AROUND MAHAN TPP (2022-23) - PM 2.5 CONCENTRATION

PM2.5 (µg/Nm3)												
Month	Station 1				Station 2				Station 3			
	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD
Apr-22	25.10	27.20	26.80	1.59	23.80	29.10	27.08	1.59	24.80	28.60	26.60	1.17
May-22	22.20	28.20	25.51	1.60	27.60	33.70	30.38	2.12	25.10	31.20	28.30	1.88
Jun-22	22.90	24.90	24.04	0.85	22.60	28.30	26.01	1.95	24.10	27.20	25.64	0.99
Jul-22	23.70	26.20	24.94	0.85	24.60	27.50	26.30	1.03	24.20	26.70	25.56	0.79
Aug-22	23.70	28.30	26.43	1.49	31.20	35.80	33.41	1.61	28.30	33.30	30.86	1.70
Sep-22	28.30	33.70	31.14	1.54	29.40	32.40	31.29	0.87	29.80	36.50	32.78	1.91
Oct-22	32.20	35.90	34.20	1.05	30.50	32.10	31.14	0.63	24.80	28.10	26.53	1.30
Nov-22	27.50	33.30	30.88	2.14	31.20	37.10	34.93	1.95	23.70	30.00	27.03	2.18
Dec-22	28.20	36.70	32.39	2.48	30.70	36.80	33.82	1.94	21.60	28.40	25.27	2.22
Jan-23	33.74	38.74	35.96	1.67	32.50	41.70	36.81	2.95	24.60	32.10	28.92	2.55
Feb-23	33.70	40.50	37.85	2.18	36.90	42.10	39.30	1.89	28.70	33.30	30.96	1.55
Mar-23	35.40	44.80	39.32	2.66	34.60	43.70	38.93	2.40	26.70	37.40	32.03	2.89
NAAQS	60 (µg/Nm3)											

Station 1: Admin
Station 2: Gate no. 2
Station 3: Gate no. 3

FIGURE 2.5 (A): PM2.5 CONCENTRATION AROUND MAHAN TPP (2022-23)

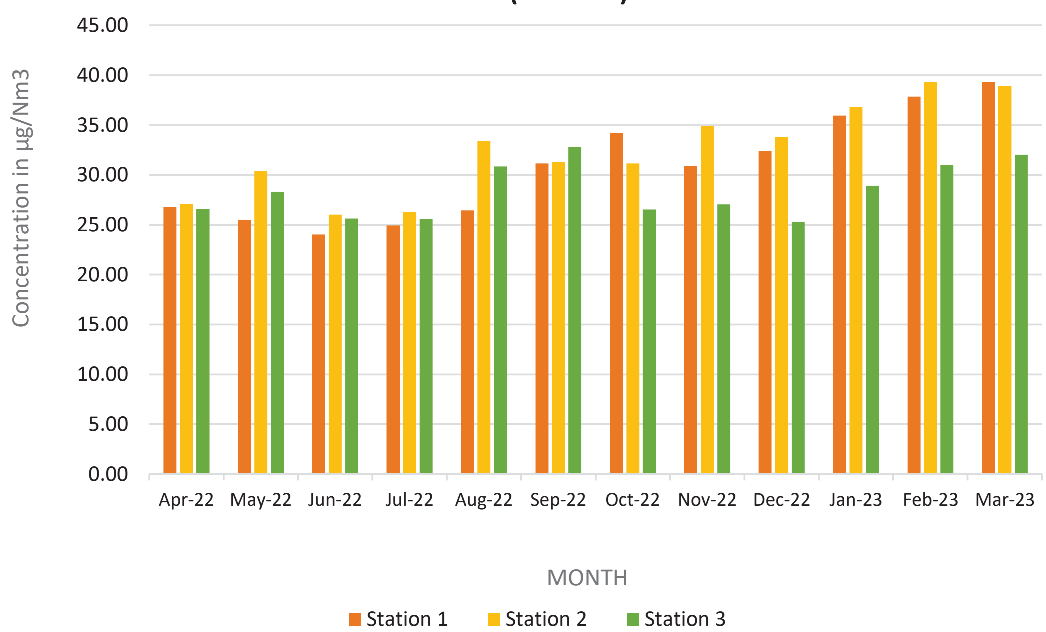


TABLE 2.2 (B): MONTHLY VARIATION IN AMBIENT AIR QUALITY AROUND MAHAN TPP (2023-24) - PM 2.5 CONCENTRATION

PM2.5 (µg/Nm3)												
Month	Station 1				Station 2				Station 3			
	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD
Apr-23	33.30	36.70	34.94	1.10	31.20	40.00	36.65	2.81	28.70	34.60	30.78	1.75
May-23	33.10	37.80	34.91	1.42	32.90	41.20	36.89	2.56	29.50	34.20	31.77	1.38
Jun-23	31.20	36.20	33.59	1.46	30.50	36.20	33.84	1.69	29.80	35.00	32.76	1.69
Jul-23	17.63	28.76	21.89	3.61	17.33	28.33	23.79	3.24	16.45	29.41	22.72	3.76
Aug-23	14.16	24.95	19.71	3.19	15.22	26.31	20.76	3.25	15.72	23.18	19.83	2.36
Sep-23	20.44	29.43	24.53	2.82	23.74	32.48	28.31	3.07	19.47	23.93	21.70	1.52
Oct-23	34.42	42.47	38.91	2.48	36.24	43.72	40.15	2.32	29.93	36.12	32.80	2.04
Nov-23	37.75	46.98	41.49	2.95	34.57	46.13	41.70	3.73	29.18	37.75	33.60	2.71
Dec-23	32.32	42.41	38.12	3.12	31.76	40.85	36.18	3.11	30.87	37.55	34.74	2.31
Jan-24	37.97	43.76	41.11	2.01	38.72	44.86	41.70	2.25	32.81	38.84	35.47	1.87
Feb-24	36.72	44.78	39.27	2.43	39.71	46.98	42.59	2.07	34.37	45.76	39.63	3.79
Mar-24	34.76	42.65	38.21	2.54	35.16	46.12	41.04	3.71	38.54	45.34	41.21	2.42
NAAQS		**60 (µg/Nm3)**										

Station 1: Admin
Station 2: Gate no. 2
Station 3: Gate no. 3

FIGURE 2.5 (B): PM2.5 CONCENTRATION AROUND MAHAN TPP (2023-24)

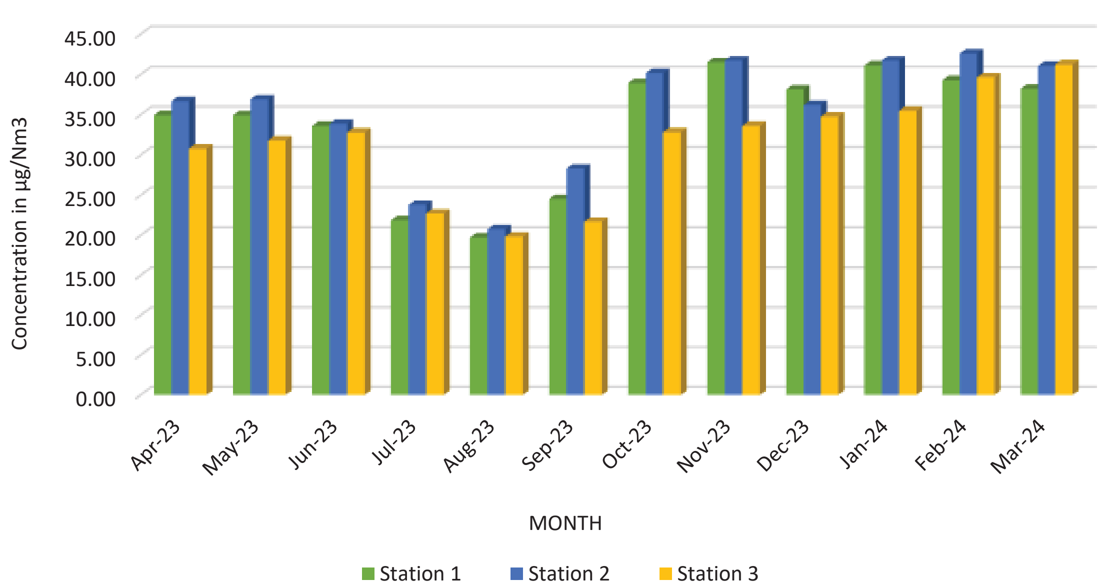


TABLE 2.3 (A): MONTHLY VARIATION IN AMBIENT AIR QUALITY AROUND MAHAN TPP (2022-23) – SO_2 CONCENTRATION

Month	Station 1				Station 2				Station 3			
	SO_2 (µg/Nm3)											
	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD
Apr-22	22.80	27.20	25.08	1.59	20.50	25.10	23.58	1.44	21.30	26.10	24.24	1.50
May-22	22.10	27.60	25.03	1.63	23.10	27.90	25.49	1.39	25.10	28.10	26.71	0.98
Jun-22	17.60	22.30	20.53	1.54	20.70	24.60	22.75	1.54	20.70	25.80	22.68	1.65
Jul-22	12.50	14.10	13.45	0.65	13.10	15.50	13.85	0.77	13.00	16.10	14.25	0.91
Aug-22	14.40	154.90	30.89	43.85	17.10	19.90	18.34	0.78	14.60	17.30	15.83	0.80
Sep-22	16.20	21.10	18.43	1.63	15.90	23.60	20.13	2.37	18.40	27.40	22.36	2.46
Oct-22	14.30	19.60	16.18	1.74	13.80	16.90	15.08	1.01	13.20	16.80	14.66	1.26
Nov-22	14.70	17.20	16.03	0.98	16.50	19.20	17.48	0.84	13.40	17.40	15.33	1.22
Dec-22	12.80	18.70	15.49	1.69	15.30	21.50	18.14	1.89	10.20	15.80	13.13	1.94
Jan-23	13.00	16.50	14.82	1.13	13.70	20.30	17.00	1.99	12.70	17.50	15.06	1.47
Feb-23	12.40	17.30	14.53	1.39	11.80	17.80	15.10	1.76	13.50	18.00	15.25	1.28
Mar-23	11.30	16.70	14.03	1.52	11.90	17.10	14.53	1.45	13.10	17.10	15.50	1.35
NAAQS	**80 (µg/Nm3)**											

Station 1: Admin
Station 2: Gate no. 2
Station 3: Gate no. 3

FIGURE 2.6 (A) : SO2 CONCENTRATION AROUND MAHAN TPP (2022-23)

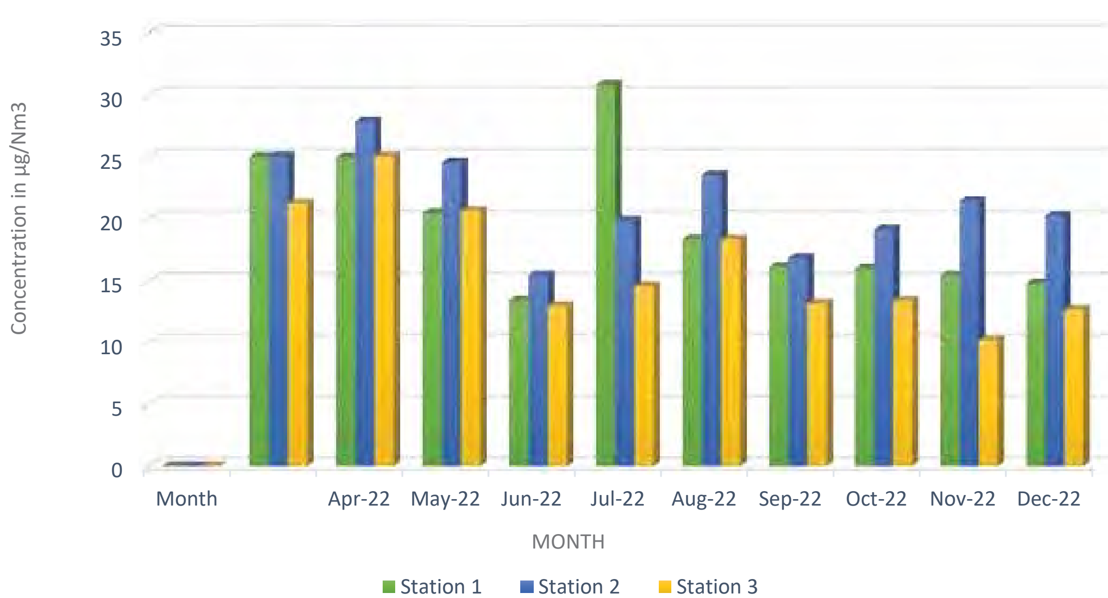


TABLE 2.3 (B): MONTHLY VARIATION IN AMBIENT AIR QUALITY AROUND MAHAN TPP (2023-24) – SO_2 CONCENTRATION

SO2 (µg/Nm3)												
Month	Station 1				Station 2				Station 3			
	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD
Apr-23	12.70	14.70	13.49	0.70	12.70	16.60	14.61	1.30	11.80	14.30	12.74	0.78
May-23	12.60	16.30	14.20	1.17	12.60	15.30	13.79	0.92	11.30	14.80	13.11	1.04
Jun-23	12.00	15.10	13.61	1.05	12.00	14.20	13.33	0.65	12.80	15.40	14.17	0.88
Jul-23	9.35	14.20	11.74	1.82	11.23	16.74	14.10	1.85	10.67	17.98	14.72	2.40
Aug-23	8.91	16.89	12.06	2.75	9.87	17.52	13.24	2.62	8.19	16.04	11.99	2.52
Sep-23	9.13	15.19	12.25	1.92	10.83	15.80	13.51	1.54	7.71	13.12	10.43	1.70
Oct-23	8.35	15.93	11.94	2.36	9.39	15.62	13.23	2.09	7.23	12.64	10.23	1.76
Nov-23	10.65	15.23	12.87	1.68	11.33	16.88	13.48	1.61	8.96	14.25	11.57	1.80
Dec-23	9.15	16.43	12.28	2.19	11.98	16.97	14.10	1.47	8.57	14.62	11.99	1.76
Jan-24	12.98	16.77	14.94	1.26	11.76	17.18	14.55	1.46	12.06	15.57	13.67	1.17
Feb-24	10.67	16.32	14.38	1.62	12.64	16.94	14.71	1.54	10.65	16.75	13.72	1.63
Mar-24	11.43	15.98	13.20	1.35	10.96	15.94	13.78	1.49	11.14	16.84	13.78	1.77
NAAQS	80 (µg/Nm3)											

Station 1: Admin
Station 2: Gate no. 2
Station 3: Gate no. 3

FIGURE 2.6 (B): SO2 CONCENTRATION AROUND MAHAN TPP (2023-24)

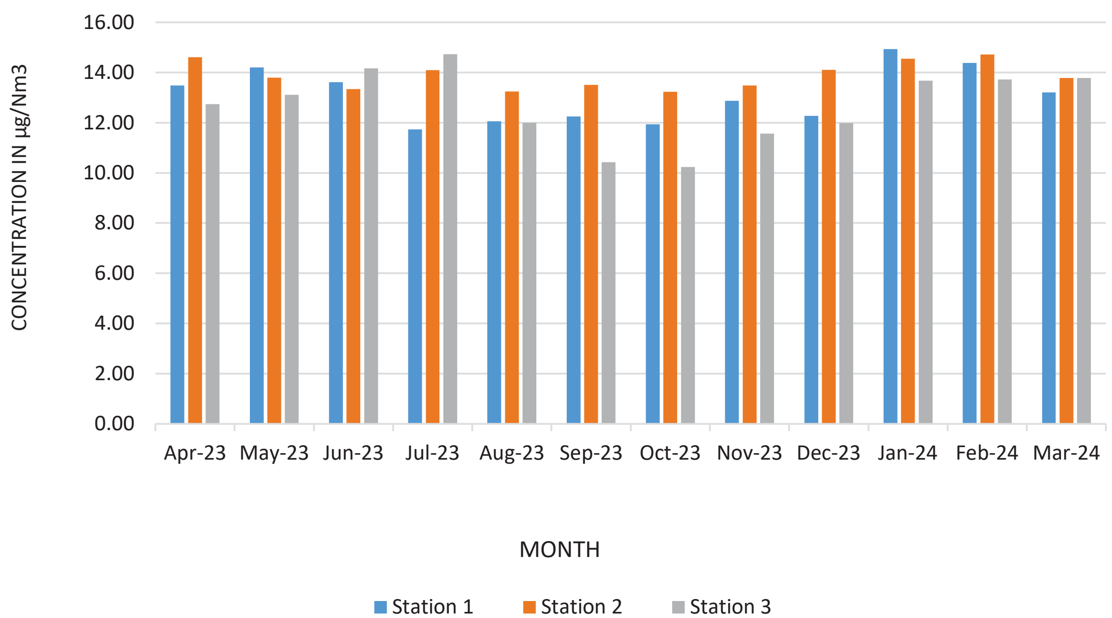


TABLE 2.4 (A): MONTHLY VARIATION IN AMBIENT AIR QUALITY AROUND MAHAN TPP (2022-23) – NO_x CONCENTRATION

Month	NOX (µg/Nm3) Station 1				Station 2				Station 3			
	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD
Apr-22	24.60	28.60	26.88	1.48	27.10	36.90	29.03	3.06	25.10	29.20	27.44	1.34
May-22	24.60	29.10	27.35	1.48	27.90	31.30	29.39	1.03	27.10	33.10	29.78	1.79
Jun-22	20.70	25.90	23.99	1.54	25.10	29.20	27.26	1.38	22.80	30.10	26.59	2.07
Jul-22	16.80	18.80	17.90	0.67	17.40	19.90	18.53	0.85	17.10	22.90	19.56	1.61
Aug-22	18.90	22.50	20.51	1.18	22.00	24.90	23.62	0.80	19.00	23.30	20.64	1.29
Sep-22	20.30	25.30	22.90	1.39	20.60	26.90	23.62	2.02	23.90	30.40	27.04	2.21
Oct-22	22.50	28.80	25.71	2.06	19.30	24.60	22.06	1.64	17.70	22.70	20.14	1.39
Nov-22	20.70	24.30	22.81	1.10	23.10	28.80	24.83	1.62	19.50	26.60	22.38	1.89
Dec-22	20.70	26.90	24.03	2.14	20.60	28.10	25.10	2.25	16.80	24.70	20.42	2.44
Jan-23	20.04	25.62	23.60	1.88	23.20	26.60	24.66	1.06	19.40	24.60	22.84	1.48
Feb-23	20.70	26.60	23.13	1.90	21.70	27.20	24.26	1.88	19.40	26.00	22.98	2.02
Mar-23	18.10	27.60	22.16	2.89	20.40	18.40	23.94	2.77	18.70	28.20	23.86	2.62
NAAQS	**80 (µg/Nm3)**											

Station 1: Admin
Station 2: Gate no. 2
Station 3: Gate no. 3

FIGURE 2.7 (A): NO_X CONCENTRATION AROUND MAHAN TPP (2022-23)

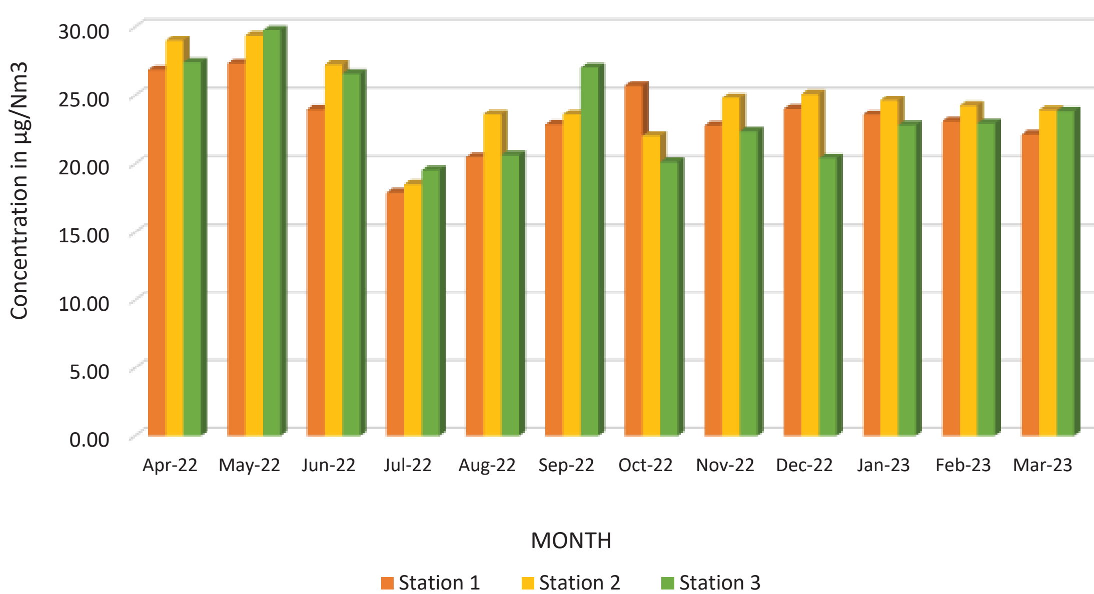
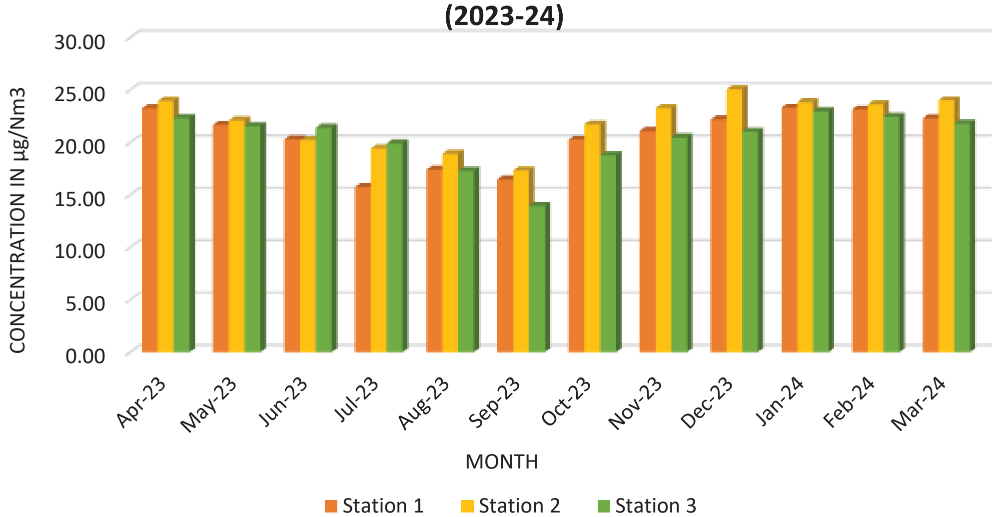


TABLE 2.4 (B): MONTHLY VARIATION IN AMBIENT AIR QUALITY AROUND MAHAN TPP (2023-24) – NO_x CONCENTRATION

NOX (µg/Nm3)												
Month	Station 1				Station 2				Station 3			
	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD
Apr-23	21.60	24.70	23.26	1.12	20.00	26.30	23.96	2.17	20.30	24.40	22.33	1.31
May-23	20.20	23.50	21.67	1.00	20.80	23.20	22.10	0.83	19.90	24.00	21.54	1.12
Jun-23	18.60	22.40	20.30	1.16	18.20	22.10	20.22	1.20	19.20	23.20	21.41	1.13
Jul-23	11.76	19.02	15.75	2.20	13.25	22.02	19.43	2.76	13.98	25.13	19.89	3.59
Aug-23	11.65	23.31	17.42	3.25	12.34	23.87	18.92	3.36	12.85	21.76	17.29	2.95
Sep-23	13.94	18.43	16.48	1.61	14.50	19.12	17.32	1.55	11.79	16.44	13.94	1.53
Oct-23	16.32	23.98	20.26	2.41	18.31	24.41	21.71	1.89	16.18	21.36	18.78	1.71
Nov-23	19.08	23.14	21.10	1.41	19.54	26.72	23.27	2.35	17.57	23.02	20.48	1.89
Dec-23	18.35	24.98	22.19	2.16	22.63	28.77	25.07	1.79	18.12	24.65	21.03	2.08
Jan-24	20.15	25.87	23.29	1.74	20.54	26.33	23.82	1.87	20.62	24.45	22.97	1.19
Feb-24	19.23	26.65	23.13	2.20	19.98	26.76	23.64	1.90	19.54	25.63	22.46	2.05
Mar-24	19.67	24.78	22.30	1.78	20.09	26.06	24.02	1.79	18.42	24.32	21.80	1.89
NAAQS	80 (µg/Nm3)											

Station 1: Admin
Station 2: Gate no. 2
Station 3: Gate no. 3

FIGURE 2.7 (B): NO_X CONCENTRATION AROUND MAHAN TPP (2023-24)



2.4.2 Noise Quality

The examination of noise levels surrounding the Mahan Thermal Power Plant (TPP) for the years 2022-23 and 2023-24, as detailed in Tables 2.5 (A) and 2.5 (B) respectively, is depicted by Figures 2.8-2.11, which delineate the temporal variations in noise levels during both day and night at four distinct locations. In accordance with the Central Pollution Control Board (CPCB) standards for industrial areas, wherein the permissible noise limits are set at 75 dB during the day and 70 dB during the night, the analysis reveals that the noise levels recorded at all four monitoring stations remain well within these regulatory thresholds. This meticulous assessment not only attests to the Mahan TPP's adherence to statutory noise regulations but also underscores its dedication to minimizing potential noise disturbances within the vicinity. Such compliance reflects the plant's conscientious efforts towards upholding environmental quality standards and fostering harmonious coexistence with the surrounding community.

TABLE 2.5 (A): STATUS OF NOISE QUALITY AROUND MAHAN TPP (2022-23)

Month		Station 1			Station 2			Station 3			Station 4		
		Max	Min	Leq	Max	Min	Leq	Max	Min	Leq	Max	Min	Leq
Apr-22	Day	57.1	47.8	53.2	72.1	52.9	67.2	72.0	50.8	68.1	68.6	51.2	64.6
	Night	52.6	48.7	49.3	67.2	38.0	63.2	65.6	50.1	60.6	65.1	47.6	52.7
May-22	Day	58.2	45.1	54.3	73.0	54.2	68.1	70.7	53.1	66.6	66.9	53.7	60.2
	Night	55.2	43.1	48.7	65.3	45.1	61.8	66.1	47.3	61.1	58.6	44.2	54.1
Jun-22	Day	55.9	37.2	52.1	70.2	57.2	66.2	71.1	55.6	64.3	68.2	56.1	59.8
	Night	51.6	40.3	47.1	60.9	42.6	57.1	62.5	54.9	58.6	55.2	42.1	50.6
Jul-22	Day	68.6	51.7	64.1	67.4	50.5	62.9	69.8	52.9	65.3	67.5	50.6	63.0
	Night	53.0	46.5	50.3	53.2	46.8	50.0	55.1	47.7	51.5	52.8	45.4	49.2
Aug-22	Day	68.2	53.1	63.7	68.1	54.1	63.3	69.4	54.6	64.7	69.3	52.1	64.0
	Night	52.8	46.1	49.7	56.1	45.3	51.5	57.1	47.2	63.3	51.9	46.1	48.8
Sep-22	Day	68.9	50.5	64.8	67.4	50.5	62.9	70.2	51.7	64.9	67.5	50.6	63.0
	Night	55.8	46.1	51.5	53.2	46.8	50.0	54.9	47.6	50.9	52.8	45.4	49.2
Oct-22	Day	69.7	49.2	63.2	73.4	65.8	71.4	71.2	55.1	67.8	70.1	51.3	65.3
	Night	61.2	46.5	52.3	66.0	52.3	65.0	64.3	51.2	58.9	56.2	44.7	56.4
Nov-22	Day	62.5	44.1	58.4	70.3	53.4	65.8	68.4	49.9	63.1	57.8	44.1	53.3
	Night	52.1	39.7	26.2	56.1	49.7	52.8	53.1	45.8	49.1	45.6	35.7	42.8
Dec-22	Day	59.5	44.9	51.5	68.4	53.9	60.4	67.3	51.8	62.0	58.5	41.5	45.2
	Night	53.7	39.8	48.4	61.5	45.1	58.0	62.8	45.2	59.4	51.2	37.4	40.8
Jan-23	Day	59.6	48.6	54.0	68.0	57.5	62.4	65.2	54.3	60.2	56.2	40.3	47.2
	Night	54.6	49.7	50.4	58.6	49.1	54.8	60.1	47.4	56.5	46.2	36.1	42.1
Feb-23	Day	58.9	47.3	54.9	71.2	54.6	61.1	62.0	53.1	59.0	52.4	46.2	47.6
	Night	50.9	46.5	48.7	53.8	51.7	52.8	59.2	49.2	55.3	43.9	39.6	42.2
Mar-23	Day	69.5	63.9	67.3	70.2	58.2	61.9	71.6	65.6	69.2	58.4	53.1	56.2
	Night	57.6	48.2	54.4	62.8	50.7	54.1	67.3	63.7	65.4	52.1	44.6	48.8
ANS		**75 dB (Day), 70 dB (Night)**											

Station 1: Admin
Station 2: Gate no. 1
Station 3: Gate no. 2
Station 4: Gate no. 3

TABLE 2.5 (B): STATUS OF NOISE QUALITY AROUND MAHAN TPP (2023-24)

Month		Station 1			Station 2			Station 3			Station 4		
		Max	Min	Leq	Max	Min	Leq	Max	Min	Leq	Max	Min	Leq
Apr-23	Day	68.5	60.1	66.3	71.4	59.4	63.1	68.0	62	65.5	56.7	49.3	54.6
	Night	56.6	47.2	53.4	57.4	51.9	55.3	63.7	58.6	61.8	50.4	40.3	47.1
May-23	Day	69.3	53.7	63.5	69.2	54.3	61.3	67.4	54.2	60.5	59.3	53.1	56.6
	Night	57.3	46.5	54.0	58.2	50.8	54.7	59.6	53.8	56.1	61.4	51.9	57
Jun-23	Day	60.2	52.9	57.4	67.5	52.3	58.8	65.2	52.8	57.2	59.9	53.6	57.6
	Night	57.1	43.1	50.5	56.3	47.6	52.8	54.8	46.3	51.4	53.5	43.2	49.8
Jul-23	Day	73.4	55.6	62.6	71.2	54.2	68.6	68.1	51	64.3	66.3	48.5	58.0
	Night	64.2	52.3	55.3	67.3	49.8	61.9	60.5	47.3	59.4	59.4	41.3	52.4
Aug-23	Day	68.6	46.4	57.4	70.2	52.2	66.8	69.8	51.4	65.2	72.7	56.8	61.2
	Night	55.3	40.7	50.8	65.9	45.3	59.6	62.2	49.7	56.6	67.1	50.6	53.8
Sep-23	Day	67.1	52.6	62.6	73.4	55.3	60.8	74.8	68.5	64.6	68.2	56.8	61.6
	Night	60.5	50.0	55.3	66.5	50.6	52.3	57.2	47.1	57.6	55.4	42.6	50.0
Oct-23	Day	68.6	51.2	63.6	65.1	54.4	60.28	71.8	52.8	66.91	76.6	50.1	58.61
	Night	63.1	45.8	53.1	58.6	44.1	55.17	66.9	47.5	60.77	64.7	45.0	53.19
Nov-23	Day	69.4	50.3	64.70	66.4	55.7	63.84	73.4	54.1	67.8	78.3	51.3	60.2
	Night	64.1	42.8	56.12	60.1	44.1	53.12	67.2	48.1	63.4	66.9	44.3	55.76
Dec-23	Day	49.3	62.6	65.9	45.3	61.2	67.6	44.7	68.1	74.0	43.9	61.1	69.2
	Night	41.3	55.4	61.5	43.5	54.7	59.8	44.7	61.1	65.4	40.6	59.7	65.4
Jan-24	Day	64.5	45.2	57.6	68.2	46.2	60.9	70.6	48.4	66.34	58.9	41.3	52.47
	Night	60.4	40.3	54.2	60.4	42.5	53.7	62.3	42.1	59.82	53.8	39.3	48.51
Feb-24	Day	66.3	43.8	56.4	66.2	42.9	69.3	67.2	45.7	60.6	57.8	40.7	49.4
	Night	61.2	45.7	49.5	58.1	40.3	48.9	59.8	41.6	57.2	52.6	38.9	47.2
Mar-24	Day	65.8	44.3	57.6	67.4	43.5	68.7	66.8	46.5	61.3	58.6	41.8	50.1
	Night	60.9	46.4	50.3	57.6	41.2	49.7	60.3	42.5	56.3	53.4	39.7	46.5
ANS		**75 dB (Day), 70 dB (Night)**											

Station 1: Admin
Station 2: Gate no. 1
Station 3: Gate no. 2
Station 4: Gate no. 3

FIGURE 2.8 (A): STATUS OF NOISE LEVEL IN STATION 1 OF MAHAN TPP (2022-23)

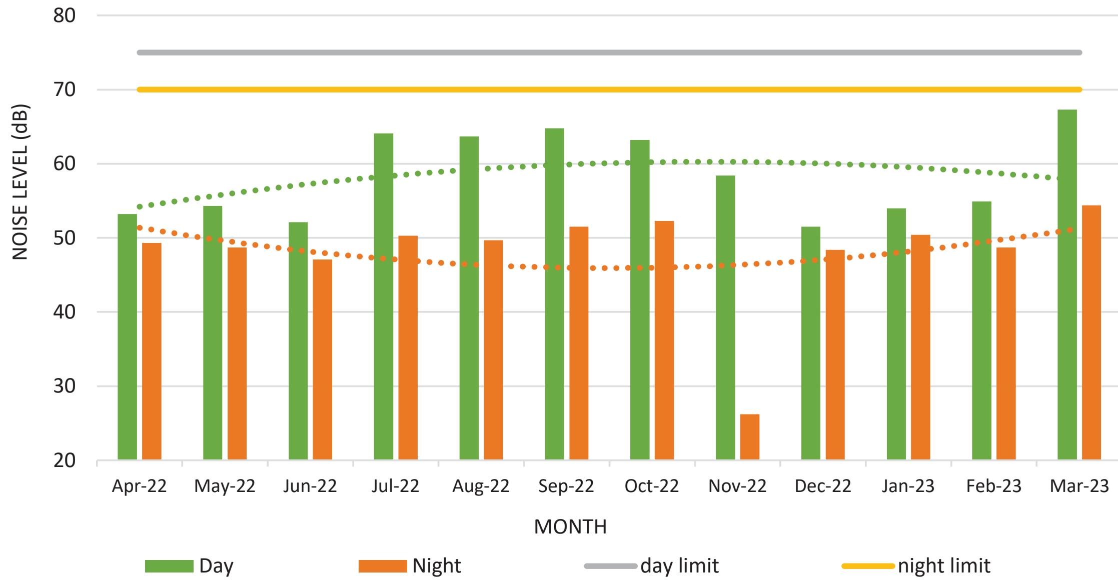


FIGURE 2.8 (B): STATUS OF NOISE LEVEL IN STATION 1 OF MAHAN TPP (2023-24)

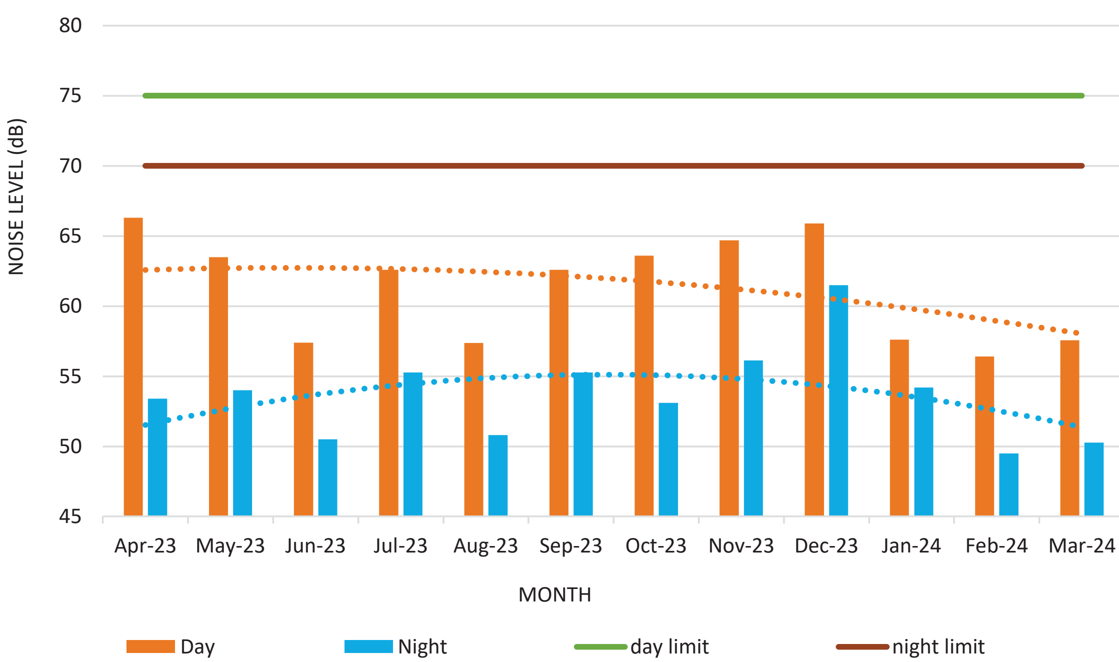


FIGURE 2.9 (A): STATUS OF NOISE LEVEL IN STATION 2 OF MAHAN TPP (2022-23)

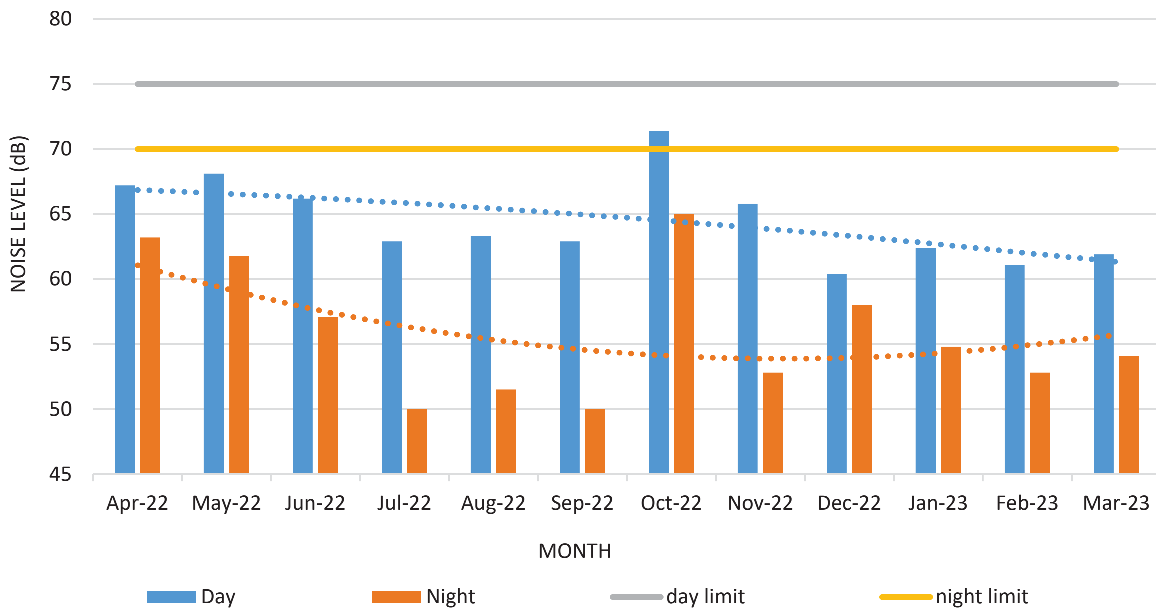


FIGURE 2.9 (B): STATUS OF NOISE LEVEL IN STATION 2 OF MAHAN TPP (2023-24)

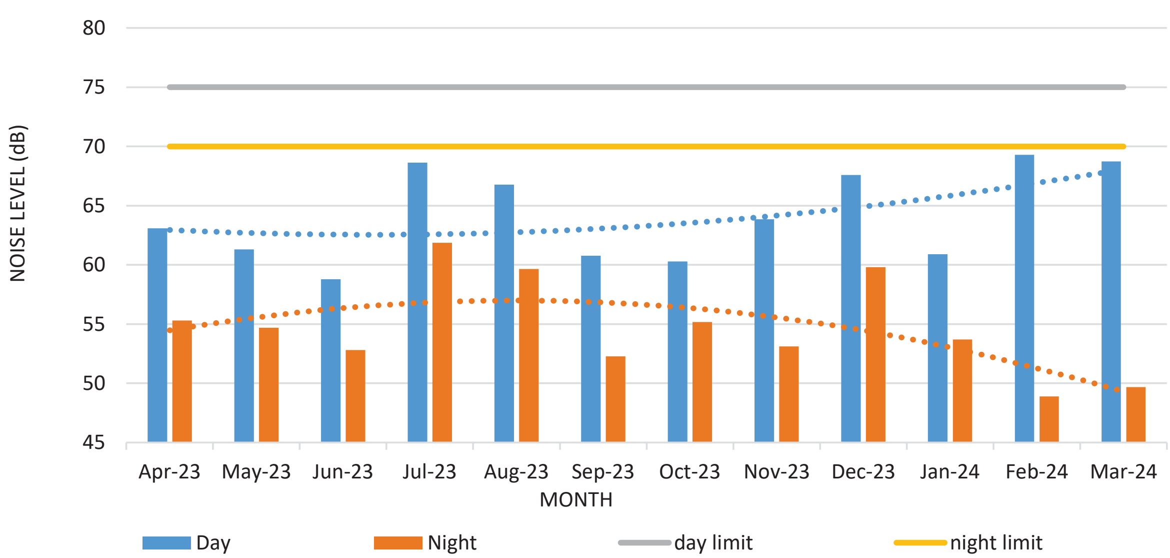


FIGURE 2.10 (A): STATUS OF NOISE LEVEL IN STATION 3 OF MAHAN TPP (2022-23)

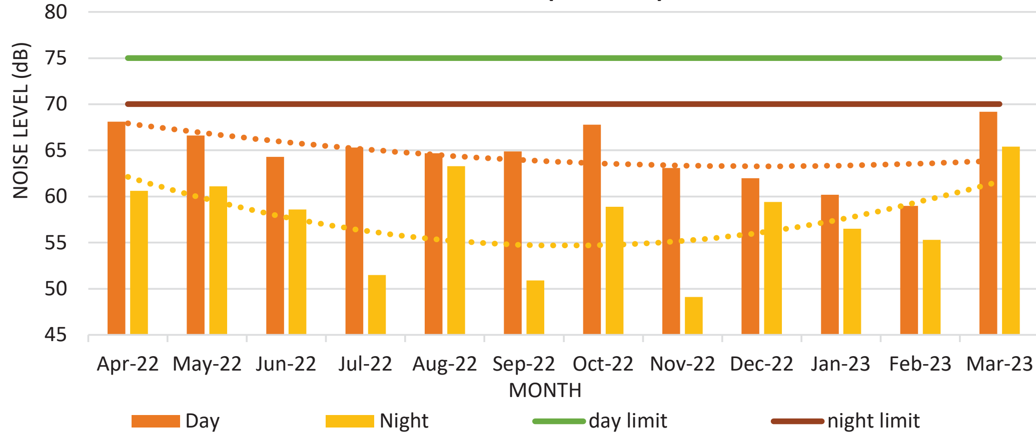


FIGURE 2.10 (B): STATUS OF NOISE LEVEL IN STATION 3 OF MAHAN TPP (2022-23)

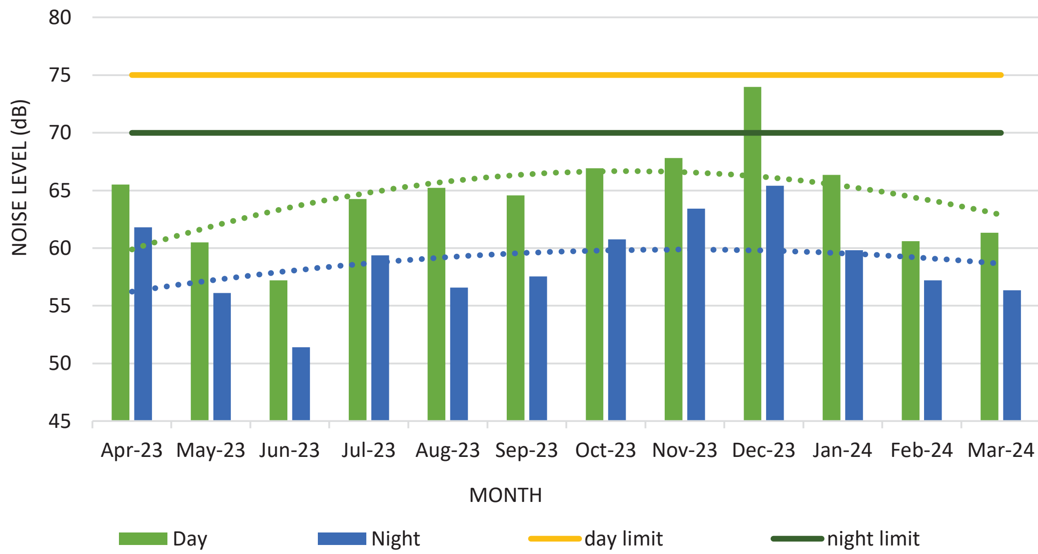


FIGURE 2.11 (A): STATUS OF NOISE LEVEL IN STATION 4 OF MAHAN TPP (2022-23)

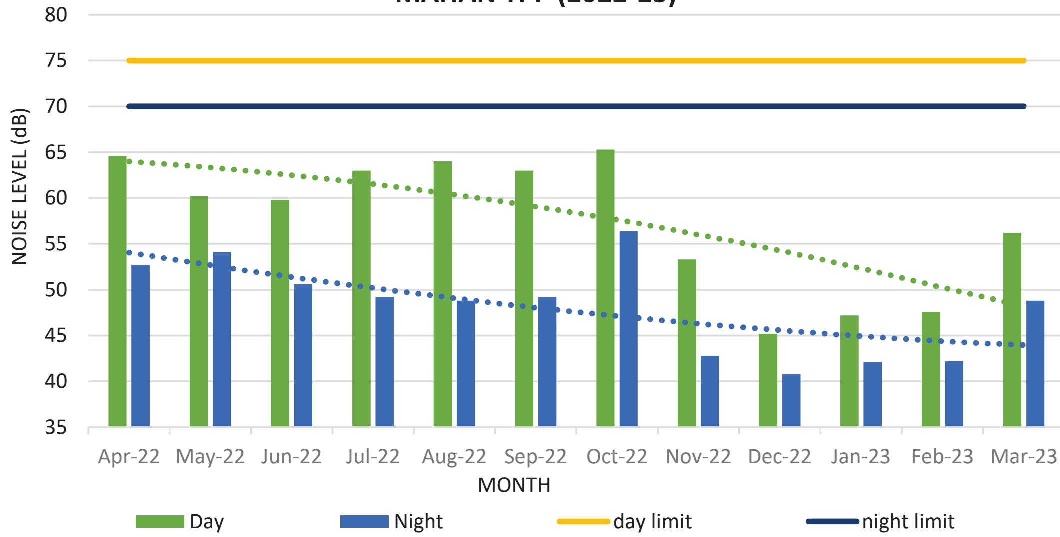
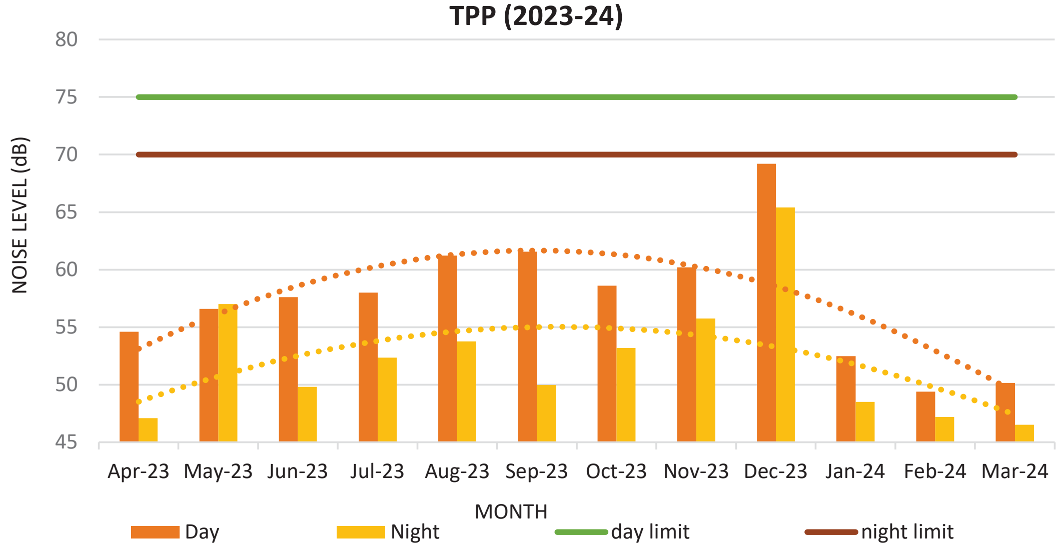
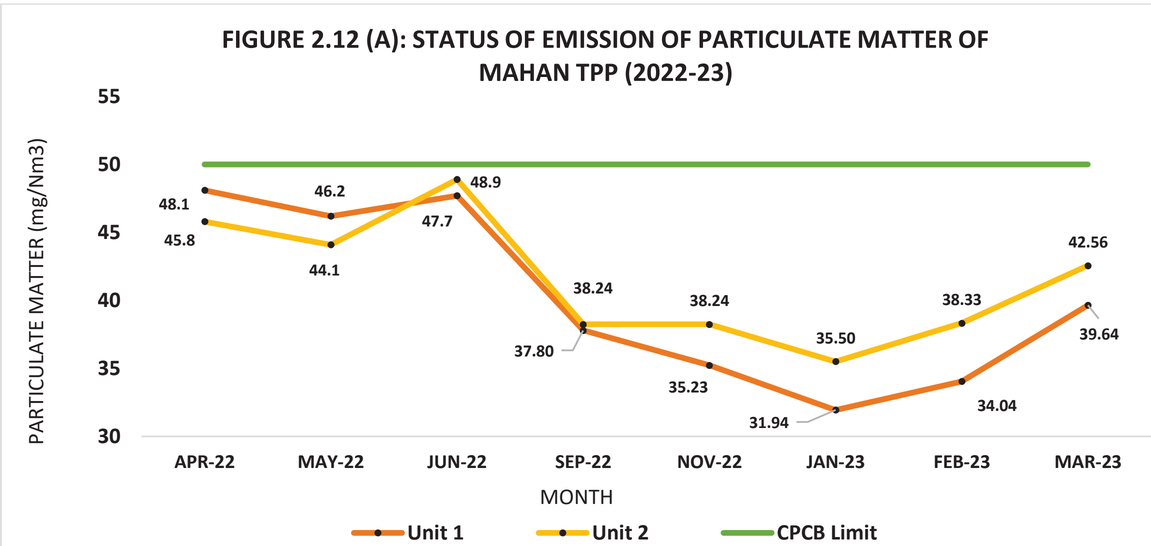


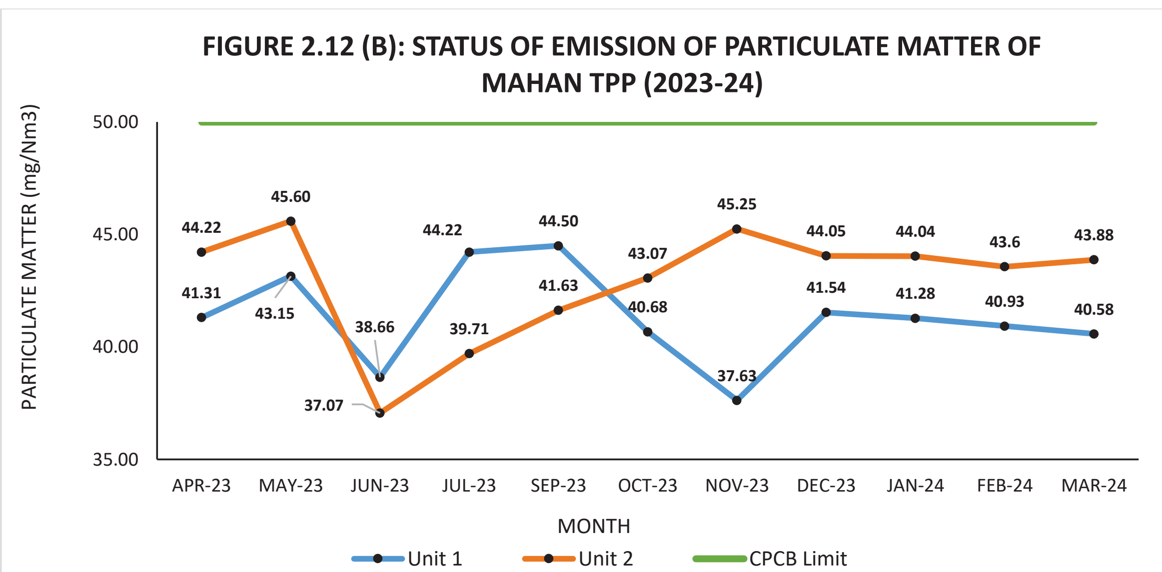
FIGURE 2.11 (B) STATUS OF NOISE LEVEL IN STATION 4 OF MAHAN TPP (2023-24)



2.3.3 Status of Emission

The analysis of stack emissions from Unit 1 and 2 of the Mahan TPP for the period 2022-23 and 2023-24, as depicted in Figures 2.12-2.14 indicates that emissions of various pollutants such as PM and NOx are well within permissible limits, however it was taken into account that the levels of sulfur dioxide (SO_2) emissions was significantly higher. In response to this, the installation of Flue Gas Desulfurization (FGD) technology is currently underway, aimed at mitigating SO_2 emissions from the stack. As per MoEF&CC notification dated 5th September 2022, MEL is a Category "C" TPP and timeline for compliance of SO_2 emission is upto 31st December 2026. This installation of FGD is expected to yield significant reductions in SO2 emissions, thereby aligning with environmental regulatory standards and contributing to improved air quality in the surrounding region of Mahan TPP.





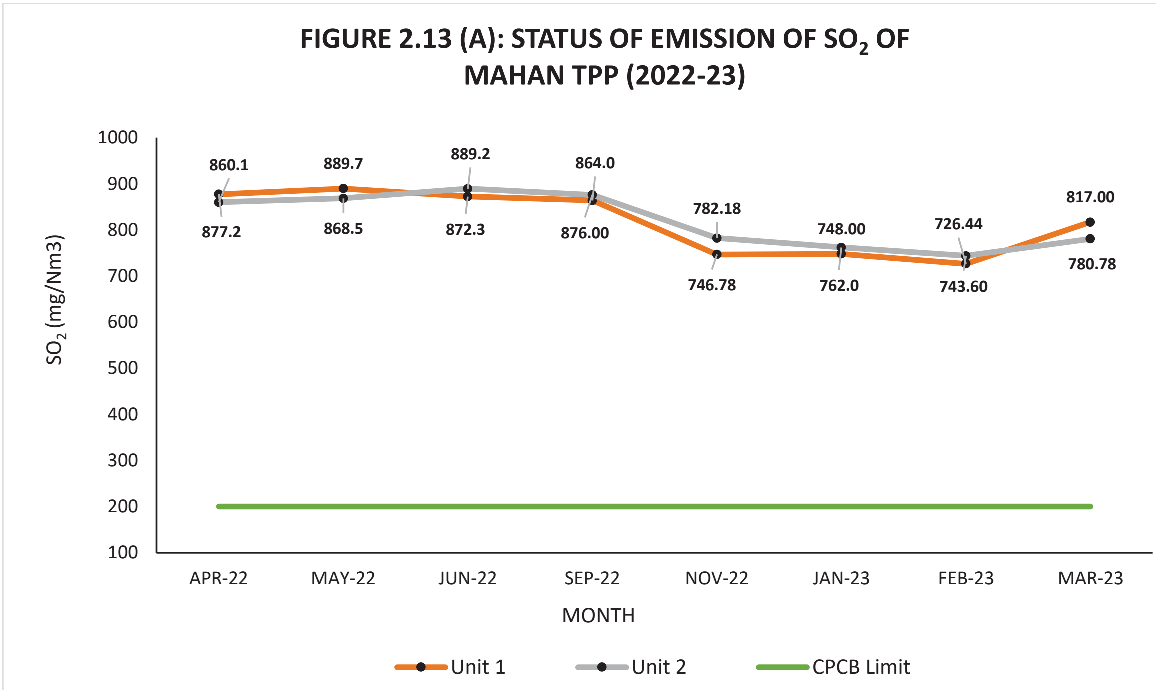


FIGURE 2.13 (A): STATUS OF EMISSION OF SO_2 OF MAHAN TPP (2022-23)
SO_2 (mg/Nm3)
1000
900
800
700
600
500
400
300
200
100
860.1
889.7
889.2
864.0
782.18
748.00
726.44
817.00
877.2
868.5
872.3
876.00
746.78
762.0
743.60
780.78
APR-22
MAY-22
JUN-22
SEP-22
NOV-22
JAN-23
FEB-23
MAR-23
MONTH
Unit 1
Unit 2
CPCB Limit

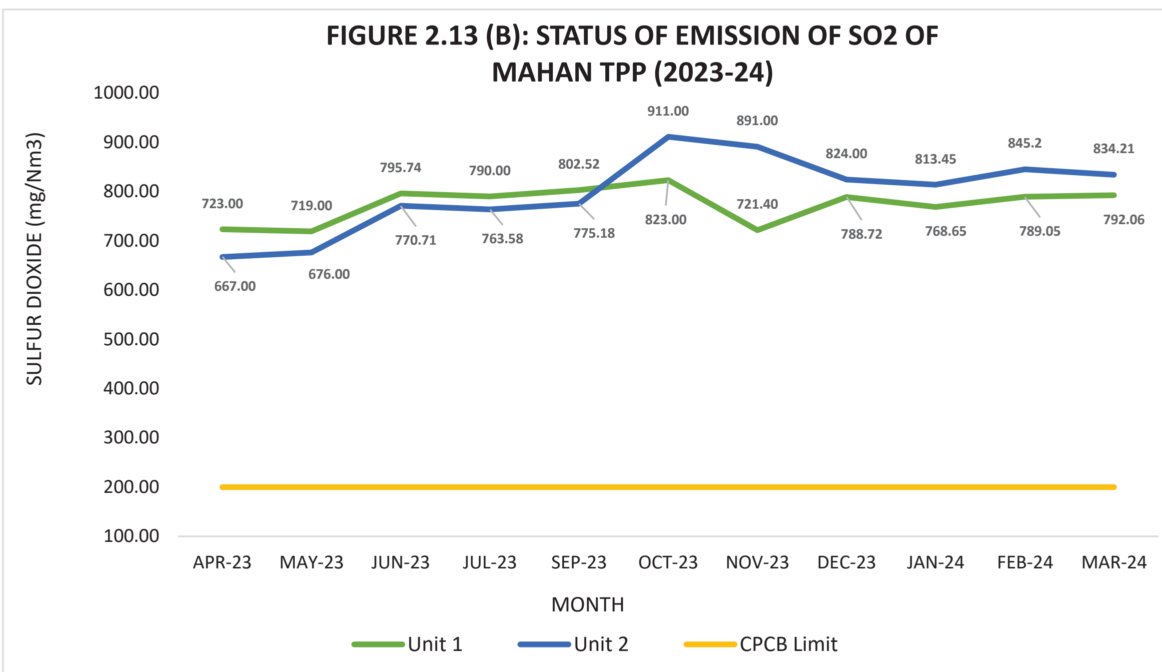


FIGURE 2.13 (B): STATUS OF EMISSION OF SO2 OF MAHAN TPP (2023-24)
SULFUR DIOXIDE (mg/Nm3)
1000.00
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
723.00
719.00
795.74
790.00
802.52
911.00
891.00
824.00
813.45
845.2
834.21
667.00
676.00
770.71
763.58
775.18
823.00
721.40
788.72
768.65
789.05
792.06
APR-23
MAY-23
JUN-23
JUL-23
SEP-23
OCT-23
NOV-23
DEC-23
JAN-24
FEB-24
MAR-24
MONTH
Unit 1
Unit 2
CPCB Limit

FIGURE 2.14 (A): STATUS OF EMISSION OF NO_X OF MAHAN TPP (2022-23)

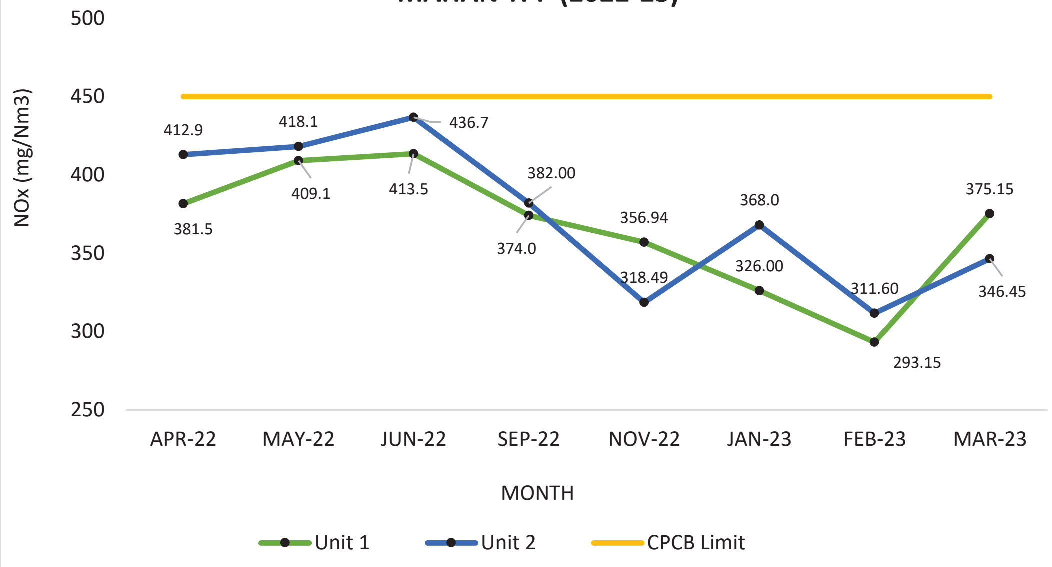
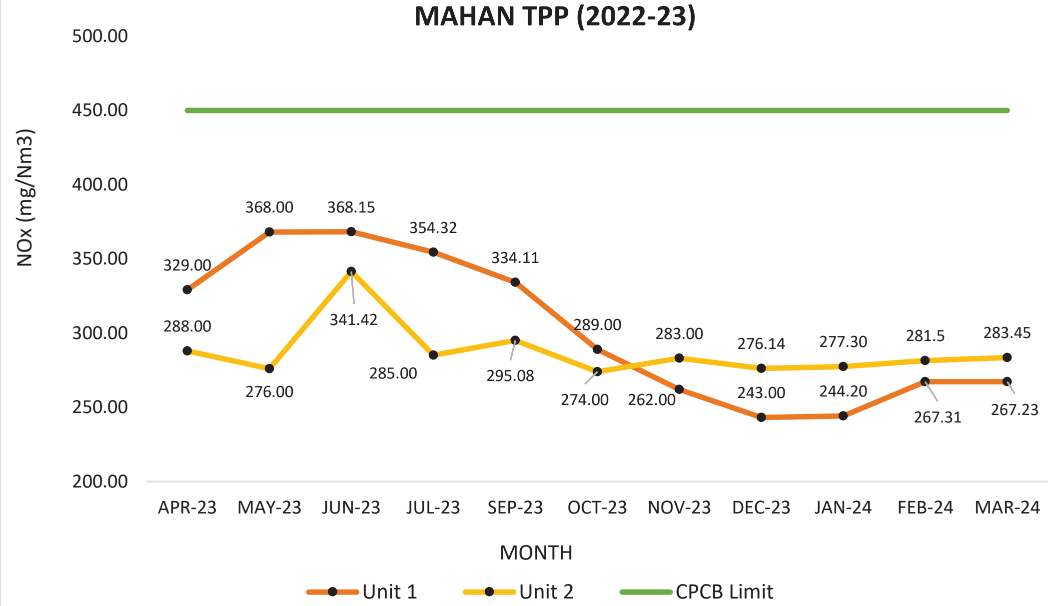


FIGURE 2.14 (B): STATUS OF EMISSION OF NO_X OF MAHAN TPP (2022-23)

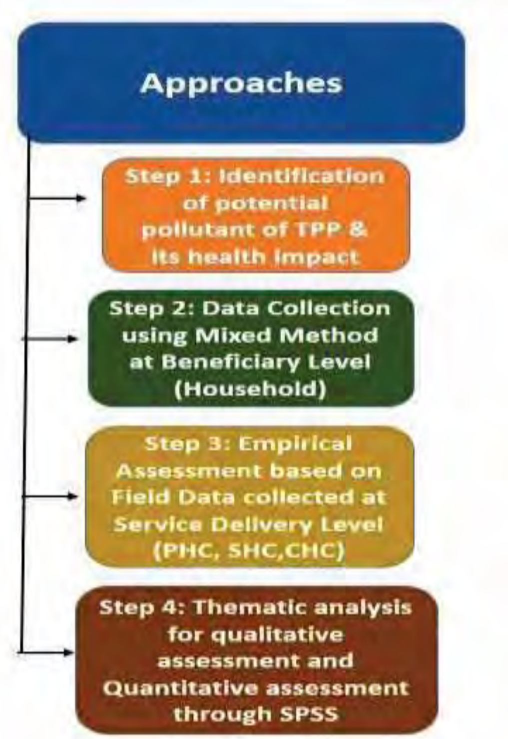


IISWBM

3.0 TOOLS & METHODOLOGY

The state-of-the-art method was employed for the health status assessment study of the Mahan Thermal Power Plant (TPP). This advanced approach ensured a comprehensive and accurate evaluation of the health impacts on the local community. The study was explanatory in nature, utilizing both primary and secondary data to provide a detailed understanding of the health status and associated factors. Figure 3.1 depicts the detailed approach of the study.

FIGURE 3.1: DETAILED APPROACH OF THE STUDY



The following considerations were integral in planning and designing the framework for the present study:

Study Design

For the comprehensive assessment of health impacts within the buffer zone of the Mahan TPP, a mixed methods approach was meticulously adopted, employing a sequential explanatory design. This robust methodological approach commenced with the collection and analysis of quantitative data, which provided a foundational understanding of the health-related variables and prevalence of health issues within the community. This phase involved the systematic gathering of numerical data through a carefully developed questionnaire, designed after an extensive review of relevant literature, to quantify the extent of health impacts associated with TPP operations.

Following the quantitative analysis, a qualitative data collection phase was undertaken to delve deeper into the contextual and experiential aspects of the health impacts observed. This phase included semi structured in-depth interviews and discussions with health advisors in the community, allowing for the exploration of health issues and community perceptions. The qualitative study provided insights into the lived experiences of the population within the study area, shedding light on specific health challenges, perceived causes, and the community's response to these health issues.

By integrating the quantitative findings with qualitative insights, the mixed methods approach enabled a comprehensive and nuanced understanding of the health impacts within the buffer zone of Mahan TPP. This method not only quantified the health effects but also contextualized them within the socio-economic and cultural framework of the local community, thereby facilitating the development of targeted and effective health intervention strategies. The detailed design of Sequential Explanatory approach has been depicted in Figure 3.2.

FIGURE 3.2: SEQUENTIAL EXPLANATORY DESIGN

Population and Sampling

- The present study focused on the core zone villages surrounding the Mahan TPP.
- The population in the study area comprised villages within a 10-kilometer radius of the project site.
- A random sampling technique was employed to assess the perceptions and health status of community members through a quantitative survey. Approximately 20-30 respondents from each village were selected for the study to ensure a representative sample.
- Purposive sampling was utilized to identify and select respondents for qualitative interviews, targeting healthcare providers, Panchayat officials, and community members. More than 20 respondents were interviewed to gain in-depth insights into the health impacts and community dynamics.

Study Tools

Based on a comprehensive review of the literature, the study tools were developed and employed for the present study. These tools included structured questionnaires designed to capture quantitative data on health perceptions and status from a broad cross-section of the community, using a random sampling technique to select adequate number of respondents from each village. Additionally, semi-structured interview guides were created for qualitative data collection, targeting healthcare providers, Panchayat officials, and community members through purposive sampling to gather in-depth insights into health impacts and community dynamics. Environmental monitoring instruments were also incorporated to measure air and water quality parameters, ensuring a holistic assessment of potential environmental health risks. Furthermore, secondary data from existing health records and environmental reports were analyzed to complement and validate the primary data. These study tools enabled a comprehensive and accurate evaluation of the health impacts within the buffer zone of the Mahan TPP, facilitating the development of effective intervention strategies.

Primary Data

- Survey was conducted using the questionnaire in the community with the stakeholders such as healthcare providers, panchayat officials and community members.

- The questions on the survey focussed on getting an overview of the range of health status and needs of the community through the health service providers.

- Perception of stakeholders about health status was captured by using in-depth interview guide.

- WHO recommended scientific methods were applied to check the air and water quality with the help of experts.

Secondary Data

Interaction with local authorities were undertaken to obtain comprehensive secondary data on health concerns, the emergence of new illnesses, and the prevalence of common communicable & non-communicable diseases within the community. Analysis was undertaken to determine trends and patterns and assess the existing community health status. This multi-faceted approach ensured a robust and detailed understanding of both past and present health conditions, thereby enriching the overall health status assessment and facilitating the identification of critical areas for intervention.

Data Analysis

- The quantitative data collected for the study was meticulously analyzed using the SPSS. This software facilitated the application of appropriate statistical tests to identify associations and correlations between various health-related variables. This statistical analysis ensured that the quantitative data was interpreted accurately and provided robust conclusions about the health impacts within the buffer zone of the Mahan TPP.

- For the qualitative data, a thorough thematic analysis was conducted to extract meaningful patterns from the collected narratives. This involved systematically coding the data and organizing them into coherent categories that reflected the key health issues and perceptions of the community. Thematic analysis enabled to gain deep insights into the lived experiences of community members, healthcare providers, and Panchayat officials, highlighting the nuances of health impacts and the socio-cultural context in which they occur. By integrating these qualitative insights with the quantitative findings, the study provided a comprehensive and nuanced understanding of the health status and challenges in the area, informing targeted intervention strategies.

Reconnaissance Survey

The reconnaissance survey was undertaken by a team led by Dr. Priyanka Roy, Dr. K. M. Agrawal and Ms Asmita Basu from IISWBM along with MEL Team from 8th - 9nd March, 2024. The team had a kick-off meeting at the MEL TPP on 7th March, 2024 to finalise the modalities for commencing the field study as well as collection of secondary data.

Initially, MEL Team appraised the objective of proposed study and the required coverage of the same as per MoEF&CC Environmental Clearance condition. MEL Team also shared the detailed information regarding the existing health status of the area. They also shared the detail of the availability of healthcare infrastructure as well as healthcare services within the study area. During the meeting detail plan for undertaking field study was also discussed and resolved that all the required primary data need to be collected within stipulated time frame.

The survey was undertaken to primarily examine the existing healthcare facilities as well as interact with various stakeholders such as healthcare professionals, workers, local community etc. within the buffer zone of Mahan TPP for the formulation of cost effective health management plan.

FIGURE 3.1: FIELD SURVEY FOR BASELINE HEALTH DATA COLLECTION

FIGURE 3.2: FOCUSSED GROUP DISCUSSIONS WITH ANGANWADI WORKERS

4.0 BASELINE HEALTH STATUS

The National Family Health Survey (NFHS) serves as a cornerstone in understanding the health dynamics in the project area. Providing invaluable insights into various health indicators, NFHS emerges as a comprehensive resource aiding policymakers, healthcare professionals, and researchers alike. Through meticulously collected data, NFHS sheds light on crucial aspects such as maternal and child health, reproductive health, nutrition, and the prevalence of diseases. The detail of the status of various health indicators in the project region has been presented in the subsequent section.

4.1 BASELINE HEALTH STATUS IN THE PROJECT REGION

4.1.1 Marriage and Fertility

The relationship between marriage and fertility suggests that women who marry at a younger age produce more children than women who marry late. In Madhya Pradesh (MP) there is a tendency to get girls married even before they turn 18 in the hope of conceiving more children which often results in adverse impact on women health. Additionally, it is observed that the value is higher in the project region than the stage average. However, there has been a marked improvement in the project region in the percentage of women age 20-24 years who got married before 18 years which has significantly reduced from 38.4% to 24.7%. The total fertility rate as per NFHS-5 is 2.0 children per woman at present which declined from 2.2 children per woman in 2015- 16 (NFHS-4) and is currently below the replacement level of fertility of 2.1 children per woman. At the state level, the fertility rate has also decreased from 2.3 to 2.0 which indicates development of awareness with regard to the family planning methods among people. In India, more than 7% of women aged 15-19 have begun childbearing. Teenage pregnancy is relatively high in rural areas. 4.4% of women in the project region in the age group 15-19 have begun childbearing. However, in the project region there has been a marked improvement noted in NFHS-5 as compared to NFHS-4 where the percentage of women aged 15-19 years who were already mothers or pregnant at the time of the survey declined from 11.7 to 4.4. The adolescent fertility rate is defined as the number of births per 1,000 women aged 15 to 19. Having children this early in life exposes adolescent women to unnecessary risks. Their chance of dying is twice as high as that of a woman who waited until her 20s to begin childbearing. Even though the percentage has dropped in the country since NFHS-4, the fertility rate still remains double in rural areas. Additionally, It is remarkable to note that women aged 15-24 years who use hygienic methods of protection during their menstrual period has significantly increased from 18.8% to 54.7% in the study region for NFHS-4 & NFHS-5 respectively.

TABLE 4.1: STATUS OF MARRIAGE AND FERTILITY IN ADOLESCENT WOMEN

	MP (NFHS-4)	MP (NFHS-5)	Singrauli (NFHS-4)	Singrauli (NFHS-5)
Married before 18 years	32.4%	23.1%	38.4%	24.7%
Mothers /pregnant (15-19 years)	7.3%	5.1%	11.7%	4.4%

4.1.2 Family Planning Methods

With the increasing awareness about family planning, people have started adopting different both control measures to limit the number of babies born. Female sterilization is still the most popular contraceptive method and in the project region, the percentage has increased from 31.7% to 42.1% since 2015-16 whereas modern contraceptive use by currently married women has increased from 34.8% to 50% between 2015-16 and 2019-21. From India's context, more than three-fourths of currently married women age 15-49 have a demand for family planning; after having a baby, it is often beneficial for the mother to wait for at least 18 months before having the next baby. This 18-month rest period is called "birth spacing." When the time between pregnancies is less than 18 months, a woman's body may not be ready to have a healthy baby. In the project region, 5.2% have a demand for spacing births which has reduced from 7.1% since 2015-16. However, 12.5% of currently married women have an unmet need for family planning which has reduced from 16% since NFHS-4. The total demand for family planning among currently married women age 15-49 in India increased from 66% in 2015-16 to 76% in 2019-21. Along with that, percentage of health worker who talked to female non-users about family planning method has considerably increased between 2015-16 and 2019-21 from 19.2% to 39% in the project region. Table 4.2 represents the change of status of the usage of modern family planning method between 2015-16 and 2019-21 at national, state and district levels.

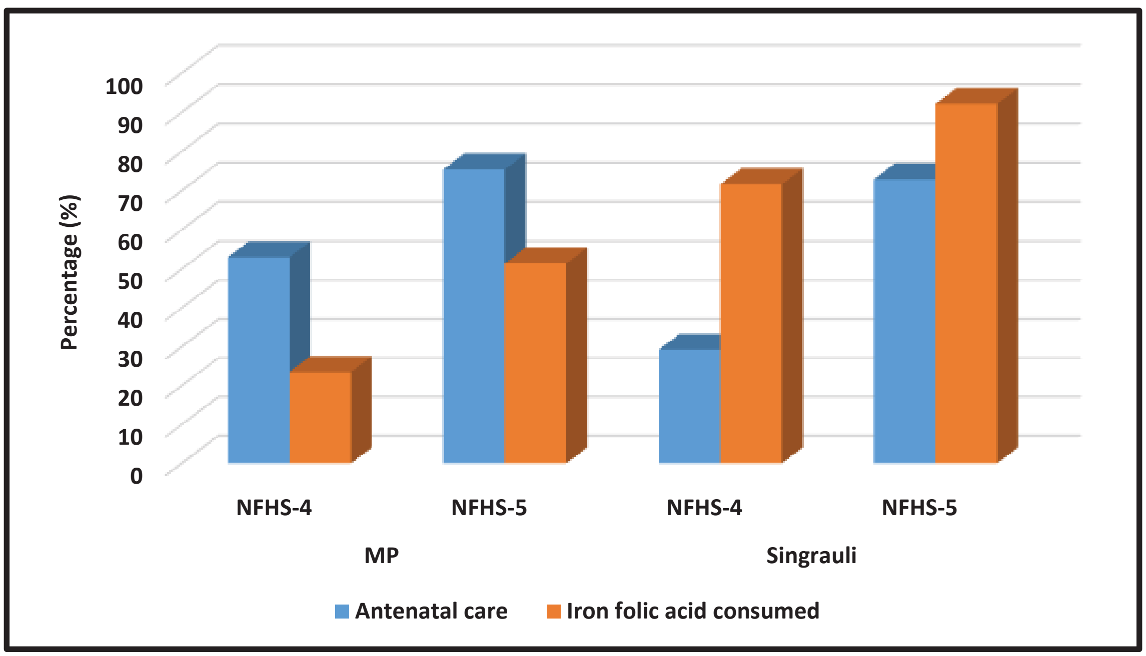
TABLE 4.2: STATUS OF USAGE OF MODERN FAMILY PLANNING METHODS BETWEEN NFHS-4 AND NFHS-5

India (NFHS-4)	India (NFHS-5)	MP (NFHS-4)	MP (NFHS-5)	Singrauli (NFHS-4)	Singrauli (NFHS-5)
48%	56%	49.6%	65.5%	34.8%	50%

4.1.3 Maternity Care

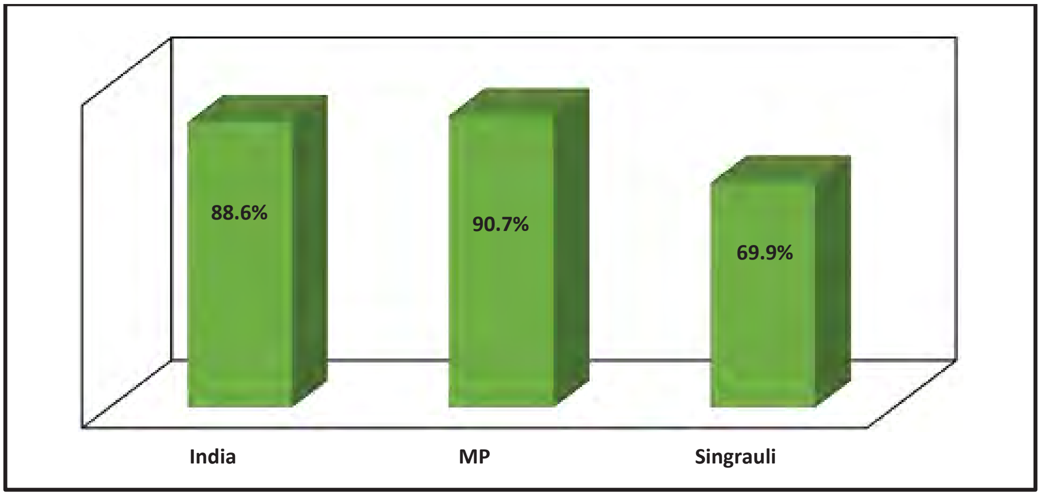
Maternal Health is an important aspect for the development of any country in terms of increasing equity & reducing poverty. The survival and well-being of mothers is not only important in their own right but are also critical to solving large broader, economic, social and developmental challenges. Antenatal care (ANC) is a means to identify high-risk pregnancies and educate women so that they might experience a healthier delivery and outcome. The proportion of women age 15-49 in India who received ANC has risen from 84% in NFHS-4 (2015-16) to 94% in NFHS-5 (2019-2021). 70% of women had their first ANC visit during the first trimester and 59% had four or more ANC visits, an increase from 51% in 2015-16. Whereas in case of the project region, percentage of women who had an antenatal check-up in the first trimester has risen substantially from 29.2% during NFHS-4 to 73% during NFHS-5. Additionally, 58.1% mothers had at least 4 antenatal care visits in the project region which is a great progress since NFHS-4 where only 21% mothers availed the same facility. In India, 92% of women's last live births were protected against neonatal tetanus. On the other hand, in the project region, the number has increased from 79.6% to 92.1% women receiving the same protection. Mothers who consumed iron folic acid for 100 days or more when they were pregnant stands at 49.1% in case of the rural part of MP whereas the value is nearly 59% for the project region which is relatively higher than the total number at national level (44%). It is to be taken into account that the number has shown marked improvement in the project region since 2015-16 where it was only 19%. Figure 4.1 depicts the status of women who receive pre-natal care at the state and district level by comparison with NFHS-4.

FIGURE 4.1: STATUS OF WOMEN RECEIVING PRE-NATAL CARE



The Mother and Child Protection Card (MCP Card) is a tool for informing and educating mothers and families on different aspects of maternal and child care and linking maternal and childcare into a continuum of care through the Integrated Child Development Services (ICDS) scheme. Registered pregnancies for which the mother received a Mother and Child Protection (MCP) card is 97.3% in the project region which is equal to rural population of MP (97.4%) and slightly higher than the national average (96%). A large proportion of maternal and neonatal deaths occur during the first 24 hours after delivery. For both the mother and the infant, prompt postnatal care is important to treat complications that arise from delivery and to provide the mother with important information on caring for herself and her baby. At national level, 61% women age 15-49 giving birth in the five years received postnatal care but in MP, 82.2% rural women receive received postnatal care which is a great improvement since 2015-16 where the total number of women availing the facility was only 55%. However it is to be noted that even though the number is lower in case of the project region (72%), there has been a marked improvement since NFHS-4 where the total number availing the facility was only 32%. In India, 82% of new born in the last five years had a first postnatal check within the first 2 days after birth but for rural population of MP it is 82.3 which indicates that they have started prioritizing maternal and child health. However, for the project region the number is 67% which indicates a dire need to increase awareness generation among the community regarding child health. Average out-of-pocket expenditure per delivery in a public health facility has reduced from rupees 3k to 2k since 2015-16 at national level. The percentage of institutional births for MP has increased from 80.8% to 90.7% between 2015-16 and 2019-21 with 89.2% in rural area. In the project region, there has been a marked improvement as the value has significantly increased from 43.5 since NFHS-4 to 70% during NFHS-5. This implies that people over time have become more aware about the benefits of institutional births for both mother and child. Figure 4.2 represents change in number of institutional births at national state and district levels. Access to caesarean section (C-section) can reduce maternal and neonatal mortality and complications such as obstetric fistula. Births delivered by caesarean section in India is 22% whereas for rural part of MP it is merely 8.8% whereas the number is even lower in case of the project region (4.3%). Births attended by skilled health personnel in the rural part of the state has been reported as 88.4% whereas the number in the project region at present stands at 77.5%.

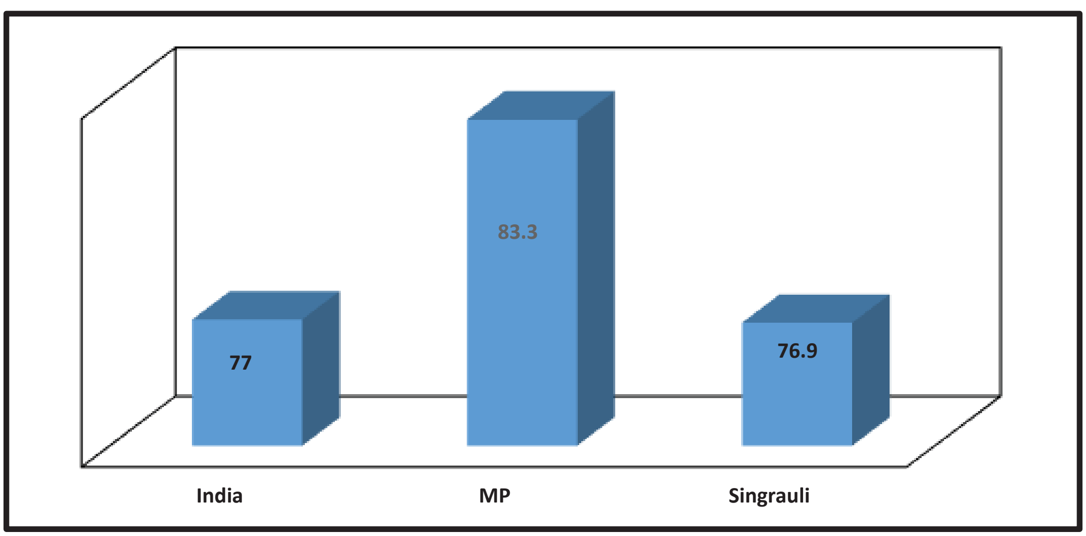
FIGURE 4.2: STATUS OF TOTAL INSTITUTIONAL BIRTHS TAKING PLACE DURING NFHS-5



4.1.4 Child Vaccinations and Vitamin A Supplementation

Immunizing children against vaccine preventable diseases can greatly reduce childhood morbidity and mortality. In the study region, 76.9% children (age 12-23 months) have received vaccination which is equal to country's overall vaccination status of children i.e. 77% of children age 12-23 months. It is to be noted that the number has increased significantly in the study region since NFHS-4 (42%). Figure 4.3 represents the status of fully vaccinated children at national, state and district levels. In the project region, children age 9-35 months who received a vitamin A dose in the last 6 months is 81.8% which has shown significant improvement compared to that in the last five years which was 56.1%.

FIGURE 4.3: PERCNTAGE DISTRIBUTION OF VACCINATION STATUS OF CHILDREN



4.1.5 Treatment of Childhood Diseases

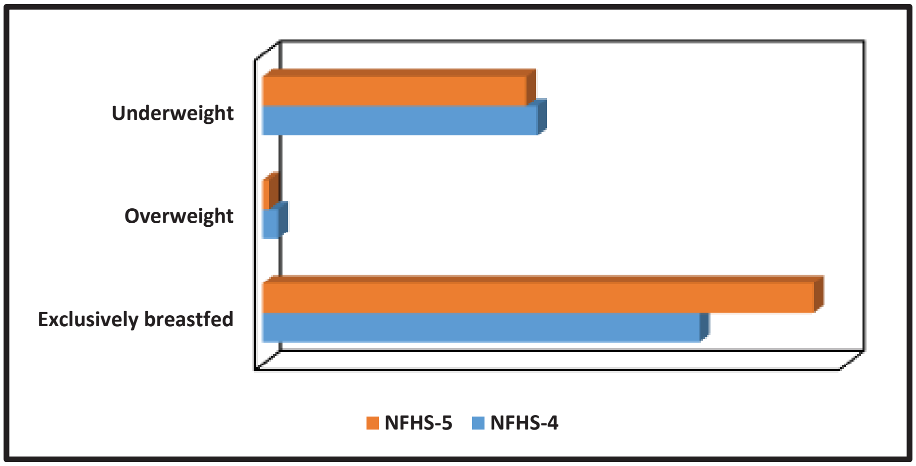
Acute respiratory infections (ARI) are defined as those infections of the respiratory system, caused by viruses or bacteria, with an evolution of less than 15 days, and which manifest with symptoms such as cough, nasal congestion and obstruction, sore throat, dysphonia or respiratory distress. Children, especially those under five years old, are particularly vulnerable to ARIs due to their developing immune systems and close interactions in school or daycare settings. Prevalence of symptoms of acute respiratory infection (ARI) in the 2 weeks preceding the NFHS-5 in the project region is 0% whereas during NFHS-4 it was 1.6% whereas in the state level it is around 2.6% which increased from 2.1%. Even though no cases of ARI was reported during the study, it should be noted that the analysis signifies that over the span of last five years, the ambient air quality has deteriorated indicating increase the pollution level.

Diarrhoea is usually caused by a virus, or sometimes, contaminated food. Symptoms include frequent, loose, watery stools and stomach pain. Prevalence of diarrhoea in the 2 weeks preceding the NFHS-5 in the study area is 3.8 which is lower than the status of the same in rural part of MP ie. 6.2%.

4.1.6 Child Feeding Practices & Nutritional Status of Children

Breast milk provides the ideal nutrition for infants. It has a nearly perfect mix of vitamins, protein, and fat -- everything a baby requires for its growth. Breast milk also contains antibodies that help the baby fight off viruses and bacteria. Children under age 6 months who were exclusively breastfed stands at 75.5% in the project region which has shown a tremendous progress since 2015-16 when the percentage was merely 59.8%. at present, the value is higher than overall status of the country for the same ie.64%. The number of underweight children (under 5 years) has slightly reduced from 37.5% to 36% in the project region with the implication of overall improvement of nutritional status. On the other hand, it is to be noted that the number of overweight children has also reduced considerably from 2.1% to 0.9% indicating an improvement in the likelihood of prevalence of several diseases like diabetes, high blood pressure etc. along with age. Figure 4.4 represents the changing pattern of the nutritional status of children in the study region in the span of five years.

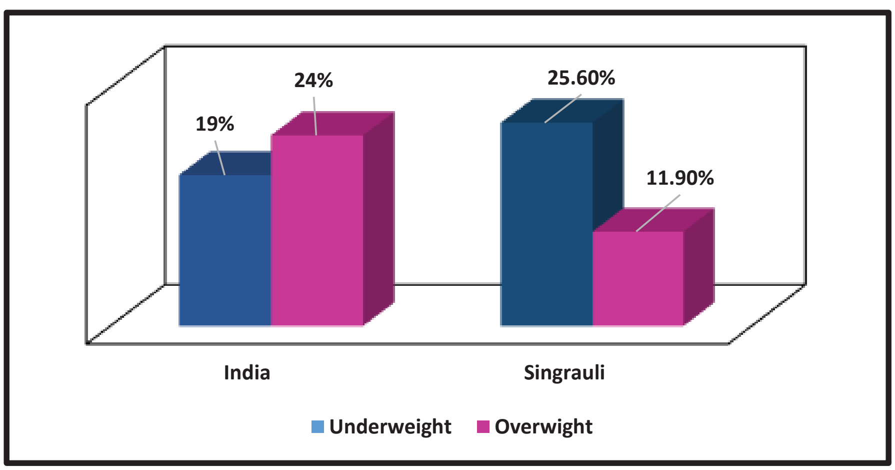
FIGURE 4.4 : NUTRITIONAL STATUS OF CHILDREN IN PROJECT REGION



4.1.7 Nutritional Status of Adults

Body Mass Index (BMI) is a person's weight in kilograms (or pounds) divided by the square of height in meters (or feet). A high BMI can indicate high body fatness whereas low BMI indicates less fat content in the body. In the study region, the number of women whose BMI value remained below the normal has drastically increased from 19.4% to 25.6% whereas for the rural population of MP it is 23%. This indicates a dire need to improve the nutrition status of women. There are 11.9% women in the study area who are overweight or obese which is comparatively less than the status of rural part of the state ie. 13%. Figure 4.5 demonstrates the distribution of number of women as per their nutritional status at national and district level.

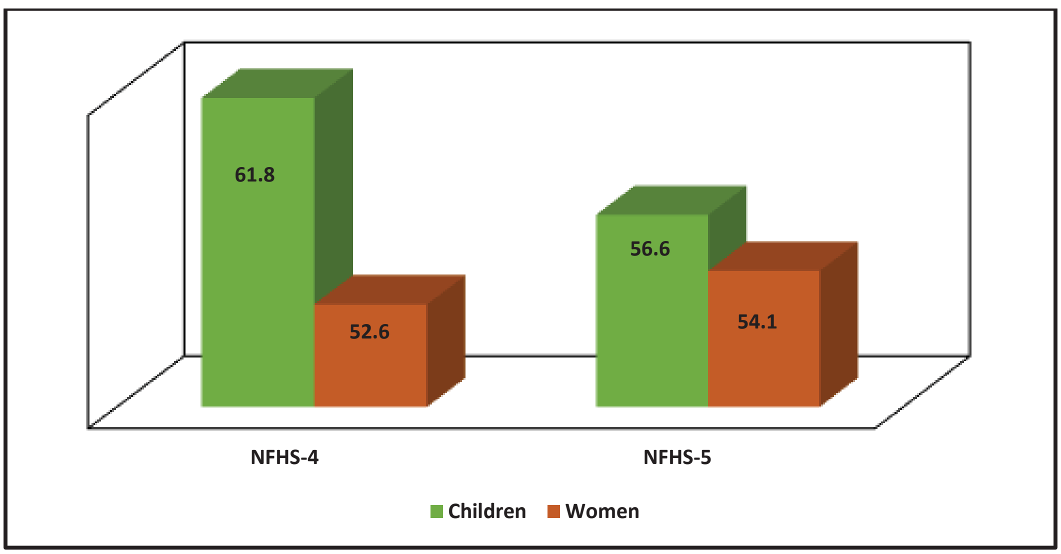
FIGURE 4.5: NUTRITIONAL STATUS OF WOMEN IN PROJECT REGION



4.1.8 Anaemia among Children & Adults

Anaemia results from a lack of red blood cells or dysfunctional red blood cells in the body. This leads to reduced oxygen flow to the body's organs. Anaemia in pregnant women increases the risk of premature birth resulting in low birth weight of the baby and postpartum depression. Pregnant women age 15-49 years who are anaemic is nearly 55% in the rural part of MP which has not shown significant improvement in the span of five years whereas in the study region, there were no cases reported during NFHS-5. In case of total anaemic women (15-49 yeaars), the number in the study region stands at 54.1% which slightly lower than overall status in the country ie.57% which implies that greater number of women should be provided with iron supplements. On the other hand, for children the number has substantially reduced from 61.8% during NFHS-4 to 56.6% during NFHS-5 which needs to be taken into account. Figure 4.6 depicts status of anaemia among women and children in the study region for NFHS-4 and NFHS-5.

FIGURE 4.6 : STATUS OF CHILDREN AND WOMEN SUFFERING FROM ANAEMIA IN THE PROJECT REGION



4.1.9 Blood Sugar Level among Adults

The blood sugar level in women can be an important factor to determine their overall. High diabetes level can increase the likelihood of making a person more susceptible to other diseases. In the study area percentage of women recorded with high blood sugar level is 5.9% which is slightly higher than 5.2% that is the status of rural part of the state.

4.1.10 Hypertension among Adults

Usually hypertension is defined as blood pressure above 140/90, and is considered severe if the pressure is above 180/120. High blood pressure often has no symptoms. Over time, if untreated, it can cause health conditions, such as heart disease and stroke. 18.9% women in the study region is suffering from hypertension which is significantly less than that the overall status of country ie.21%.

4.11 Screening for Cancer among Adults

Screening means checking the body for cancer before prevalence of any symptoms. Getting screening tests regularly may find breast, cervical, and colorectal (colon) cancers early, when treatment is likely to be more effective. 2.5% women get screened for cancer in the country whereas only 0.9% women in the study region have gone through any kind of screening for cancer.

4.12 Tobacco Use & Alcohol Consumption among Adults

Excessive consumption of alcohol and tobacco can have greater negative impact on women than men in a short span of time. Women age 15 years and above who use any kind of tobacco in the study area is 5.8 which is lower than the percentage in the rural part of the state ie.8.6%. Additionally around 1.2% women consume alcohol in both study region as well as rural MP. Table 4.3 depicts the status of different health issues in women by drawing comparison between Singrauli and the entire MP.

TABLE 4.3: STATUS OF DIFFERENT HEALTH RELATED ISSUES IN WOMEN

Disease	Singrauli	MP
Diabetes	4.2%	3.6%
Hypertension	18.9%	19.9%
Cancer screening	0.9%	2%
Tobacco use	5.8%	11.6%
Alcohol use	1.2%	1.2%

4.2 BASELINE HEALTH STATUS IN THE BUFFER ZONE OF MAHAN TPP

The baseline health status in the buffer zone of the Mahan TPP has been thoroughly assessed through an extensive field survey. This assessment involved visits to various healthcare facilities, including rural health clinic, Primary Health Centres (PHC), Sub-Health Centre (SHC), and Community Health Centres (CHC). During these visits, in-depth interviews were conducted with a range of healthcare professionals, such as doctors, Auxiliary Nurse Midwives (ANMs), Anganwadi workers, and other health staff. These interviews provided valuable insights into the healthcare infrastructure and services available in the region.

In addition to interviewing healthcare professionals, interactions with local communities were also carried out. These community interactions were instrumental in evaluating the prevalent disease patterns within the area. Through these discussions, it was possible to identify the most common health issues faced by residents. Furthermore, the survey highlighted specific areas in need of improvement, particularly in terms of medical facilities and emergency services.

The following section provides a detailed account of the observations recorded during the field survey.

Primary Health Center, R&R Colony Nagwa

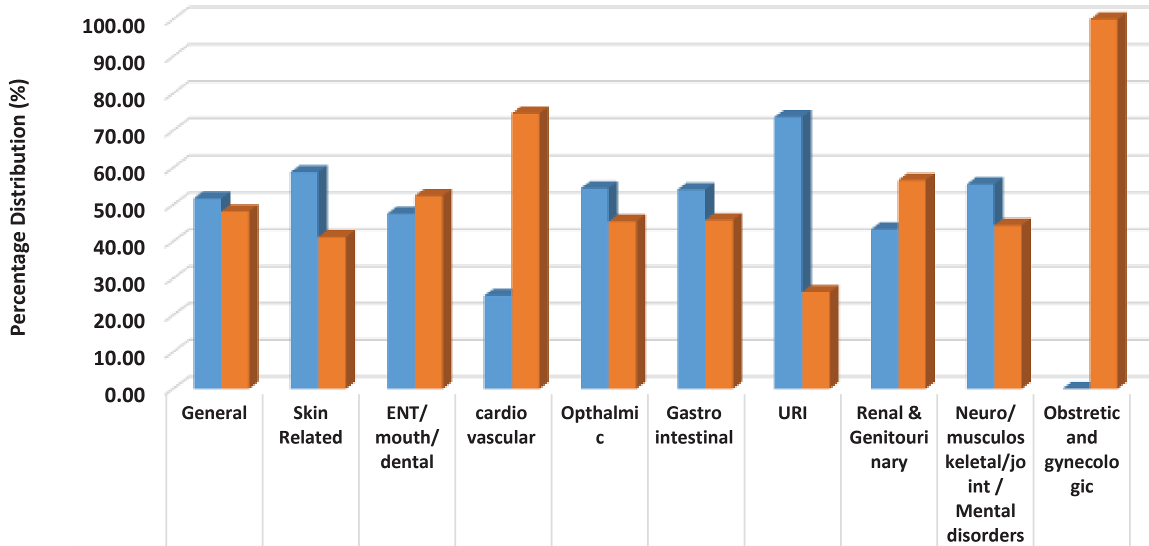
The center is operated by MEL and is staffed by one doctor, Dr. K.K. Tiwari, two pharmacists, two Auxiliary Nurse Midwives (ANMs), one health worker, one lab technician, two ambulance drivers, and one housekeeping staff member. During an interaction with Dr. Tiwari, it was revealed that the clinic provides medical services free of cost to the local community, including facilities such as Day IPD, Pathology Services, Free Medicine Services, Ambulance Services, and OPD. On average, the OPD sees 50-60 patients daily, with common cases including fever, cough and cold, urinary tract infections (UTIs) among females, various communicable diseases such as malaria and typhoid, and gastric problems. Lung diseases such as bronchopneumonia are also reported. Patients are initially treated with empirical medicines, and if these are inadequate, they are referred to the nearest district hospital, located about 40-45 km away, or to Nehru Hospital, about 50 km from the center. While bus services are available to the district hospital, additional transport is needed to reach Nehru Hospital. Dr. Tiwari mentioned a high incidence of UTIs, attributed to the lack of sanitary pad usage among females. Alcoholism is a major problem in the area, with many patients visiting the OPD under the pretense of having a cough and cold to obtain free cough syrup for misuse. There have been deaths due to malaria and other communicable diseases, as people often rely on quacks for quick relief. Maternal mortality is also a concern, likely due to the absence of a delivery point, except at the Health Sub-Centre (HSC) in Chauda village, forcing most pregnant women to travel to the district hospital for childbirth. The clinic's laboratory and pharmacy are well-equipped, offering tests such as Total Count (TC), Differential Count (DC), hemoglobin, blood sugar, and albumin. Additionally, health camps are regularly conducted by MEL in different schools.

A comprehensive data analysis of diseases recorded at the Primary Health Center in R&R Colony Nagwa was undertaken to assess the overall disease patterns within the study area. The diseases were meticulously categorized based on their symptoms into several distinct groups. General ailments included conditions such as cough, cold, fever, general body pain, injuries, insect bites, burns, abrasions, jaundice, vector-borne diseases like malaria and dengue, typhoid, weakness, dizziness, hernia, appendix issues, anaemia, and under nutrition. Skin-related issues encompassed itching, various skin problems, warts, eczema, fungal infections, and dermatitis. ENT, mouth, and dental conditions included ear and mouth disorders such as otitis, tonsillitis, dental caries, and gingivitis. Cardiovascular conditions covered hypertension, coronary artery disease (CAD), diabetes, and thyroid disorders. Ophthalmic issues were categorized under cataracts and other eye-related problems. Gastrointestinal problems included constipation, diarrhoea, vomiting, acidity, peptic ulcers, blood in stool, and fissures. Upper respiratory infections (URI) encompassed respiratory issues, tuberculosis (TB), asthma, pyrexia, and dyspnoea. Renal and genitourinary conditions included urinary tract infections (UTIs), reproductive tract infections (RTIs), kidney problems, stones, and prostate issues. Neurological, musculoskeletal, joint, and mental disorders were categorized under epilepsy, back pain, soft tissue injuries, rheumatoid arthritis, osteoarthritis, gout, neuropathic issues, and mental and behavioural disorders. Finally, obstetric and gynecologic conditions covered menstruation-related issues and uterus-related problems. This detailed categorization facilitates a thorough understanding of the prevalent health issues within the community and aids in targeted healthcare planning and intervention.

The gender wise distribution of disease patterns recorded in the Primary Health Center in R&R Colony Nagwa for the periods 2022-23 and 2023-24 have been presented in Figure 4.7 and 4.8 respectively. The analysis reveals notable differences in the distribution of diseases between males and females. For general ailments, males reported a higher percentage at 51.75%, compared to 48.25% for females. Skin-related issues were more prevalent among males at 58.81%, whereas females accounted for 41.19%. Conversely, ENT, mouth, and dental conditions were slightly higher in females at 52.41%, with males at 47.59%. Cardiovascular conditions exhibited a significant disparity, with females representing 74.65% of cases, in contrast to 25.35% for males. Ophthalmic issues were more common in males at 54.47% compared to 45.53% in females. Similarly, gastrointestinal problems were slightly more prevalent in males at 54.12%, whereas females accounted for 45.88%. Upper respiratory infections (URI) showed a significant difference, with males at 73.68% and females at 26.32%.

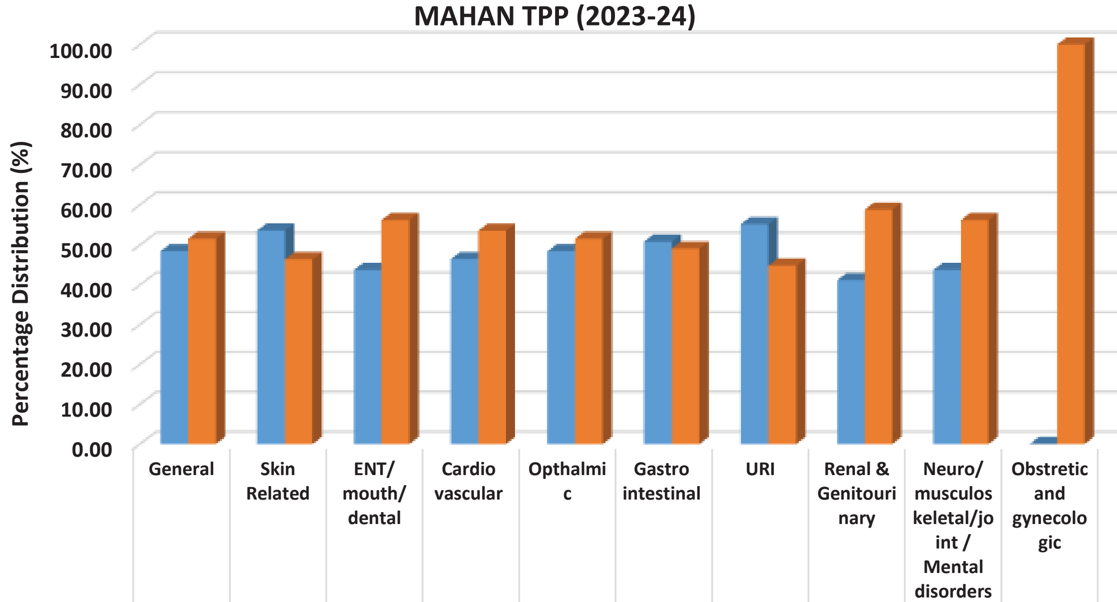
Moreover, renal and genitourinary conditions were more frequent among females at 56.67%, compared to 43.33% for males. Neuro, musculoskeletal, joint, and mental disorders were reported more by males at 55.56%, while females accounted for 44.44%. As expected, obstetric and gynecologic conditions were exclusively reported by females, accounting for 100% of such cases. This detailed comparison highlights gender-specific health trends and underscores the need for tailored healthcare interventions to address these disparities effectively.

FIGURE 4.7: GENDER DISTRIBUTION OF DISEASE PATTERN AROUND MAHAN TPP (2022-23)



	General	Skin Related	ENT/ mouth/ dental	cardio vascular	Opthalmic	Gastro intestinal	URI	Renal & Genitourinary	Neuro/ musculoskeletal/joint / Mental disorders	Obstretic and gynecologic
Male	51.75	58.81	47.59	25.35	54.47	54.12	73.68	43.33	55.56	0.00
Female	48.25	41.19	52.41	74.65	45.53	45.88	26.32	56.67	44.44	100.00

FIGURE 4.8: GENDER DISTRIBUTION OF DISEASE PATTERN AROUND MAHAN TPP (2023-24)



	General	Skin Related	ENT/ mouth/ dental	Cardio vascular	Opthalmic	Gastro intestinal	URI	Renal & Genitourinary	Neuro/ musculoskeletal/joint / Mental disorders	Obstretic and gynecologic
Male	48.44	53.61	43.75	46.43	48.42	50.86	55.20	41.18	43.75	0.00
Female	51.56	46.39	56.25	53.57	51.58	49.14	44.80	58.82	56.25	100.00

Sub Health Center in Nagwa

Interaction with the Anganwadi workers at the Sub Health Center in Nagwa revealed several critical gaps in healthcare services. Notably, there is no Auxiliary Nurse Midwife (ANM) available at the center, and there are no facilities for conducting child deliveries or vaccination drives. Despite these limitations, a Community Health Officer (CHO) visits the center regularly to prescribe medicines to patients. The CHO faces a significant workload, attending to 300-400 patients on a regular basis, especially during seasonal changes.

The center is equipped to perform essential diagnostic tests, including blood sugar, blood pressure (BP), and urine tests. Vaccines, such as those for polio, are sourced from the Sub Health Center in Chauda. Pregnant women who visit the Nagwa center receive iron tablets as part of their prenatal care. Recognizing the transportation challenges faced by pregnant women, the government has initiated a service that provides car facilities, mobilizing 108 wingers throughout the area to transport them to the district hospital for childbirth.

During the field visit, it was observed that the government was conducting a mosquito net distribution drive for children. This initiative aims to protect them from mosquito-borne diseases such as dengue and malaria, highlighting efforts to improve preventive healthcare measures in the region.

Sub Health Center in Chaura

At the Sub Health Center in Chaura, a detailed discussion took place with Ladies Health Visitor (LHV) Maya Vishwakarma, who currently oversees healthcare services across 28 villages. Highly experienced in child delivery, LHV Vishwakarma plays a pivotal role in maternal and child health in the region. The center also employs an ASHA worker responsible for sample collection for various diagnostic tests. The Community Health Officer (CHO) at Chauda is tasked with managing Non-Communicable Diseases (NCDs) in the area.

LHV Vishwakarma reported that the region commonly faces diseases such as malaria, diarrhea, and typhoid. Additionally, there have been notable cases of sexually transmitted diseases (STDs) like HIV and AIDS, which are primarily attributed to the influx of migrant workers. Recently, the center documented 25 cases of leprosy, as well as instances of hypo-pigmentation and filariasis. These observations underscore the diverse health challenges faced by the community and highlight the critical need for comprehensive healthcare services and preventive measures in the area.

Community Health Center in Khutar

During the visit to the Community Health Center (CHC) in Khutar, interactions with the staff provided a comprehensive overview of the center’s capabilities and challenges. The CHC is staffed by a dedicated team comprising 2 doctors, 6 nurses, 1 lab technician, 2 pharmacists, and 1 housekeeping staff member. Despite this skilled team, the center faces significant limitations, particularly in the area of maternal health, as it lacks a gynecologist. On average, the CHC handles 2-4 cases of complicated pregnancies per month, underscoring the urgent need for specialized care.

The most commonly reported diseases at the CHC include fever, diarrhea, and cough and cold. However, a notable concern is the significant number of upper respiratory infections (URI) being reported. This pattern highlights the need for enhanced respiratory care services and possibly more robust public health interventions to address these issues effectively. Overall, while the CHC in Khutar provides essential healthcare services to the community, there are critical gaps that need to be addressed to improve health outcomes.

Occupational Health Center within Mahan TPP

The Occupational Health Center (OHC) within the Mahan Thermal Power Plant (TPP) is staffed by a dedicated team of 2 doctors, 4 pharmacists, 4 nursing staff, and 4 ambulance drivers. The OHC has been providing essential healthcare services, attending to an average of 20-25 patients per day. The center has established ties with Misra Polyclinic and Nehru Hospital to enhance its healthcare services and has conducted pre-medical examinations for 1,400 workers to date.

The injury patterns commonly reported at the OHC include cuts and scratches, slips, trips, and falls, often resulting from slippery conditions within the plant. To mitigate these risks, the OHC regularly conducts first aid training sessions for the workers, emphasizing the importance of immediate and effective responses to workplace injuries.

Additionally, the OHC conducts Pulmonary Function Tests (PFT) for the workers, revealing a significant concern for respiratory health. The results have shown 6-7 mild cases, 40 moderate cases, and nearly 40 severe cases of pulmonary issues. These findings underscore the need for continuous monitoring and intervention to ensure the well-being of the workforce, particularly regarding respiratory health in an industrial environment.

Role of Anganwadi centers

Anganwadi centers play a crucial role in maintaining the health and well-being of local communities. These centers, part of the Indian government's Integrated Child Development Services (ICDS) program, serve as pivotal points for delivering essential health services, nutrition, and early education to children and mothers. Anganwadi workers provide vital services such as growth monitoring, immunization support, and the distribution of supplementary nutrition to combat malnutrition. They also conduct health education sessions for mothers, focusing on topics like breastfeeding, hygiene, and prenatal and postnatal care. By facilitating access to healthcare, promoting healthy practices, and ensuring the nutritional needs of children and pregnant women are met, Anganwadi centers significantly contribute to reducing infant and maternal mortality rates and improving the overall health of the community. The village wise distribution of anganwadi centers in the buffer zone of Mahan TPP has been presented in Figure 4.9. The analysis reveals that majority of the centers are located in Nagwa and Raila (5 centers each) whereas Bandhuara has the minimum number of centers.

FIGURE 4.9: VILLAGE WISE DISTRIBUTION OF ANGANWADI CENTERS WITHIN BUFFER ZONE

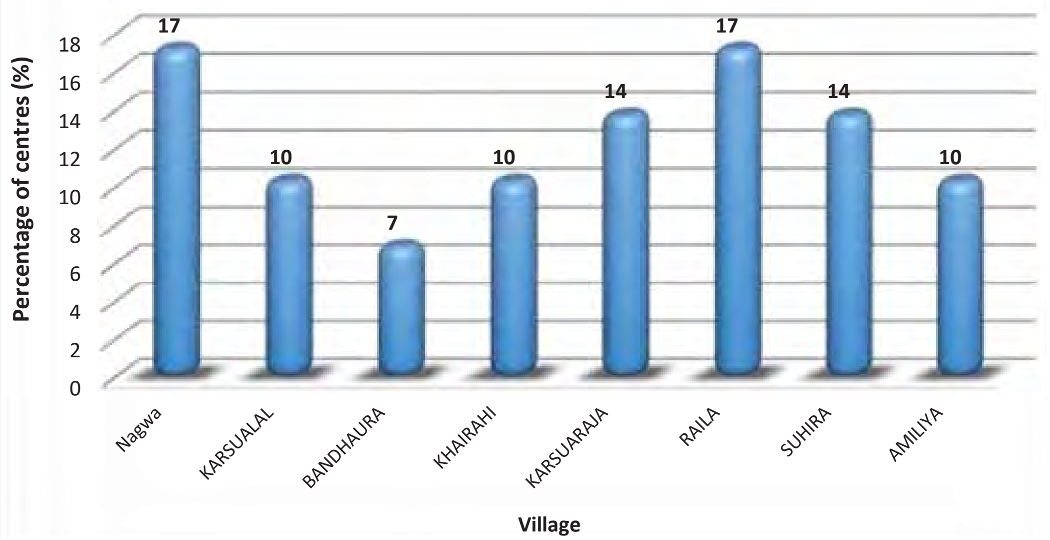


FIGURE 4.10: AVAILABILITY OF HEALTHCARE SERVICES WITHIN PHC, R&R COLONY NAGWA

FIGURE 4.11: AVAILABILITY OF HEALTHCARE SERVICES WITHIN OHC

5.0 STRATEGIES AND ACTION PLAN

The overall analysis of the various health impacts due to the operationalization of the coal-based TPP and the health status in the buffer zone of Mahan TPP has been presented in the previous sections. The key highlights of the study include:

High Incidence of Waterborne Diseases: There is a notable prevalence of waterborne diseases in the area, which may be linked to the local water supply system. Improving water quality and sanitation infrastructure is essential to address this issue.

Cardiovascular Cases: The study has reported numerous cardiovascular cases among the local population. These cases can be linked to coal dust generation, as exposure to particulate matter from coal can lead to significant heart and vascular issues, including hypertension and coronary artery disease.

SO2 Emissions: Sulfur dioxide (SO2) emissions from the power plant stack have been reported to be significantly higher. As per MoEF&CC notification dated 5th Sep 2022, MEL is a Category "C" TPP and timeline for compliance of SO2 emission is up to 31st December 2026. Although the SO2 levels in the ambient air are currently within permissible limits, continuous monitoring is essential to ensure that these levels remain safe and within regulatory standards, preventing potential respiratory and other health issues.

Sexually Transmitted Diseases (STDs): There have been records of STDs in the community. This underscores the need for increased awareness generation and educational programs focusing on sexual health, safe practices, and the importance of regular medical check-ups to reduce the incidence of these diseases.

Coal Workers' Pneumoconiosis Risk: Workers, particularly those in the Coal Handling Plant (CHP) area, ash pond area, and those involved in coal transportation, are at a heightened risk of developing coal workers' pneumoconiosis (black lung disease). Strengthening stringent dust control measures and regular health screenings for these workers is critical to mitigate this occupational health risk.

Incidents of Injuries: Recorded injury cases include slips, trips, and falls. Establishing injury prevention initiatives such as documenting near-miss incidents and implementing hazard mitigation strategies are crucial steps towards enhancing workplace safety standards.

Noise Hazards for Workers: Workers, especially those operating in areas such as coal crushers and Boiler-Turbine-Generator (BTG) zones, are exposed to potentially harmful noise levels. Providing appropriate protective gear such as earplugs is essential to safeguard their auditory health.

Challenges with Local Transport: The inadequacy of local transportation facilities poses difficulties for patients seeking medical care at distant hospitals. As part of its Corporate Social

Responsibility (CSR) initiatives, Mahan Energy Limited (MEL) could explore opportunities to address this issue, thereby enhancing access to healthcare services for the local community.

5.1 STRATEGIES TO MINIMIZE HEALTH IMPACTS

In order to mitigate potential health impacts associated with the operation of the Mahan TPP, a series of preventive measures and effective controls are proposed. These strategies aim to proactively address health concerns and safeguard the well-being of both workers within the TPP premises and the local community.

1. Air Quality Management: Strengthening of advanced pollution control technologies and stringent emission monitoring systems to ensure compliance with air quality standards. This includes regular maintenance of pollution control equipment and periodic air quality assessments.

2. Noise Pollution Control: Deploying sound insulation measures and strengthening noise reduction technologies to minimize noise pollution generated by plant operations. Additionally, ensuring regular monitoring of noise levels and promptly implementing corrective actions as deemed necessary to address any deviations from acceptable thresholds.

3. Water Quality Monitoring: Strengthening of comprehensive water quality monitoring programs to assess the impact of plant operations on local water bodies. Implementing measures to prevent water contamination and ensuring compliance with water quality standards.

4. Health Education and Awareness: Conducting health education and awareness programs for workers within the TPP and the local community to raise awareness about potential health risks associated with plant operations. Providing information on preventive measures and promoting healthy lifestyle practices.

5.2 ACTION PLAN FOR MANAGEMENT OF HEALTH RISKS

5.2.1 Measures for Mitigation of Health Risks of Workers within TPP

1. Occupational Health Programs: Implementing comprehensive occupational health programs is essential for promoting the health and safety of workers within the TPP premises. These programs should include regular health screenings, periodical medical examinations, ergonomic assessments, and training on workplace safety measures. Regular health screenings and medical examinations help in the early detection and management of health issues, ensuring workers maintain optimal health. Ergonomic assessments are vital for identifying and mitigating risks associated with physical strain and injury in the workplace. Additionally, providing thorough training on workplace safety measures ensures that employees are well-informed about best practices and safety protocols, thereby reducing the risk of accidents and promoting a safer work environment overall.

2. Healthcare Facilities Strengthening: Enhancing healthcare facilities within the TPP premises involves a multifaceted approach to significantly improve the well-being of the workforce. This includes upgrading medical infrastructure to modern standards, which ensures that all healthcare services are delivered efficiently and effectively. Providing access to specialized medical care is crucial, enabling workers to receive advanced treatments for specific health conditions without the need for offsite referrals. Additionally, ensuring the availability of comprehensive emergency medical services is paramount. This involves equipping the facility with state-of-the-art emergency equipment and training personnel to handle medical emergencies promptly and proficiently.

5.2.2 Measures for Mitigation of Health Risks of the Local Community

1. Mobile Health Care Unit Operationalization: Establishing and operationalizing a mobile healthcare unit in collaboration with Mahan Energy Limited (MEL) is a strategic initiative to extend vital healthcare services to the local community. This mobile unit will facilitate regular health camps, providing medical consultations and screenings to address a wide range of health issues. Additionally, the unit will ensure the distribution of essential medicines, making healthcare more accessible to those in remote or underserved areas. By bringing healthcare services directly to the community, this initiative aims to improve overall health outcomes, promote preventive care, and ensure timely medical intervention. The collaboration with MEL underscores a commitment to corporate social responsibility and the well-being of the local population.

2. Community Health Initiatives: Launching community health initiatives focused on preventive healthcare, disease awareness, and promoting healthy living practices is essential for improving the overall health and well-being of the local population. These initiatives will include organizing regular health camps that offer free medical check-ups, vaccinations, and screenings for common diseases, ensuring early detection and timely intervention. Conducting health awareness workshops will educate the community on various health issues, including nutrition, hygiene, and chronic disease management, empowering individuals with the knowledge to make informed health decisions. Additionally, facilitating access to healthcare resources, such as distributing informational materials and connecting residents with healthcare providers, will ensure that the community has the tools and support needed to maintain a healthy lifestyle. These comprehensive efforts will foster a culture of health and wellness, reducing the prevalence of preventable diseases and enhancing the quality of life for all community members.

By implementing these strategies and action plans, the Mahan TPP aims to minimize health impacts and ensure the well-being of both its workforce and the surrounding community. These efforts underscore the plant's commitment to responsible and sustainable operations, prioritizing the health and safety of all stakeholders involved.

Annexure IX

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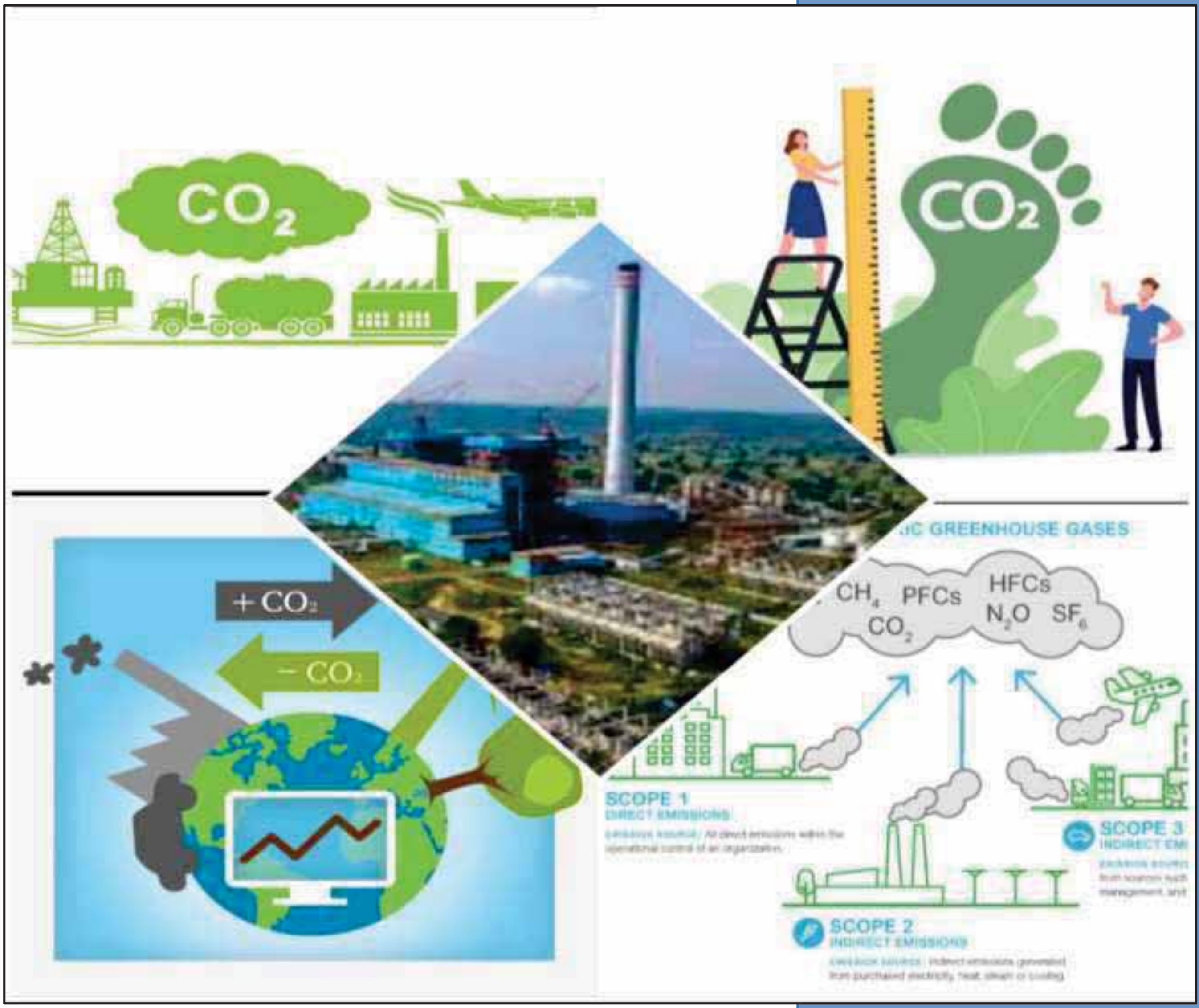
GHG EMISSION ACCOUNTING OF MAHAN TPP

Document No: IISWBM/IRP/GEA-APL/2024-25/04 V1.0 Dated 04/06/2024



IISWBM

June 2024

GHG Emission Accounting of Mahan TPP

Document No: IISWBM/IRP/GEA-APL/2024-25/04 V1.0 Dated 04/06/2024

Submitted By

Mahan Energen Limited

Vill-Bandhuara, Block-Baidhan
Singrauli (MP)

Executed By

DEPARMENT OF ENVIRONMENT MANAGEMENT
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JUNE, 2024

CONTENTS

EXECUTIVE SUMMARY

1.0 INTRODUCTION

Adani Power Limited (APL), a member of the Adani Group, has taken up the implementation of large Thermal Power Projects at various locations in India in view of the growing needs of power requirements in the country. APL is also actively planning to implement Thermal Power Stations at various locations in India, totalling to about 20,000 MW in the coming years.

In accordance with its mission of being an environmentally and socially responsible corporate entity with a focus on sustainable development, MEL aims to accurately account for greenhouse gas (GHG) emissions from its current installed capacity at Mahan TPP and estimate CO_2 emissions for the proposed expansion project. This study is essential for formulating a comprehensive plan that addresses both immediate and long-term environmental impacts. By employing a holistic approach to GHG accounting, MEL seeks to manage and mitigate its carbon footprint effectively. The study involves detailed analysis and active participation of various stakeholders to ensure sustainable management of emissions. Through practices such as improving fuel efficiency, adopting cleaner technologies, and optimizing operational processes, the plan aims to reduce GHG emissions, enhance operational sustainability, and contribute to broader environmental goals.

The objectives of the study are as follows:

- To quantify and analyze the existing GHG emissions from the Mahan TPP (2x600MW).
- To estimate the projected CO_2 emissions resulting from the proposed expansion of Mahan TPP (2x800MW).
- To evaluate Life Cycle Impact Assessment (LCIA) of existing as well as expansion of Mahan TPP.
- To develop strategies for reducing GHG emissions to align with sustainable development goals.

The detailed scope of work for the proposed study is as follows:

- Collecting primary data from the plant and secondary data from relevant sources to ensure comprehensive analysis.
- Carrying out a detailed assessment of GHG emissions within the plant premises, focusing on both the core operational areas.

- Observing and analyzing the sources of GHG emissions, including fuel combustion processes, auxiliary operations, and other relevant activities.
- Mapping and quantifying CO2 emissions using advanced tools and methodologies to create an accurate emission inventory.
- Identifying opportunities for enhancing operational efficiency to reduce emissions, such as adopting cleaner technologies and optimizing fuel use.
- Developing strategies for reducing GHG emissions through best practices, technological upgrades, and process optimizations.
- Establishing protocols for continuous monitoring and evaluation of GHG emissions to ensure the effectiveness of implemented measures.
- Providing recommendations on institutional mechanisms for the implementation of GHG reduction strategies and ensuring compliance with environmental standards.

2.0 APPROACH & METHODOLOGY

The state-of-the-art method was employed for the GHG Emission study of the Mahan Thermal Power Plant (TPP). This advanced approach ensured a comprehensive and accurate evaluation of the estimation of the GHG emissions due to the operation of Mahan TPP.

A kick-off meeting was organized on March 7th, 2024, at Mahan Energen Limited (MEL) to finalize the modalities for undertaking the study for accounting GHG emissions of Mahan TPP. The meeting was conducted under the guidance and leadership of Shri R N Shukla, Head, Environment & Forest, APL, Ahmedabad along with Santosh Kumar, Environment Head, MEL and other EHS executives of MEL along with the Project Team members of IISWBM.

Initially, the Shri Shukla & his team members appraised the objectives of the proposed study and the required coverage as per MoEF&CC Environmental Clearance conditions. The project involves the estimation of GHG emissions from Mahan TPP including expansion project (2X800 MW). MEL Team also shared detailed information regarding the monthly variation in GHG emissions from Mahan TPP. It was decided that the estimation will be calculated for the existing 1200 MW plant and for the proposed expansion, where 1600 MW (2x800 MW) will be added. The emissions would be calculated to provide a comparative analysis of the change in CO_2 emissions envisaged for the proposed expansion. During the meeting, a detailed plan for undertaking the field study was also discussed, and it was resolved that all the required primary data needed to be collected within a stipulated time frame. MEL Team shared the details of the new plant design, including coal and auxiliary fuel consumption, and the modern technologies that would be used, as these factors were integrated into the analysis.

For the GHG emission accounting study of Mahan TPP, the station-level emissions were initially calculated based on CEA guidelines. Following this, a Life Cycle Assessment (LCA) model was employed to quantify the impact on various categories such as climate change and human toxicity. The LCA model also determined the percentage contribution of different inputs to these impacts.

3.0 ESTIMATION OF CO_2 EMISSION

The Mahan TPP is a significant contributor to power generation, relying on coal as its primary fuel source. To accurately assess the environmental impact of its operations, it is crucial to estimate the CO_2 emissions at the station level. This estimation not only aids in understanding the plant's carbon footprint but also supports efforts to optimize performance and implement cleaner technologies.

It is to be taken into account that CO_2 emission estimation for Mahan TPP encompasses both the current operational capacity and the anticipated changes due to its proposed expansion project. Presently, the plant operates with an installed capacity of 1200 MW, consisting of two units of 600 MW each. To provide a comprehensive environmental assessment, CO_2 emissions for this existing capacity have been meticulously calculated.

In addition to evaluating the current emissions, a forward-looking analysis has been conducted to estimate the probable changes in CO_2 emissions resulting from the proposed expansion of Mahan TPP. The expansion project plans to increase the capacity by an additional 1600 MW, with two new units of 800 MW each. This prospective increase in capacity necessitates a thorough assessment to understand its potential impact on the plant's overall carbon footprint.

The status of monthly variation in fuel consumption and electricity generation for existing 1200 MW plant at MEL during the period 2023-24 indicates that over the 12-month span, the plant consumed a total of 4,231,145.30 metric tons (MT) of coal and 2,438.33 kiloliters (KL) of auxiliary fuel. The gross electricity generation during this period amounted to 6,736,175.90 megawatts (MW), while the auxiliary consumption of electricity was 472,941.15 MW.

The monthly variation in total and specific CO_2 emissions for different fuel consumption types and overall emissions at the Mahan TPP for the existing 1200 MW (2x600 MW) plant for 2023-24 reveals consistent emissions with minor fluctuations over the specified period. The overall specific CO_2 emission, which combines emissions from both coal and auxiliary fuel combustion, remained relatively stable, averaging 0.971 t/MWh over the year.

The total CO_2 emissions from coal combustion varied monthly, with the highest emissions recorded in December 2023 at 6.98 lakh tons and the lowest in September 2023 at 3.49 lakh tons. The total CO_2 emissions from auxiliary fuel combustion were significantly lower, with a peak of 0.014 lakh tons in March 2024. Overall, the total CO_2 emissions for the year amounted to 65.43 lakh tons, indicating a well-managed emission profile with consistent monitoring and control measures in place.

The comparative analysis of variation in estimated electricity generation and CO_2 emission for existing and proposed capacity reveals a noteworthy reduction in the overall specific CO_2 emission after the proposed expansion. The current specific CO_2 emission of 0.97 t/MWh is expected to decrease to 0.76 t/MWh at 100% PLF for proposed 1600 MW capacity and 0.86 t/MWh overall when combining the existing and proposed capacities. This reduction can largely be attributed to the installation of ultra-supercritical technology in the new expansion project. Ultra-supercritical technology operates at higher temperatures and pressures compared to traditional coal-fired power plants, resulting in more efficient fuel combustion and significantly lower specific coal consumption. Consequently, this enhances the plant's overall efficiency and leads to a substantial reduction in specific CO_2 emissions at the station level.

4.0 LIFE CYCLE ASSESSMENT

The Life Cycle Assessment is a process of gathering and evaluating input and output data and assessing a product's potential effect on the environment during its life cycle.

In present study an approach of 'cradle to gate' has been used for LCA due to the constraint in data availability outside the plant boundary which takes into account the environmental effects of consumption of electricity at generated from Mahan TPP. Accordingly, it was resolved that in present study primarily, a cradle-to-gate system boundary was selected to quantify the environmental footprint of power generation.

The LCIA phase includes optional procedures as well – normalization (calculating the normalized indicator values with respect to reference values, without assessing the importance of the environmental impact), grouping (assigning the impact category to one or more sets according to the goal and scope of the study), weighting (assigning importance to each impact category and damage category), or data quality analysis.

A life cycle impact analysis was conducted for the generation of 1 MW of power from the existing 1200 MW Mahan TPP; for proposed expansion of 1600MW at PLF 90% & 100% and for overall 2800 MW including the existing and proposed capacities. The results indicate that power generation from Mahan thermal power plant has the most significant impact on the climate change category, followed by fossil resource depletion and human toxicity. The high impact on climate change is primarily due to the substantial carbon dioxide emissions produced during coal combustion. Fossil resource scarcity is affected as coal is a finite resource, and its extraction and consumption contribute to resource depletion. Human toxicity is impacted due to the release of harmful pollutants, such as sulfur dioxide and mercury, which may pose serious health risks to the local population.

Sensitivity analysis involves assessing how alterations in data and methodological decisions impact the outcomes of the Life Cycle Impact Assessment (LCIA).

The sensitivity analysis of consumption of material and energy for generation of 1MW power from 1200 MW Mahan thermal power plant indicates that, the material and energy consumption primarily influence the climate change category. The analysis of the percentage contribution of raw materials across various impact categories viz. climate change, fossil resource depletion, human toxicity, terrestrial acidification, particulate matter formation, ionizing radiation, and water depletion, reveals that coal combustion is the primary contributor to all these impact categories. Coal combustion significantly impacts these areas due to several inherent characteristics of the process.

The sensitivity analysis of proposed 1600 MW Mahan TPP conducted at both 100% and 90% Plant Load Factor (PLF) revealed that coal combustion is the primary contributor across various impact categories considered. In both scenarios, the impact of coal combustion vastly outweighs that of other raw materials and processes. The contribution of transportation, diesel usage, and water consumption remains insignificant in comparison, underscoring that the combustion of coal is the dominant factor influencing the environmental footprint of the Mahan TPP.

The sensitivity analysis for the 2800 MW Mahan TPP, which includes the existing capacity and the proposed 1600 MW expansion, revealed that coal combustion remains the primary contributor across various impact categories. This was consistent in both scenarios: i) at 100% PLF and ii) at 90% PLF for the proposed expansion. In each scenario, the contribution from coal combustion significantly overshadowed that of other raw materials and processes, such as transportation, diesel usage, and water consumption, which were found to be relatively insignificant. This highlights the critical need for strategies to improve coal combustion efficiency and explore cleaner fuel alternatives to effectively mitigate the environmental impact of the Mahan TPP.

5.0 STRATEGIES & MITIGATION MEASURES

With the increasing demand for electricity, there is a corresponding rise in greenhouse gas (GHG) emissions and other pollutants in the atmosphere. Emissions from anthropogenic activities, such as fossil fuel power stations, significantly contribute to global warming. Therefore, mitigating these emissions has become crucial. Several factors, including the carbon and sulfur content of the fuel, the amount of energy generated, the technology used, energy efficiency, and improper waste disposal, all play a role in the level of emissions produced.

Recognizing the urgency of this issue, and looking at the current scenario, it is imperative to keep an account of GHG emissions. Hence, MEL conducted this study to accurately measure these existing emissions as well as like emissions from proposed expansion project. This will enable MEL to plan and strategize effectively to reduce the GHG emissions and ensure sustainable operations.

Greenbelt development around power plants can serve as a vital mitigation measure to reduce greenhouse gas (GHG) emissions. While sequestration is often thought of as absorption, it is actually a broader process. Sequestration involves not only absorbing carbon dioxide but also storing it in the soil through the ecological system. This long-term storage of carbon dioxide or other forms of carbon helps to mitigate the greenhouse effect and combat climate change.

Consequently, developing a peripheral greenbelt around Mahan TPP is a constructive measure to address the environmental impact of GHG emissions and promote sustainable development. Thus, in addition to the existing greenbelt within the Mahan TPP, MEL has taken up the initiative of peripheral greenbelt development. This initiative is expected to provide a significant reduction in GHG emissions by creating a robust ecological barrier that absorbs and stores carbon dioxide.

One of the primary factors contributing to high GHG emissions is improper fuel combustion. Maintaining the correct air-fuel ratio is essential for achieving extensive combustion, which in turn increases energy efficiency. During the combustion process, if the fuel is not burned properly, it results in the emission of particulates and other pollutants.

By transitioning to ultra-supercritical technology for the new 800 MW units, the Mahan TPP will significantly reduce its CO2 emissions. This technology not only improves fuel efficiency but also aligns with global best practices for sustainable energy production, positioning Mahan TPP as a leader in environmentally responsible power generation. The shift from subcritical to ultra-supercritical technology marks a critical step in reducing the environmental impact of coal-based power generation, contributing to broader efforts to mitigate climate change.

Mahan TPP can minimize pollutants and enhance efficiency by opting for cleaner coal types and implementing advanced technologies. The proposed expansion to ultra-supercritical technology at Mahan TPP is a step in this direction, ensuring reduced CO2 emissions and improved combustion efficiency. Clean coal technologies are crucial for reducing pollutants to acceptable levels, thereby contributing to both environmental sustainability and operational efficiency.

In addition to this, by replacing old equipment such as motors that run pumps, fans, lights, and auxiliary systems with new, efficient ones, Mahan TPP can significantly enhance overall efficiency.

In the context of Mahan TPP, adopting comprehensive waste management strategies can help reduce the plant's overall emissions and enhance environmental health. Waste-to-energy projects, which convert waste materials into useful energy, are particularly beneficial. By integrating these projects, Mahan TPP can not only manage its waste more effectively but also generate additional energy, thus improving its overall efficiency and sustainability.

Regular maintenance is crucial for ensuring that the TPP operates at optimal efficiency. Scheduled inspections and timely replacements of worn-out parts help in preventing sudden breakdowns, thereby ensuring continuous and efficient operation. By maintaining equipment such as boilers, generators, and turbines, the plant can avoid unexpected shutdowns and maintain high performance levels, reducing the overall environmental impact and enhancing the plant's operational longevity.

1.0 INTRODUCTION

1.1 BACKGROUND

The Adani Group (1988) has grown from being a trading house to a diversified business group with interests from infrastructural development to FMCGs. The Adani Group has made foray into high growth sector like Power, Infrastructure, Global Trading, Logistics and Energy.

Adani Power Limited (APL), a member of the Adani Group, has taken up implementation of large Thermal Power Projects at various locations in India in view of the growing needs of power requirements in the country. APL is also actively planning to implement Thermal Power Stations at various locations in India, totaling to about 20,000 MW in the coming years.

Mahan Energen Limited – MEL is a subsidiary company of Adani Power Limited (APL) which has been formed to develop 2x800 MW Ultra Super Critical Thermal Power Plant at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh. The Project is proposed to be developed as an expansion of the existing 2 x 600 MW units at the site and all the necessary infrastructure to cater the requirement of the enhanced capacity will be developed while also using the facilities of the existing plant.

The Project is conceptualised to be operated by utilising coal from nearby commercial coal mines and water from the Rihand reservoir. For auxiliaries' viz. Coal Handing, Ash Handling and Plant Water System, it is proposed to utilise the latest technology with adequate margin to ensure high availability of the Project. Land Area of about 920 Acres has been identified for the Project which includes the existing 1200 MW plant and land area for accommodation of coal stockyard, water reservoir, roads & green belt etc.

In accordance with its mission of being an environmentally and socially responsible corporate entity with a focus on sustainable development, MEL aims to accurately account for greenhouse gas (GHG) emissions from its current installed capacity at Mahan TPP and estimate CO_2 emissions for the proposed expansion project. This study is essential for formulating a comprehensive plan that addresses both immediate and long-term environmental impacts. By employing a holistic approach to GHG accounting, MEL seeks to manage and mitigate its carbon footprint effectively. The study involves detailed analysis and active participation of various stakeholders to ensure sustainable management of emissions. Through practices such as improving fuel efficiency, adopting cleaner technologies, and optimizing operational processes, the plan aims to reduce GHG emissions, enhance operational sustainability, and contribute to broader environmental goals.

1.2 OBJECTIVES OF THE STUDY

The objectives of the study are as follows:

- To quantify and analyze the existing GHG emissions from the Mahan TPP (2x600MW).
- To estimate the projected CO_2 emissions resulting from the proposed expansion of Mahan TPP (2x800MW).
- To evaluate Life Cycle Impact Assessment (LCIA) of existing as well as expansion of Mahan TPP.
- To develop strategies for reducing GHG emissions to align with sustainable development goals.

1.3 SCOPE OF THE STUDY

The scope of the study includes undertaking a reconnaissance survey to lay the groundwork for a comprehensive GHG emission accounting. Based on the reconnaissance survey, a framework will be developed for a time-bound, detailed field survey within the influence zone of the project site (i.e., within the plant premises). The detailed scope of work for the proposed study is as follows:

- Collecting primary data from the plant and secondary data from relevant sources to ensure comprehensive analysis.
- Carrying out a detailed assessment of GHG emissions within the plant premises, focusing on both the core operational areas.
- Observing and analyzing the sources of GHG emissions, including fuel combustion processes, auxiliary operations, and other relevant activities.
- Mapping and quantifying CO2 emissions using advanced tools and methodologies to create an accurate emission inventory.
- Identifying opportunities for enhancing operational efficiency to reduce emissions, such as adopting cleaner technologies and optimizing fuel use.
- Developing strategies for reducing GHG emissions through best practices, technological upgrades, and process optimizations.
- Establishing protocols for continuous monitoring and evaluation of GHG emissions to ensure the effectiveness of implemented measures.

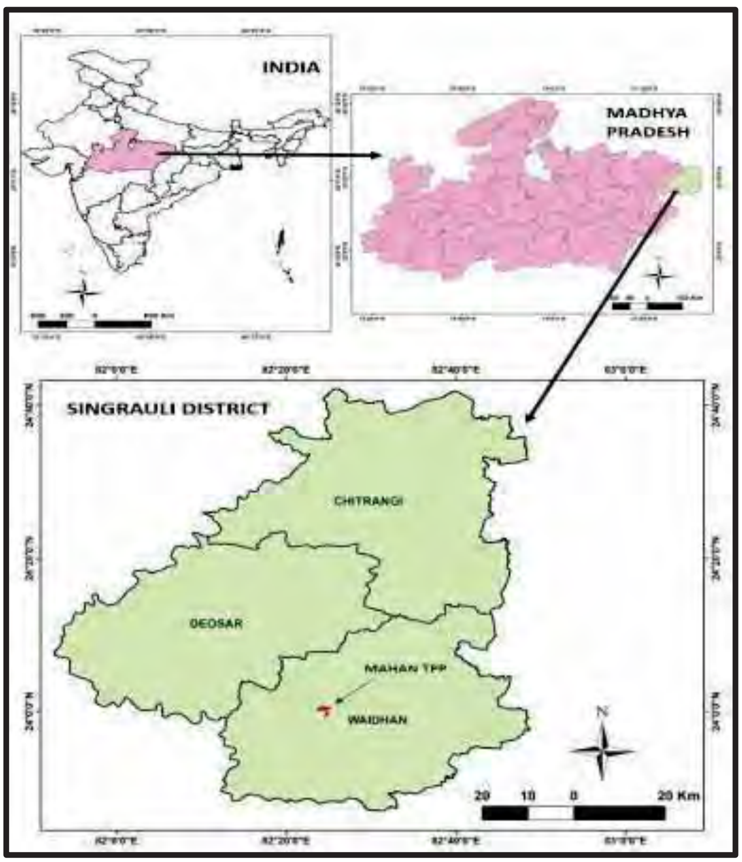
- Providing recommendations on institutional mechanisms for the implementation of GHG reduction strategies and ensuring compliance with environmental standards.

The Scope of Work would also include presentation of the study report before the Expert Appraisal Committee of MoEF&CC and subsequent preparation of replies to the clarifications asked, if any.

1.4 DETAIL OF PROJECT LOCATION

The study area is located at Bandhaura, Nagwa, Karsualal and Khairahi villages under Singrauli District, Madhya Pradesh (Figure 1.1). Geographical Coordinates of the Mahan TPP is 24°0'28.90"N latitude /82°24'49.94"E longitude.

FIGURE 1.1: LOCATION OF MAHAN TPP-SINGARAULI MADHYA PRADESH



The layout map of Mahan TPP has been presented in Figure 1.2.

FIGURE 1.2: LAYOUT MAP OF MAHAN TPP

1.5 PROJECT AT A GLANCE

General:

Project Authority (SPV)	:	Mahan Energen Ltd.
Project	:	2x800 MW Ultra Super-Critical ThermalPower Project.
Selected Location	:	Bandhaura, Nagwa, Karsualal and Khairahi village, Singrauli District, M.P.
Latitude and Longitude of the site	:	24°0'28.90"N latitude / 82°24'49.94"E longitude
Altitude	:	320 to 340 m.

Average RL	:	335 m.
Annual average rain fall	:	1132.7 mm
Nearest Major Town	:	Waidhan and Singrauli
Seismic Zone	:	Zone-III as per IS 1893
Access by Road	:	State Highway (SH14) is passing about 16km from the site.
Access by Rail	:	Singrauli Station is located at 52 km fromProject Site.
Access by Air	:	Nearest Airport is at Varanasi at a distanceof 280 km.
Access by Sea	:	Nearest Seaport is at Dhamra at a distanceof 770 km.

Preliminary Project Particulars:

Main Fuel	:	Coal from Commercial Coal Mines (GCV 3000-4200 Kcal/Kg)
Fuel Transportation	:	Through Long Belt conveyor (LBC) system.
Water	:	From the Rihand Reservoir at 36 km fromSite.
Land	:	920 Acres of land is available for the PowerProject.
Layout Features	:	2 X 800 MW Ultra Super-Critical Units

Technical Features:

Power Generating Unit sets	:	Two units of 800 MW turbine generator fed by steam from coal fired P.F. boiler operating at Ultra Super-critical range.

Cooling System	:	Closed recirculating condenser cooling system with induced draft cooling tower.
Coal Handling System	:	Coal handling facility, which comprises receipt of coal from Mines through LBC system, with on-line existing & new crushing and stacking by existing & new stacker-cum-reclaimer in the existing & new coal yard and finally feeding the bunker level conveyors.
Ash Disposal System	:	Provision will be made for disposal of fly ash in dry form to adjacent Cement Plants/ Mineback filling. Provision will be made for disposal of ash in high concentration slurry form.
Power Evacuation	:	At 400 kV level to State Transmission Unit (STU)
Environmental Aspects	:	Elaborate arrangements for Flue gas desulphurization (FGD) and Selective Catalytic Reduction (SCR) systems complying with emission norms as per latest MoEF & CC. Independent steel wet flue foreach unit, down- stream of FGD of suitable height as per MoEF & CC guidelines and an adequately designed electrostatic precipitator with more than 99.99% efficiency are envisaged. Waste water quality to be maintained as per MoEF & CC notification. Zero Plant Discharge facility shall be present since the cooling water, blow down water, waste water and ash water would be recycled back to the systemafter suitable treatment for reuse. For coal transportation from mines, pipe conveyor technology will be adopted to mitigate environmental concerns.

Rehabilitation Requirement	:	Nil

Other Facilities:

Township	:	Township with civic amenities would be developed.
Mode of Implementation	:	The Project would be implemented on EPCconcept.
Project Time Frame	:	54 months from Zero Date i.e. the date of 'Financial Closure' for Commercial Operation of Unit#3 and 60 months for Unit#4

FIGURE 1.3: VIEW OF MAHAN TPP AT SINGRAULI MADHYA PRADESH

2.0 APPROACH & METHODOLOGY

The state-of-the-art method was employed for the GHG Emission study of the Mahan Thermal Power Plant (TPP). This advanced approach ensured a comprehensive and accurate evaluation of the estimation of the GHG emissions due to the operation of existing as well as proposed expansion of Mahan TPP.

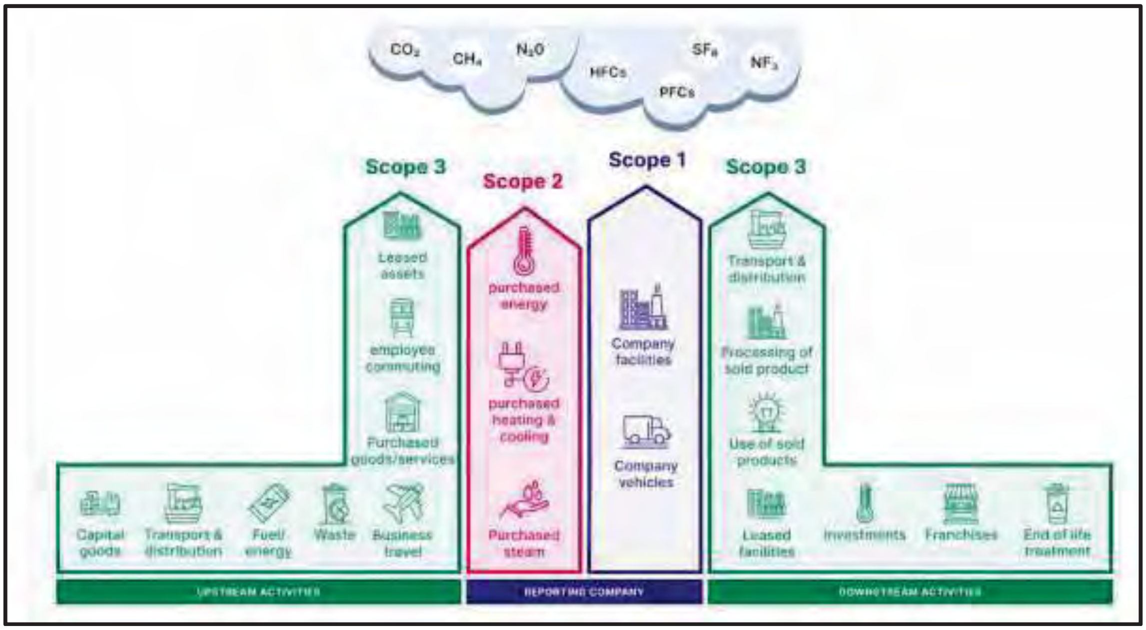
2.1 FRAMEWORK FOR GHG EMISSION MONITORING

The ISO 14060 family of standards aims to provide clarity and consistency in quantifying, monitoring, reporting, and validating GHG emissions and removals. Its primary objective is to support sustainable development by promoting a low-carbon economy and benefiting organizations, project proponents, and interested parties worldwide. Specifically, the use of the ISO 14060 family:

- Improves the accuracy and reliability of GHG quantification, enhancing environmental integrity.
- Boosts the credibility, consistency, and transparency of GHG quantification, monitoring, reporting, verification, and validation processes.
- Simplifies the development and implementation of GHG management strategies and plans.
- Streamlines the execution of mitigation actions by facilitating emission reductions or removal enhancements.
- Enables better tracking of performance and progress in reducing GHG emissions and/or increasing GHG removals over time.

The schematic diagram of the types of GHG emissions have been presented in Figure 2.1. The framework for GHG emission monitoring for coal based thermal power plant has been depicted in Figure 2.2.

FIGURE 2.1: SCHEMATIC DIAGRAM OF GHG EMISSION TYPES



Scope 1 emission- The direct emission that occurs from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles.

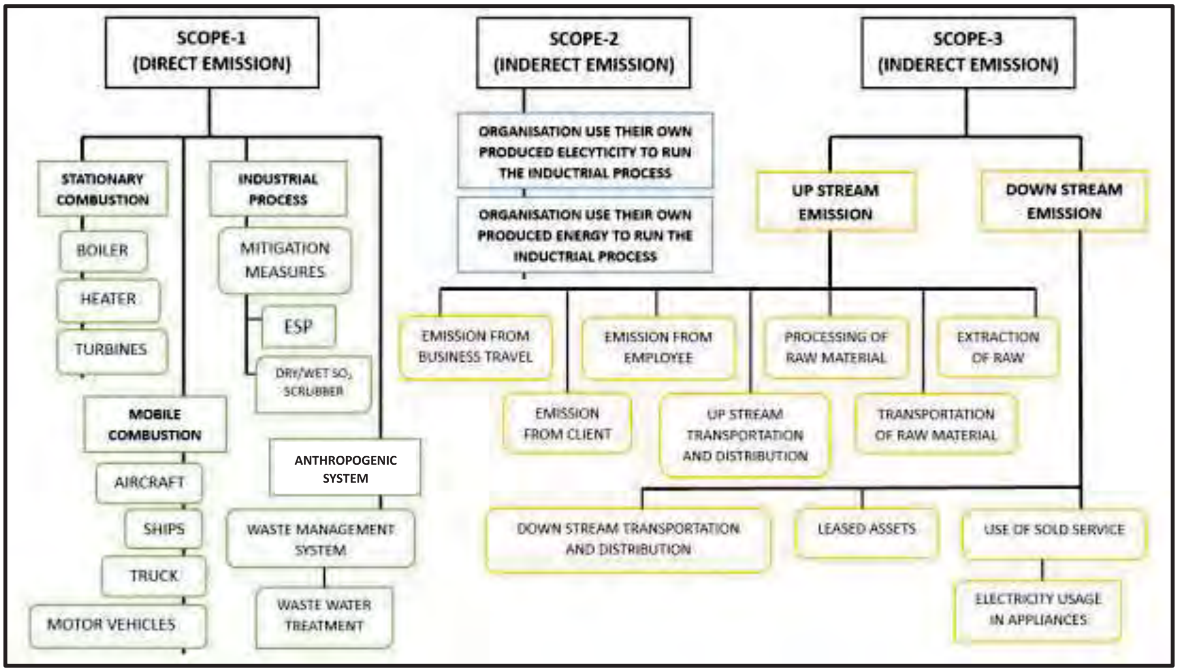
Scope 2 emission- The indirect emission, accounts for GHG emissions from the generation of purchased electricity consumed by a company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company.

Scope 3 emission- The indecent emission in scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. This category can be further classified into up-stream emission and down-stream emission.

- **Upstream emissions** refers to the indirect emissions generated during the production of goods or services a company purchases or uses before a product or service is delivered to the customer. For example, raw material extraction, transportation and processing, upstream transportation and distribution.

- **Downstream emissions** refers to the indirect emissions generated during the use, end-of-life treatment, and disposal phases of a product or service. These emissions occur after the product has been sold to the consumer. For example, use of sold services and goods, leased assets, downstream transportation and distribution.

FIGURE 2.2: FRAMEWORK FOR GHG EMISSION MONITORING FROM COAL-BASED THERMAL POWER PLANT



2.2 RECONNAISSANCE SURVEY

A kick-off meeting was organized on March 7th, 2024, at Mahan Energen Limited (MEL) to finalize the modalities for undertaking the study for accounting GHG emissions of Mahan TPP. The meeting was conducted under the guidance and leadership of Shri R N Shukla, Head, Environment & Forest, APL, Ahmedabad along with Santosh Kumar, Environment Head, MEL and other EHS executives of MEL along with the Project Team members of IISWBM.

Initially, the Shri Shukla & his team members appraised the objectives of the proposed study and the required coverage as per MoEF&CC Environmental Clearance conditions. The project involves the estimation of GHG emissions from Mahan TPP including expansion project (2X800 MW). MEL Team also shared detailed information regarding the monthly variation in GHG emissions from Mahan TPP. It was decided that the estimation will be calculated for the existing 1200 MW plant and for the proposed expansion, where 1600 MW (2x800 MW) will be added. The emissions would be calculated to provide a comparative analysis of the change in CO_2 emissions envisaged for the proposed expansion. During the meeting, a detailed plan for undertaking the field study was also discussed, and it was resolved that all the required primary data needed to be collected within a stipulated time frame. MEL Team shared the details of the new plant design, including coal and auxiliary fuel consumption, and the modern technologies that would be used, as these factors were integrated into the analysis.

2.3 DATA COLLECTION

The study has used primary as well as secondary data for the purpose of analysis. Secondary data viz., various literatures, annual reports, documents, etc. that are available with the MEL, Central Electricity Authority (CEA) and other related department have been used. Primary data has been collected through field survey and interview with various stakeholders and discussions with MEL officials.

The collated information regarding existing management practices of greenhouse gas emissions was verified and validated through field visit for the assessment of baseline status of key environmental and social parameters in and around the Mahan TPP.

All data collected through the survey was computerized on MS-Excel and SPSS.

2.4 DATA ANALYSIS

All data and information collected through the study was analyzed and interpreted with a view to formulate a comprehensive action plan and evolve sustainable greenhouse gas accounting model. The analysed data has been presented through tables, figures. Interpretation of data and information are fundamental to the study and hence environmentalists, ecologists, sociologists, economists were involved in this study. Such an approach will not only facilitate appropriate planning and speedy implementation of the greenhouse gas accounting plan for the Mahan TPP but will also help the MEL officials in managing their greenhouse gas inventory in an efficient manner.

The interpretation has given equal weightage to qualitative and quantitative aspects so that a balanced view of the impact of existing advanced technologies for reduction of emissions may be identified and cost effective greenhouse gas accounting plan for the TPP can be formulated.

For the GHG emission accounting study of Mahan TPP, the station-level emissions were initially calculated based on CEA guidelines. Following this, a Life Cycle Assessment (LCA) model was employed to quantify the impact on various categories such as climate change, human toxicity, particulate matter formation etc. The LCA model also determined the percentage contribution of different inputs to these impacts.

The LCA of a coal based thermal power plant encompasses three main stages: upstream processes, the coal-to-electricity cycle, and downstream processes. The study focused on estimating greenhouse gas emissions throughout the coal-to-electricity cycle, which consists of four stages. The mining stage involves methane leakage from coal mines into the atmosphere, and the consumption of electricity and diesel by mining equipment. The coal beneficiation stage includes coal selection and washing processes. The transportation stage covers the transportation of coal from the mine to the power plant using trucks and trains. Finally, the fuel combustion stage includes the combustion of coal and oil.

In addition to determining the impact categories, the LCA also assessed the percentage contribution of different inputs, providing a comprehensive understanding of the environmental impact of the entire coal power generation process at Mahan TPP.

FIGURE 2.3: FIELD SURVEY FOR DATA COLLECTION AT MAHAN TPP

3.0 ESTIMATION OF CO_2 EMISSION

To effectively assess the potential risks of GHGs, it is crucial to meticulously account for total GHG emissions from coal-based thermal power plants (TPPs). Recognizing this necessity, the Central Electricity Authority (CEA) has provided detailed guidelines for calculating GHG emissions at the station level. These initiatives aim to ensure accurate monitoring and reporting of emissions, thereby facilitating the implementation of the Clean Development Mechanism (CDM) projects under the Kyoto Protocol to the UNFCCC and contributing to India's overall efforts in mitigating climate change.

3.1 CEA GUIDELINE FOR ESTIMATION OF CO_2 EMISSION AT STATION LEVEL

3.1.1 Assumptions at Station Level

At the station level, certain assumptions were made in instances where specific data could not be provided by the respective stations.

3.1.2 Net Generation

In cases where data on auxiliary power consumption was not available, the Central Electricity Authority (CEA) standard values were applied. These standard values ensure a consistent approach across various thermal stations. The total net generation figures were provided directly by the plants.

3.1.3 Gross Calorific Value (GCV):

According to the CEA guidelines, default GCV values were used for some thermal power stations where station-specific GCV data was unavailable. For the present study, a GCV of 4072 Kcal/kg, as provided by the Mahan TPP, was used. This standardized approach ensures uniformity and accuracy in the calculation and assessment of the stations' performance metrics.

These assumptions are necessary to maintain the integrity and consistency of the data analysis, ensuring that even in the absence of specific station-level data, the overall evaluation remains robust and reliable.

3.1.4 Calculation Approach

Baseline data and annual database were used to calculate carbon dioxide emission at station level. Calculation of CO_2 emissions at station level was done by using the formula:

$$\mathbf{AbsCO_2\ (station)_y = \sum_{i=1}^{2} FuelCon_{iy} \times GCV_{iy} \times Ef_i \times Oxid_i}$$

Where, **$AbsCO_2$ (station)$_y$** is Absolute CO_2 emission of the station in the given fiscal year 'y', **$FuelCon_{iy}$** is amount of fuel of type 'i' consumed in the fiscal year 'y', **GCV_{iy}** is CO_2 emission factor of the fuel 'i' based on GCV, **$Oxid_i$** is oxidation factor of the fuel 'i'.

The emission factor for Indian Coal and lignite were calculated based on the values provided in India's Initial National Communication under the UNFCCC (Ministry of Environment and forest, 2004). To calculate specific CO_2 emission of station, the following formula was used:

$$SpecCO_2\,(station)_y = AbsCO_2(station)_y \,/\, NetGen(station)_y$$

Where, **($AbsCO_2(station)_y$)** is the absolute emission estimated by the formula provided above and **[$NetGen(station)_y$]** is the station's net generation.

3.2 STATION LEVEL ESTIMATION OF CO_2 EMISSION AT MAHAN TPP

The Mahan TPP is a significant contributor to power generation, relying on coal as its primary fuel source. To accurately assess the environmental impact of its operations, it is crucial to estimate the CO_2 emissions at the station level. This estimation not only aids in understanding the plant's carbon footprint but also supports efforts to optimize performance and implement cleaner technologies.

It is to be taken into account that CO_2 emission estimation for Mahan TPP encompasses both the current operational capacity and the anticipated changes due to its proposed expansion project. Presently, the plant operates with an installed capacity of 1200 MW, consisting of two units of 600 MW each. To provide a comprehensive environmental assessment, CO_2 emissions for this existing capacity have been meticulously calculated.

In addition to evaluating the current emissions, a forward-looking analysis has been conducted to estimate the probable changes in CO_2 emissions resulting from the proposed expansion of Mahan TPP. The expansion project plans to increase the capacity by an additional 1600 MW, with two new units of 800 MW each. This prospective increase in capacity necessitates a thorough assessment to understand its potential impact on the plant's overall carbon footprint.

By examining both the existing and future scenarios, the CO_2 emission estimates will aid in identifying the environmental implications of the expansion. This detailed analysis is crucial for strategic planning, ensuring that the proposed growth aligns with environmental standards and contributes to the sustainable development goals. The comprehensive analysis for determination of CO_2 emission at station level by adhering to the guidelines set forth by the CEA has been presented in the subsequent section.

The status of monthly variation in fuel consumption and electricity generation for existing 1200 MW plant at MEL during the period 2023-24 has been presented in Figure 3.1. The data indicates that over the 12-month span, the plant consumed a total of 4,231,145.30 metric tons (MT) of coal and 2,438.33 kiloliters (KL) of auxiliary fuel. The gross electricity generation during this period amounted to 6,736,175.90 megawatts (MW), while the auxiliary consumption of electricity was 472,941.15 MW. Consequently, the net electricity generation, which accounts for the electricity used by the plant itself, totalled 6,264,843.08 MW. These figures reflect the operational efficiency and fuel utilization of the plant, providing a comprehensive overview of its performance over the year.

TABLE 3.1: STATUS OF FUEL CONSUMPTION & ELECTRICITY GENERATION OF EXISTING 1200 MW (2X600 MW) PLANT AT MEL DURING 2023-24

Month	Coal consumption (MT)	Auxiliary Fuel consumption (HSD) (KL)	Gross Electricity Generation (MW)	Auxiliary power consumption (MW)	Auxiliary power consumption (%)	Net Electricity generation (MW)
Apr-23	444756.60	91.74	698419.40	46485.40	7	651934.00
May-23	351919.00	84.13	551661.20	40741.11	7	510920.09
Jun-23	358024.30	198.4	564938.80	42848.80	8	522159.00
Jul-23	361347.50	305.5	572667.30	44176.02	8	528660.00
Aug-23	240257.30	108.53	378224.30	28421.20	8	349803.10
Sep-23	226061.98	412.56	342964.10	28319.38	8	315461.12
Oct-23	418434.25	118.16	678204.80	44744.80	7	633460.00
Nov-23	313584.12	288.55	491513.20	34731.20	7	456782.00
Dec-23	451785.88	172.29	716690.60	45764.52	6	671087.00
Jan-24	419552.12	102.12	685184.20	43753.20	6	641431.00
Feb-24	335851.00	114.5	549807.80	37616.10	7	512191.70
Mar-24	309571.25	441.85	505900.20	35339.41	7	470954.07
TOTAL	4231145.30	2438.33	6736175.90	472941.15	7	6264843.08

The monthly variation in total and specific CO_2 emissions for different fuel consumption types and overall emissions at the Mahan TPP for the existing 1200 MW (2x600 MW) plant for 2023-24 has been presented in Table 3.2. The analysis reveals consistent emissions with minor fluctuations over the specified period. The overall specific CO_2 emission, which combines emissions from both coal and auxiliary fuel combustion, remained relatively stable, averaging 0.971 t/MWh over the year.

In most months, the specific CO_2 emission from coal combustion hovered around 0.944 to 1.018 t/MWh, indicating steady combustion efficiency. The auxiliary fuel combustion had minimal impact on the overall specific CO_2 emissions due to its significantly lower contribution, typically ranging from 0.0004 to 0.0037 t/MWh. Notably, in September 2023, there was a slight increase in specific CO_2 emissions from auxiliary fuel combustion, reaching 0.0037 t/MWh, which corresponded with a higher overall specific CO_2 emission of 1.022 t/MWh. Conversely, the lowest overall specific CO_2 emissions were recorded in January and

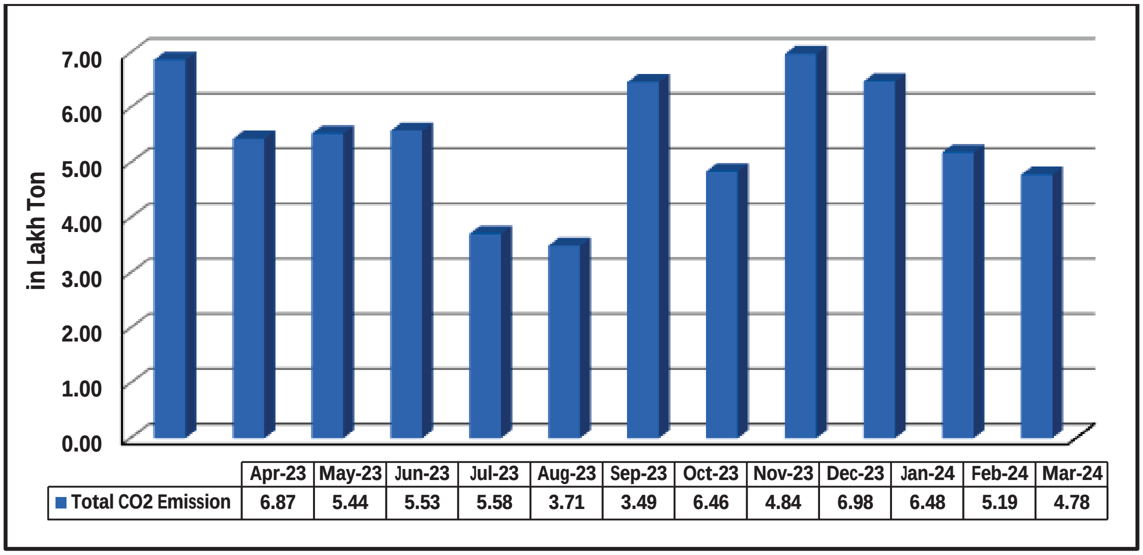
February 2024, at 0.946 t/MWh and 0.944 t/MWh, respectively, primarily due to efficient coal combustion and minimal auxiliary fuel use.

The total CO_2 emissions from coal combustion varied monthly, with the highest emissions recorded in December 2023 at 6.98 lakh tons and the lowest in September 2023 at 3.49 lakh tons. The total CO_2 emissions from auxiliary fuel combustion were significantly lower, with a peak of 0.014 lakh tons in March 2024. Overall, the total CO_2 emissions for the year amounted to 65.43 lakh tons, indicating a well-managed emission profile with consistent monitoring and control measures in place.

TABLE 3.2: MONTHLY VARIATION IN CO_2 EMISSION AT STATION LEVEL FOR EXISTING 1200 MW (2X600 MW) PLANT AT MEL

Month	CO_2 emission from coal combustion	Specific CO_2 emission from coal combustion	CO_2 emission from auxiliary fuel combustion	Specific CO_2 emission of auxiliary fuel combustion (HSD)	Overall CO_2 emission	Overall Specific CO_2 emission
	(lakh ton)	(t/MWh)	(lakh ton)	(t/MWh)	(lakh ton)	(t/MWh)
Apr-23	6.87	0.984	0.003	0.0004	6.87	0.984
May-23	5.44	0.985	0.003	0.0005	5.44	0.986
Jun-23	5.53	0.979	0.006	0.0011	5.54	0.980
Jul-23	5.58	0.975	0.010	0.0017	5.59	0.976
Aug-23	3.71	0.981	0.003	0.0009	3.71	0.982
Sep-23	3.49	1.018	0.013	0.0037	3.50	1.022
Oct-23	6.46	0.953	0.004	0.0006	6.47	0.954
Nov-23	4.84	0.985	0.009	0.0019	4.85	0.987
Dec-23	6.98	0.974	0.005	0.0008	6.98	0.974
Jan-24	6.48	0.946	0.003	0.0005	6.48	0.946
Feb-24	5.19	0.944	0.004	0.0007	5.19	0.944
Mar-24	4.78	0.945	0.014	0.0029	4.80	0.948
OVERALL	65.35	0.970	0.076	0.0012	65.43	0.971

FIGURE 3.1: MONTHLY VARIATION IN TOTAL CO_2 EMISSION AT MAHAN TPP 2X600 MW (2023-24)



The yearly variation in specific CO_2 emission of Mahan TPP at station level (Table 3.3) shows a gradual decrease in emissions. This downward trend indicates continuous improvements in operational efficiency and possibly the adoption of cleaner technologies and better fuel management practices over the decade. The consistent reduction in specific CO_2 emissions reflects the plant's efforts to mitigate its environmental impact and enhance sustainability.

TABLE 3.3: YEARLY VARIATION IN CO_2 EMISSION AT STATION LEVEL FOR EXISTING (2X600 MW) MAHAN TPP

Year	Coal consumption (MT)	Auxiliary fuel consumption (HSD) (KL)	Gross power Generation (MW)	Net power generation (MW)	CO_2 emission from coal combustion (Lakh Ton)	CO_2 emission from auxiliary fuel combustion (Lakh Ton)	Total CO_2 emission (Lakh Ton)
2013-14	1214960.00	1267.90	1803870.00	1663770.00	18.76	0.04	18.8
2018-19	1331140.00	1037.44	1979050.00	1825360.00	20.56	0.03	20.59
2023-24	4231145.30	2438.33	6736175.90	6264843.082	65.35	0.07	65.43

FIGURE 3.2: COMPARATIVE ANALYSIS OF TOTAL CO_2 EMISSION AT MAHAN TPP

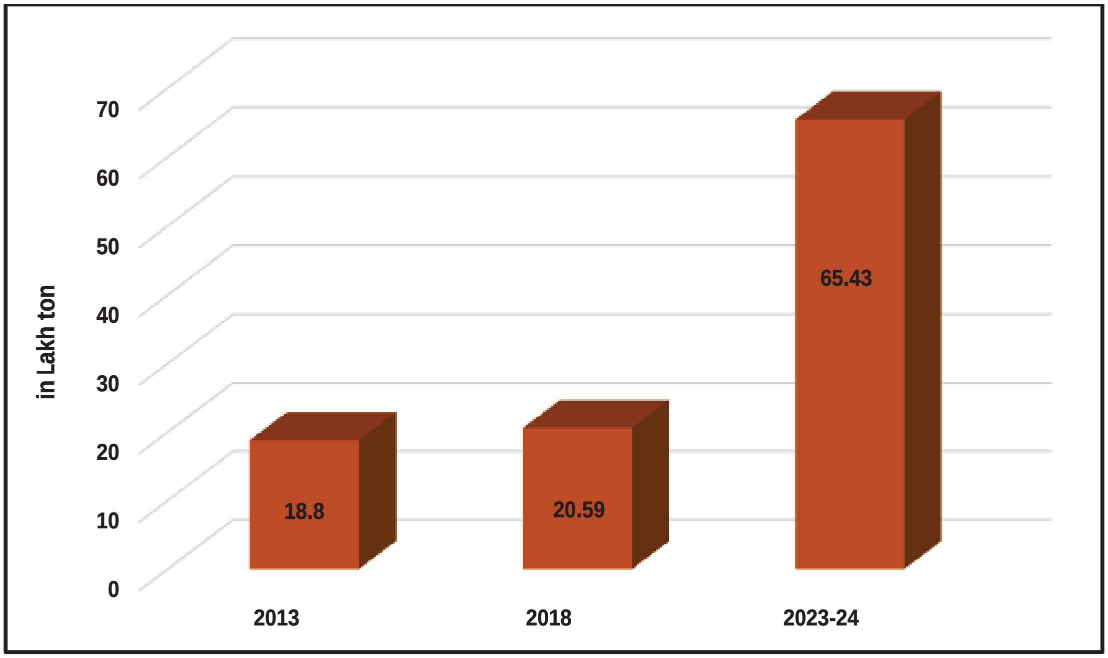
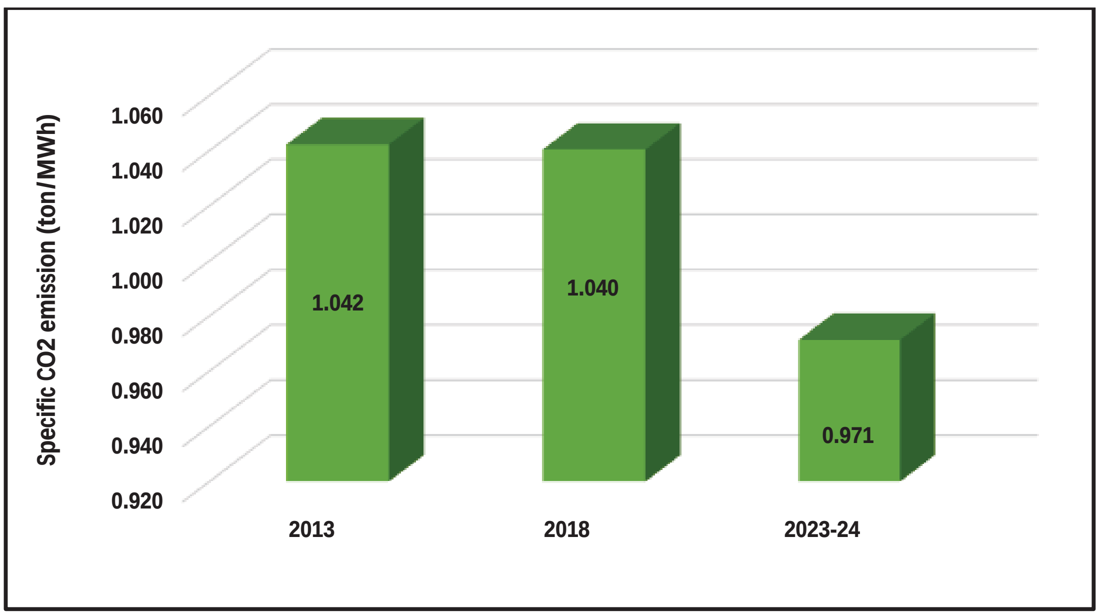


FIGURE 3.3: COMPARATIVE ANALYSIS OF SPECIFIC CO_2 EMISSION AT MAHAN TPP



3.3 ESTIMATION OF CO_2 EMISSION AT MAHAN TPP FOR PROPOSED EXPANSION

The estimated variation in electricity generation for the proposed expansion of the Mahan Thermal Power Plant (TPP) has been presented in Table 3.4, whereas Table 3.5 details the estimated variation in specific CO_2 consumption for the same expansion. These tables offer a comprehensive overview of the expected changes in both electricity generation and CO_2 emissions, considering the current and expanded capacities of the plant.

Three scenarios have been considered for undertaking the analysis which are as follows:

1. Existing Capacity (2x600 MW):

The current operational setup with an installed capacity of 1200 MW generated 6,736,175.90 MW of gross electricity and 6,264,843.08 MW of net electricity annually. The specific CO_2 emission for this capacity is recorded at 1.04 t/MWh, resulting in total CO2 emissions of 6,542,909.21 tons.

2. Proposed Expansion (2x800 MW) at 100% PLF:

For the proposed expansion, assuming a 100% Plant Load Factor (PLF), which signifies that the plant operates at its maximum capacity continuously over a given period, the gross electricity generation is estimated at 14,016,000 MW, with a net generation of 13,034,880.00 MW. The specific CO_2 emission is projected to be significantly lower at 0.81 t/MWh, leading to total CO_2 emissions of 10,599,038.15 tons.

3. Proposed Expansion (2x800 MW) at 90% PLF:

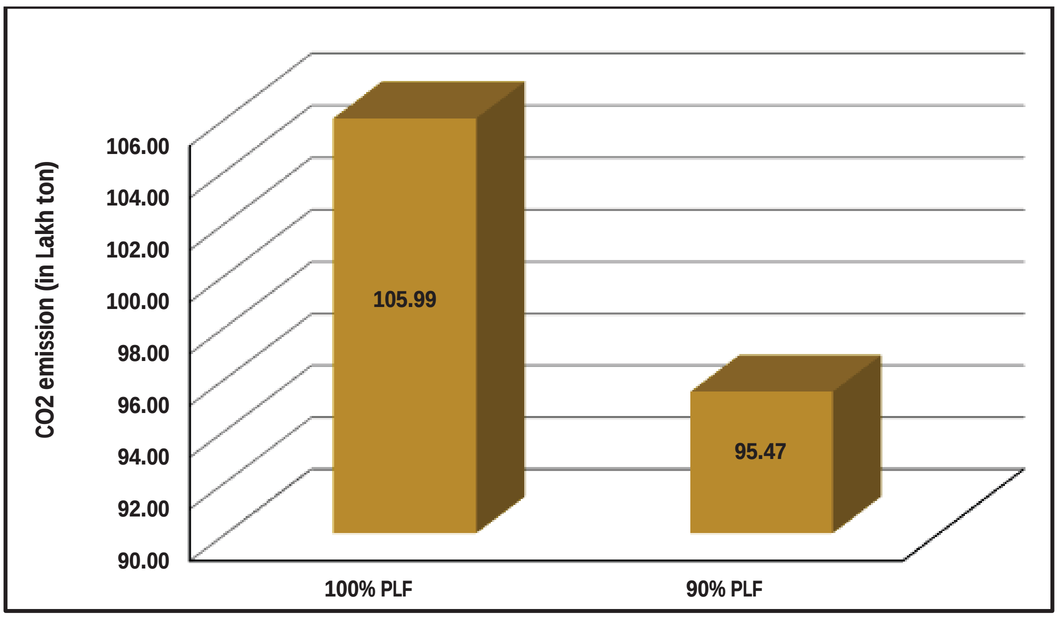
Under the scenario where the proposed expansion operates at 90% PLF, the gross electricity generation is estimated at 12,614,400 MW, and the net electricity generation at 11,731,392 MW.

Table 3.4 presents the estimated variation in fuel consumption and CO_2 emissions for the proposed expansion of the Mahan TPP to the existing 1600 MW capacity. The table provides data for two scenarios: operating at 100% Plant Load Factor (PLF) and at 90% PLF. At 100% PLF, the plant is expected to consume 6.85 million tons per annum (MTPA) of coal and 6000 kiloliters (Kl) of auxiliary fuel (HSD), generating 14,016,000 MW of gross electricity and 13,034,880 MW of net electricity. This scenario results in a total CO_2 emission of 105.99 lakh tons, with 105.80 lakh tons from coal combustion and 0.19 lakh tons from auxiliary fuel combustion. In the 90% PLF scenario, coal consumption is estimated at 6.17 MTPA with the same auxiliary fuel usage, leading to a gross electricity generation of 12,614,400 MW and net generation of 11,731,392 MW. This scenario results in a slightly lower total CO_2 emission of 95.49 lakh tons, with 95.30 lakh tons from coal and 0.19 lakh tons from auxiliary fuel. The analysis indicates that operating at a lower PLF reduces both coal consumption and CO_2 emissions, highlighting the significant impact of plant utilization rates on fuel efficiency and environmental performance.

TABLE 3.4: ESTIMATED VARIATION IN FUEL CONSUMPTION & CO_2 EMISSION FOR PROPOSED EXPANSION

1600 MW Capacity	Coal consumption	Auxiliary fuel consumption (HSD)	Gross Electricity Generation	Net Generation	CO2 Emission from Coal	CO2 Emission from Auxiliary fuel	Total CO2 Emission
	(MTPA)	(Kl)	(MW)		(Lakh ton)		
100% PLF	6.85	6000	14016000	13034880.00	105.80	0.19	105.99
90% PLF	6.17	5400	12614400	11731392	95.30	0.17	95.47

FIGURE 3.4 CO_2 EMISSION ESTIMATED FOR THE PROPOSED EXPANSION OF MAHAN TPP



PLF, or Plant Load Factor, is a critical metric that measures the ratio of actual output to the maximum possible output of a plant. It is significant in estimating station-level CO2 emissions because it reflects the efficiency and utilization rate of the plant. A higher PLF typically indicates more efficient operation and better utilization of resources, potentially leading to lower specific CO_2 emissions.

The comparative analysis of variation in estimated electricity generation and CO_2 emission for existing and proposed capacity have been presented in Table 3.5 and 3.6 respectively. The study reveals a noteworthy reduction in the overall specific CO_2 emission after the proposed expansion. The current specific CO_2 emission of 0.97 t/MWh is expected to decrease to 0.76 t/MWh at 100% PLF for proposed 1600 MW capacity and 0.86 t/MWh overall when combining the existing and proposed capacities. This reduction can largely be attributed to the installation of ultra-supercritical technology in the new expansion project. Ultra-supercritical technology operates at higher temperatures and pressures compared to traditional coal-fired power plants, resulting in more efficient fuel combustion and significantly lower specific coal consumption. Consequently, this enhances the plant's overall efficiency and leads to a substantial reduction in specific CO_2 emissions at the station level.

By adopting these advanced technologies, the Mahan TPP not only aims to increase its electricity generation capacity but also to minimize its environmental impact, aligning with broader sustainability and emission reduction goals. The analysis clearly indicate the potential benefits of such technological upgradation in reducing the carbon footprint of coal-based power generation.

TABLE 3.5: STATUS OF ELECTRCITY GENERATION FOR EXISTING AND PROPOSED EXPANSION OF MAHAN TPP

Installed Capacity	1200 MW	Proposed Expansion (1600 MW)	
		100% PLF	90% PLF
Gross Electricity Generation (MW)	6736175.90	14016000	12614400
Net Electricity Generation (MW)	6264843.08	13034880.00	11731392

TABLE 3.6: COMPARATIVE ANALYSIS OF VARIATION IN CO_2 EMISSION FOR EXISTING AND PROPOSED EXPANSION OF MAHAN TPP

Total Installed capacity (MW)	Total CO_2 emission (Ton)	Specific CO_2 emission (t/MWh)
1200	6542909.21	0.97
1600	10599038.15	0.76
Overall	17141947.35	0.86

FIGURE 3.5: COMPARATIVE ANALYSIS OF TOTAL CO_2 EMISSION AT MAHAN TPP

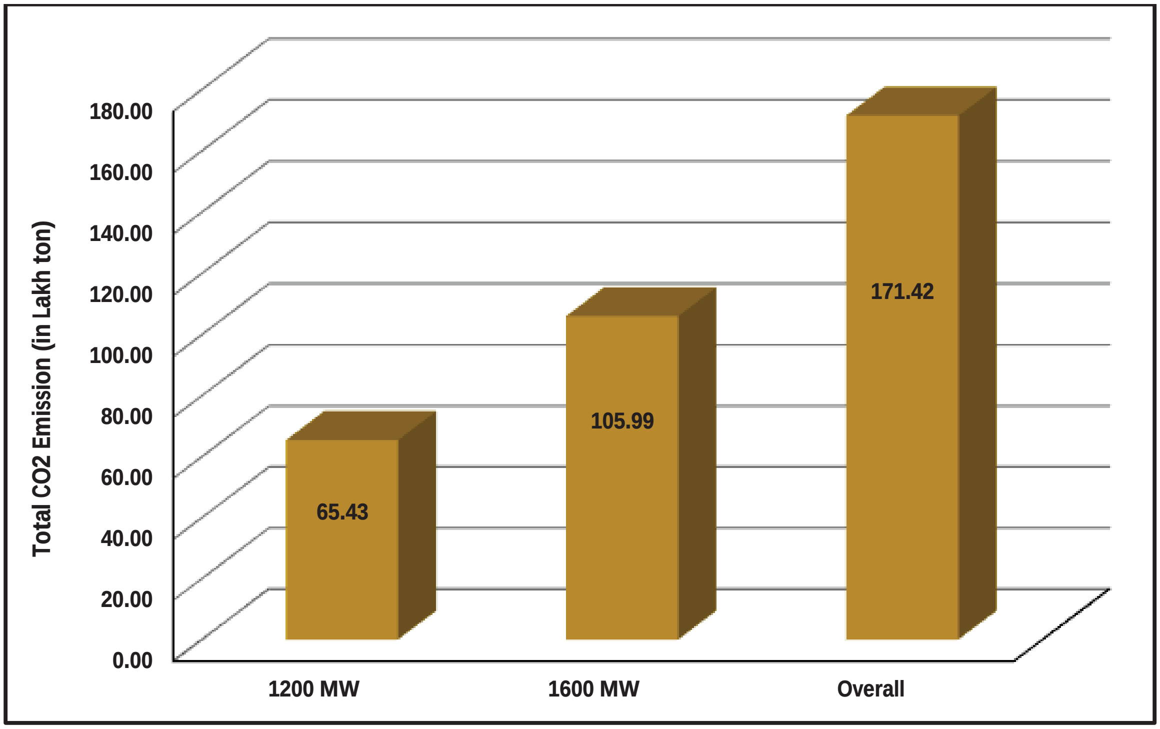
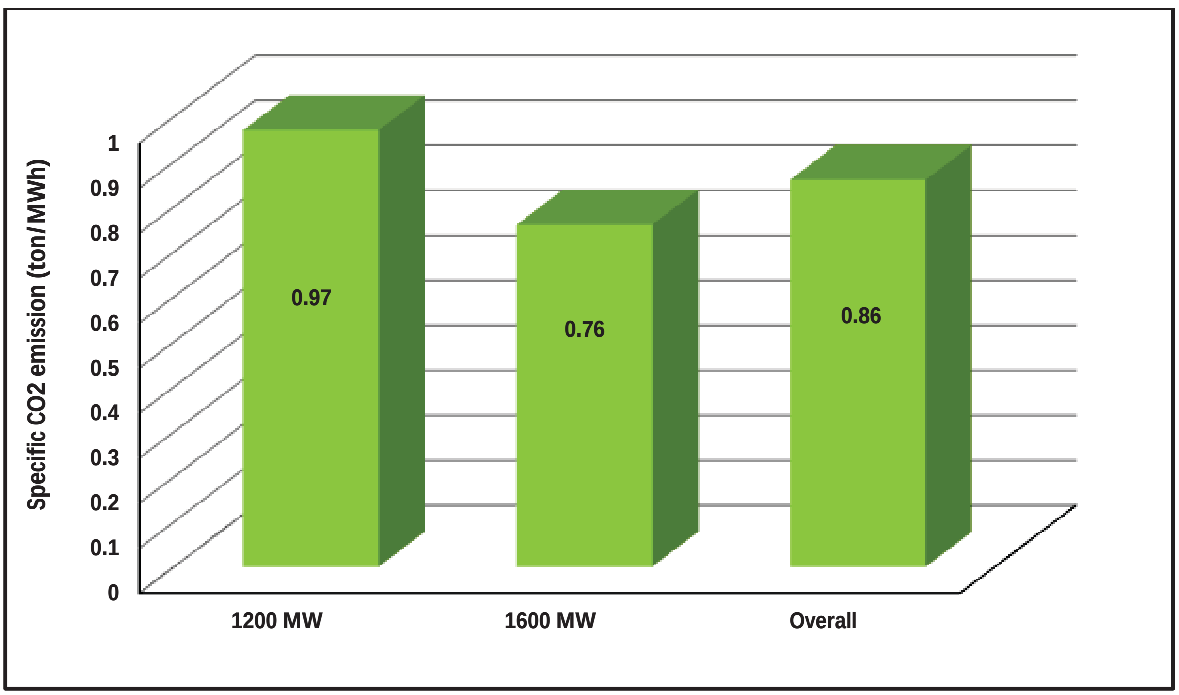


FIGURE 3.6: COMPARATIVE ANALYSIS OF SPECIFIC CO_2 EMISSION AT MAHAN TPP

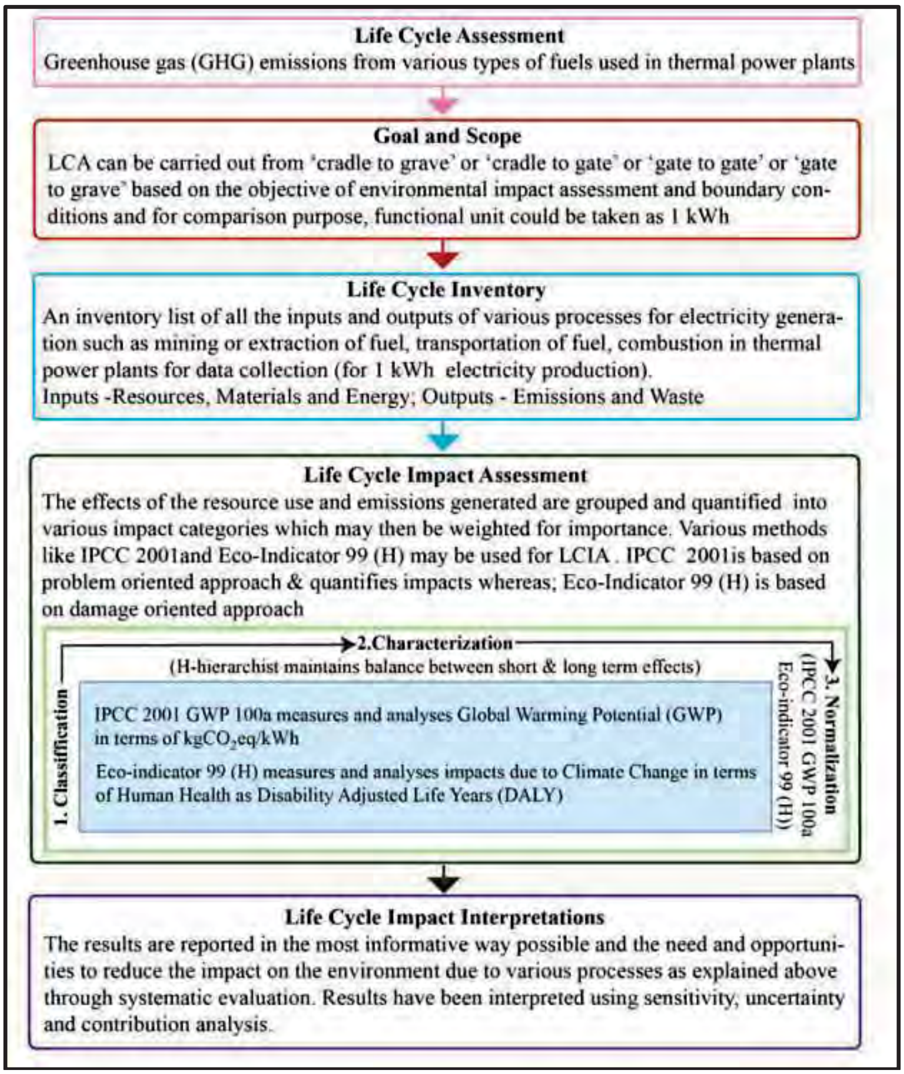


4.0 LIFE CYCLE ASSESSMENT

The Life Cycle Assessment is a process of gathering and evaluating input and output data and assessing a product's potential effect on the environment during its life cycle.

The LCA study for electricity generation in Mahan TPP has been carried out in reference with the guidelines of the International Organization for Standardization (ISO) and more specifically, the principles of the ISO 14040 (2006) and ISO 14044 (2006) standards. As per the ISO 14040 guidelines for comprehensive Life Cycle Assessments (LCA) studies, there is a structured framework comprising four essential stages: goal and scope definition, inventory analysis, impact assessment, and interpretation of results (Figure 4.1).

FIGURE 4.1: FRAMEWORK FOR LIFE CYCLE ASSESSMENT



1. Determining the goal and scope of the study (choosing the functional unit and system boundaries);
2. Analysis of an inventory of inputs and outputs (analysis of the technological process, balance of flows of raw materials, energy, and auxiliary materials, waste balance, and identification of their potential sources);
3. Assessment of the environmental impact of the life cycle (transforming the data collected into impact category or damage category indicators);
4. Interpretation (conclusions and verification of results).

The present study also reviewed the recent studies on life cycle assessment (LCA) in the context of the generation of electricity. In analyzing the environmental consequences of electricity generation from Mahan TPP, it is necessary to distinguish between the impact at the level of industrial production technologies and during their application in electricity generation.

Various studies related to estimation of GHG emissions from coal based thermal power plants through the utilization of LCA technique has been presented in the subsequent section.

LCA was carried out to investigate the GHG emissions from a coal based thermal power plant. The various stages involved in the assessment of life cycle GHG emissions in the specific study included coal mining, transportation of coal to the power plant and coal combustion for electricity generation. The results showed that direct CO_2 emission from coal combustion is about 0.98 ton CO_2-e/MWh, whereas life cycle GHG emissions amount to 1.02 ton CO2-e/MWh.

The life cycle assessment approach was used for assessing GHG emissions and their impacts due to natural gas combined cycle (NGCC) and imported coal thermal power plants using the IPCC 2001 and Eco-Indicator 99(H) methods. For the study, SimaPro software and ecoinvent V2.2 database was utilized. The results indicated that the total GHG emission from the thermal power plant using imported coal was approximately 1.24 ton CO_2 eq/MWh electricity generation.

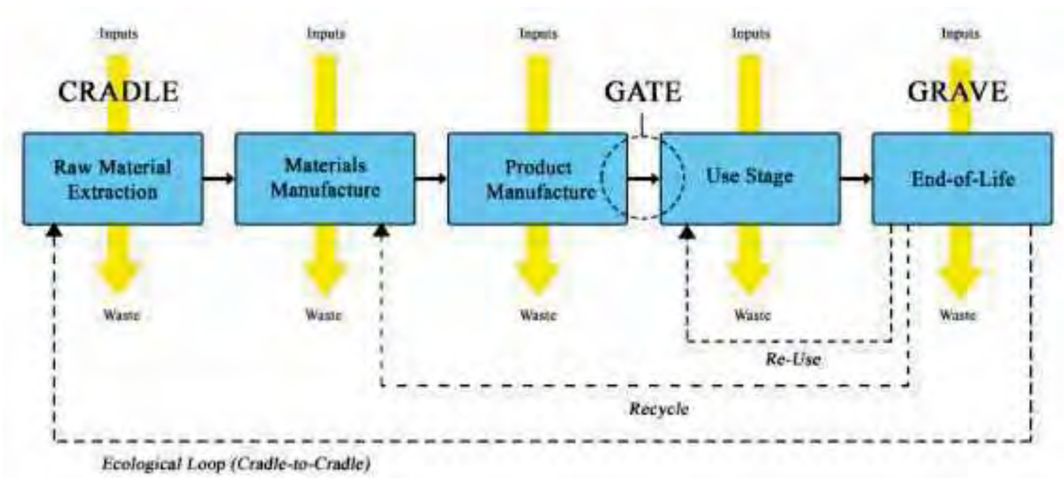
A study was carried through the life cycle assessment approach to determine the environmental footprint of coal and imported gas based power generation in India. The study revealed that for thermal power plants utilizing domestic coal, the overall GHG emissions varied between 0.95-1.23 ton/MWh because of heterogeneity in existing power plant characteristics such as efficiency, age, and capacity. The study further suggested that the GHG intensity of the Indian coal-power sector may be reduced by 13% by retiring plants with the lowest efficiencies and replacing them with higher efficiency supercritical plants.

4.1 SYSTEM BOUNDARY

The System boundary means that the inputs of the system include energy, water consumption and raw materials for all stages of generation and for every unit, as well as for the final outputs of the system, which is the final product i.e. electricity.

In present study an approach of 'cradle to gate' has been used for LCA due to the constraint in data availability outside the plant boundary which takes into account the environmental effects of consumption of electricity at generated from Mahan TPP. Accordingly, it was resolved that in present study primarily, a cradle-to-gate system boundary was selected to quantify the environmental footprint of power generation (Figure 4.1).

FIGURE 4.1: TYPICAL SYSTEM BOUNDARY FOR LCA STUDY

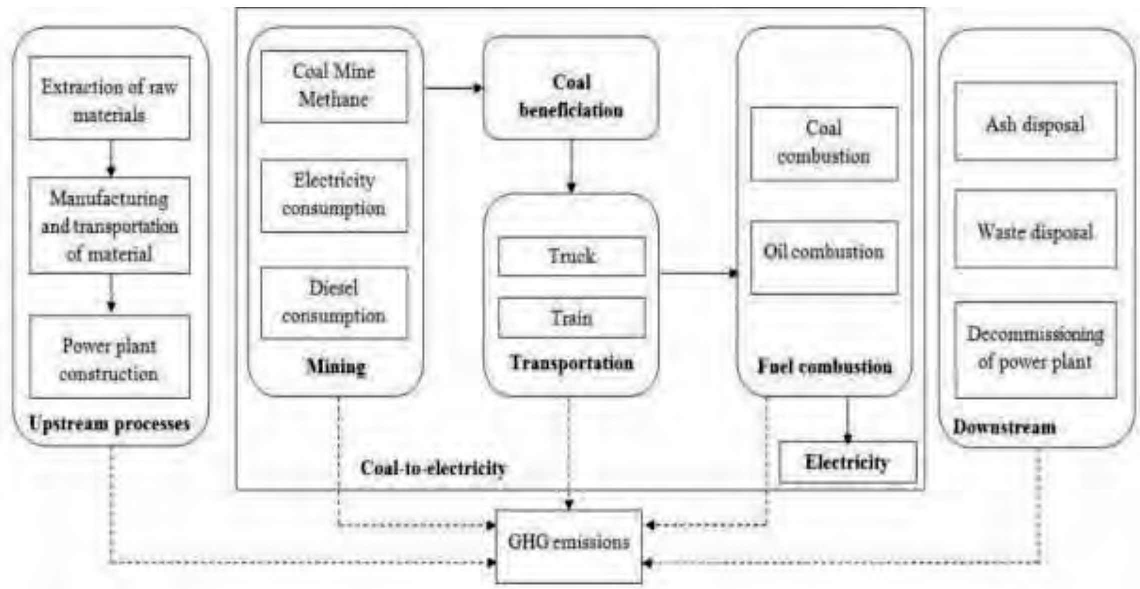


To analyse material inputs, the process starts by initially choosing which inputs to examine. This selection process should stem from identifying the inputs linked to each of the unit processes that will be represented in the model. This identification task can involve gathering data from specific locations or consulting published sources. The objective is to pinpoint the noteworthy inputs connected to each unit process.

In cases where the study aims to make comparative claims intended for public disclosure, the final sensitivity analysis of input and output data should encompass mass, energy, and environmental significance criteria. This ensures that all inputs that collectively contribute above a defined threshold (e.g., a percentage) to the total impact are incorporated into the study. All of the selected inputs identified through this process must be represented as basic flows. Additionally, it is essential to determine which input and output data need to be traced to other product systems, including flows subject to allocation. The description of the system should be comprehensive and clear enough to enable another practitioner to imitate the inventory analysis.

LCA of coal based thermal power plant has three main stages i.e., upstream processes, coal to electricity cycle and downstream processes as shown in Figure 4.2. The present study focuses on greenhouse gas emissions from coal-to-electricity cycle. In this cycle there are four stages. Mining stage includes coal mine methane leakage into atmosphere, and electricity and diesel consumption by mining equipments. Coal beneficiation stage includes coal selection and washing. Transportation stage includes transportation of coal from mine to the power plant by trucks and trains. Fuel combustion stage includes coal and oil combustion.

FIGURE 4.2: SYTEM BOUNDARY OF A COAL BASED THERMAL POWER PLANT



4.2 APPROACH & TOOLS FOR LCIA

Following approach using the state-of-the-art methods have been adopted for Life Cycle Impact Assessment/Analysis (LCIA) of electricity generation from Mahan TPP:

4.2.1 Inventory Analysis

- ***Data Acquisition:*** The input data used for the present study have been obtained from the primary as well as secondary sources including Mahan Thermal Power Plant.

- ***Life Cycle Inventory (LCI):*** The second phase of the LCA involves identifying, gathering, and analyzing the inventory of inputs (consumption of natural resources, materials, energy carriers) and outputs (e.g., emissions of substances into the atmosphere, water, and land, waste, by-products) in the product system, which are usually assigned to each unit process. Data on the processes are procured by means of measurements and calculations, from available databases, publications, and reports, and on the basis of unpublished information from Mahan TPP, research institutions, etc.

4.2.2 Life Cycle Impact Analysis/Assessment

This phase assesses the impact of the product or process on the environment. In order to transform the LCI data into impact category indicators and to obtain values (indicator results for each impact category), three mandatory tasks to be considered:

- Selection of impact categories, category indicators, and characterization models;
- Classification (assigning LCI results to particular impact categories); and
- Characterization (calculating the value for the impact category indicator using characterization factors).

The LCIA phase includes optional procedures as well – normalization (calculating the normalized indicator values with respect to reference values, without assessing the importance of the environmental impact), grouping (assigning the impact category to one or more sets according to the goal and scope of the study), weighting (assigning importance to each impact category and damage category), or data quality analysis. LCIA is the most important and most controversial phase of LCA. Transforming LCI results into indicators is made more difficult by the fact that there are many models for replacing a given type of emission with units of indicator result and assigning them to an impact category. Thus, the LCIA results often only identify and define potential environmental impacts.

To accomplish the aim and scope of the present study the ReCiPe method was selected, which has been developed recently in the Netherlands to harmonize the CML and Eco indicator 99 methods, as life cycle impact assessment method. Generally, a total of 18 impact categories are calculated in this method: namely Climate Change (CC), Ozone depletion (OD), Terrestrial acidification (TA), Freshwater eutrophication (FE), Marine eutrophication (ME), Human toxicity (HT), Photochemical oxidant formation (POF), Particulate matter formation (PMF), Terrestrial ecotoxicity (TET), Freshwater ecotoxicity (FET), Marine ecotoxicity (MET), Ionising radiation (IR), Agricultural land occupation (ALO), Urban land occupation (ULO), Natural land transformation (NLT), Water depletion (WD) and Fossil depletion (FD). The brief detail of these impacts are presented in subsequent section:

- **Global Warming Potential (GWP)**: This category evaluates the extent to which a product's lifecycle emissions contribute to global climate change. It focuses on greenhouse gases like carbon dioxide and their role in trapping heat in the atmosphere.

- **Ozone Depletion Potential (ODP)**: Ozone-depleting substances released during a product's lifecycle are assessed in this category, considering their potential to damage the protective ozone layer in the Earth's stratosphere.
- **Acidification Potential (AP)**: The emissions of acidic compounds from a product's lifecycle are analyzed here. This category assesses their potential to lower soil and water pH, impacting ecosystems and aquatic life.
- **Eutrophication Potential (EP)**: This category measures the extent to which emissions contribute to nutrient enrichment in water bodies, causing excessive plant growth, oxygen depletion, and ecological imbalances.
- **Human Toxicity Potential (HTP)**: Evaluates the potential harm posed to human health due to toxic substances released during a product's lifecycle, considering routes of exposure and their impacts.
- **Freshwater Ecotoxicity Potential (FETP)**: This category assesses the potential toxicity of emissions on aquatic organisms, focusing on the impact on freshwater ecosystems and their inhabitants.
- **Marine Ecotoxicity Potential (METP)**: Similar to FETP, this category evaluates the potential toxicity of emissions on marine ecosystems and organisms, reflecting the unique characteristics of saltwater environments.
- **Terrestrial Ecotoxicity Potential (TETP)**: This category considers the impact of emissions on terrestrial ecosystems, particularly soil organisms and plants, assessing their potential toxicity.
- **Particulate Matter Formation Potential (PMFP)**: The formation of particulate matter in the atmosphere due to emissions is examined here, considering the potential implications for air quality and human respiratory health.
- **Photochemical Ozone Creation Potential (POCP)**: Assessing emissions that contribute to the formation of ground-level ozone, this category highlights their role in air pollution and its effects on human health.
- **Resource Depletion Potential (RDP)**: This category evaluates the potential depletion of non-renewable resources due to a product's lifecycle activities, considering factors like extraction rates and resource availability.
- **Abiotic Depletion Potential (ADP)**: Focuses on the potential depletion of abiotic resources, including minerals and metals, due to extraction and usage, highlighting their scarcity implications.
- **Water Depletion Potential (WDP)**: The amount of water consumed throughout a product's lifecycle is assessed here, considering local water scarcity and the potential impact on water resources.
- **Land Use Potential (LUP)**: Evaluates the area of land required for a product's lifecycle activities, assessing potential impacts on ecosystems, habitat loss, and biodiversity.
- **Fossil Fuel Depletion Potential (FFDP)**: This category measures the potential depletion of fossil fuel resources, like coal, oil, and natural gas, considering their finite availability.

- **Mineral Depletion Potential (MDP)**: Examines the potential depletion of mineral resources used in a product's lifecycle, encompassing ores and minerals and their impact on resource availability.
- **Biotic Resource Depletion Potential (BRDP)**: Focuses on the potential depletion of biotic resources, such as wood, plants, and animal products, assessing their sustainable utilization.
- **Ionizing Radiation Potential (IRP)**: This category evaluates the potential release of ionizing radiation from nuclear processes, considering their impact on human health and ecosystems due to their potentially harmful nature.

The data collected to develop the LCI was translated into potential human health and environmental impacts. In the present study, the ReCiPe 2008 method has been applied. ReCiPe 2008 offers the ability to assess systems and processes by using both midpoint (targeting the environmental mechanisms) and endpoint (targeting the impact) indicators (Figure 4.3). The overall objective of the ReCiPe method implementation is to translate the list of LCI results into a number of indicator scores, expressing the relative severity on an environmental impact category.

FIGURE 4.3: IMPACT CATEGORY CONSIDERED IN RECIPE METHOD OF LCIA

LCIA method	Impact category	Unit of measurement
ReCiPe midpoint	Global warming	kg CO_2 eq
	Stratospheric ozone depletion	kg CFC11 eq
	Ionizing radiation	kBq Co-60 eq
	Ozone formation, human health	kg NO_x eq
	Fine particulate matter formation	kg $PM_{2.5}$ eq
	Ozone formation, terrestrial ecosystems	kg NO_x eq
	Terrestrial acidification	kg SO_2 eq
	Freshwater eutrophication	kg P eq
	Marine eutrophication	kg N eq
	Terrestrial ecotoxicity	kg 1,4-DCB
	Freshwater ecotoxicity	kg 1,4-DCB
	Marine ecotoxicity	kg 1,4-DCB
	Human carcinogenic toxicity	kg 1,4-DCB
	Human non-carcinogenic toxicity	kg 1,4-DCB
	Land use	m^2a crop eq
	Mineral resource scarcity	kg Cu eq
	Fossil resource scarcity	kg oil eq
	Water consumption	m^3
ReCiPe endpoint[a]	Human health	Daily
	Ecosystem	Species.yr
	Resources	Dollar ($)

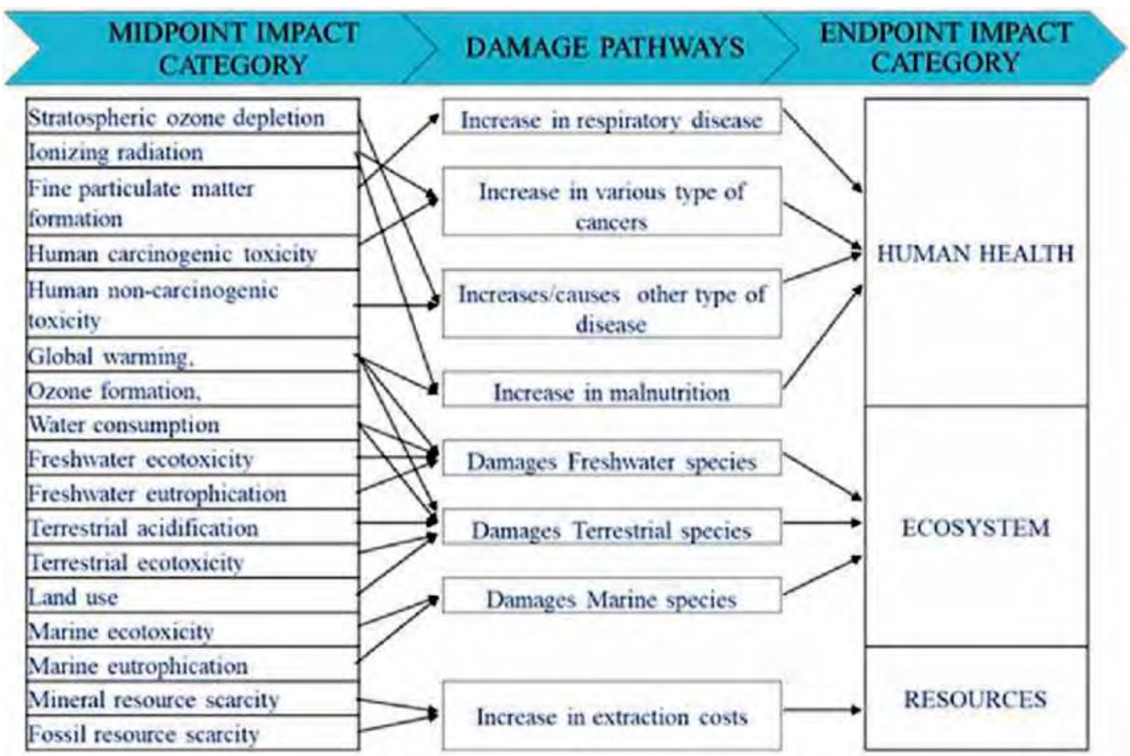
Concerning the endpoint indicators, ReCiPe is aimed at damage assessment, deriving from the respective environmental impacts. The results are reflected in eleven impact categories, which, through the use of weighting factors, are finally organized in three parent categories of damage, namely (Figure 4.4):

- Damage to human health, which is expressed as the sum of years lost and the years that someone lives in disability. This sum is expressed by the DALY (disability adjusted life years) indicator from the World Bank and the World Health Organization.

- Damage to ecosystem diversity, which is expressed as losses of species in a specific geographic location, during a specific time period.

- Damage to resource availability, which is expressed as the extra energy needed for the future extraction of minerals and fossil fuels.

FIGURE 4.4: ULTIMATE IMPACT CATEGORIES CONSIDERED IN RECIPE METHOD



For the interpretation of the results, the ReCiPe method was selected in the present study. ReCiPe is a life cycle impact assessment method that transforms the data from the life cycle inventory into tangible results. It was selected because it includes a broad set of impact categories, and it is widely used in similar studies; however, as with every impact assessment method, there are some compromises. ReCiPe, in particular, lacks a quantitative assessment for terrestrial and aquatic eutrophication and acidification. In addition, the normalization process in ReCiPe is performed partially, yet it still functions within the acceptable range set by ISO standards.

4.3 INVENTORY FOR LCA

Collection of site inventory data was facilitated by the Environment Department of MEL. All the inputs/outputs quantities correspond to one year plant operation i.e. 2023-24 so that the data is representative and corresponds to typical time averaged site production.

4.3.1 Inputs

The term input covers raw materials, energy, consumables, semi-finished products, which are utilised by the coal based thermal power plant. As done in any LCA study, all of the site inputs of the thermal power plant have not been recorded: many inputs are consumed in small quantities and their contribution in the final Life Cycle Impact (LCI) is negligible.

4.3.2 Air Emissions

An inventory of all known significant air emissions was drawn up for each process. Air emission data were supplied by the site. Only stack emissions were included for air emission.

4.3.3 Water Emissions

An inventory of all known significant air emissions was drawn up for each process. The rules used with other flow categories were applied to water emissions, namely the distinction between non available, non-relevant and real nil data.

Most of the data has been collected from Mahan TPP site itself.

4.3.4 Site Upstream Inventory

The site upstream sub-systems refer to the production and the transportation of the site inputs: raw materials, consumables and energy, the site input production inventory data are either customised to each site or standardised for all sites using data from Eco invent database depending on their assumed contribution to the LCI.

4.3.5 Inventory of all Raw Materials

The site inventory for generation of 1 MW of electricity in the Mahan TPP (ie .emission at station level) has been presented in table 4.1. It is to be taken into account that transportation has been factored into the life cycle impact analysis for generating 1 MW of power, as the coal is transported by dumper from a distance of 12 km to the Mahan TPP.

TABLE 4.1: SITE INVENTORY FOR POWER GENERATION FROM EXISTING 2X600 MW MAHAN TPP

(For 1 MW Generation of Electricity at Mahan TPP)

Category	Unit	Value
Input		
Coal	kg	630
Water	m^3	3
Diesel	l	0.362
Transport	t*km	12
Output		
CO_2	kg	1606.5
SO_2	kg	1.663
NO_X	kg	0.873
N_2O	kg	1.427
CH_4	kg	0.69
TSP	kg	14.73

TABLE 4.2: SITE INVENTORY FOR POWER GENERATION FROM PROPOSED 2X800 MW MAHAN TPP AT 100% PLF

(For 1 MW Generation of Electricity at Mahan TPP)

Category	Unit	Value
Input		
Coal	Kg	488.7
Water	m^3	2.33
Diesel	l	0.428
Transport	t*km	5
Output		
CO_2	kg	804.1
SO_2	kg	1.293
NO_X	kg	0.68
N_2O	kg	1.11
CH_4	kg	0.54
TSP	kg	11.45

TABLE 4.3: SITE INVENTORY FOR POWER GENERATION FROM PROPOSED 2X800 MW MAHAN TPP AT 90% PLF

(For 1 MW Generation of Electricity at Mahan TPP)

Category	Unit	Value
Input		
Coal	kg	489.1
Water	m^3	2.33
Diesel	kl	0.428
Transport	t*km	5
Output		
CO_2	kg	804.76
SO_2	kg	1.293
NO_X	kg	0.68
N_2O	kg	1.11
CH_4	kg	0.54
TSP	kg	11.45

TABLE 4.4: SITE INVENTORY FOR POWER GENERATION FROM 2800 MW MAHAN TPP (PROPOSED EXPANSION AT 100% PLF)

(For 1 MW Generation of Electricity at Mahan TPP)

Category	Unit	Value
Input		
Coal	Kg	533.97
Water	m^3	2.33
Diesel	l	0.41
Transport	t*km	5
Output		
CO_2	kg	878.21
SO_2	kg	1.409
NO_X	kg	0.74
N_2O	kg	1.209
CH_4	kg	0.584
TSP	kg	12.483

TABLE 4.5: SITE INVENTORY FOR POWER GENERATION FROM 2800 MW MAHAN TPP (PROPOSED EXPANSION AT 90% PLF)
(For 1 MW Generation of Electricity at Mahan TPP)

Category	Unit	Value
Input		
Coal	Kg	537.51
Water	m^3	2.33
Diesel	l	4.05E-04
Transport	t*km	5
Output		
CO_2	kg	884.42
SO_2	kg	1.418
NO_X	kg	0.745
N_2O	kg	1.218
CH_4	kg	0.587
TSP	kg	12.565

4.4 LIFE CYCLE IMPACT ANALYSIS

Life Cycle Impact assessment for the identified categories viz. Global Warming (GW), Fossil resource scarcity (FRS), Stratospheric Ozone depletion (SOD), Terrestrial acidification (TA), Freshwater eutrophication (FE), Marine eutrophication (ME), Human toxicity (HT), Ozone formation (OF), Fine Particulate matter formation (FPMF), Terrestrial ecotoxicity (TET), Freshwater ecotoxicity (FET), Marine ecotoxicity (MET), Ionising radiation (IR), Land use (LU), Water consumption (WC) and Mineral resource scarcity (MRS) as per ReCipe 2016 was evaluated. The brief detail of these impacts is presented in subsequent sections.

4.4.1 Global Warming Potential/Greenhouse Effect or Climate Change

The "greenhouse effect" refers to the ability of some atmospheric gases to retain heat that is radiating from the earth, and the Global Warming Potential (GWP) is the category indicator measuring this effect. This impact assessment only considers effects over a 100-year time horizon, however other time scales can also be used.

The GWP can be defined as the ratio between the cumulative radiative force between 'present' and a future time horizon (in this case, 20, 100 and 500 years) as a result of the release of a unit mass of greenhouse gas i now, and an equal emission of the standard gas, CO2. The calculation of the GWP is based on understanding the fate of the emitted gas and the radiative effect associated with the amount remaining in the atmosphere.

A single indicator is produced for the greenhouse effect, in which:

$E = \sum GWP_i * m_i$

Where, for a greenhouse gas "*i*", m_i is the mass of the gas released (in g), and GWP_i is its Global Warming Potential, expressed in kg of CO_2 equivalents. The main classification of flows accounted for in the GWP indicator category include: CO_2, CH_4, and N_2O.

4.4.2 Acidification Potential or Terrestrial Acidification

Acidification is a consequence of acids (and other compounds which can be transformed into

$$E_4 = \sum_{j=1}^{n} ec_{4,j} B_j$$

acids) being emitted to the atmosphere and subsequently deposited in surface soils and water. Increased acidity of these environments can result in negative consequences for coniferous trees (forest dieback) and the death of fish in addition to increased corrosion of manmade structures (buildings, vehicles etc.). Acidification Potential (AP) is based on the contributions of SO_2, NO_x, HCl, NH_3 and HF to the potential acid deposition in the form of H^+ (protons). The AP value is calculated in kg using:
Where $ec_{4,j}$ represents the AP of gas j expressed relative to the value for SO_2 and B_j is its emission in kg per functional unit.

4.4.3 Stratospheric Ozone Depletion

The ozone layer is present in the stratosphere and acts as a filter absorbing harmful short wave ultraviolet light while allowing longer wavelengths to pass through. Since the late 1970s, a thinning of various layers of the ozone layer over the Antarctic has been observed during Springtime, which could amount to up to 80-98% removal of this layer (the ozone 'hole').

The corresponding indicator is the stratospheric ozone depletion (OD), classified by 22 ozone-depleting gases, CFCs being primarily the flows taken into account in the calculation. The World Meteorological Organization (WMO)1 has come up with the most accepted OD indicator characterization, below:
$OD = \sum OPD_i * m_i$

where, for an ozone depleting gas i, m_i is the mass of the gas released (in g) and ODP_i is its Ozone Depletion Potential. OD is expressed in grams of CFC-11. This impact category may be very difficult to implement in this LCIA study, as several CFC gases would need to be collected from facilities as well as show up in upstream production environmental profiles.

4.4.4 Photochemical Ozone Creation Potential (PCOP) / Tropospheric Ozone Creation Index

Under certain climatic conditions, air emissions from industry and transportation can be trapped at ground level, where they react with sunlight to produce photochemical smog. One of the components of smog is ozone, which is not emitted directly, but rather produced through the interactions of volatile organic compounds (VOCs) and NOx.

The United Nations has produced a methodology to characterize the tropospheric ozone creation indicator, also know as the photochemical ozone creation potential (POCP). In this POCP characterization method, coefficients are available for chemical families, such as alkanes, halogenated hydrocarbons, alcohols, etc., as well as for hydrocarbons (unspecified).

To calculate the POCP, the following formula is applied:

$E = \sum POCPi * mi$

where, for a VOC gas i, mi is the mass of the gas released (in g) and POCPi is its photochemical ozone creation potential. The POCP indicator is expressed in grams of ethylene.

4.4.5 Eco-Toxicity and Human-Toxicity

Risk to human health because of toxic chemical exposures is a desirable outcome of LCA. Toxic equivalency potentials fulfill this requirement but present a number of challenges. The most sophisticated approaches currently in use, these combine a multimedia environmental fate model with a multi- pathway exposure model to generate estimates of the health risks posed by the total chemical dose received by an exposed population. This integrated model estimates the dose of a pollutant received through a specific exposure route resulting from unit release of a pollutant into a specific compartment.

4.4.6 Eutrophication

Eutrophication is defined either as the enrichment in mineral salts of marine or lake waters when it refers to the natural process or as the enrichment in nutritive elements of waters when referring to human intervention. Human activities have dramatically accelerated eutrophication by releasing organic matter (urban and industrial effluents) and other chemical compounds into the water.

Water eutrophication occurs mainly in lakes, although the eutrophication processes also affect rivers and coastal marine waters.

A commonly used method is the CML methodology for the “eutrophication” impact indicator, or oxygen depletion index, which deals with terrestrial and aquatic nutrification. The 13 inventory flows included are all the nutritive compounds containing either phosphorus or nitrogen that are released as air emissions or water effluents. In addition, Chemical Oxygen Demand (COD) is included on the list since oxygen depletion is an intermediary step towards the final consequences of eutrophication (ecosystem shift and depletion).

The eutrophication indicator (E) is calculated as follows:

$E = \sum NP_i * m_i$

Where, for the nutritive compound *i*, m_i is the mass of the compound (in g), and NP_i is the Nutrification Potential of the compound. The Eutrophication index is expressed in grams of phosphate.

A life cycle impact analysis was conducted for the generation of 1 MW of power (as presented in Table 4.6-4.10) from the existing 1200 MW Mahan TPP; for proposed expansion of 1600MW at PLF 90% & 100% and for overall 2800 MW including the existing and proposed capacities. The results indicate that power generation from Mahan thermal power plant has the most significant impact on the climate change category, followed by fossil resource depletion and human toxicity. The high impact on climate change is primarily due to the substantial carbon dioxide emissions produced during coal combustion. Fossil resource scarcity is affected as coal is a finite resource, and its extraction and consumption contribute to resource depletion. Human toxicity is impacted due to the release of harmful pollutants, such as sulfur dioxide and mercury, which may pose serious health risks to the local population.

TABEL 4.6: LIFE CYCLE IMPACT ANALYSIS OF POWER GENERATION FROM 1200 MW MAHAN TPP (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Unit	Impact
Climate Change	kg CO2 eq	1631.87
Fossil Depletion	kg oil eq	705.58
Human Toxicity	kg 1,4-DCB	765.02
Ionising Radiation	kg U235-Eq	51.77
Particulate Matter Formation	kg PM10-Eq	4.42
Terrestrial Acidification	kg SO2-Eq	9.56
Water Depletion	m^3	5.99

TABEL 4.7: LIFE CYCLE IMPACT ANALYSIS OF POWER GENERATION FROM PROPOSED 1600 MW MAHAN TPP AT 100% PLF (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Unit	Impact
Climate Change	kg CO2 eq	1600.522
Fossil Depletion	kg oil eq	629.533
Human Toxicity	kg 1,4-DCB	687.773
Ionising Radiation	kg U235-Eq	53.908
Particulate Matter Formation	kg PM10-Eq	4.433
Terrestrial Acidification	kg SO2-Eq	9.529
Water Depletion	m^3	5.655

TABEL 4.8: LIFE CYCLE IMPACT ANALYSIS OF POWER GENERATION FROM PROPOSED 1600 MW MAHAN TPP AT 90% PLF (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Unit	Impact
Climate Change	kg CO2 eq	1600.695
Fossil Depletion	kg oil eq	629.772
Human Toxicity	kg 1,4-DCB	688.023
Ionising Radiation	kg U235-Eq	53.917
Particulate Matter Formation	kg PM10-Eq	4.434
Terrestrial Acidification	kg SO2-Eq	9.530
Water Depletion	m^3	5.656

TABEL 4.9: LIFE CYCLE IMPACT ANALYSIS OF POWER GENERATION FROM 2800 MW MAHAN TPP (PROPOSED EXPANSION AT 100% PLF) (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Unit	Impact
Climate Change	kg CO2 eq	1620.088
Fossil Depletion	kg oil eq	656.663
Human Toxicity	kg 1,4-DCB	716.040
Ionising Radiation	kg U235-Eq	54.953
Particulate Matter Formation	kg PM10-Eq	4.461

TABEL 4.10: LIFE CYCLE IMPACT ANALYSIS OF POWER GENERATION FROM 2800 MW MAHAN TPP (PROPOSED EXPANSION AT 90% PLF) (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Unit	Impact
Climate Change	kg CO2 eq	1621.618
Fossil Depletion	kg oil eq	658.785
Human Toxicity	kg 1,4-DCB	718.251
Ionising Radiation	kg U235-Eq	55.035
Particulate Matter Formation	kg PM10-Eq	4.463

4.5 SENSITIVITY ANALYSIS

Sensitivity analysis involves assessing how alterations in data and methodological decisions impact the outcomes of the Life Cycle Impact Assessment (LCIA).

The present study examines the cradle-to-gate environmental impact of generation of electricity from Mahan thermal power plant. The assessment considers the overall environmental burdens of the entire production system, using a product-related functional unit approach, and evaluates its impact across various environmental impact assessment categories.

Sensitivity of major raw materials for generation of electricity has been undertaken to assess the consumption on various midpoint impacts as a function of major raw material consumption besides the identification of hotspots to explore alternatives for reducing the LCIA.

4.5.1 Sensitivity Analysis for Power Generation from 1200 MW Mahan TPP

The sensitivity analysis of consumption of material and energy for generation of 1MW power from 1200 MW Mahan thermal power plant have been presented in Table 4.11-4.17 and depicted in Figure 4.5-4.11. The study indicates that, the material and energy consumption primarily influence the climate change category. The analysis of the percentage contribution of raw materials across various impact categories viz. climate change, fossil resource depletion, human toxicity, terrestrial acidification, particulate matter formation, ionizing radiation, and water depletion, reveals that coal combustion is the primary contributor to all these impact categories. Coal combustion significantly impacts these areas due to several inherent characteristics of the process. Firstly, coal combustion releases a substantial amount of carbon dioxide (CO_2), a major greenhouse gas, contributing to climate change. The process also emits sulfur dioxide (SO_2) and nitrogen oxides (NOx), which lead to terrestrial acidification and the formation of particulate matter that affects air quality and human health. The burning of coal also releases heavy metals and other toxic substances, contributing to human toxicity and environmental pollution. Furthermore, coal combustion consumes a vast amount of fossil resources, exacerbating resource depletion.

In addition, the process generates significant amounts of ionizing radiation due to the presence of trace elements like uranium and thorium in coal. Lastly, while water is not consumed in large quantities during combustion itself, the overall coal lifecycle, including mining and processing, requires substantial water, leading to water depletion.

In contrast, transportation contributes insignificantly to these impact categories as the emissions and resource use associated with moving coal are relatively lower compared to combustion. Similarly, the use of diesel and water in the context of the entire coal lifecycle shows negligible contributions to these impact categories. Hence, coal combustion remains the dominant factor affecting these environmental and health-related impact categories.

TABLE 4.11: IMPACT OF RAW MATERIAL CONSUMPTION FOR POWER GENERATION FROM 1200 MW MAHAN TPP ON CLIMATE CHANGE (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Result [kg CO2 eq]
Coal Combustion	1629.59
Transport	2.29
Water	0.00010
Diesel	0.00003

FIGURE 4.5: PERCENTAGE CONTRIBUTION OF INPUTS IN CLIMATE CHANGE FOR POWER GENERATION

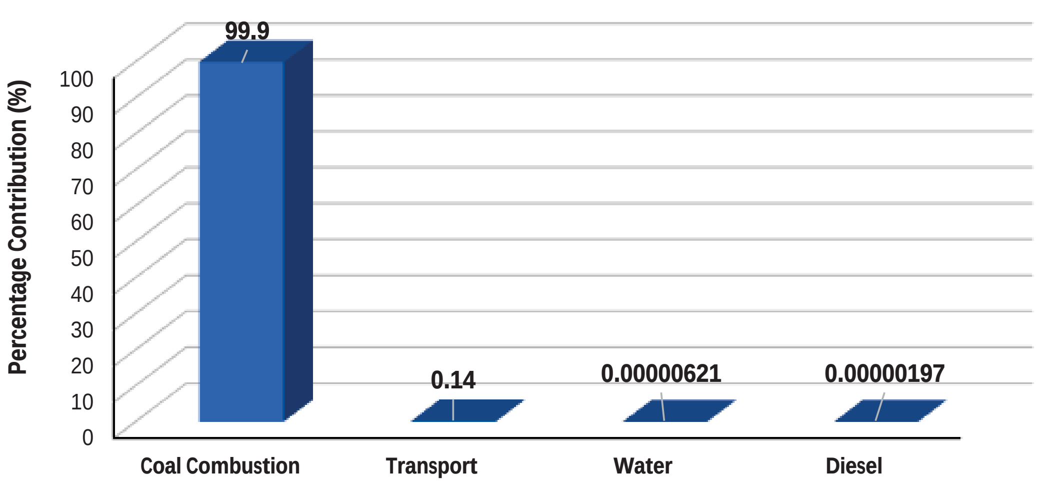


TABLE 4.12: IMPACT OF RAW MATERIAL CONSUMPTION FOR POWER GENERATION FROM 1200 MW MAHAN TPP ON FOSSIL DEPLETION (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Result [kg oil-eq]
Coal Combustion	704.73
Transport	0.85
Water	0.00002
Diesel	0.00001

FIGURE 4.6: PERCENTAGE CONTRIBUTION OF INPUTS IN FOSSIL DEPLETIONFOR POWER GENERATION

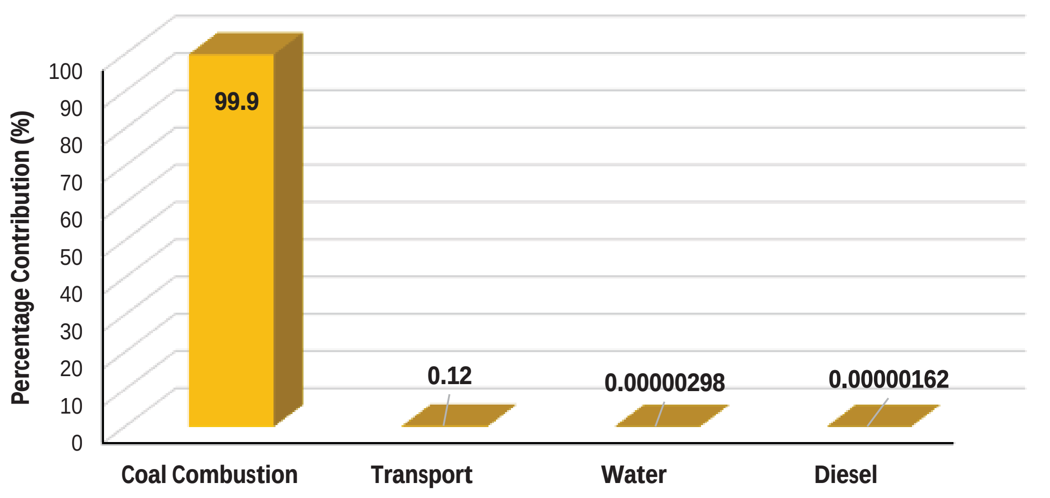


TABLE 4.13: IMPACT OF RAW MATERIAL CONSUMPTION FOR POWER GENERATION FROM 1200 MW MAHAN TPP ON HUMAN TOXICITY (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Result [kg 1,4-DCB-Eq]
Coal Combustion	764.76
Transport	0.26
Water	0.000043
Diesel	0.000001

FIGURE 4.7: PERCENTAGE CONTRIBUTION OF INPUTS IN HUMAN TOXICITY FOR POWER GENERATION

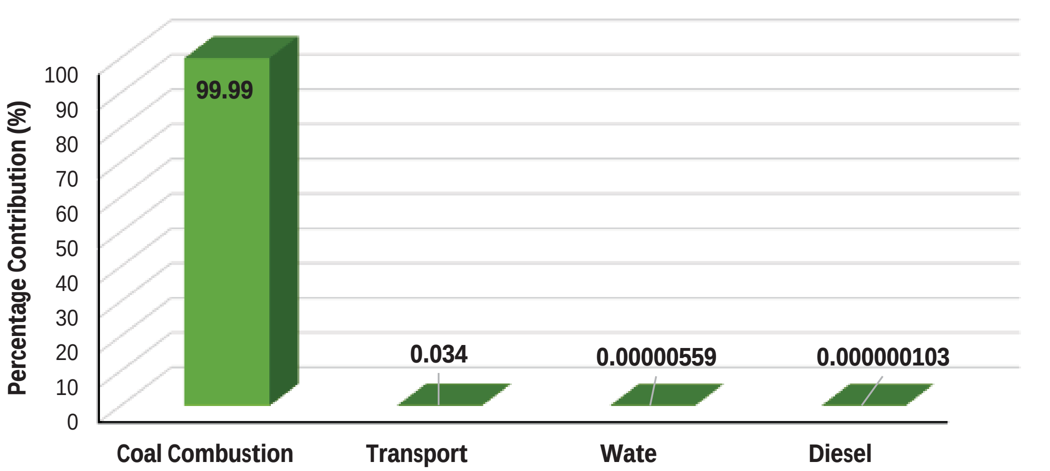


TABLE 4.14: IMPACT OF RAW MATERIAL CONSUMPTION FOR POWER GENERATION FROM 1200 MW MAHAN TPP ON IONIZING RADIATION (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Result [kg U235-Eq]
Coal Combustion	51.58
Transport	0.18
Water	0.000007
Diesel	0.000002

FIGURE 4.8: PERCENTAGE CONTRIBUTION OF INPUTS IN IONISING RADIATION FOR POWER GENERATION

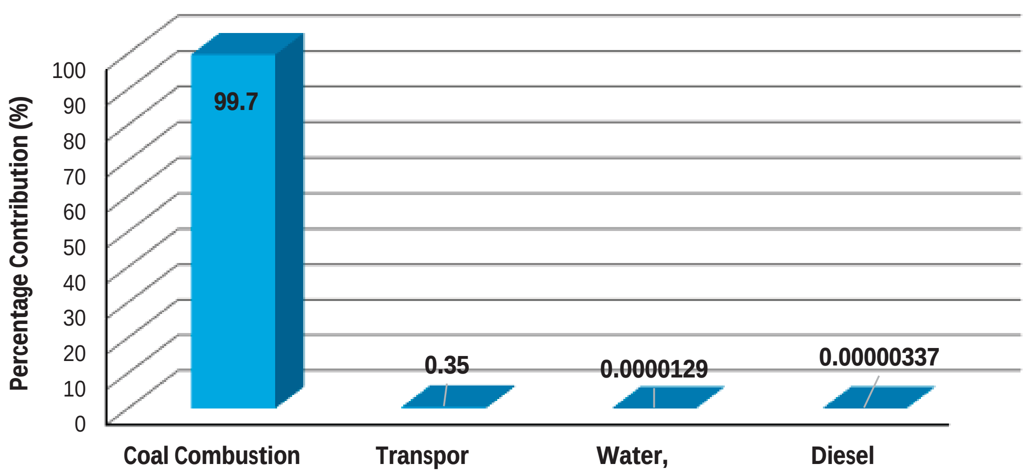


TABLE 4.15: IMPACT OF RAW MATERIAL CONSUMPTION FOR POWER GENERATION FROM 1200 MW MAHAN TPP ON PARTICULATE MATTER FORMATION (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Result [kg PM10-Eq]
Coal Combustion	4.41
Transport	0.005
Water	0.0000002
Diesel	0.0000002

FIGURE 4.9: PERCENTAGE CONTRIBUTION OF INPUTS IN PARTICULATE MATTER FORMATION FOR POWER GENERATION

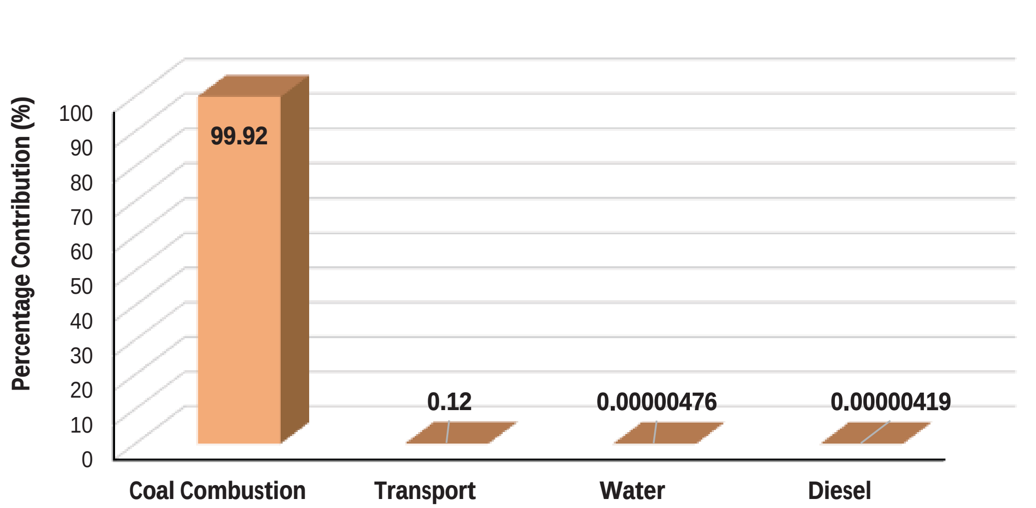


TABLE 4.16: IMPACT OF RAW MATERIAL CONSUMPTION FOR POWER GENERATION FROM 1200 MW MAHAN TPP ON TERRESTRIAL ACIDIFICATION (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Result [kg SO2-Eq]
Coal Combustion	9.55
Transport	0.01
Water	0.0000004
Diesel	0.0000003

FIGURE 4.10: PERCENTAGE CONTRIBUTION OF INPUTS IN TERRESTRIAL ACIDIFICATION FOR POWER GENERATION

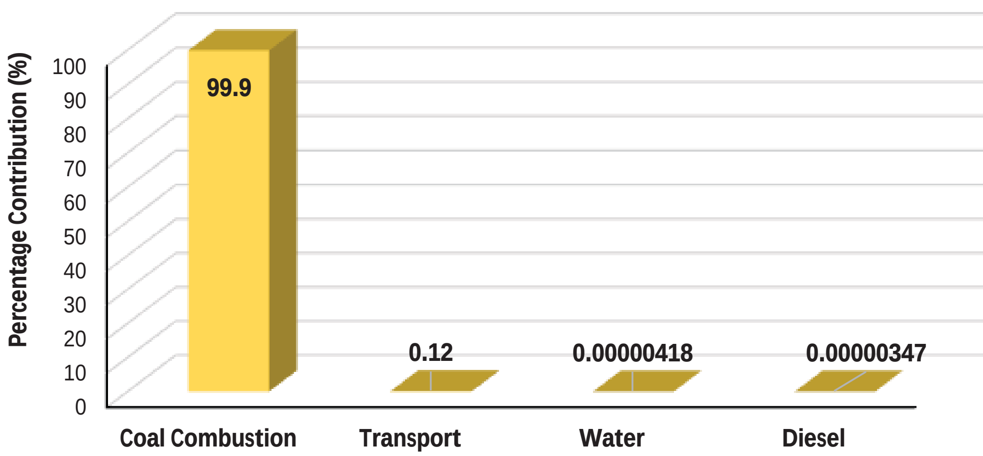
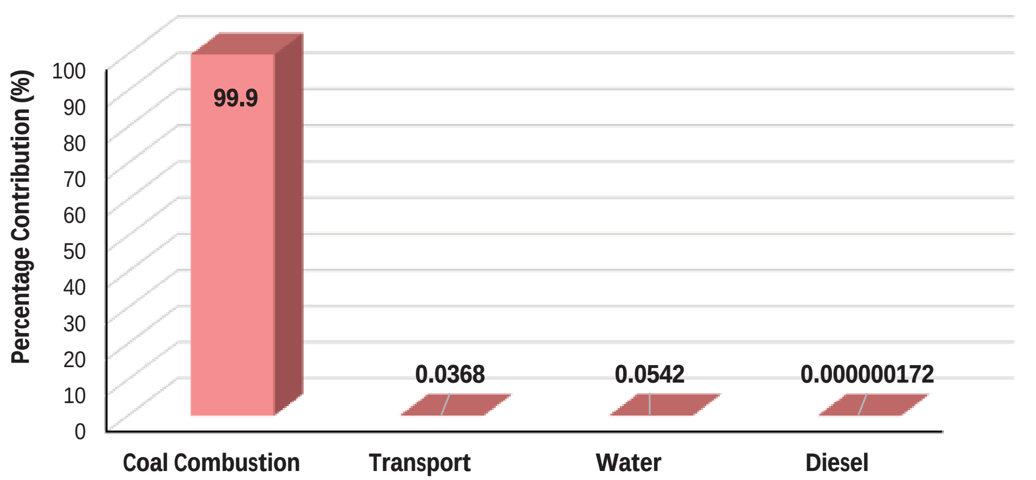


TABLE 4.17: IMPACT OF RAW MATERIAL CONSUMPTION FOR POWER GENERATION FROM 1200 MW MAHAN TPP ON WATER DEPLETION (FOR GENERATION OF 1 MW ELECTRICITY)

Name	Result [m^3]
Coal Combustion	5.98
Transport	0.002
Water	0.003
Diesel	0.00000001

FIGURE 4.11: PERCENTAGE CONTRIBUTION OF INPUTS IN WATER DEPLETION FOR POWER GENERATION



4.5.2 Sensitivity Analysis for Power Generation from 1600 MW Mahan TPP

4.5.2.1 At 100% PLF

The sensitivity analysis for generation of 1 MW power from the proposed 1600 MW Mahan TPP at 100% PLF have been presented in Figure 4.12-4.15.

FIGURE 4.12: PERCENTAGE CONTRIBUTION OF INPUTS IN CLIMATE CHANGE FOR POWER GENERATION

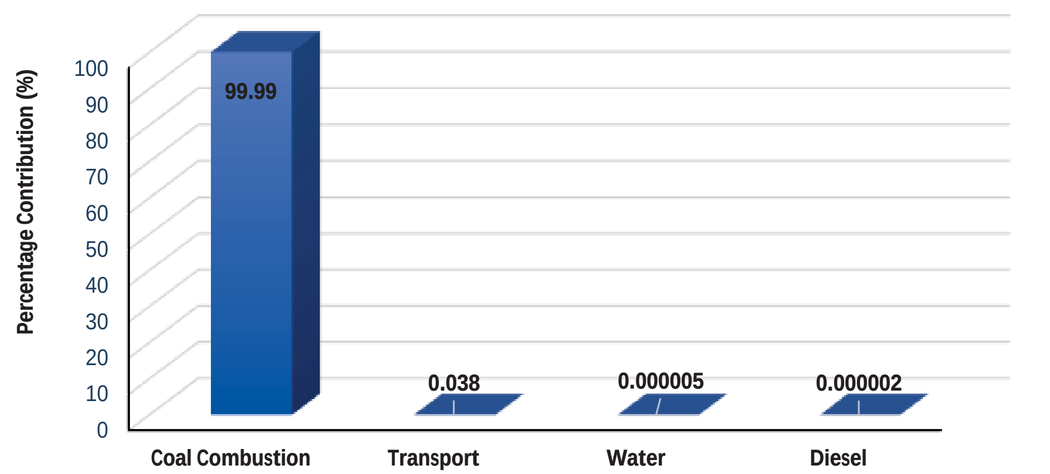


FIGURE 4.13: PERCENTAGE CONTRIBUTION OF INPUTS IN FOSSIL DEPLETION FOR POWER GENERATION

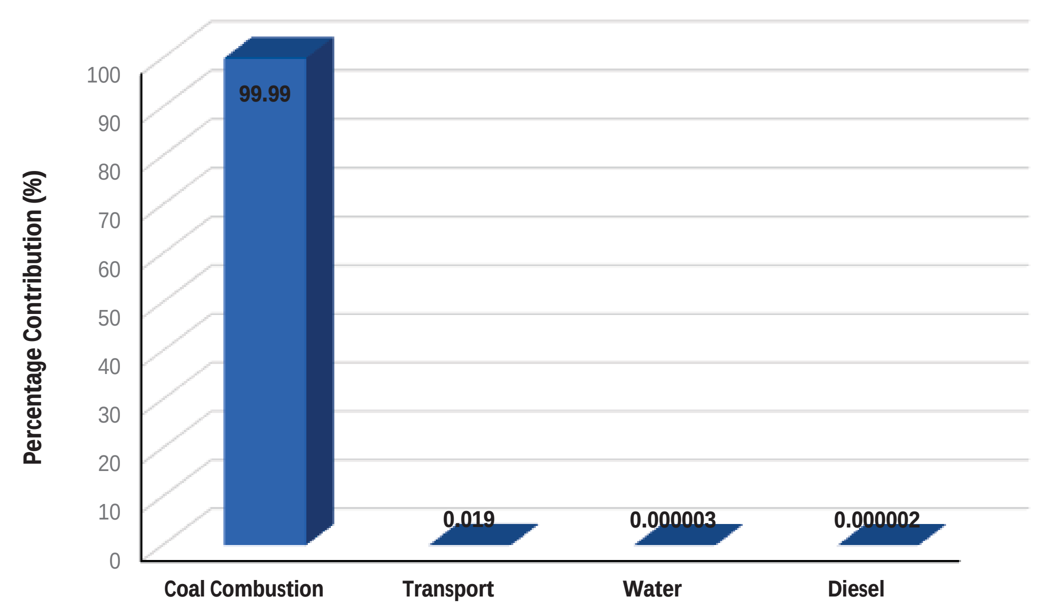


FIGURE 4.14: PERCENTAGE CONTRIBUTION OF INPUTS IN HUMAN TOXICITY FOR POWER GENERATION

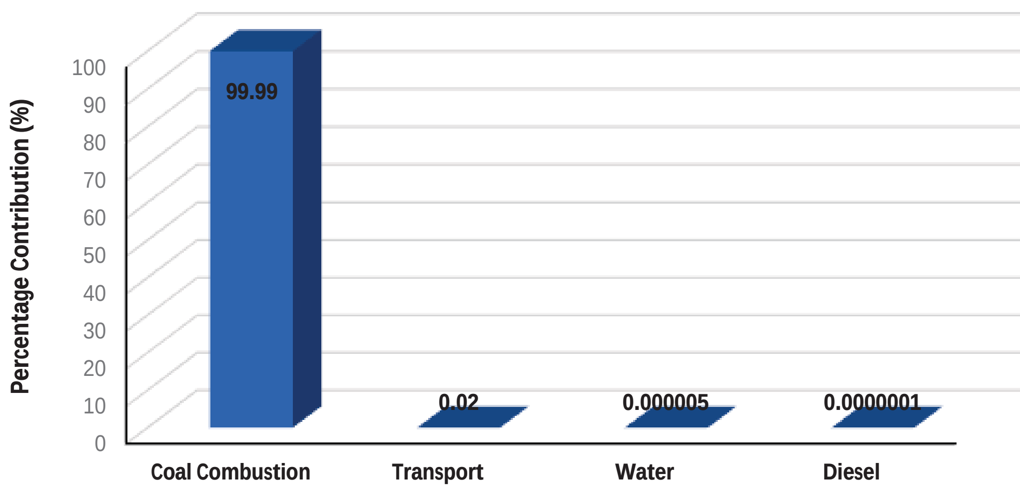
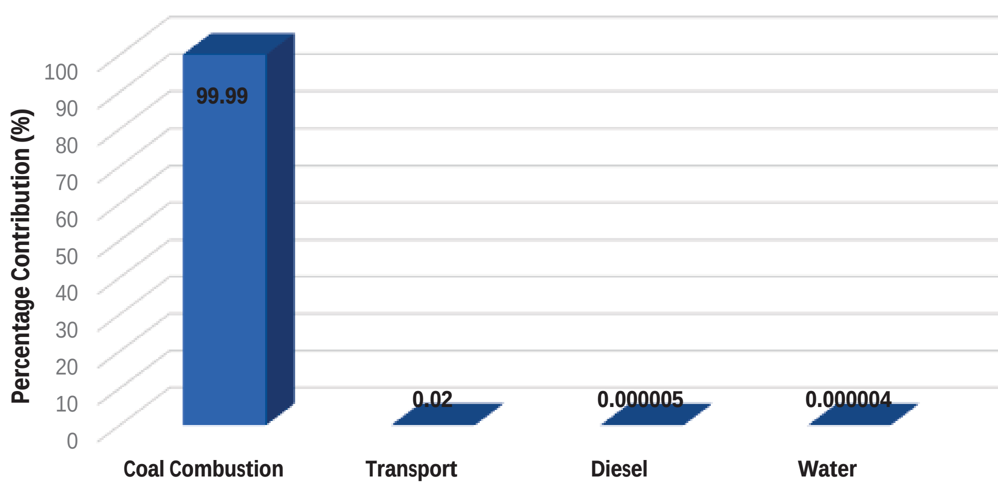


FIGURE 4.15: PERCENTAGE CONTRIBUTION OF INPUTS IN PARTICULATE MATTER FORMATION FOR POWER GENERATION



4.5.2.2 At 90% PLF

The sensitivity analysis for generation of 1 MW power from the proposed 1600 MW Mahan TPP at 100% PLF have been presented in Figure 4.16-4.19.

FIGURE 4.16: PERCENTAGE CONTRIBUTION OF INPUTS IN CLIMATE CHANGE FOR POWER GENERATION

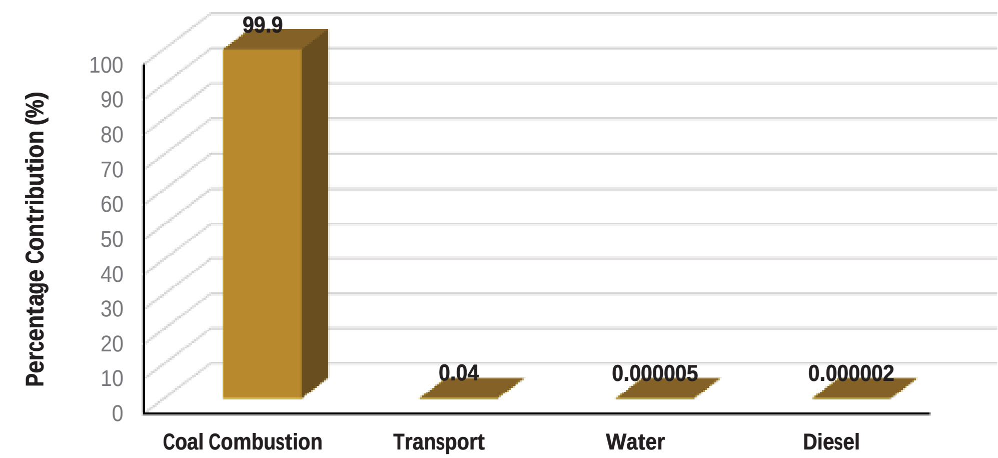


FIGURE 4.17: PERCENTAGE CONTRIBUTION OF INPUTS IN FOSSIL DEPLETION FOR POWER GENERATION

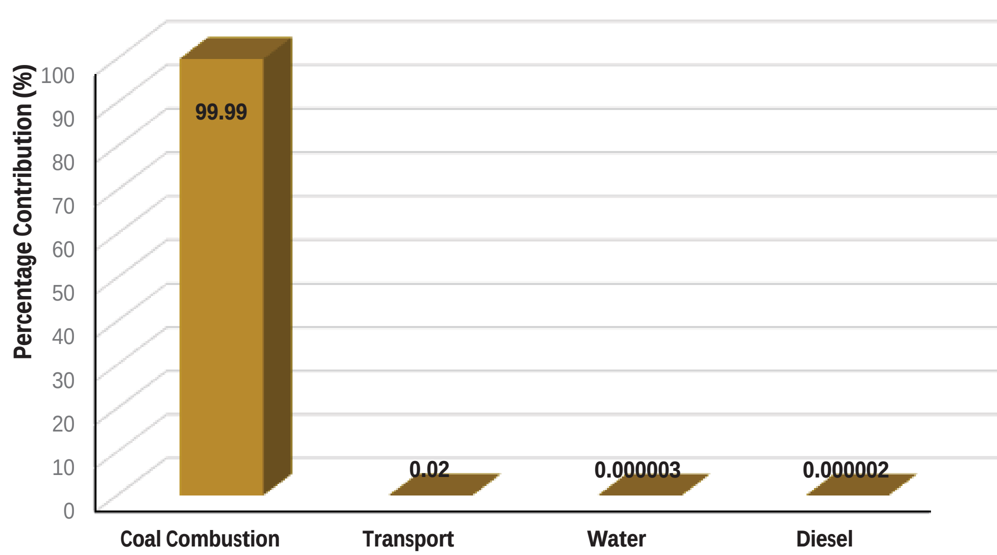


FIGURE 4.18: PERCENTAGE CONTRIBUTION OF INPUTS IN HUMAN TOXICITY FOR POWER GENERATION

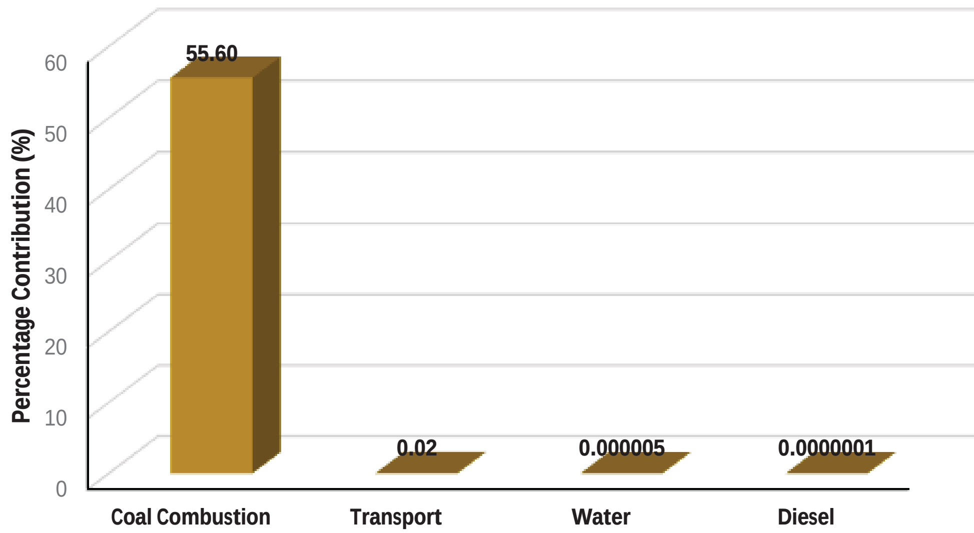
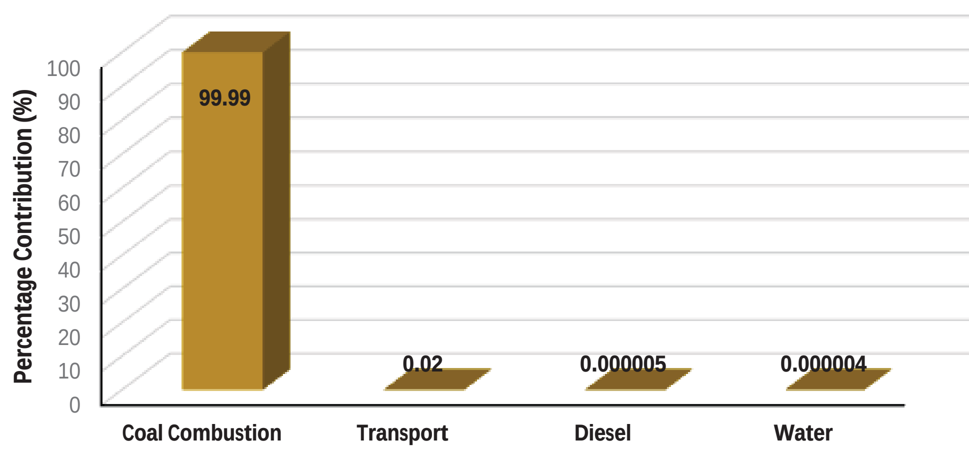


FIGURE 4.19: PERCENTAGE CONTRIBUTION OF INPUTS IN PARTICULATE MATTER FORMATION FOR POWER GENERATION



The sensitivity analysis of proposed 1600 MW Mahan TPP conducted at both 100% and 90% Plant Load Factor (PLF) revealed that coal combustion is the primary contributor across various impact categories considered. In both scenarios, the impact of coal combustion vastly outweighs that of other raw materials and processes. The contribution of transportation, diesel usage, and water consumption remains insignificant in comparison, underscoring that the combustion of coal is the dominant factor influencing the environmental footprint of the Mahan TPP.

4.5.3 Sensitivity Analysis for Power Generation from 2800 MW Mahan TPP

4.5.3.1 At 100% PLF

The sensitivity analysis for generation of 1 MW power from the 2800 MW Mahan TPP which includes the existing capacity and the proposed capacity at 100% PLF have been presented in Figure 4.20-4.23.

FIGURE 4.20: PERCENTAGE CONTRIBUTION OF INPUTS IN CLIMATE CHANGE FOR POWER GENERATION

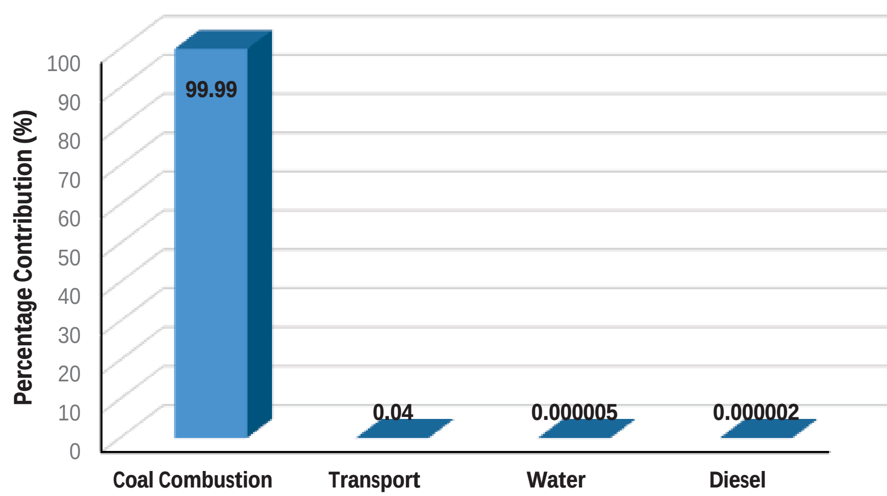


FIGURE 4.21: PERCENTAGE CONTRIBUTION OF INPUTS IN FOSSIL DEPLETION FOR POWER GENERATION

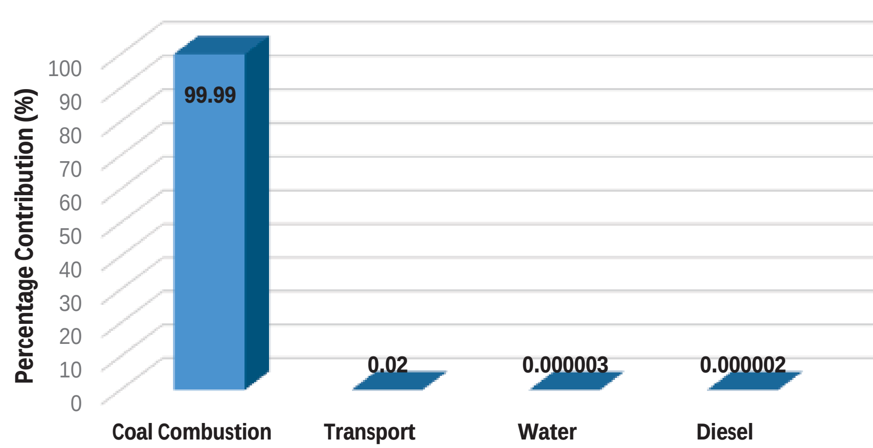


FIGURE 4.22: PERCENTAGE CONTRIBUTION OF INPUTS IN HUMAN TOXICITY FOR POWER GENERATION

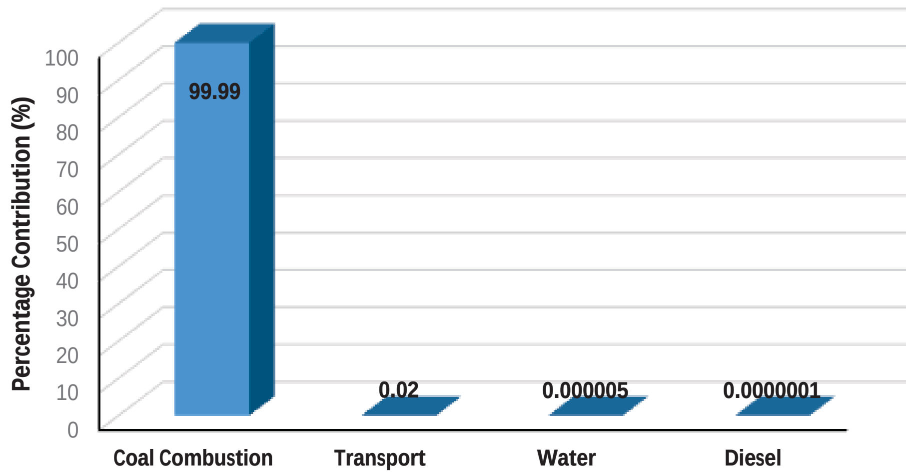
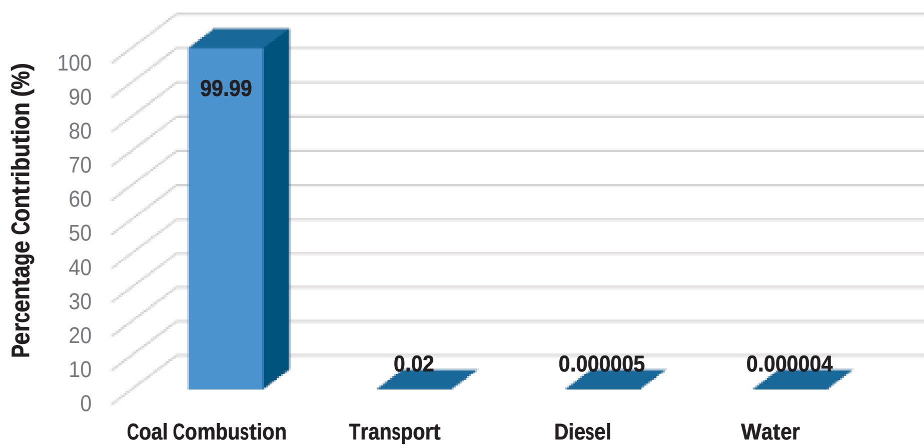


FIGURE 4.23: PERCENTAGE CONTRIBUTION OF INPUTS IN PARTICULATE MATTER FORMATION FOR POWER GENERATION



4.5.3.2 At 90% PLF

The sensitivity analysis for generation of 1 MW power from the 2800 MW Mahan TPP which includes the existing capacity and the proposed capacity at 90% PLF have been presented in Figure 4.24-4.27.

FIGURE 4.24: PERCENTAGE CONTRIBUTION OF INPUTS IN CLIMATE CHANGE FOR POWER GENERATION

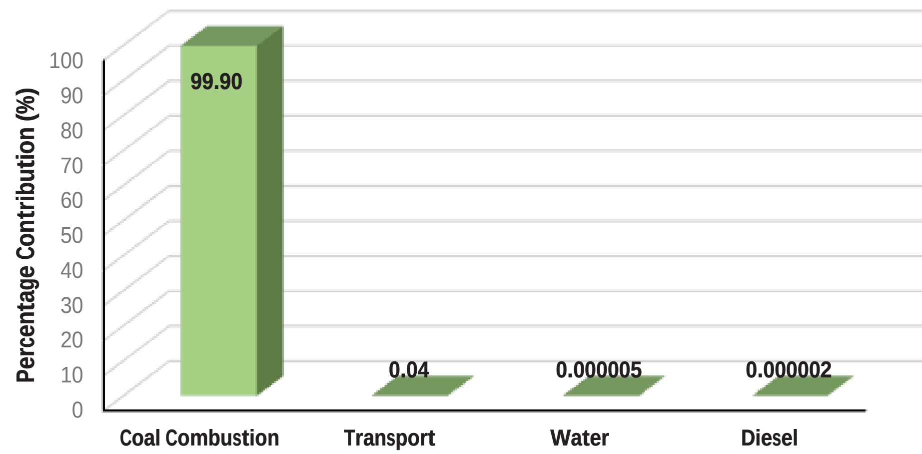


FIGURE 4.25: PERCENTAGE CONTRIBUTION OF INPUTS IN FOSSIL DEPLETION FOR POWER GENERATION

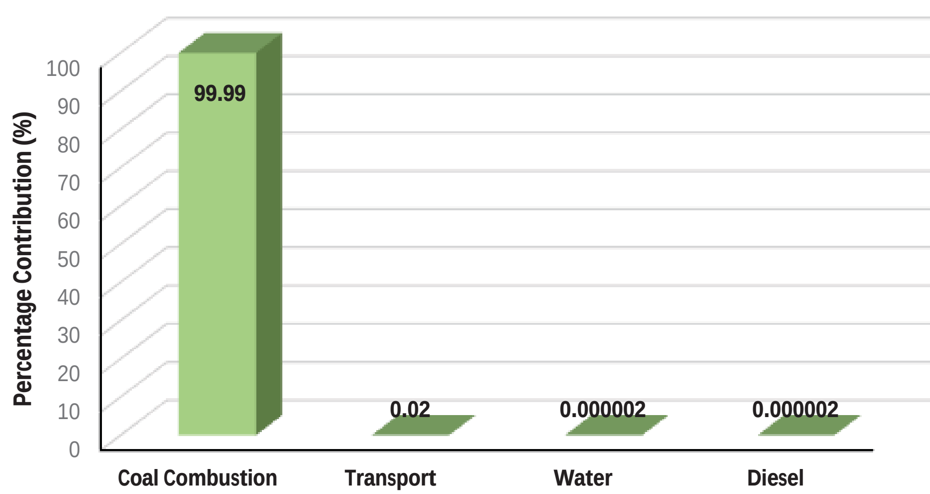


FIGURE 4.26: PERCENTAGE CONTRIBUTION OF INPUTS IN HUMAN TOXICITY FOR POWER GENERATION

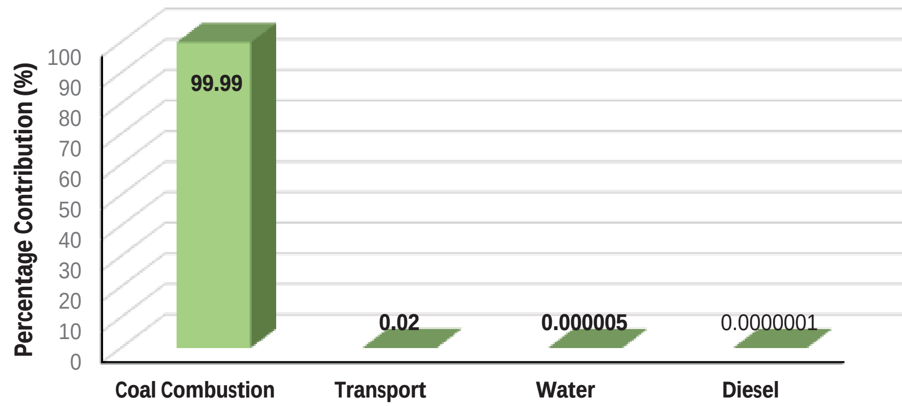
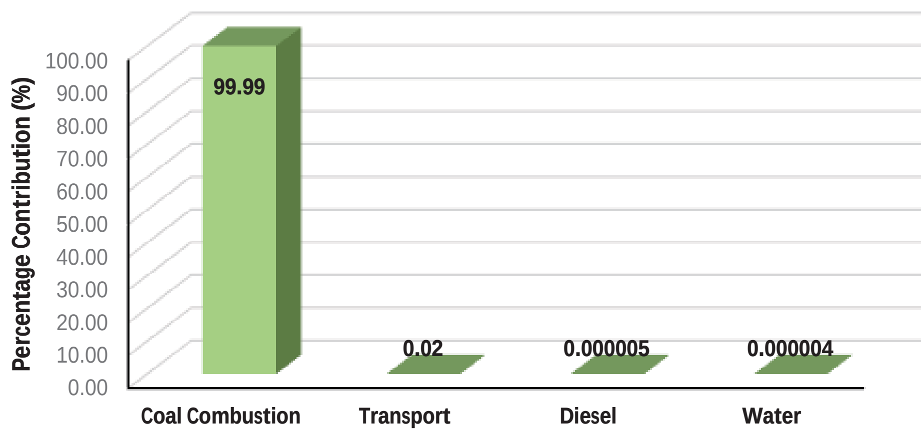


FIGURE 4.27: PERCENTAGE CONTRIBUTION OF INPUTS IN PARTICULATE MATTER FORMATION FOR POWER GENERATION



The sensitivity analysis for the 2800 MW Mahan TPP, which includes the existing capacity and the proposed 1600 MW expansion, revealed that coal combustion remains the primary contributor across various impact categories. This was consistent in both scenarios: i) at 100% PLF and ii) at 90% PLF for the proposed expansion. In each scenario, the contribution from coal combustion significantly overshadowed that of other raw materials and processes, such as transportation, diesel usage, and water consumption, which were found to be relatively insignificant. This highlights the critical need for strategies to improve coal combustion efficiency and explore cleaner fuel alternatives to effectively mitigate the environmental impact of the Mahan TPP.

5.0 STRATEGIES & MITIGATION MEASURES

With the increasing demand for electricity, there is a corresponding rise in greenhouse gas (GHG) emissions and other pollutants in the atmosphere. Emissions from anthropogenic activities, such as fossil fuel power stations, significantly contribute to global warming. Therefore, mitigating these emissions has become crucial. Several factors, including the carbon and sulfur content of the fuel, the amount of energy generated, the technology used, energy efficiency, and improper waste disposal, all play a role in the level of emissions produced.

Recognizing the urgency of this issue, and looking at the current scenario, it is imperative to keep an account of GHG emissions. Hence, MEL conducted this study to accurately measure these existing emissions as well as like emissions from proposed expansion project. This will enable MEL to plan and strategize effectively to reduce the GHG emissions and ensure sustainable operations.

5.1 STRATEGIES FOR MITIGATING IMPACTS OF GHG EMISSIONS

5.1.1 Peripheral Greenbelt Development around Mahan TPP

Greenbelt development around power plants can serve as a vital mitigation measure to reduce greenhouse gas (GHG) emissions. While sequestration is often thought of as absorption, it is actually a broader process. Sequestration involves not only absorbing carbon dioxide but also storing it in the soil through the ecological system. This long-term storage of carbon dioxide or other forms of carbon helps to mitigate the greenhouse effect and combat climate change.

Trees play a crucial role in carbon sequestration by capturing carbon dioxide and releasing oxygen through photosynthesis. The captured carbon is converted into biomass, including branches, roots, and leaves, using solar energy. Thus, planting trees around the power plant, where CO_2 is produced is an essential and effective strategy. Tree plantation is a cost-effective and eco-friendly approach to reduce pollution from GHG emissions at power generating stations. By selecting plant species with high carbon sequestration efficiency, we can significantly enhance the capture and storage of carbon dioxide. This not only helps in mitigating the emissions from coal burning processes but also improves local air quality.

Furthermore, greenbelts play a role in climate resilience. By improving soil structure and reducing erosion, they help maintain soil fertility and support agriculture. They also enhance water infiltration and reduce surface runoff, which can mitigate the risk of flooding and support groundwater recharge.

Consequently, developing a peripheral greenbelt around Mahan TPP is a constructive measure to address the environmental impact of GHG emissions and promote sustainable development. Thus, in addition to the existing greenbelt within the Mahan TPP, MEL has taken up the initiative of peripheral greenbelt development. This initiative is expected to provide a significant reduction in GHG emissions by creating a robust ecological barrier that absorbs and stores carbon dioxide. Furthermore, this greenbelt will enhance the aesthetic value of the area, contribute to biodiversity, and provide additional benefits such as reducing noise pollution and providing habitat for local wildlife.

The comprehensive greenbelt development plan at Mahan TPP demonstrates MEL's commitment to environmental stewardship and sustainable practices. By focusing on long-term ecological benefits and engaging in proactive environmental management, MEL aims to create a healthier and more sustainable environment for the surrounding communities and contribute positively to the global effort of reducing the carbon footprint.

5.1.2 Utilization of Modern Technologies

A significant number of power stations in India have been operational for long periods, leading to inefficiencies and higher GHG emissions. Technological advancements can greatly reduce these emissions. Aging equipment often produces more emissions compared to newer, more efficient technologies. One of the primary factors contributing to high GHG emissions is improper fuel combustion. Maintaining the correct air-fuel ratio is essential for achieving extensive combustion, which in turn increases energy efficiency. During the combustion process, if the fuel is not burned properly, it results in the emission of particulates and other pollutants.

In coal-based power plants, optimizing the performance of pulverized coal is a strategic approach to enhancing energy efficiency. Lower rank coals, such as brown coal, can be dewatered to recover their calorific value before being pulverized for combustion. This process improves the energy conversion efficiency of coal.

The existing Mahan TPP currently operates using subcritical technology. However, the proposed expansion project, which includes two new 800 MW units, will employ ultra-supercritical technology. This advanced technology is expected to lead to a significant reduction in CO2 emissions.

Subcritical technology, which is used in the existing units, operates at relatively lower temperatures and pressures. Typically, subcritical plants function below the critical point of water, which is 374°C and 22.1 MPa. This results in lower thermal efficiency and higher fuel consumption. Consequently, subcritical technology produces more CO2 emissions per unit of electricity generated, contributing significantly to greenhouse gas emissions.

In contrast, ultra-supercritical technology operates at much higher temperatures and pressures, above the critical point of water. Ultra-supercritical plants typically function at temperatures exceeding 600°C and pressures around 25-30 MPa. These higher operational parameters lead to more efficient fuel combustion, reducing the amount of coal needed to produce the same amount of electricity. The increased efficiency translates directly into lower CO2 emissions per unit of electricity generated. Additionally, ultra-supercritical technology often incorporates advanced materials and engineering techniques to withstand these extreme conditions, further enhancing plant efficiency and reliability.

By transitioning to ultra-supercritical technology for the new 800 MW units, the Mahan TPP will significantly reduce its CO2 emissions. This technology not only improves fuel efficiency but also aligns with global best practices for sustainable energy production, positioning Mahan TPP as a leader in environmentally responsible power generation. The shift from subcritical to ultra-supercritical technology marks a critical step in reducing the environmental impact of coal-based power generation, contributing to broader efforts to mitigate climate change.

5.1.3 Selection of Fuels

Fuel selection is critical for reducing GHG emissions in coal-based thermal power plants. There is a significant variation in CO_2 emissions per MWh of electricity generated due to differences in energy conversion efficiency, fuel type, and plant age. The variation in GHG emissions of different fuel types has been presented in Table 5.1. The data reveals significant differences in emissions between hard coal and brown coal, underscoring the environmental impact of coal type selection for power generation. Hard coal emits 94,600 kg of CO2 per kJ, while brown coal emits even more, at 101,000 kg of CO2 per kJ, highlighting the higher carbon intensity of brown coal. Additionally, brown coal produces substantially higher levels of sulfur dioxide (SO2) and particulate matter compared to hard coal. Specifically, brown coal emits 1361 kg of SO2 per kJ and 3254 kg of particulate matter per kJ, compared to 765 kg of SO2 and 1203 kg of particulate matter for hard coal. These elevated emissions make brown coal a significantly more polluting option. Therefore, opting for hard coal over brown coal can be a more environmentally favorable choice, although both types still have considerable environmental impacts compared to cleaner energy sources. This analysis emphasizes the importance of fuel selection in mitigating greenhouse gas and pollutant emissions in coal-based power plants.

TABLE 5.1: VARIATION IN LEVEL OF GHG EMISSIONS OF DIFFERENT FUEL TYPES

Pollutant	Hard Coal	Brown Coal	Fuel Oil	Other Oil	Gas
CO2 (kg/kJ)	94,600	1,01,000	77400	74100	56100
SO2 (kg/kJ)	765	1361	1350	228	0.68
NOx (kg/kJ)	292	183	195	129	93.3
CO (kg/kJ)	89.1	89.1	15.7	15.7	14.5
Non methane organic compounds (kg/kJ)	4.92	7.78	3.7	3.24	1.58
Particulate matter (kg/kJ)	1203	3254	16	1.91	0.1
Flue gas volume total (m3 /GJ)	360	444	279	276	272

Hence, by opting for cleaner coal types and implementing advanced technologies, Mahan TPP can minimize pollutants and enhance efficiency. The proposed expansion to ultra-supercritical technology at Mahan TPP is a step in this direction, ensuring reduced CO2 emissions and improved combustion efficiency. Clean coal technologies are crucial for reducing pollutants to acceptable levels, thereby contributing to both environmental sustainability and operational efficiency.

5.1.4 Optimization Process

Conventional power plants use 7% to 15% of their own generated electrical power for industrial processes and electrical systems, which does not reach the grid. At Mahan TPP, this auxiliary power consumption (APC) is approximately 7%. Optimization processes focus on improving the performance of combustion and steam processes. By replacing old equipment such as motors that run pumps, fans, lights, and auxiliary systems with new, efficient ones, Mahan TPP can significantly enhance overall efficiency. Implementing these upgrades, Mahan TPP would be able to reduce its auxiliary power consumption, thereby increasing the net power available for the grid and improving the plant's overall operational efficiency.

5.1.5 Waste Disposal Techniques

The release of waste, including solid particles and exhaust heat, from power plants significantly impacts the environment. These wastes often contaminate water, soil, and air, leading to extensive pollution and adverse environmental effects. Proper waste management is essential for mitigating these impacts and reducing greenhouse gas (GHG) emissions. Implementing advanced waste management techniques, such as recycling and efficient disposal technologies, can significantly minimize the environmental footprint of power plants.

In the context of Mahan TPP, adopting comprehensive waste management strategies can help reduce the plant's overall emissions and enhance environmental health. Waste-to-energy projects, which convert waste materials into useful energy, are particularly beneficial. By integrating these projects, Mahan TPP can not only manage its waste more effectively but also generate additional energy, thus improving its overall efficiency and sustainability.

5.1.6 Ageing Effects

The electrical equipment such as generators, transformers, and switchgear experience significant environmental and operational stress throughout their service life. Over time, these stress factors can lead to deterioration, affecting the overall efficiency of the power plant. In particular, key components like boilers, generators, and turbines may suffer from wear and tear, which can lead to reduced performance and increased maintenance costs.

To address these aging issues, Mahan TPP focuses on analyzing root causes and conducting predictive maintenance through advanced monitoring techniques. By continuously monitoring the condition of critical equipment, potential problems can be identified and addressed before they lead to unexpected shutdowns. This proactive approach not only helps in maintaining high efficiency but also extends the lifespan of the equipment.

Regular maintenance is crucial for ensuring that the TPP operates at optimal efficiency. Scheduled inspections and timely replacements of worn-out parts help in preventing sudden breakdowns, thereby ensuring continuous and efficient operation. By maintaining equipment such as boilers, generators, and turbines, the plant can avoid unexpected shutdowns and maintain high performance levels, reducing the overall environmental impact and enhancing the plant's operational longevity.

Annexure X

PERIPHERAL GREEN BELT DEVELOPMENT PLAN FOR MAHAN THERMAL POWER PLANT

Document No: IISWBM/IRP/PGBD-APL/2024-25/01 V1.0 Dated 30/04/2024

IISWBM

April 2024

PERIPHERAL GREEN BELT DEVELOPMENT PLAN FOR MAHAN THERMAL POWER PLANT

Document No: IISWBM/IRP/PGBD-APL/2024-25/01 V1.0 Dated 30/04/2024

Submitted By

Mahan Energen Limited
Vill-Bandhuara, Block-Baidhan
Singrauli (MP)

Executed By

DEPARMENT OF ENVIRONMENT MANAGEMENT
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APRIL, 2024

CONTENTS

EXECUTIVE SUMMARY

Adani Power Limited (APL), a member of the Adani Group, has taken up implementation of large Thermal Power Projects at various locations in India in view of the growing needs of power requirements in the country. APL is also actively planning to implement Thermal Power Stations at various locations in India, totaling to about 20,000 MW in the coming years.

Mahan Energen Limited – MEL is a subsidiary company of Adani Power Limited (APL) which has been formed to develop 2x800 MW Ultra Super Critical Thermal Power Plant at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh. The Project is proposed to be developed as an expansion of the existing 2 x 600 MW units at the site and all the necessary infrastructure to cater the requirement of the enhanced capacity will be developed while also using the facilities of the existing plant.

A detailed assessment of existing green belt in and around Mahan TPP is necessary to further strengthen the green cover and develop a plan for development of peripheral green belt around Mahan TPP for effective utilization of natural resources besides creating sustainable livelihood for local people.

The prime objectives of peripheral green belt development include:

- To assess the existing status of green belt in and around Mahan TPP (core as well as buffer area).
- To identify public/common areas for developing additional green belt within the study area.
- To formulate strategies and action plan for peripheral green belt development around Mahan TPP.

The detail scope of work for the study was as follows:

1) Collection of the Primary data from the field and Secondary data and study was conducted by the team experts
2) The detailed study was undertaken for the study zone (core and buffer zone) i.e. 2 km radius from the project site of the project area and the study was carried out by Ecologist/Botanist/Environment Professional.
3) Mapping of the Land Use, Water bodies and Forest, Vegetation types within the 2 km radius area from the project site was done using GIS and

remote sensing.

4) Ecological status of the study area such as habitat type and its quality, species, diversity, rarity, fragmentation, ecological and study have provided information regarding the nature and distribution of vegetation in and around the project area.

5) Promotion of afforestation and reforestation to protect and improve the local environment.

6) Sustainable livelihoods for local communities through sustainable agriculture and alternative income-generating activities.

7) Monitoring and evaluation of project outcomes to ensure effective resource management and sustainable development.

8) Recommendation on institutional mechanism for implementation of green belt and micro watershed development plan.

The approach for development of peripheral green belt in the buffer zone of Mahan TPP includes:

- **Regulatory Guidelines:** Design and development of the green belt would align with industry-specific requirements and guidelines provided by relevant regulatory bodies, such as the Central Pollution Control Board (CPCB).

- **Site Selection**: Determination of the location and area for the proposed green belt development have been done based on project-specific factors.

- **Species Selection**: Local or native fast-growing tree species would be chosen that is suited to the region's climate and soil conditions. Preference would be given to species with economic, medicinal, or ecological value, as well as those that bear fruits. Additionally, non-edible shrub species would be preferred to support biodiversity.

- **Planting Arrangement**: Optimization of planting patterns would be done to maximize the effectiveness of the green belt in reducing pollution. Plantation of trees, shrubs, and bio-fencing in circular rows, with recommended spacing between trees and shrubs would be done to ensure adequate growth and coverage. In terms of planting arrangement, Miyawaki technique would be employed to develop greenbelt in the wasteland areas whereas Double Row plantation technique would be used for development of green cover in public land such as schools, health centers etc.

- **Plantation and Protection**: Sufficient number of trees and shrubs would be planted to achieve the desired density and coverage. Bamboo or iron tree guards would be used to protect saplings from damage.

- **Consultation with Authorities:** Consultation would be done with local forest departments or environmental agencies to identify suitable plant species and ensure compliance with regulations.

For the peripheral green belt development surrounding the Mahan TPP, a comprehensive approach has been devised, taking into account the involvement of various key stakeholders and the identification of strategic locations for development of green cover. Educational institutes, gram panchayat offices, health centers, and other government institutions have been identified within a 2km buffer zone of the Mahan TPP. Additionally, wasteland areas within this vicinity have been identified for potential transformation.

The LULC analysis revealed that tree cover comprises a significant portion of the study area, covering approximately 7.4 km^2 and accounting for 20.5% of the total area. Following this, open grasslands occupy nearly 14 km^2, constituting more than 38% of the buffer zone. Croplands span approximately 12 km^2, representing 33% of the total area. Conversely, the built-up area of settlements occupies a smaller proportion, accounting for 6.8% of the buffer zone. Additionally, water bodies and bare ground/wasteland cover minimal areas, with water bodies occupying 0.6% and bare ground/wasteland covering 0.5% of the buffer zone respectively.

The NDVI analysis revealed that out of 35.87 km^2 of the buffer area, around 27.2 km^2 is having low vegetative cover that is approximately 76 % of the entire buffer zone. Whereas nearly 7 km^2 of the buffer zone is covered by moderately dense vegetation which accounts for 19 % of the total area. According to NDVI analysis, vegetation that falls under "Very Dense/Healthy Vegetation Cover" is absent in the area. The buffer zone also consists of 5.05 km^2 of land that is devoid of vegetation cover and is nearly around 2% of the entire buffer zone. Additionally, a very small portion of the area is occupied by water bodies (0.06 km^2 or 0.17 %).

The strategies formulated for development of peripheral green belt include:

Analysis of Land Use/Land cover- The land use/land cover analysis indicates that approximately 740 hectares of the total buffer zone identified within 2 Km of Mahan TPP are characterized by tree cover, indicating a significant presence of green cover. Conversely, around approximately 20 hectares are designated as wastelands, representing areas with limited vegetation or degraded landscapes.

Assessment of Existing Green Cover- The assessment of the existing green cover in the buffer zone of Mahan TPP revealed that a significant portion of the study area is characterized by low vegetation density, while patches of lands devoid of vegetation have also been identified interspersed within the landscape. The green belt development plan would be implemented through careful selection of plant species in targeted areas that in turn would lead to the increase in the overall green cover of the buffer zone by an estimated 20-25%.

The selection of plant species for green belt development depends on several factors including climate, elevation, and soil conditions. While selecting tree species for plantation, it is essential to consider certain desirable characteristics. The primary objectives in selecting suitable trees for a site involve ensuring adequate space both above and below ground for the tree's canopy and roots to grow, as well as considering its future maintenance needs. The aim is to plant trees that can reach full maturity with minimal need for pruning, as pruning cuts can leave trees vulnerable to decay.

The wasteland constitutes an area of approximately 21.13 Ha and it is envisioned that approximately 31695 trees will be planted within this area, contributing to the transformation of barren land into a flourishing green landscape. It is envisaged that a total of 960 trees would be strategically planted across the school premises and 240 trees would be planted withim gram panchayat offices symbolizing a concerted effort to enhance the aesthetic appeal and ecological functionality of these community infrastructure.

In the proposed development of green belts within the identified wasteland areas around Mahan TPP, the innovative Miyawaki technique is proposed for implementation. The method involves densely planting native species in multiple layers to accelerate forest growth and biodiversity. The double row technique of plantation is proposed to be implemented in schools, health centers, and other public land around Mahan TPP.

The total estimated budget for the implementation of green belt development plan is 54.52 Lakhs INR.

In conclusion, the peripheral green belt development plan for the Mahan TPP buffer zone represents a proactive and holistic approach towards environmental conservation and community development.

The recommendations for the development of green belt in the buffer zone of Mahan TPP include:

- Given the significant presence of wastelands in the buffer zone, targeted tree plantation initiatives should be undertaken to rejuvenate degraded landscapes and enhancing biodiversity.

- Adequate allocation of resources should be done for tree plantation in the public institutions to create vibrant and sustainable ecosystems that benefit local communities.

- A proper tracking mechanism should be followed to monitor the progress of green belt development plan.

- Frequent assessments should be undertaken to evaluate the impact of tree plantation efforts on increasing green cover and improving environmental sustainability in the buffer zone surrounding the Mahan TPP.

- Local residents should be encouraged to actively participate in tree plantation drives and environmental conservation efforts, fostering a sense of ownership.

- Adoption of sustainable maintenance practices should be ensured to support the long-term health and vitality of newly planted trees.

- Collaboration with relevant stakeholders including government agencies, non-profit organizations, and local communities is recommended to leverage resources and expertise in green belt development plan.

- It is recommended to conduct awareness campaigns and educational programs to promote the importance of green belt development and environmental conservation among local communities around Mahan

1.0 INTRODUCTION

1.1 BACKGROUND

The Adani Group (1988) has grown from being a trading house to a diversified business group with interests from infrastructural development to FMCGs. The Adani Group has made foray into high growth sector like Power, Infrastructure, Global Trading, Logistics and Energy.

Adani Power Limited (APL), a member of the Adani Group, has taken up implementation of large Thermal Power Projects at various locations in India in view of the growing needs of power requirements in the country. APL is also actively planning to implement Thermal Power Stations at various locations in India, totaling to about 20,000 MW in the coming years.

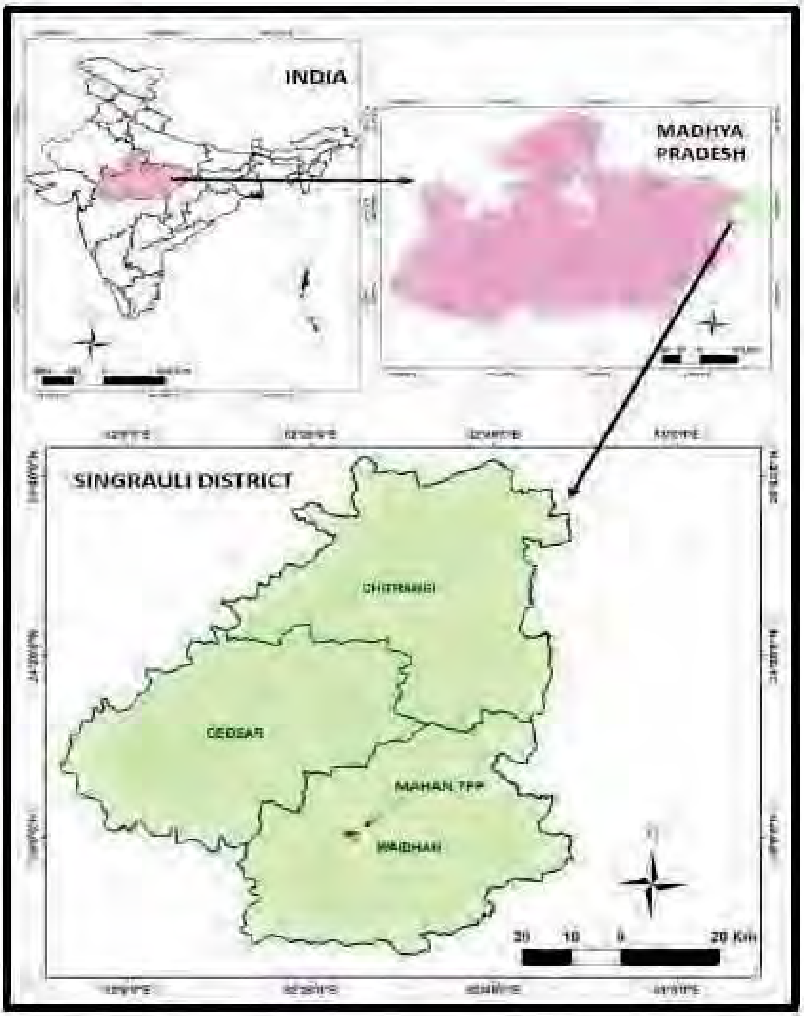
Mahan Energen Limited – MEL is a subsidiary company of Adani Power Limited (APL) which has been formed to develop 2x800 MW Ultra Super Critical Thermal Power Plant at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh (Figure 1.1). The Project is proposed to be developed as an expansion of the existing 2 x 600 MW units at the site and all the necessary infrastructure to cater the requirementof the enhanced capacity will be developed while also using the facilities of the existing plant.

The Project is conceptualised to be operated by utilising coal from nearbycommercial coal mines and water from the Rihand reservoir. For auxiliaries' viz.Coal Handing, Ash Handling and Plant Water System, it is proposed to utilise thelatest technology with adequate margin to ensure high availability of the Project. Land Area of about 920 Acres has been identified for the Project which includesthe existing 1200 MW plant and land area for accommodation of coal stockyard,water reservoir, roads & green belt etc.

A detailed assessment of existing green belt in and around Mahan TPP is necessary to further strengthen the green cover and develop a plan for development of peripheral green belt around Mahan TPP for effective utilization of natural resources besides creating sustainable livelihood for local people. The effective peripheral greenbelt around Mahan TPP would also help greatly to reduce the effect of Air pollution, Noise pollution, Soil erosion, act as a wind barrier, increase the water holding capacity of soil, reduce the surface water run-off, providing shelter to animals and ultimately improve the biodiversity of the area.

In accordance with its mission of being enviro-socially responsible corporate entity with thrust on sustainable development, MEL aims to focus on strengthening green belt around its Mahan TPP. To accomplish this mission, it is imperative to carry out proposed study that can facilitate in formulating a comprehensive short as well as long-term green belt development plan.

FIGURE 1.1: LOCATION OF PROPOSED USCTPP AT SINGARAULI MADHYA PRADESH



1.2 OBJECTIVES OF THE STUDY

The prime objectives of peripheral green belt development include:

- To assess the existing status of green belt in and around Mahan TPP (core as well as buffer area).
- To identify public/common areas for developing additional green belt within the study area.
- To formulate strategies and action plan for peripheral green belt development around Mahan TPP.

1.3 SCOPE OF THE STUDY

The scope of the study includes the undertaking of a reconnaissance survey. On the basis of the reconnaissance survey a framework was evolved for undertaking time bound detailed field survey within the influence zone of the project site (i.e. 2 km radius) and assessment of existing greenbelt was done. The detail scope of work for the study was as follows:

1) Collection of the Primary data from the field and Secondary data and study was conducted by the team experts

2) The detailed study was undertaken for the study zone (core and buffer zone) i.e. 2 km radius from the project site of the project area and the study was carried out by Ecologist/Botanist/Environment Professional.

3) Mapping of the Land Use, Water bodies and Forest, Vegetation types within the 2 km radius area from the project site was done using GIS and remote sensing.

4) Ecological status of the study area such as habitat type and its quality, species, diversity, rarity, fragmentation, ecological and study have provided information regarding the nature and distribution of vegetation in and around the project area.

5) Promotion of afforestation and reforestation to protect and improve the local environment.

6) Sustainable livelihoods for local communities through sustainable agriculture and alternative income-generating activities.

7) Monitoring and evaluation of project outcomes to ensure effective resource management and sustainable development.

8) Recommendation on institutional mechanism for implementation of green belt and micro watershed development plan.

The layout map of Mahan TPP has been presented in Figure 1.2 and the buffer zone map around Mahan TPP proposed for peripheral green belt development has been presented in Figure 1.3.

FIGURE 1.2: LAYOUT MAP OF MAHAN TPP

FIGURE 1.3: BUFFER ZONE (2KM RADIUS) IDENTIFIED FOR PERIPHERAL GREEN BELT DEVELOPMENT AROUND MAHAN TPP

1.4 PROJECT AT A GLANCE

General:

Project Authority (SPV)	:	Mahan Energen Ltd.
Project	:	2x800 MW Ultra Super-Critical ThermalPower Project.
Selected Location	:	Bandhaura, Nagwa, Karsualal and Khairahi village, Singrauli District, M.P.
Latitude and Longitude of the site	:	24°0'28.90"N latitude / 82°24'49.94"E longitude
Altitude	:	320 to 340 m.
Average RL	:	335 m.
Annual average rain fall	:	1132.7 mm
Nearest Major Town	:	Waidhan and Singrauli
Seismic Zone	:	Zone-III as per IS 1893
Access by Road	:	State Highway (SH14) is passing about 16km from the site.
Access by Rail	:	Singrauli Station is located at 52 km fromProject Site.
Access by Air	:	Nearest Airport is at Varanasi at a distanceof 280 km.
Access by Sea	:	Nearest Seaport is at Dhamra at a distanceof 770 km.

Preliminary Project Particulars:

Main Fuel	:	Coal from Commercial Coal Mines (GCV 3000-4200 Kcal/Kg)
Fuel Transportation	:	Through Long Belt conveyor (LBC) system.
Water	:	From the Rihand Reservoir at 36 km fromSite.
Land	:	920 Acres of land is available for the PowerProject.
Layout Features	:	2 X 800 MW Ultra Super-Critical Units

Technical Features:

Power Generating Unit sets	:	Two units of 800 MW turbine generator fed by steam from coal fired P.F. boiler operating at Ultra Super-critical range.
Cooling System	:	Closed recirculating condenser cooling system with induced draft cooling tower.
Coal Handling System	:	Coal handling facility, which comprises receipt of coal from Mines through LBC system, with on-line existing & new crushing and stacking by existing & new stacker-cum-reclaimer in the existing & new coal yard and finally feeding the bunker level conveyors.
Ash Disposal System	:	Provision will be made for disposal of fly ash in dry form to adjacent Cement Plants/ Mineback filling. Provision will be made for disposal of ash in high concentration slurry form.
Power Evacuation	:	At 400 kV level to State Transmission Unit (STU)

Environmental Aspects	:	Elaborate arrangements for Flue gas desulphurization (FGD) and Selective Catalytic Reduction (SCR) systems complying with emission norms as per latest MoEF & CC. Independent steel wet flue foreach unit, down- stream of FGD of suitable height as per MoEF & CC guidelines and an adequately designed electrostatic precipitator with more than 99.99% efficiency are envisaged. Waste water quality to be maintained as per MoEF & CC notification. Zero Plant Discharge facility shall be present since the cooling water, blow down water, waste water and ash water would be recycled back to the systemafter suitable treatment for reuse. For coal transportation from mines, pipe conveyor technology will be adopted to mitigate environmental concerns.
Rehabilitation Requirement	:	Nil

Other Facilities:

Township	:	Township with civic amenities would be developed.
Mode of Implementation	:	The Project would be implemented on EPCconcept.
Project Time Frame	:	54 months from Zero Date i.e. the date of 'Financial Closure' for Commercial Operation of Unit#3 and 60 months for Unit#4

FIGURE 1.4: VIEW OF MAHAN TPP AT SINGRAULI MADHYA PRADESH

2.0 FRAMEWORK FOR PERIPHERAL GREEN BELT DEVELOPMENT

Peripheral green belt development for industrial areas plays a pivotal role in fostering sustainable development and mitigating the adverse impacts of industrial activities on the surrounding environment. It involves the strategic planning and establishment of green cover around the periphery of project area to create a protective barrier that shields neighbouring communities and ecosystems from pollution and other detrimental effects.

One of the key benefits of peripheral green belt development is its ability to mitigate air pollution. Vegetation within the green belt acts as a natural filter, absorbing harmful pollutants such as carbon dioxide, sulfur dioxide, and particulate matter emitted by industrial activities. Through photosynthesis, trees and plants not only sequester carbon but also release oxygen, thereby improving air quality and reducing the concentration of greenhouse gases in the atmosphere. Furthermore, development of green cover serves as a noise barrier, dampening the sound waves generated by machinery, transportation, and other industrial processes.

In addition to its role in pollution abatement, the peripheral green belt contributes to soil conservation and erosion control. The roots of trees and vegetation stabilize the soil, preventing erosion caused by rainfall and runoff. By enhancing the water-holding capacity of the soil, the green belt also helps regulate surface water runoff, reducing the risk of flooding and soil degradation. On the other hand, green belt provides habitat and refuge for a diverse range of flora and fauna, promoting biodiversity and ecological resilience. By preserving natural habitats and creating corridors for wildlife movement, it supports the conservation of native species and fosters ecological connectivity within the landscape.

From a socio-economic perspective, peripheral green belt development enhances the aesthetic appeal of industrial areas, transforming them into visually pleasing landscapes that blend seamlessly with the natural surroundings. This not only elevates the standard of living for nearby residents but also boosts the desirability of the area for potential investments and tourism.

Overall, peripheral green belt development represents a holistic approach to sustainable urban planning, integrating environmental protection, public health, and economic prosperity. By investing in the creation and maintenance of green spaces around industrial zones, communities can achieve a balance between industrial development and environmental conservation, ensuring a healthier and more resilient future for generations to come.

2.1 APPROACH FOR GREEN BELT DEVELOPMENT

The approach for development of peripheral green belt for Mahan TPP follows a structured process to ensure environmental sustainability and compliance with regulatory standards. The approach for development of peripheral green belt includes:

- **Regulatory Guidelines:** Design and development of the green belt would align with industry-specific requirements and guidelines provided by relevant regulatory bodies, such as the Central Pollution Control Board (CPCB).

- **Site Selection**: Determination of the location and area for the proposed green belt development have been done based on project-specific factors.

- **Species Selection**: Local or native fast-growing tree species would be chosen that is suited to the region's climate and soil conditions. Preference would be given to species with economic, medicinal, or ecological value, as well as those that bear fruits. Additionally, non-edible shrub species would be preferred to support biodiversity.

- **Planting Arrangement**: Optimization of planting patterns would be done to maximize the effectiveness of the green belt in reducing pollution. Plantation of trees, shrubs, and bio-fencing in circular rows, with recommended spacing between trees and shrubs would be done to ensure adequate growth and coverage. In terms of planting arrangement, Miyawaki technique would be employed to develop greenbelt in the wasteland areas whereas Double Row plantation technique would be used for development of green cover in public land such as schools, health centers etc.

    - **Miyawaki Technique**: This method would involve densely planting native species in multiple layers to accelerate forest growth and biodiversity. It would focus on creating compact, diverse ecosystems within a small area, making it suitable for maximizing green cover in the wastelands.

    - **Double Row Technique:** The technique would involve planting two rows about 8 inches apart which would allow growing two rows of plants in almost the same amount of space as one row would require.

- **Plantation and Protection**: Sufficient number of trees and shrubs would be planted to achieve the desired density and coverage. Bamboo or iron tree guards would be used to protect saplings from damage.

- **Consultation with Authorities:** Consultation would be done with local forest departments or environmental agencies to identify suitable plant species and ensure compliance with regulations.

2.2 SITE SELECTION

For the peripheral green belt development surrounding the Mahan TPP, a comprehensive approach has been devised, taking into account the involvement of various key stakeholders and the identification of strategic locations for development of green cover. Educational institutes, gram panchayat offices, health centers, and other government institutions have been identified within a 2km buffer zone of the Mahan TPP. Additionally, wasteland areas within this vicinity have been identified for potential transformation. The proposed approach emphasizes the greening of essential community institutions such as schools, gram panchayat offices, health facilities etc. By focusing on the identified areas, the proposed peripheral green belt development plan would not only aim to enhance the environmental resilience of the area but would also directly benefit the well-being and quality of life of local community.

2.2.1 Land Use/Land Cover Analysis

The land use/land cover characteristics of the area within 2 km of the Mahan TPP was analyzed to assess the prevailing land pattern within the buffer zone in order to identify suitable location for development of green belt. The data has been derived from the ESA Sentinel-2 imagery at 10 m resolution downloaded for the year 2023.

The description of the different LULC classes derived from the imagery are as follows:

1. Waterbodies: Areas where water was predominantly present throughout the year; may not cover areas with sporadic or ephemeral water; contains little to no sparse vegetation, no rock outcrop nor built up features like docks; examples: rivers, ponds, lakes, oceans, flooded salt plains.

2. Tree Cover: Any significant clustering of tall (~15 feet or higher) dense vegetation, typically with a closed or dense canopy; examples: wooded vegetation, clusters of dense tall vegetation within savannas, plantations, swamp or mangroves (dense/tall vegetation with ephemeral water or canopy too thick to detect water underneath).

3. Flooded Vegetation: Areas of any type of vegetation with obvious intermixing of water throughout a majority of the year; seasonally flooded area that is a mix of grass/shrub/trees/bare ground; examples: flooded mangroves, emergent vegetation, rice paddies and other heavily irrigated and inundated agriculture.

4. Cropland: Human planted/plotted cereals, grasses, and crops not at tree height; examples: corn, wheat, soy, fallow plots of structured land.

5. Built-up Area: Human made structures; major road and rail networks; large homogenous impervious surfaces including parking structures, office buildings and residential housing; examples: houses, dense villages / towns / cities, paved roads, asphalt.

6. Bare Ground: Areas of rock or soil with very sparse to no vegetation for the entire year; large areas of sand and deserts with no to little vegetation; examples: exposed rock or soil, desert and sand dunes, dry salt flats/pans, dried lake beds, mines.

7. Open Grassland: Open areas covered in homogenous grasses with little to no taller vegetation; wild cereals and grasses with no obvious human plotting (i.e., not a plotted field); examples: natural meadows and fields with sparse to no tree cover, open savanna with few to no trees, parks/golf courses/lawns, pastures. Mix of small clusters of plants or single plants dispersed on a landscape that shows exposed soil or rock; scrub-filled clearings within dense forests that are clearly not taller than trees; examples: moderate to sparse cover of bushes, shrubs and tufts of grass, savannas with very sparse grasses, trees or other plants.

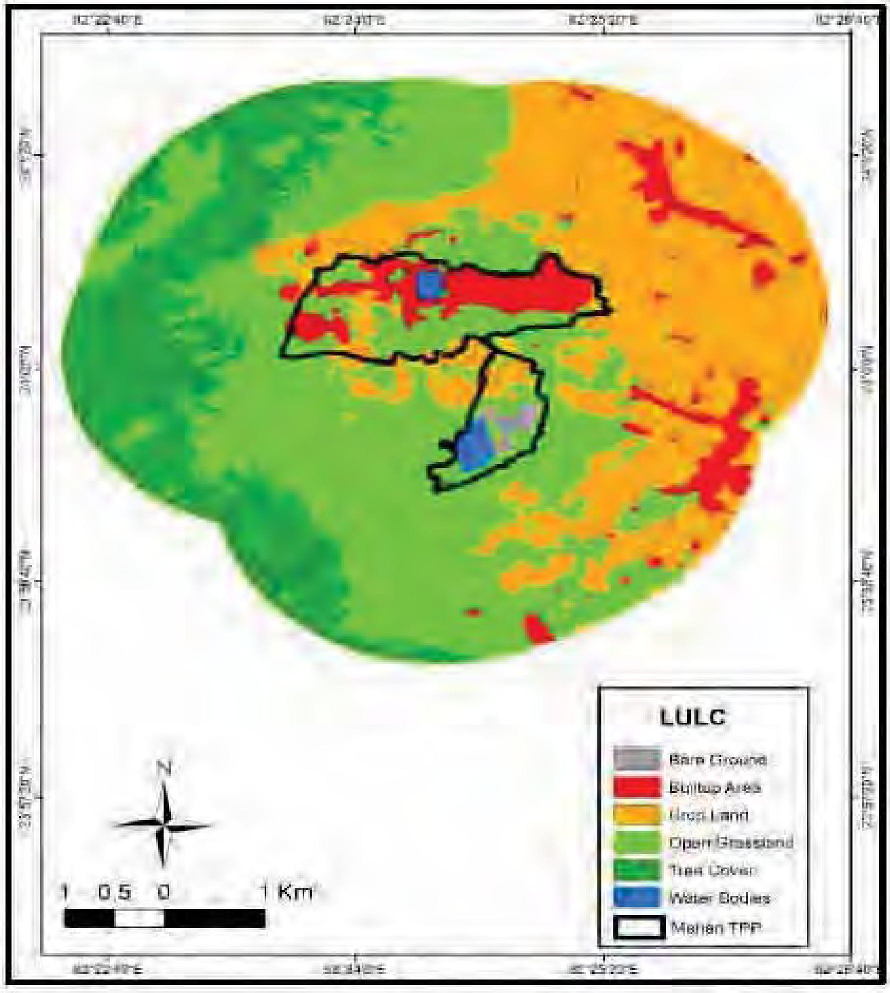
Table 2.1 and Figure 2.1 present the results of land use/land cover classification in the study area within 2 Km buffer zone of Mahan TPP. The analysis highlights that the tree cover comprises a significant portion of the study area, covering approximately 7.4 km^2 and accounting for 20.5% of the total area. Following this, open grasslands occupy nearly 14 km^2, constituting more than 38% of the buffer zone. Croplands span approximately 12 km^2, representing 33% of the total area. Conversely, the built-up area of settlements occupies a smaller proportion, accounting for 6.8% of the buffer zone. Additionally, water bodies and bare ground/wasteland cover minimal areas, with water bodies occupying 0.6% and bare ground/wasteland covering 0.5% of the buffer zone respectively. The significant presence of tree cover and the notable extent of wastelands indicate the potential for enhancement of green cover within the 2 Km buffer zone of Mahan TPP.

TABLE 2.1: AREA STATISTICS OF LANDUSE-LANDCOVER CLASSES WITHIN 2 KM BUFFER ZONE OF MAHAN TPP

LULC Classes	Pixel* Count	Area (Km^2)	Per Cent of Total Area
Water	2263	0.23	0.63
Tree Cover	73885	7.39	20.58
Crop Land	119135	11.91	33.18
Buildup Land	24291	2.43	6.77
Bare Ground/Wasteland	1960	0.20	0.55
Open Grassland	137516	13.75	38.30
Total	**359050**	**35.91**	**100**

* Spatial Resolution = 10 m.

FIGURE 2.1: LAND USE LAND COVER CHARACTERISTICS WITHIN 2KM OF MAHAN TPP



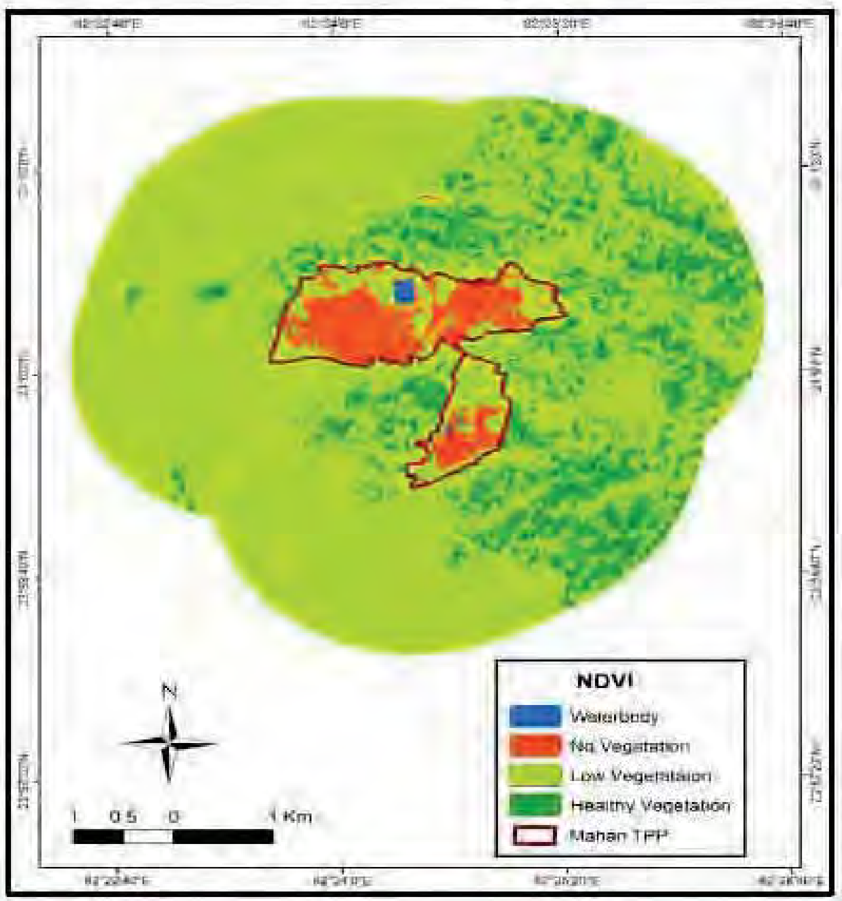
2.2.2 NDVI of Study Area

The Normalized Difference Vegetation Index (NDVI) analysis was undertaken to assess the existing status of vegetation cover around the 2 Km buffer zone of Mahan TPP. The study was conducted on GIS platform using Landsat-8 data of March 12, 2024 (Figure 2.2). The analysis revealed the status of the vegetation cover of the study area within 2 km radius of the Mahan TPP. Out of 35.87 km^2 of the buffer area, around 27.2 km^2 is having low vegetative cover that is approximately 76 % of the entire buffer zone (Table 2.2). Whereas nearly 7 km^2 of the buffer zone is covered by moderately dense vegetation which accounts for 19 % of the total area. According to NDVI analysis, vegetation that falls under "Very Dense/Healthy Vegetation Cover" is absent in the area. The buffer zone also consists of 5.05 km^2 of land that is devoid of vegetation cover and is nearly around 2% of the entire buffer zone. Additionally, a very small portion of the area is occupied by water bodies (0.06 km^2 or 0.17 %).

TABLE 2.2: NORMALIZED DIFFERENCE VEGETATION INDEX CALCULATION FOR THE STUDY AREA

Reclassification Value	NDVI		Pixel* Count	Feature	Area (sqkm)	Percentage (%)
	Minimum	Maximum				
0	-1	0	68	Waterbody	0.06	0.17
1	0	0.1	2014	No Vegetation Cover	1.81	5.05
2	0.1	0.3	30234	Low Vegetation Cover	27.21	75.86
3	0.3	0.7	7540	Healthy Vegetation Cover	6.79	18.92
Total			**39856**		**35.87**	**100**

FIGURE 2.2: NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI) MAP WITHIN 2KM OF MAHAN TPP



2.2.3 Wastelands

Wasteland areas were identified within a 2-kilometer radius of Mahan TPP using GIS and subsequent field verification during February – March, 2024. The data has been derived from the ESA Sentinel-2 imagery at 10 m resolution downloaded for the year 2023. The identified waste land within buffer zone of Mahan TPP are as depicted in Figure 2.3. For the purpose, an inventory constituting the detailed locations of the wasteland areas within the buffer zone have been prepared as presented in Table 2.3. This empirical observation underscores the necessity for targeted intervention to revitalize these underutilized spaces into vibrant green zones. The strategic identification of these wasteland areas serves as a crucial foundation for the formulation of peripheral green belt development plan around Mahan TPP, providing a tangible roadmap for sustainable land use planning and ecological restoration efforts. By repurposing these wastelands, the project aims to not only enhance the aesthetic appeal of the surroundings but also to harness their potential to mitigate environmental degradation and promote biodiversity conservation.

FIGURE 2.3: LOCATION MAP OF WASTELANDS WITHIN 2 KM OF MAHAN TPP

TABLE 2.3: DETAIL OF WASTELANDS WITHIN BUFFER ZONE OF MAHAN TPP

Sl No	Name	Co-ordinates	Direction	Area (Hectors)
1	Barren land 1	23°59'34.59"N/82°22'47.97"E	South-West	4.35
2	Barren land 2	23°59'23.62"N/82°23'10.39"E	South	1.19
3	Barren land 3	23°59'30.74"N/82°23'29.55"E	South	3.79
4	Barren land 4	23°59'13.10"N/82°23'48.11"E	South	14.7
5	Barren land 5	23°58'57.92"N/ 82°24'4.78"E	South	6.31
6	Barren land 6	24° 1'38.25"N/ 82°24'35.11"E	North	5.63
7	Barren land 7	24° 1'36.61"N/ 82°24'46.75"E	North	0.37
8	Barren land 8	24° 1'25.74"N/ 82°24'25.28"E	North	4.1
9	Barren land 9	24° 1'30.65"N/ 82°24'37.72"E	North	0.90
10	Barren land 10	24°1'45.60"N/82°24'15.47"E	North	1.1
11	Barren land 11	23°58'48.13"N/82°24'26.18"E	South	16.4
12	Barren land 12	23°58'39.37"N/ 82°24'8.07"E	South	9.66
13	Barren land 13	23°58'35.37"N/82°24'15.92"E	South	8.60

2.2.4 Public Land

2.2.4.1 Schools

For the purpose of identification of educational institutions for green belt development, an inventory of schools constituting detailed information falling within the buffer zone have been prepared (as presented in Table 2.4). During on-field verification, schools located within a 2-kilometer radius of the Mahan TPP were identified as having suitable space for green belt development, as depicted in Figure 2.4. This critical assessment highlights the opportunity to leverage educational institutions as focal points for green infrastructure integration, enhancing both environmental sustainability and educational outreach. By strategically incorporating green belts within school premises, the initiative not only contributes to ecological restoration but also facilitates experiential learning opportunities for students, fostering a deeper connection with nature and environmental stewardship. The detail of schools and anganwadi centers falling within CSR zone of Mahan TPP is presented in Figure 2.1.

FIGURE 2.4: LOCATION MAP OF SCHOOLS WITHIN 2 KM OF MAHAN TPP

TABLE 2.4: DETAIL OF SCHOOLS WITHIN 2 KM OF MAHAN TPP

Block	School Name	Co-ordinate
Waidhan	(i) Shaskiya Purba Madhyamik Vidyalaya, Bhanduara	Lat- 24.013511 Long- 82.411736
	(ii) Shas. Prath. Pathsala Chirihoba,Karsuaraja	Lat- 24.007499 Long- 82.422681
	(iii) Shaskiya Purba Madhyamik Vidyalaya Khairahi School Kendra Karsualal	Lat-23.99854 Long- 82.425211

2.2.4.2 Gram Panchayats

Following field verification, it was determined that gram panchayats located within a 2-kilometer radius of the Mahan TPP boundary possess ample space suitable for green belt development, as illustrated in Figure 2.5. The inventory providing detailed information regarding the gram panchayats falling within the project area is presented in Table 2.5. This insightful assessment underscores the potential to integrate green infrastructure within these areas, empowering grassroots communities to actively participate in environmental conservation efforts. By strategically implementing green belts within gram panchayat premises, the initiative not only enhances ecological resilience but also fosters community engagement and ownership, catalyzing sustainable development at the grassroots level. The detail of GP offices falling within CSR zone of Mahan TPP is presented in Annexure 2.1.

FIGURE 2.5: LOCATION MAP OF GRAM PANCHAYATS WITHIN 2 KM OF MAHAN TPP

TABLE 2.5: DETAIL OF GRAM PANCHAYATS WITHIN 2 KM OF MAHAN TPP

Block	Panchayat Name	Co-ordinate
Waidhan	(i) Karyalay Gram panchayat khetra -Bandhuara	Lat-24.007703 Long-82.422704
	(ii) Karya. Gram Panchayat Khairahi	Lat-23.993556 Long-82.40535
	(iii)Nagwa Panchayat	Lat-23.98137500 Long-82.41978056

2.2.4.3 Health Centers

Upon thorough field verification, it was identified that health centers situated within buffer zone of Mahan TPP offer suitable space for green belt development, as delineated in Figure 2.6. Furthermore, Table 2.6 presents the detail of health centers falling within the buffer zone. The detail of health facilities falling within the CSR zone of Mahan TPP have been presented in Annexure 2.1. This meticulous inventorization not only identifies potential sites for green infrastructure integration but also underscores the critical role of health institutions in fostering community well-being and environmental sustainability. By strategically implementing green belts within the premises of these health centers, the initiative would not only enhance ecological resilience but also promote public health and community resilience in the buffer zone of Mahan TPP.

FIGURE 2.6: LOCATION MAP OF HEALTH CENTERS WITHIN 2 KM OF MAHAN TPP

TABLE 2.6: DISTRIBUTION OF HEALTH FACILITIES WITHIN 2 KM OF MAHAN TPP

S.No.	Name Of Health Facility	Location
1	Primary Health Center	R&R Colony, Nagwa
2	Sub Center,Nagwa	Nagwa

FIGURE 2.7: FIELD SURVEY FOR FORMULATION OF PERIPHERAL GREEN BELT DEVELOPMENT PLAN

3.0 STRATEGIES & ACTION PLAN

The strategies proposed to be adopted for peripheral greenbelt development around the Mahan TPP along with action plan for the same is presented in subsequent section.

3.1 STRATEGIES FOR PERIPHERAL GREEN BELT DEVELOPMENT

The strategies formulated for development of peripheral green belt include:

Analysis of Land Use/Land cover- A detailed analysis of the Land Use and Land Cover (LULC) pattern was conducted to comprehensively understand the existing land patterns within the study area, with a specific focus on identifying wastelands. The findings indicate that approximately 740 hectares of the total buffer zone identified within 2 Km of Mahan TPP are characterized by tree cover, indicating a significant presence of green cover. Conversely, around approximately 20 hectares are designated as wastelands, representing areas with limited vegetation or degraded landscapes. The on-site verification, presented unique opportunity to strategically develop green cover in these underutilized spaces, thereby contributing to the overall enhancement of the green cover around the buffer zone of Mahan TPP. Proactive measures would be undertaken to reclaim and revitalizie the wastelands to further strengthen the green cover around the Mahan TPP.

Assessment of Existing Green Cover- An extensive assessment of the existing green cover was undertaken utilizing Normalized Difference Vegetation Index (NDVI) analysis. This analysis revealed that a significant portion of the study area is characterized by low vegetation density, while patches of lands devoid of vegetation have also been identified interspersed within the landscape. In response to these findings, the green belt development plan would adopt a strategic approach. The plan would be implemented through careful selection of plant species in targeted areas that in turn would lead to the increase in the overall green cover of the buffer zone by an estimated 20-25%. This proactive initiative would further contribute to the enhancement of ecological resilience and biodiversity around the Mahan TPP. Through meticulous planning and execution, the green belt development plan would ensure the significant increase in the green cover within the 2 Km buffer area of Mahan TPP.

3.2 PERIPHERAL GREEN BELT DEVELOPMENT

3.2.1 Criteria for Selection of Plant Species

The selection of plant species for green belt development depends on several factors including climate, elevation, and soil conditions. While selecting tree species for plantation, it is essential to consider certain desirable characteristics. The primary objectives in selecting suitable trees for a site involve ensuring adequate space both above and below ground for the tree's canopy and roots to grow, as well as considering its future maintenance needs. The aim is to plant trees that can reach full maturity with minimal need for pruning, as pruning cuts can leave trees vulnerable to decay. To mitigate the risk of widespread diseases and pests, it is advisable to plant a diverse range of tree species rather than relying on uniform avenues of identical trees, although there may be specific situations where such uniformity is appropriate. The following factors would be taken into account for selection of a tree species species for green belt development.

1. The species should be fast growing and providing optimum penetrability.

2. The species should be wind-firm and deep rooted.

3. The species should form a dense canopy.

4. As far as possible, the species should be indigenous and locally available.

5. Species tolerant to air pollution like SO_2 and NO_2 should be preferred.

6. The species should have large leaf area index to arrest the Particulate Matter.

7. Trees with high foliage density, leaves with larger leaf area and hairy on both the surfaces.

8. Ability to withstand conditions like inundation and drought.

9. Soil improving plants (Nitrogen fixing rapidly decomposable leaf litter).

10. Attractive appearance with good flowering and fruit bearing.

11. Bird and insect attracting tree species.

12. Sustainable green cover with minimal maintenance.

3.2.2 Site Selection

3.2.2.1 Green Belt Development Plan for Wastelands

Table 3.1 presents the detail of wasteland areas identified within the buffer zone of Mahan TPP. The wasteland considered for the proposed green belt development is depicted in Figure 3.1-3.3. Spanning a total area of approximately 21.13 Ha, this designated space presents an opportunity for environmental rehabilitation and ecosystem restoration. Through the green belt development plan, it is envisioned that approximately 31695 trees will be planted within this area, contributing to the transformation of barren land into a flourishing green landscape.

TABLE 3.1: DETAIL OF WASTELAND AREAS IDENTIFIED FOR PROPOSED GREEN BELT DEVELOPMENT WITHIN BUFFER ZONE

Sl No	Name	Co-ordinates	Direction	Total Area (Ha)	Proposed Area for plantation (Ha)	Proposed number of trees
1	Barren land 1	23°59'23.62"N/ 82°23'10.39"E	South-east section 1	1.19	0.4	600
2	Barren land 2	23°59'30.74"N/ 82°23'29.55"E	South-east section 2	4.70	1.5	2250
3	Barren land 3	23°59'13.10"N/ 82°23'48.11"E	South section 1	14.7	4.8	7200
4	Barren land 4	23°58'57.92"N/ 82°24'4.78"E	South section 3	9.1	3	4500
5	Barren land 5	23°58'48.13"N/ 82°24'26.18"E	South section 3	16.4	5.4	8100
6	Barren land 6	23°58'39.37"N/ 82°24'8.07"E	South section 4	9.66	3.2	4800
7	Barren land 7	23°58'35.37"N/ 82°24'15.92"E	South section 5	8.60	2.83	4245
Total				**64.35**	**21.13**	**31695**

FIGURE 3.1: PROPOSED WASTELAND AREA FOR GREEN BELT DEVELOPMENT WITHIN BUFFER ZONE

FIGURE 3.2: IDENTIFICATION OF WASTELAND AREAS FOR GREEN BELT DEVELOPMENT AT SELECTED LOCATIONS WITHIN BUFFER ZONE

FIGURE 3.3: IDENTIFICATION OF WASTELAND AREAS FOR GREEN BELT DEVELOPMENT AT SELECTED LOCATIONS WITHIN BUFFER ZONE

3.2.2.2 Green Belt Development Plan in Public Land

The criteria for green belt development in public land such as schools, gram panchayat offices, and health centers would emphasize the selection of tree species suitable for the rural environment. The schools considered for inclusion in the proposed green belt development initiative are delineated in Table 3.2. Covering a combined area of approximately 2 hectares, these educational institutions offer ample space for the development of green cover. It is envisaged that a total of 960 trees would be strategically planted across these school premises (0.64 Ha), fostering a green and sustainable learning environment for students. Additionally, the detail of gram panchayat offices identified for greenbelt development has been presented in Table 3.3. Out of the total area, 0.16 Ha of land has been identified for plantation. Within this designated space, approximately 240 trees are proposed for plantation, symbolizing a concerted effort to enhance the aesthetic appeal and ecological functionality of these community infrastructure. Table 3.4 provides comprehensive information on the health centers considered for inclusion in the green belt development plan. These vital healthcare facilities represent focal points for environmental enhancement efforts. It is anticipated that in the 0.08 Ha of identified land, nearly 120 plants would be strategically planted within this designated area, aiming to create a healthier and more sustainable environment for both patients and healthcare providers alike. This initiative underscores a commitment to promoting holistic well-being and integrating green infrastructure into critical community institutions within the buffer zone of Mahan TPP.

TABLE 3.2: DETAIL OF SCHOOLS IDENTIFIED FOR PROPOSED GREEN BELT DEVELOPMENT WITHIN BUFFER ZONE

Sl no	School name	Coordinates	Total Area (Ha)	Proposed Area for plantation (Ha)	Proposed number of trees
1	Shashakiya Purba Madhyamik Vidyalay Bandhuara	24°0'48.64"N/82°24'42.25"E	0.54	0.18	270
2	Shash Pratha Pathshawala Chirihawa	24°0'27.00"N/82°25'21.65"E	0.25	0.08	120
3	Govt. Higher Secondary School Karsuaraja	23°59'35.22"N/82°26'5.56"E	0.24	0.08	120

4	Saraswati Sishu Mandir Nanda Vihar, Nagwa	23°58'34.69"N/82°24'15.35"E	0.9	0.3	450
		Total	**1.93**	**0.64**	**960**

TABLE 3.3: DETAIL OF GRAM PANCHAYATS IDENTIFIED FOR PROPOSED GREEN BELT DEVELOPMENT

Sl no	GP name	Coordinates	Total Area (Ha)	Proposed Area for plantation (Ha)	Proposed number of trees
1	Bandhaura GP	24°0'27.70"N/82°25'21.13"E	0.04	0.013	20
2	Khairahi GP	23°59'32.75"N/82°24'11.29"E	0.04	0.013	20
3	Nagwa GP	23°58'52.95"N/82°25'11.21"E	0.40	0.13	200
		Total	**0.48**	**0.16**	**240**

TABLE 3.4: DETAIL OF HEALTH CENTERS IDENTIFIED FOR PROPOSED GREEN BELT DEVELOPMENT

Sl no	GP name	Coordinates	Area (Hector)	Proposed Area for plantation (Ha)	Proposed number of trees
1	PHC Nagwa	23°58'27.33"N/82°24'39.30"E	0.16	0.05	75
2	Health Sub Center, Suhira	24° 0'38.98"N/82°25'4.10"E	0.1	0.03	45
		Total	**0.26**	**0.08**	**120**

FIGURE 3.4: IDENTIFICATION OF PUBLIC LAND FOR GREEN BELT DEVELOPMENT AT SELECTED LOCATIONS AROUND MAHAN TPP

FIGURE 3.5: IDENTIFICATION OF PUBLIC LAND FOR GREEN BELT DEVELOPMENT AT SELECTED LOCATIONS AROUND MAHAN TPP

3.3 ACTION PLAN FOR PERIPHERAL GREEN BELT DEVELOPMENT

3.3.1 Plantation Scheme

3.3.1.1 Wasteland

Table 3.5 provides a comprehensive overview of potential plant species that would be suitable for planting in wasteland around Mahan TPP, offering valuable insights into selection of plant species that can thrive in challenging environments. These species would be carefully selected based on their resilience and adaptability to harsh conditions, making them suitable for green belt development in degraded landscapes.

TABLE 3.5: DETAIL OF PLANT SPECIES SUITABLE FOR PLANTATION IN WASTELANDS AROUND MAHAN TPP

Sl No.	Local Name	Scientific Name	Family
1	Mango	*Mangifera indica*	Anacardiaceae
2	Bahera	*Terminalia bellirica*	Rubiaceae
3	Peeple	*Ficus religiosa*	Moraceae
4	Kadam	*Neolamarckia cadamba*	Rubiaceae
5	Neem	*Azadirachta indica*	Meliaceae
6	Muchukunda	*Pterospermum acerifolium*	Sterculiaceae
7	Haldu	*Adina cordifolia*	Rubiaceae
8	Arjun	*Terminalia arjuna*	Combretaceae
9	Katbadam	*Terminalia catappa*	Combretaceae
10	Chatim	*Alstonia scholaris*	Apocynaceae
11	Teak	*Tectona grandis*	Lamiaceae
12	Palas	*Butea monosperma*	Fabaceae
13	Indian gooseberry	*Phyllanthus emblica*	Phyllanthaceae
14	Indian jujube	*Ziziphus Mauritiana*	Rhamnacea
15	Jamun	*Syzygium cumini*	Myrtaceae
16	Asan	*Terminalia elliptica*	Combretaceae
17	Kanchan	*Bauhinia purpurea*	Fabaceae
18	Champa	*Michelia champaca*	Magnoliaceae
19	Tamarind	*Tamarindus indica*	Fabaceae
20	Sisoo	*Dalbergia sissoo*	Fabaceae
21	Sausage Tree/Worsboom	*Kigelia pinnata*	Bignoniaceae
22	Bel	*Aegle marmelos*	Rutaceae
23	Sal	*Shorea robusta*	Dipterocarpaceae
24	Kendu	*Diospyros melanoxylon*	Ebenaceae
25	Sidha	*Anogeissus latifolia*	Lythraceae
26	Marking nut	*Semecarpus anacardium*	Anacardiaceae
27	Khair	*Acacia catechu*	Fabaceae

3.3.1.2 Public Land

For development of green belt in public land such as schools, gram panchayats and health centers located within 2 Km radius if Mahan TPP, a focus on using fruit-bearing and flowering plants would be prioritized to enhance the aesthetic appeal and functionality of these areas. The plantation would be undertaken by following the double row technique. Table 3.6 provides a detailed overview of suitable plant species that would be planted in the first row which has been worked out based on the land availability and climatic conditions whereas table 3.7 presents the detail of plant species that are proposed to be planted in the second row. The selection of plant species would be done in a way that it provides additional benefits such as shade, food, and habitat for wildlife along with enhancement of aesthetic appeal. Through plantation of fruit-bearing and flowering plants, the green belt development plan would aim to further increase and enhance the existing green cover around Mahan TPP.

Figure 3.6 depicts the status of existing green cover within the 2 Km buffer zone of Mahan TPP.

TABLE 3.6: DETAIL OF PLANT SPECIES SUITABLE FOR PLANTATION IN 1ST ROW IN PUBLIC LAND

Sl No.	Local Name	Scientific Name	Family
1	Neem	*Azadirachta indica*	Meliaceae
2	Pipal	*Ficus religiosa*	Moraceae
3	Imli	*Tamarindus indica*	Fabaceae
4	Bargad	*Ficus benghalensis*	Moraceae
5	silk floss tree	*Chorisia Speciosa*	Malvaceae
6	Sisham	*Dalbergia sissoo*	Fabaceae
7	Mango	*Mangifera Indica*	Anacardiaceae

TABLE 3.7: DETAIL OF PLANT SPECIES SUITABLE FOR PLANTATION IN 2ND ROW IN PUBLIC LAND

Sl No.	Local Name	Scientific Name	Family
1	Bambo	*Bambusa vulgaris*	Poaceae
2	Amaltas	*Cassia fistula*	Fabaceae
3	Rosy trumpet tree or Pink pouli	*Tabebuia rosea*	Bignoniaceae
4	Arjun	*Terminalia arjuna*	Combretaceae
5	Kachnar Gulmorh	*auhinia variegata*	Caesalpiniaceae
6	Jamun	*Syzygium cumini*	Myrtaceae
7	Cape Honeysuckle	*Tecoma capensis*	Bignoniaceae

FIGURE 3.6: STATUS OF EXISTING GREEN COVER WITHIN BUFFER ZONE OF MAHAN TPP

3.3.2 Plantation Technique

3.3.2.1 Miyawaki Technique

In the proposed development of green belts within the identified wasteland areas around Mahan TPP, the innovative Miyawaki technique is proposed for implementation. The method involves densely planting native species in multiple layers to accelerate forest growth and biodiversity. By harnessing this technique, the wasteland areas can be transformed into lush green spaces teeming with diverse flora, contributing significantly to environmental restoration and ecosystem revitalization. The detail of the Miyawaki plantation technique is as follows:

Integrating the concepts of ecological successions, potential natural vegetation (PNV), cooperative processes of high-density plating in humus rich soils, Dr. Akira Miyawaki developed the ecological engineering technique popularly known as “Miyawaki method” in the early 1970s for the restoration of indigenous forests in Japan using native tree species.

This crowd foresting technique build a dense and efficient forest ecosystem as equivalent as that of a 100–150-year-old forest in a short span of 20-30 years if developed in compliance with the recommended steps. Four stages of the Miyawaki foresting technique for development of a forest successfully includes:

Initial Survey of the Locality:

The initial survey of the study area would be undertaken to develop an understanding about the soil characteristics of the site and the potential natural vegetation of the locality. According to different definitions PNV covers either the original vegetation or the subsequent vegetation established naturally in the area subsequent to any major environment al changes like soil erosion. The underlying idea is the planting native vegetation would help forest cover to get established even under no human interference in later stages of the forest development process.

Collection of Seeds:

The stage commences once the tree species for plantation have been identified. Identification of trees should be planned in such a way that the forest after establishment be a multilayered one. Hence, identified tree species are divided into four layers such as shrub, tree, sub tree and canopy layers and percentage of each tree species would be decided accordingly. Seeds of the selected vegetation are collected in large numbers from a natural forest locally or from a similar geo-climatic area and germinate them properly in a nursery bed. The seedlings would be transplanted at 2-3 leaves stage to grow in bags filled with potting mixture prepared using equal amount of soil, coir pith/wood chips, rice/wheat hull and dry cow dung. The plants would be kept under partial shade for a minimum period of 2-3 months before planting in the main field.

Preparation of the Planting Site:

The stage begins with loosening the soil by incorporating organic biomass like wood chips, coir pith, bagasse, rice or wheat hull etc. so that the soil holds more water. For this, the first step would be digging the soil up to one metre deep. Then, the soil to a depth of 50 cm would be taken out and filled with a mixture of soil (20-30 cm topsoil of the site), locally available organic biomass, and dry cow dung. Additionally, microorganisms isolated from a natural forest soil would be used to enhance the soil fertility of the new forest. This loosened fertile soil would help the samplings to grow fast with better spread of roots deep into the soil.

Plantation:

Plantation would be done densely where one square meter area accommodates at least 4 trees with different layers (1 canopy level,1 tree level, 1 sub tree level and 1 shrub level) for a multilayered forest.The site would be mulched using any organic mulch preferably rice/wheat straw to protect the soil from being eroded. As the soil is loose, saplings need to be supported with sticks to withstand conditions like wind, heavy rain etc. The planted site would be managed with timely irrigation and weeding in the first 2-3 years. Once the trees attain a height of 2 meters or more the forest would not require any human interference to grow further.

The subsequent section meticulously outlines a comprehensive, step-by-step process for implementing the Miyawaki plantation technique, providing detailed guidance for the successful development of green cover within the identified wasteland areas around Mahan TPP.

Step 1: Soil Analysis and Soil Preparation

Understanding the texture of the soil helps to analyse the water holding capacity of the soil, the capacity of root perforation, water infiltration, and retention of nutrients by the soil. This includes assessment of soil parameters like physical texture, organic carbon, nitrogen, soil pH, potassium, phosphorus and visible evidence of micro or macro fauna in the soil. This analysis helps to design natural methods for treatment of soil. This includes use of perforation material such as wheat, groundnut shells, corn husk, rice husk which will significantly improve perforation and help the roots to grow. Water retention materials like coco peat and sugarcane stock help the soil retain water and moisture. Addition of vermicompost, cow manure helps to improve the soil nutrient conditions. Addition of cultures of bacteria and mycorrhiza can also be decided based on the assessment results. Soils that are deficient in nitrogen would benefit immensely through Arbuscular Mycorrhizal Fungi (AMF) and nitrogen fixing bacteria like Rhizobium. AMF is available commercially and can even be cultured. Nitrogen fixing bacteria can be cultured and can also be added to the soil by planting nitrogen fixing leguminous plants. Soil texture also needs to be studied. Loamy soils are the most preferred as they contain a good mix of sand, clay and organic matter and provide the ideal balance of water, nutrients as well as drainage, thereby supporting good plant growth. At the end, it is essential to add a layer of mulch. This will protect and insulate the soil, thereby preventing excessive water loss due to evaporation. Some excellent options are dried grass, dried leaves, barley stalk, wheat stalk, rice straw, and corn stalk.

For preparation of the soil for afforestation, various biomass materials can be added which includes:

- **Ingredients for the Soil-**

(i) Adding perforator materials such as wheat, groundnut shells, corn husk, rice husk will significantly improve perforation and help the roots to grow.

(ii) Water retainers should be added next to help the soil retain water and moisture. Materials such as sugarcane stalk and cocopeat are recommended.

(iii) For the soil to receive nutrition, organic fertilizers such as vermicompost, cow manure can be used.

(iv) The final step would be to add a layer of mulch as it protects and insulates the soil. It also prevents sun rays to fall directly on the soil and ensures that the water in the soil does not evaporate. Some excellent options are dried grass, dried leaves, barley stalk, wheat stalk, rice straw, and corn stalk.

• Organic fertilizers- The ground requires fertilizer to provide nutrients for plant growth. Some organic fertilizers are cowpat, goat muck and vermicompost.

• Perforating materials- These materials are helpful for plants to penetrate their roots deeper into the ground. Rice husk, wheat husk, or groundnut shells can be an excellent resource to increase perforation.

• Water retainers- A ground must have significant water retention power to develop a forest. An afforest can add coconut coir and peat moss to strengthen the soil's water retention power.

• Mulch- It is usually layered over the ground to protect it from the scorching sun. It is vital, especially for saplings, as their growth may be affected in dried soil. Afforests can use decaying leaves, dried bark, or even composts.

Step 2: Determination of Native Species and Floral Composition through Quadrat Survey

This step involves developing a database of the floral diversity through a quadrat survey in a native forest in the same agroclimatic zone as the site where the Miyawaki forest is aimed to be developed. Through this survey, the potential natural vegetation can be determined. The same also needs to be validated using secondary information such as the published flora of the region (in India, the Botanical Survey of India regularly updates the flora of different regions and the same should be referred to). The data (quantitative and qualitative), thus collected will help to develop the plant community composition that will be developed through the Miyawaki technique. The community composition should comprise of plants of all forms (trees, shrubs, herbs) in order to develop a natural forest. Species selection should be done in a manner that a mix of flowering, medicinal, timber, and fruiting species are chosen. While choosing the trees for the Miyawaki forest to be developed, emphasis should be given on selecting the 5 most dominant native trees (based on the results from the quadrat analysis). These trees will constitute around 50 percent of the floral diversity of the forest. The next abundant native species (based on the results from the quadrat analysis) will constitute 25-40 percent of the forest. The rest of the forest will be comprised of native species which have been found in the next level of abundance in the quadrat study.

The detailed step by step approach for the second step is as follows:

• Afforests must select the native plant species and identify their genus (deciduous or evergreen), height and influence on nature.

• Foresters must allocate those plants in layers, depending on all the above factors.

• 40 to 50 per cent of the total number of trees must comprise the most commonly found species in one's neighborhood. Foresters must choose at least 5 different genera that would be the significant species in that forest.

• Some moderately found native species will compose 25 to 40 per cent as supporting plants. Finally, some other minor species will constitute the rest of the forest.

• Afforests need to collect saplings of these species, which must be in a minimum height of 60 to 80 cm.

Step 3: Preparation of the Ground and Equip the Afforestation Area

The step involves meticulous preparation of the ground and equipping the afforestation area for optimal growth and development of the green belt. This crucial phase entails clearing the land of any debris or obstacles, ensuring a clean and uniform surface for planting. The soil is then carefully prepared through techniques such as loosening, aeration, and soil amendment to create a nutrient-rich substrate conducive to plant growth. Additionally, irrigation infrastructure may be installed to provide adequate water supply, essential for the establishment of young saplings. Furthermore, protective measures such as fencing or barriers may be implemented to safeguard the afforestation area from potential disturbances or encroachments. By meticulously preparing the ground and equipping the site with essential resources, it sets the stage for the successful implementation of the Miyawaki technique, facilitating robust growth and biodiversity enhancement within the green belt.

The subsequent section presents the detailed step by step approach for ground preparation and equipping the area proposed for afforestation.

• Before starting the planting process, afforests must inspect the ground to determine the possibilities and practicality of this project.

• The soil of this area must be clean from any debris and weed.

• It also must catch sunlight for at least 8-9 hours a day to start afforestation under the Miyawaki method.

• Foresters must install irrigation facilities, create 100 sq meter mounds and demark those before sowing.

Step 4: Undertaking Plantation

This is the most critical step for the successful establishment of a Miyawaki forest. The sub-steps that need to be followed are: In the plantation area, separate plantation bed area needs to be drawn out. The soil needs to be excavated for 3-4 feet. This excavated soil then needs to be mixed with the appropriate amounts of perforators, organic fertilizers and water retainers. The mixed soil should then be put back into the land. Care needs to be taken that the land does not get compressed at this stage and should be left aerated and loose. The levelled soil needs to be marked with chalk and pits (12”X12”) should be dug at every 1.5-2 feet, in a triangular manner. The saplings should then be placed in these pits, taking care that saplings of the same species are not planted next to each other. After the sapling is planted, 4-5 feet bamboo sticks should be inserted in the soil, close to the sapling. This will help prevent the sapling from drooping or bending in the first few months. Finally, a 5-7-inch-thick layer of mulch should be added to the soil (a minimum of half kg of mulch per tree needs to be added). For the first time, the saplings must be watered for an hour to make sure the mulching and the soil settle down. Tree density of 3trees/m^2 is ideal.

The subsequent section presents step by step approach for undertaking plantation.

● Outline the area to plant with chalk powder.

● Within the area of planting, draw out the plantation bed area and sperate the service area.

● Excavate the soil for about 3-4 feet and keep the excavated soil on the side.

● Mix the perforators, organic fertilizers, and water retainers, without any clumps. Ensure that they are mixed in the same ratios for each mound.

● Push back the mixed soil to fill the land. Ensure that the land is not compressed or walked upon. The idea is to leave the soil aerated and loose.

● Level the soil with hand tools.

● Mark the leveled soil with chalked powder for creating pits every 1.5-2 feet, in a triangular formation.

● Dig pits that are 12 inches wide and 12 inches deep.

● Place the saplings depending on the number of varieties you have and how your grid is created. For instance, if you have 30 species of trees, then mark the grid based on 30 pits.

● Before removing the saplings from their bags, dip the bags in a bucket that is filled with 20 part water, and 1 part Jeeva Amrut, or gaumutra, or coffee mix. Ensure that all the bubbles are settled before removing the sapling bags.

● Remove the sapling from the bag, place it in the pit, and loosely cover it with soil.

● Try not to plant two similar species next to each other and don't follow any pattern while planting. Maintain a 60cm distance between each sapling.

● After planting the saplings, insert 4-5 feet of bamboo sticks into the soil, close to the plant. These support sticks will ensure the saplings don't bend or droop during the first few months.

● Add a 5–7-inch layer of mulch in the soil. Consider at least half a kilo of mulch per tree. Tie it down with jute ropes to ensure the mulch doesn't fly around during strong winds. Tie the ropes on bamboo pegs that are nailed at the forest periphery. This will ensure that the rope is pressed down on the mulch.

● For the first time, the trees must be watered for an hour to make sure the mulching and the soil settle.

Step 5: Maintenance & Monitoring

The step involves critical tasks aimed at nurturing the newly planted saplings and facilitating their healthy growth. By meticulously levelling the soil and marking out pit locations, the groundwork is laid for the systematic planting of saplings. Careful preparation of saplings, including dipping them in a water-based solution for hydration, precedes their placement in the pits. Once planted, the saplings are secured with support sticks to prevent bending or drooping. Addition of mulch serves to retain moisture and provide essential nutrients to the soil, promoting optimal growth. Finally, watering the newly planted saplings ensures that they are adequately hydrated and settle into their new environment. These meticulous steps are essential for the successful establishment of a thriving green belt using the Miyawaki technique.

FIGURE 3.7: SCHEMATIC DIAGRAM OF MIYAWAKI PLANTATION TECHNIQUE

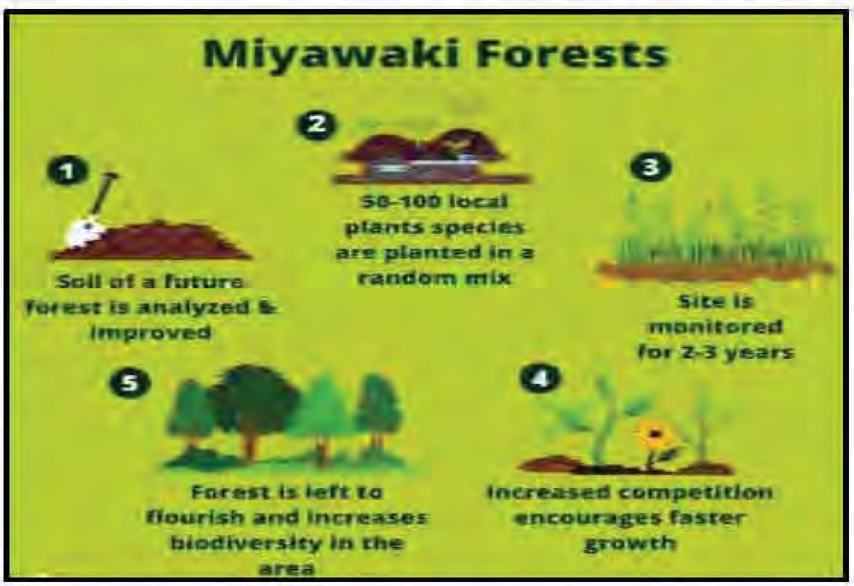


FIGURE 3.8: IMPLEMENTATION OF MIYAWAKI PLANTTAION TECHNIQUE

3.3.2.2 Double Row Technique

Implementation of the double row technique of plantation in schools, health centers, and other public land around Mahan TPP would involve a systematic approach which includes:

1. Site Assessment: Assessment of the site conditions would be undertaken including soil type, sunlight exposure, and availability of space within the schools, gram panchayats and health centers to determine the suitability for plantation.

2. Selection of Plant Species: Appropriate plant species would be chosen that are well-suited to the local climate, soil conditions, and intended purpose of the development of green belt.

3. Marking the Rows: Measuring tools and stakes would be used to mark the location of the double rows. It would be ensured that the rows are spaced appropriately to allow for healthy growth and maintenance access.

4. Digging Furrows: Digging of furrows or trenches would be done along the marked rows to prepare the planting beds. The depth and width of the furrows should accommodate the root systems of the selected plant species.

5. Plantation: Plantation of the selected trees or shrubs in double rows would be done within the prepared furrows. Appropriate spacing between each plant would be maintained to allow for adequate growth and development.

6. Backfilling and Mulching: The furrows would have to be backfilled with soil and the soil around the base of each plant would be gently firmed to provide stability. A layer of organic mulch would be applied around the plants to conserve moisture and suppress weed growth.

7. Watering and Maintenance: The newly planted trees or shrubs would be watered thoroughly to help establish root systems. A regular watering schedule would be planned, especially during dry periods, to ensure the plants remain healthy. Monitoring would be undertaken for signs of pests, diseases, or other issues appropriate measures would be taken if required.

8. Support and Protection: Support stakes or trellises would be provided for taller plants to prevent leaning or damage from wind. Installation of protective measures would be done such as tree guards or fencing.

9. Regular Pruning and Maintenance: The plants would be pruned as necessary to promote healthy growth and maintain desired shape and size. Any dead or diseased branches would be removed.

10. Monitoring and Evaluation: Regular monitoring would be undertaken to assess the growth and health of the planted trees and shrubs. The effectiveness of the double row plantation technique in achieving the desired goals of development of green cover in schools, health centers, and other public land would be evaluated.

3.4 COST ESTIMATE

Cost of the plantation for development of green belt within 2 Km buffer zone of Mahan TPP has been calculated as per the existing labor charges (Rs.100 per day), material cost (plants, FYM, tree guard, etc.) and the total area of treatment. One row each for tree, shrub and bio-fencing has been proposed with a spacing of 3 m x 3 m for trees and 2 m x 2 m for shrubs (to take care of the mortality in the next season). The pit size has been recommended as 45 x 45 x 45 cm for trees and 30 x 30 x 30 cm for shrubs. The total estimated budget for the implementation of green belt development plan is **54.52 Lakhs INR.**

TABLE 3.8: BUDGET FOR GREEN BELT DEVELOPMENT PLAN

Sl No.	Components	Budget (Rs. in Lakhs)
1	Cost of plantation including maintenance for 5 years and establishment charges @ Rs 60,000/ha for 22.01 ha	13.21
2	Thorny brushwood production guard for 2904 saplings @ Rs 10/No.	3.3
3	Fencing	2.00
4	Bamboo tree guards @ 100 each	33.01
5	Contingency	1.00
6	Watering @ Rs. 200/day for 200 days/yr for 5 yrs (200x200x5)	2.00
	Total	54.52

4.0 CONCLUSION & RECOMMENDATIONS

The peripheral green belt development plan for the Mahan Thermal Power Plant (TPP) area encompasses a comprehensive strategy aimed at enhancing environmental sustainability and community well-being. A thorough analysis of Land Use and Land Cover (LULC) analysis was undertaken to assess the existing status of land pattern in the study area. The analysis revealed that more than 20 Ha of the study area is covered by wastelands, while over 20% iof the total area is under green cover. Recognizing the potential for improvement, the focus of the green belt development plan around Mahan TPP is directed towards converting wastelands into green cover and augmenting greenery around public institutions such as schools, gram panchayats (GPs) and health centers. This would result in the overall increase of nearly 20-25% of the total green cover in the buffer zone.

The green belt development plan for the buffer zone surrounding the Mahan TPP boundary sets forth specific targets for tree plantation across various areas. A total of 31,695 trees are proposed to be planted in wasteland areas, aiming to rejuvenate and rehabilitate degraded landscapes. In addition, public institutions such as schools, gram panchayats, and health centers are identified in the previous chapter for enhancement of green cover, with 960 trees slated for schools, 240 trees for gram panchayats, and 120 trees for health centers. This strategic allocation of tree plantation efforts would enable the overall increase in the total green cover in the buffer zone.

This quantified approach would ensure that each area receives an appropriate allocation of green infrastructure, contributing to the overall improvement of the environment and quality of life in the surrounding communities. By focusing on the revitalization of wastelands and the greening of public institutions, the green belt development plan aims to create vibrant, sustainable ecosystems around the Mahan TPP. The total estimated budget for the implementation of green belt development plan is estimated to be INR 54.52 lakhs.

In conclusion, the peripheral green belt development plan for the Mahan TPP area represents a proactive and holistic approach towards environmental conservation and community development. Through collaborative efforts and strategic interventions, the plan would enhance biodiversity, mitigate environmental degradation, and foster a greener, healthier future for generations to come.

The recommendations for the development of green belt in the buffer zone of Mahan TPP include:

- Given the significant presence of wastelands in the buffer zone, targeted tree plantation initiatives should be undertaken to rejuvenate degraded landscapes and enhancing biodiversity.

- Adequate allocation of resources should be done for tree plantation in the public institutions to create vibrant and sustainable ecosystems that benefit local communities.

- A proper tracking mechanism should be followed to monitor the progress of green belt development plan.

- Frequent assessments should be undertaken to evaluate the impact of tree plantation efforts on increasing green cover and improving environmental sustainability in the buffer zone surrounding the Mahan TPP.

- Local residents should be encouraged to actively participate in tree plantation drives and environmental conservation efforts, fostering a sense of ownership.

- Adoption of sustainable maintenance practices should be ensured to support the long-term health and vitality of newly planted trees.

- Collaboration with relevant stakeholders including government agencies, non-profit organizations, and local communities is recommended to leverage resources and expertise in green belt development plan.

- It is recommended to conduct awareness campaigns and educational programs to promote the importance of green belt development and environmental conservation among local communities around Mahan TPP.

ANNEXURE 2.1
DETAIL OF PUBLIC UTILITIES FALLING WITHIN CSR ZONE OF MAHAN TPP

TABLE 2.1 (A): DETAIL OF HEALTH FACILITIES FALLING WITHIN CSR ZONE OF MAHAN TPP

S.No.	Name Of Health Facility	Location
1	Primary Health Center	R&R Colony, Nagwa
2	Sub Center,Nagwa	Nagwa
3	Sub Center, Suhira	Suhira
4	Sub Center, Amiliya	Amiliya
5	Sub center, Chaura	Chaura

TABLE 2.1 (B): DETAIL OF ANGANWADI CENTERS FALLING WITHIN CSR ZONE OF MAHAN TPP

S.No.	Location of AWC	Total Center in Village
1	Nagwa	5
2	Karsualal	3
3	Bandhaura	2
4	Khairahi	3
5	Karsuaraja	4
6	Raila	5
7	Suhira	4
8	Amiliya	3

TABLE 2.1 (C): DETAIL OF SCHOOLS FALLING WITHIN CSR ZONE OF MAHAN TPP

S.No.	Name Of School	Location
1	Govt. Primary School Adarsh,Nagwa	Nagawa
2	Govt. Primary School Churwahi	Nagawa
3	Govt. Middle School Nagawa	Nagawa
4	Govt. Primary School Naveen Karsualal	Karsualal
5	Govt. Middle School Karsualal	Karsualal
6	Govt. Primary School Palagari	Karsualal
7	Govt. Primary School Potkitola	Karsualal
8	Govt. Middle School Bandhaura	Bandhaura
9	Govt. Primary School Chirihinwa	Bandhaura
10	Govt. Primary School Semua	Bandhaura
11	Govt. Middle School Khairahi	Khairahi
12	Govt. Primari School Ambedkar Khairahi	Khairahi
13	Govt. H.S. School Kasruaraja	Karsuaraja
14	Govt. Primary School Naveen Raila	Raila

15	Govt. Primary School Gadakhand	Suhira
16	Govt. Primary School Gudari Kholi	Suhira
17	Govt. Primary School Uttaranchal	Suhira
18	Govt. H.S. School Suhira	Suhira
19	Govt. Middle School Amiliya	Amiliya
20	Govt. Primary School Sonrail Tola	Amiliya
21	Govt. Primary School Pokharitola	Amiliya

TABLE 2.1 (D): DETAIL OF GRAM PANCHAYAT OFFICES FALLING WITHIN CSR ZONE OF MAHAN TPP

S.No.	Location of AWC	Total Center in Village
1	Nagwa	1
2	Karsualal	1
3	Bandhaura	1
4	Khairahi	1
5	Karsuaraja	1
6	Raila	1
7	Suhira	1
8	Amiliya	1

Annexure XI

MICRO WATERSHED DEVELOPMENT PLAN AROUND MAHAN THERMAL POWER PLANT

Document No: IISWBM/IRP/MWSD-APL/2024-25/02 V1.0 Dated 23/05/2024

IISWBM

May 2024

MICRO WATERSHED DEVELOPMENT PLAN AROUND MAHAN THERMAL POWER PLANT

Document No: IISWBM/IRP/MWD-APL/2024-25/02 V1.0 Dated 23/05/2024

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Executed By

DEPARMENT OF ENVIRONMENT MANAGEMENT
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KOLKATA – 700 073

MAY, 2024

CONTENTS

EXECUTIVE SUMMARY

Adani Power Limited (APL), a member of the Adani Group, has taken up the implementation of large Thermal Power Projects at various locations in India in view of the growing needs of power requirements in the country. APL is also actively planning to implement Thermal Power Stations at various locations in India, totalling to about 20,000 MW in the coming years.

In accordance with its mission of being enviro-socially responsible corporate entity with thrust on sustainable development, MEL aims to focus on developing micro watershed around its Mahan TPP. To accomplish this mission, it is imperative to carry out proposed study that can facilitate in formulating a comprehensive short as well as long-term micro watershed development plan. The plan would employ a holistic approach aimed at conserving and managing natural resources within small, localized areas. It would involve the active participation of local communities and various stakeholders in the sustainable management of soil, water, and vegetation. Through practices such as soil and water conservation, afforestation and livelihood diversification, the plan seeks to reduce soil erosion, improve land productivity, enhance water availability for agriculture and domestic use, and alleviate poverty.

The objectives of the study are as follows:

- To observe the geomorphological condition of the study area including discussion on geology, and geomorphology.
- To study the meteorology of the study area
- To study the soils and drainage patterns, elevation, and LULC of the study area
- To suggest effective micro watershed development plan.

The detail scope of work for the present study is as follows:

1) The study needs to cover and collect the Primary data from the field and Secondary data. The study shall be conducted in the winter season by the team expert.

2) The detailed micro watershed assessment for the study area (core and buffer zone) i.e. 10 km radius from the project area shall be carried out by Environment professional.

3) Observing the geology, geomorphology, drainage patterns, and meteorology with the help of secondary data as well as field visits.

4) Mapping of the Land Use and water bodies within 10 km radius area from the project site using GIS and remote sensing.

5) Enhancing water availability for irrigation and domestic use through rainwater harvesting and groundwater recharge.

6) Promotion of afforestation and reforestation to protect and improve the local environment.

7) Monitoring and evaluation of project outcomes to ensure effective resource management and sustainable development.

8) Recommendation on the institutional mechanism for implementation of the Micro watershed development plan

The study area is located at Bandhaura, Nagwa, Karsualal and Khairahi villages under Singrauli District, Madhya Pradesh. Geographical Coordinates of the Mahan TPP is 24°0'28.90"N latitude /82°24'49.94"E longitude.

A watershed is a land area that channels rainfall to creeks, streams, and rivers, eventually leading to a common outlet such as a larger water body like a river, lake, or ocean. It encompasses all the land where water drains into a specific watercourse. Micro-watershed development is often implemented as part of larger watershed management programs, with a focus on improving the overall health and resilience of the entire watershed.

The plan would focus on preserving soil integrity and preventing erosion within the study area. Techniques such as contour plowing, reforestation, and terracing would help stabilize soil, minimize sediment runoff, and retain soil moisture, thus enhancing agricultural productivity and mitigating the risk of landslides and soil degradation.

The prime approaches for the development of watershed include:

- **Identification and delineation:** The first step would involve identifying and delineating micro-watersheds based on natural boundaries, such as ridgelines, streams, and terrain. This would help in understanding the specific hydrological and ecological characteristics of the area.

- **Preparation of thematic map:** The second would involve preparation of thematic map such as elevation of the area, soil types and land use/land cover. LULC maps provide critical insights into the spatial distribution of land types. Soil maps offer essential information on soil types and properties. Elevation maps depict the topography, informing decisions on water flow, erosion control measures, and infrastructure layout.

- **Watershed planning:** Once a micro-watershed is identified, and thematic map is prepared stakeholders, local communities, government agencies, and non-governmental organizations (NGOs), may collaborate to create a comprehensive development plan. This plan would consider the conservation and sustainable management of soil, water, and vegetation.

- **Soil and water conservation:** Soil erosion is a common problem in many micro-watersheds. Techniques such as contour farming, terracing, check dams, and reforestation would be implemented to reduce erosion, improve soil fertility, and increase water retention.

- **Water resource management:** Efficient water resource management is crucial for agriculture and other livelihood activities. Water harvesting structures, like ponds and percolation tanks, would be constructed to capture rainwater and replenish groundwater. This would help in ensuring a more reliable water supply for irrigation and domestic use.

- **Afforestation and reforestation:** Planting and maintaining trees and other vegetation are vital components of micro-watershed development. Trees help in stabilizing soil, preventing erosion, and improving overall ecological health.

- **Livelihood development:** Micro-watershed development programs aim to improve the socio-economic conditions of local communities. This may involve training in sustainable farming practices, promoting alternative livelihoods, and providing access to credit and markets.

- **Community participation:** Active community involvement and participation are central to the success of micro-watershed development projects. Local residents would be engaged in planning, implementing, and monitoring activities, ensuring that solutions are contextually relevant and sustainable.

- **Monitoring and evaluation:** Regular monitoring and evaluation would be done to assess the impact of micro-watershed development plan on the study area.

The reconnaissance survey was undertaken by a team led by Dr. S C Santra, Dr. K. M. Agrawal from IISWBM along with MEL Team from 8th - 9nd March, 2024. The team had a kick-off meeting at the MEL TPP on 7th March, 2024 to finalise the modalities for commencing the field study as well as collection of secondary data.

In the context of micro watershed development, understanding the geo-morphological features is paramount as the geological structure and composition of the land significantly affect water infiltration, storage, and movement within the watershed. Porous rock formations and permeable soils enhance groundwater recharge by allowing water to percolate through the subsurface efficiently, thereby increasing the availability of groundwater resources. In contrast, impermeable layers and geological faults can obstruct water flow, leading to surface runoff and potential erosion issues, which undermine water conservation efforts. Comprehensive geo-morphological assessments facilitate the identification of areas with high recharge potential and those prone to runoff or contamination, enabling the design of effective interventions such as check dams, contour bunding, and afforestation.

The geology of the district reveals the occurrence of various work formations as old as granites of the Achaean age to the Alluvium of Recent age. The other important formations outcropping in the district are the Deccan trap of cretaceous–Eocene, Gondwana's of Paleozoic to Mesozoic Sandstone, and other ranks of Vindhayans and Phyllites. Quartzites, Schist Gneisses and Granites of Archeans age.

The Singrauli region is majorly covered with alluvial soil, red sandy soil, yellow loamy Sandy soil, laterite soil, and red loam soil. The district comprises sedimentary, crystalline and metamorphic rocks, that weather into red soil. Similarly, the red colour of the laterite soil is more due to the diffusion of Iron compounds rather than due to the high proportion of Iron oxides. The alluvial soil is mostly restricted by along the banks of major rivers, whose thickness varies from few meters to 25 meters.

The three main rivers flows along with several tributaries which are the son, Gopal and Rihand. In the Southern part of the district the elevation of hills ranges varies between 142 and 743 m above MSL and it helps to developed drainage in area.

The LULC analysis in the buffer zone indicates that the tree cover comprises a significant portion of the study area, covering approximately 42% of the total area. Following this, open grasslands occupy nearly 110.28 km^2, constituting nearly 27% of the buffer zone. Croplands span approximately 106 km^2, representing nearly 26% of the total area. Conversely, the built-up area of settlements occupies a smaller proportion, accounting for 5.26% of the buffer zone. Additionally, water bodies and bare ground/wasteland cover minimal areas, with water bodies occupying 0.23% and bare ground/wasteland covering 0.06% of the buffer zone respectively.

The summer season in Singrauli is usually hot and dry. Temperatures during this period often soar, with daytime temperatures frequently exceeding 39°C. Hot, dry winds known as "loo" can sometimes blow, causing discomfort. Winter in Singrauli is relatively mild and pleasant. Daytime temperatures in winter usually range from 15°C to 25°C (59°F to 77°F), while nighttime temperatures can drop to around 5°C to 10°C (41°F to 50°F).

A number of micro watershed development schemes are practiced in India. The selection of suitable techniques for artificial recharge depends on various factors, which includes:

- Quantum of non-committed surface run-off available.
- Rainfall pattern
- Land use and vegetation
- Topography and terrain profile
- Soil type and soil depth
- Thickness of weathered / granular zones
- Hydrological and hydro-geological characteristics
- Socio-economic conditions and infrastructural facilities available
- Environmental and ecological impacts of artificial recharge scheme proposed.

The following guidelines can be followed to select a site for an artificial micro watershed development scheme:

- Adequate space for surface storage is available.
- Water level is deep enough (> 8 m) and adequate sub-surface storage is available.
- Permeable strata are available at shallow/moderate depth.
- Adequate quantity of surface water is available for recharge.

- Adequate surface drainage density is present.
- Considering the geological and hydro-geological formations of the area, the following micro watershed development schemes are recommended:
- Contour Trenches.
- Gully Plugs, Nala Bunds, Check Dams.
- Recharge Pit/Recharge Shaft.

The micro-watershed development plan can be tailored to address the specific environmental challenges and opportunities within the area that include:

1. Reforestation: Planting native tree species in the buffer zone to restore degraded forest areas and enhance vegetative cover. This would help reduce soil erosion, regulate water flow, and promote ground water recharge. The Miyawaki Plantation technique has been proposed to be implemented as a measure for reforestation.

2. Soil conservation: Implementing soil conservation measures such as contour bunding, vegetative barriers, and mulching to prevent soil erosion and improve soil moisture retention. This would contribute to enhancing the resilience of ecosystems and promoting sustainable land use practices.

3. Water management infrastructure: Constructing a variety of water management structures, such as check dams, percolation ponds, recharge wells, and deepening existing ponds, plays a crucial role in harvesting rainwater, controlling surface runoff, and facilitating groundwater recharge. These interventions are essential for mitigating the impacts of water scarcity and ensuring a reliable water supply for local communities and ecosystems.

Integration of watershed development plan into the management of the buffer zone of Mahan TPP would lead to the conservation of natural resources, promotion of ecological sustainability, and enhancement of community resilience in the surrounding area.

The estimated cost of reforestation, construction of check dams, groundwater recharge and deepening of ponds for development of micro watershed within 10 Km buffer zone of Mahan TPP has been calculated. The total estimated budget for the implementation of green belt development plan is **92.00 Lakhs INR.**

1.0 INTRODUCTION

1.1 BACKGROUND

The Adani Group (1988) has grown from being a trading house to a diversified business group with interests from infrastructural development to FMCGs. The Adani Group has made foray into high growth sector like Power, Infrastructure, Global Trading, Logistics and Energy.

Adani Power Limited (APL), a member of the Adani Group, has taken up implementation of large Thermal Power Projects at various locations in India in view of the growing needs of power requirements in the country. APL is also actively planning to implement Thermal Power Stations at various locations in India, totaling to about 20,000 MW in the coming years.

Mahan Energen Limited – MEL is a subsidiary company of Adani Power Limited (APL) which has been formed to develop 2x800 MW Ultra Super Critical Thermal Power Plant at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh. The Project is proposed to be developed as an expansion of the existing 2 x 600 MW units at the site and all the necessary infrastructure to cater the requirement of the enhanced capacity will be developed while also using the facilities of the existing plant.

The Project is conceptualised to be operated by utilising coal from nearby commercial coal mines and water from the Rihand reservoir. For auxiliaries' viz. Coal Handing, Ash Handling and Plant Water System, it is proposed to utilise the latest technology with adequate margin to ensure high availability of the Project. Land Area of about 920 Acres has been identified for the Project which includes the existing 1200 MW plant and land area for accommodation of coal stockyard, water reservoir, roads & green belt etc.

In accordance with its mission of being enviro-socially responsible corporate entity with thrust on sustainable development, MEL aims to focus on developing micro watershed around its Mahan TPP. To accomplish this mission, it is imperative to carry out proposed study that can facilitate in formulating a comprehensive short as well as long-term micro watershed development plan. The plan would employ a holistic approach aimed at conserving and managing natural resources within small, localized areas. It would involve the active participation of local communities and various stakeholders in the sustainable management of soil, water, and vegetation. Through practices such as soil and water conservation, afforestation and livelihood diversification, the plan seeks to reduce soil erosion, improve land productivity, enhance water availability for agriculture and domestic use, and alleviate poverty.

1.2 OBJECTIVES OF THE STUDY

The objectives of the study are as follows:

- To observe the geomorphological condition of the study area including assessment of geology, and geomorphology.
- To study the meteorology of the study area
- To study the soil, drainage pattern, elevation, and LULC of the study area
- To suggest effective micro watershed development plan.

1.3 SCOPE OF THE STUDY

The scope of the study includes the undertaking of a reconnaissance survey. Based on the reconnaissance survey a framework would be evolved for undertaking a time-bound detailed field survey within the influence zone of the project site (i.e. 10 km radius) and assessment of micro watershed. The detail scope of work for the proposed study is as follows:

1) The study needs to cover and collect the Primary data from the field and Secondary data.
2) The detailed micro watershed assessment for the study area (core and buffer zone) i.e. 10 km radius from the project area shall be carried out by Environment professionals.
3) Observing the geology, geomorphology, drainage patterns, and meteorology with the help of secondary data as well as field visits.
4) Mapping of the Land Use and water bodies within 10 km radius of Mahan TPP using GIS and remote sensing.
5) Enhancing water availability for irrigation and domestic use through rainwater harvesting and groundwater recharge.

6) Promotion of afforestation and reforestation to protect and improve the local environment.

7) Monitoring and evaluation of project outcomes to ensure effective resource management and sustainable development.

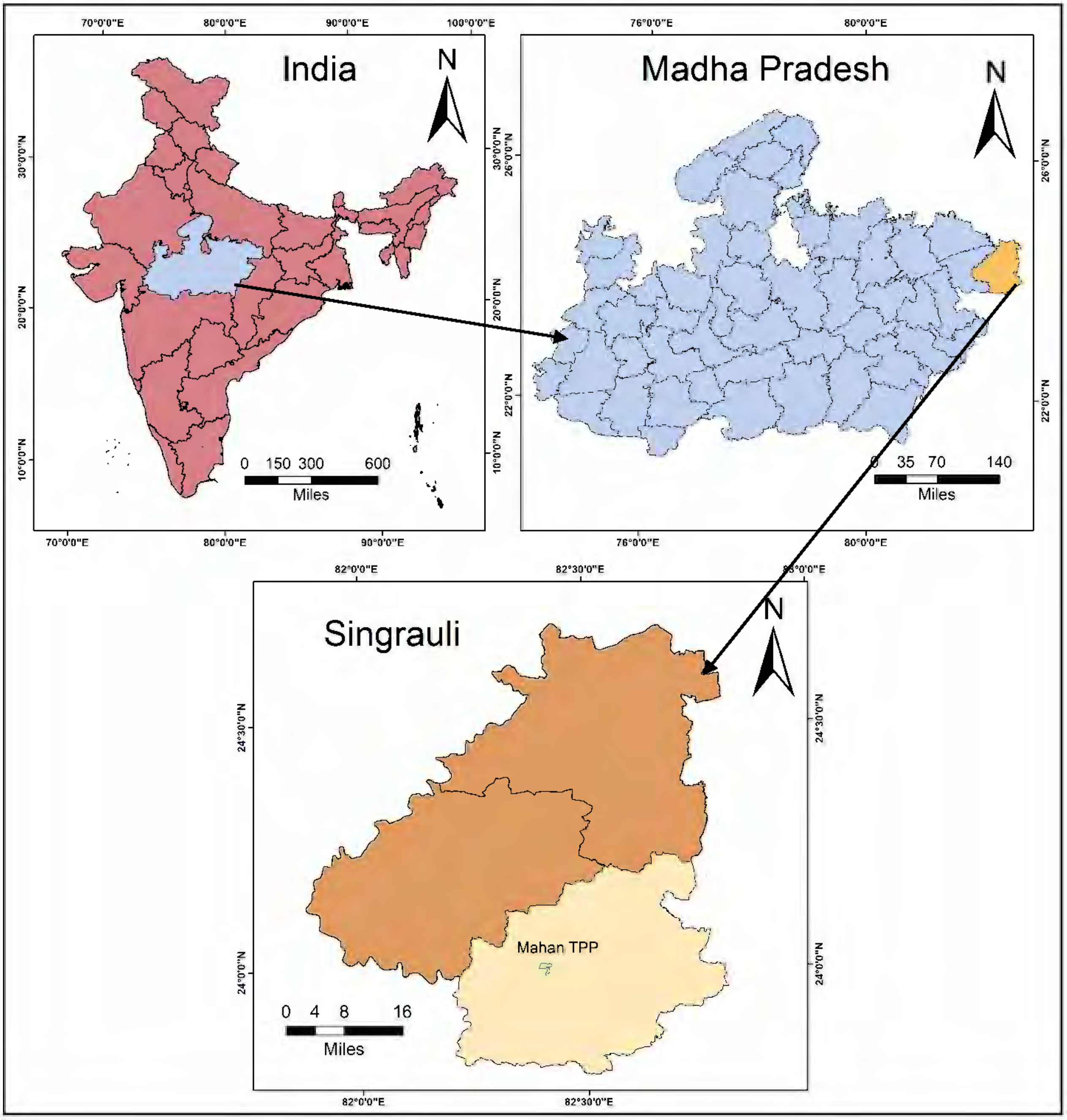
8) Recommendation on the institutional mechanism for implementation of the Micro watershed development plan

The Scope of Work would also include presentation of the study report before the Expert Appraisal Committee of MoEF&CC and subsequent preparation of replies to the clarifications asked, if any.

1.4 DETAIL OF PROJECT LOCATION

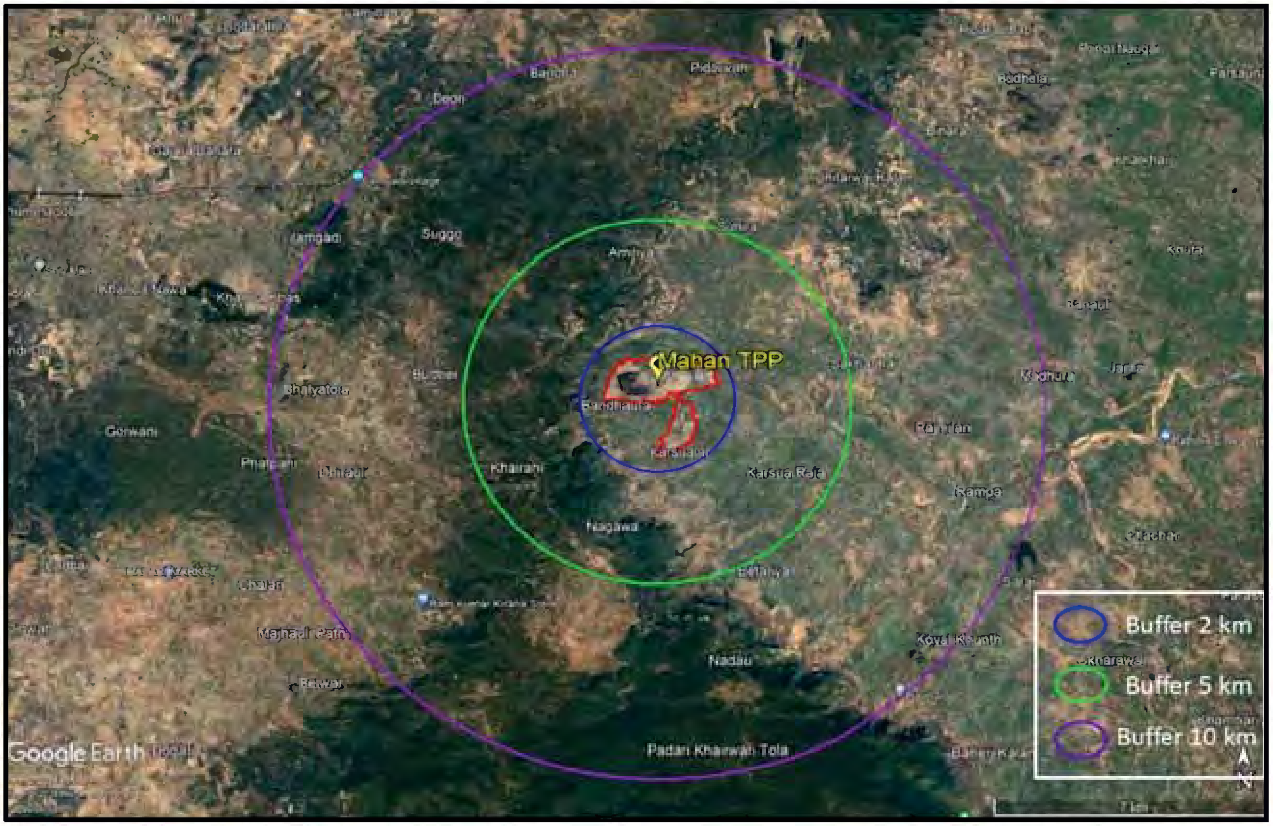
The study area is located at Bandhaura, Nagwa, Karsualal and Khairahi villages under Singrauli District, Madhya Pradesh (Figure 1.1). Geographical Coordinates of the Mahan TPP is 24°0'28.90"N latitude /82°24'49.94"E longitude.

FIGURE 1.1: LOCATION OF THE STUDY AREA OF MAHAN TPP



The buffer zone identified around Mahan TPP for development of micro watershed has been presented in Figure 1.2.

FIGURE 1.2: BUFFER ZONE FOR DEVELOPMENT OF MICRO-WATERSHED AROUND MAHAN TPP



1.5 PROJECT AT A GLANCE

General:

Project Authority (SPV)	:	Mahan Energen Ltd.
Project	:	2x800 MW Ultra Super-Critical Thermal Power Project.
Selected Location	:	Bandhaura, Nagwa, Karsualal and Khairahi village, Singrauli District, M.P.

Latitude and Longitude of the site	:	24°0'28.90"N latitude / 82°24'49.94"E longitude
Altitude	:	320 to 340 m.
Average RL	:	335 m.
Annual average rain fall	:	1132.7 mm
Nearest Major Town	:	Waidhan and Singrauli
Seismic Zone	:	Zone-III as per IS 1893
Access by Road	:	State Highway (SH14) is passing about 16km from the site.
Access by Rail	:	Singrauli Station is located at 52 km fromProject Site.
Access by Air	:	Nearest Airport is at Varanasi at a distanceof 280 km.
Access by Sea	:	Nearest Seaport is at Dhamra at a distanceof 770 km.

Preliminary Project Particulars:

Main Fuel	:	Coal from Commercial Coal Mines(GCV 3000-4200 Kcal/Kg)
Fuel Transportation	:	Through Long Belt conveyor (LBC) system.
Water	:	From the Rihand Reservoir at 36 km fromSite.
Land	:	920 Acres of land is available for the PowerProject.

Layout Features	:	2 X 800 MW Ultra Super-Critical Units

Technical Features:

Power Generating Unit	:	Two units of 800 MW turbine generator sets fed by steam from coal fired P.F. boiler operating at Ultra Super-critical range.
Cooling System	:	Closed recirculating condenser cooling system with induced draft cooling tower.
Coal Handling System	:	Coal handling facility, which comprises receipt of coal from Mines through LBC system, with on-line existing & new crushing and stacking by existing & new stacker-cum-reclaimer in the existing & new coal yard and finally feeding the bunker level conveyors.
Ash Disposal System	:	Provision will be made for disposal of fly ash in dry form to adjacent Cement Plants/ Mine back filling. Provision will be made for disposal of ash in high concentration slurry form.
Power Evacuation	:	At 400 kV level to State Transmission Unit (STU)
Environmental Aspects	:	Elaborate arrangements for Flue gas desulphurization (FGD) and Selective Catalytic Reduction (SCR) systems complying with emission norms as per latest MoEF & CC. Independent steel wet flue for each unit, down- stream of FGD of suitable height as per MoEF & CC guidelines and an adequately designed electrostatic precipitator with more than 99.99% efficiency are envisaged. Waste water quality to be maintained as per MoEF & CC notification. Zero Plant Discharge facility shall be present since the cooling water, blow down water, waste water and ash water would

		be recycled back to the systemafter suitable treatment for reuse. For coal transportation from mines, pipe conveyortechnology will be adopted to mitigate environmental concerns.
Rehabilitation Requirement	:	Nil

Other Facilities:

Township	:	Township with civic amenities would be developed.
Mode of Implementation	:	The Project would be implemented on EPCconcept.
Project Time Frame	:	54 months from Zero Date i.e. the date of 'Financial Closure' for Commercial Operation of Unit#3 and 60 months for Unit#4

FIGURE 1.3: VIEW OF MAHAN TPP AT SINGRAULI MADHYA PRADESH

2.0 FRAMEWORK FOR MICRO WATERSHED DEVELOPMENT

A watershed is a land area that channels rainfall to creeks, streams, and rivers, eventually leading to a common outlet such as a larger water body like a river, lake, or ocean. It encompasses all the land where water drains into a specific watercourse. Micro-watershed development is often implemented as part of larger watershed management programs, with a focus on improving the overall health and resilience of the entire watershed. It plays a vital role in addressing environmental degradation, enhancing agricultural productivity, and improving the quality of life for rural communities while promoting sustainable resource management practices. The micro watershed development plan would involve strategic planning and establishment of rainwater harvesting structures, check dams, and pond deepening in the suitable locations within the 10 km buffer zone of the Mahan TPP.

The plan would focus on preserving soil integrity and preventing erosion within the study area. Techniques such as contour plowing, reforestation, and terracing would help stabilize soil, minimize sediment runoff, and retain soil moisture, thus enhancing agricultural productivity and mitigating the risk of landslides and soil degradation. Implementation of the plan is crucial for controlling floods, especially in areas that are prone to waterlogging and soil erosion.

In addition, the plan would contribute to socio-economic development by enhancing livelihood opportunities through employment generation in activities involved in the development of micro watershed like afforestation and soil conservation, improving agricultural productivity through sustainable water management and soil conservation measures, ensuring water security for agricultural, industrial, and domestic purposes, stimulating economic growth through infrastructure development such as water harvesting structures and access roads, providing ecosystem services essential for socio-economic activities, attracting tourism and recreational opportunities, empowering local communities through participation in decision-making processes, and promoting education and awareness about sustainable resource management practices, thus fostering inclusive and sustainable development in rural areas.

Overall, micro watershed management plan offers a holistic approach to sustainable development, integrating environmental protection, water management, biodiversity conservation, and socio-economic development. By harnessing the resilience of natural ecosystems and implementing innovative solutions, the plan would ensure a harmonious coexistence between industrial activities and the surrounding environment, paving the way for a healthier, more resilient future for all stakeholders.

2.1 APPROACHES FOR DEVELOPMENT OF MICRO WATERSHED

The prime approaches for the development of micro watershed include:

- **Identification and delineation:** The first step would involve identifying and delineating micro-watersheds based on natural boundaries, such as ridgelines, streams, and terrain. This would help in understanding the specific hydrological and ecological characteristics of the area.

- **Preparation of thematic map:** The second would involve preparation of thematic map such as elevation of the area, soil types and land use/land cover. LULC maps provide critical insights into the spatial distribution of land types. Soil maps offer essential information on soil types and properties. Elevation maps depict the topography, informing decisions on water flow, erosion control measures, and infrastructure layout.

- **Watershed planning:** Once a micro-watershed is identified, and thematic map is prepared stakeholders, local communities, government agencies, and non-governmental organizations (NGOs), may collaborate to create a comprehensive development plan. This plan would consider the conservation and sustainable management of soil, water, and vegetation.

- **Soil and water conservation:** Techniques such as contour farming, terracing, check dams, and reforestation would be implemented to reduce erosion, improve soil fertility, and increase water retention.

- **Water resource management:** Water harvesting structures, like ponds and percolation tanks, would be constructed to capture rainwater and replenish groundwater. This would help in ensuring a more reliable water supply for irrigation and domestic use.

- **Afforestation and reforestation:** Planting and maintaining trees and other vegetation are vital components of micro-watershed development. Trees help in stabilizing soil, preventing erosion, and improving overall ecological health.

- **Livelihood development:** Micro-watershed development program would aim to improve the socio-economic conditions of local communities. This may involve training in sustainable farming practices, promoting alternative livelihoods, and providing access to credit and markets.

- **Community participation:** Active community involvement and participation are central to the success of micro-watershed development projects. Local residents would be engaged in planning, implementing, and monitoring activities, ensuring that solutions are contextually relevant and sustainable.

- **Monitoring and evaluation:** Regular monitoring and evaluation would be done to assess the impact of micro-watershed development plan on the study area.

2.2 RECONNAISSANCE SURVEY

The reconnaissance survey was undertaken by a team led by Dr. S C Santra, Dr. K. M. Agrawal from IISWBM along with MEL Team from 8th - 9nd March, 2024. The team had a kick-off meeting at the MEL TPP on 7th March, 2024 to finalise the modalities for commencing the field study as well as collection of secondary data.

Initially, MEL Team appraised the objective of proposed study and the required coverage of the same as per MoEF&CC Environmental Clearance condition. MEL Team also shared the detailed information regarding the drainage pattern of the area. They also shared the key features of existing water conservation practices in the study area. During the meeting detail plan for undertaking field study was also discussed and resolved that all the required primary data need to be collected within stipulated time frame.

The survey was undertaken to primarily examine the existing stream network as well as identification of wastelands falling within the buffer zone of Mahan TPP for the formulation of micro watershed development plan.

2.3 IDENTIFICATION AND DELINEATION OF WATERSHED

The Singrauli district lies on the Son sub-basin of the Ganga basin. In the district, three main rivers flow along with several tributaries, the major rivers in the region are the Son, Gopal, and Rihand. Micro watershed in the study area have been identified based on natural boundaries of ridgelines, streams, and terrain. It involved identifying the local stream network, focusing on smaller-scale drainage patterns within a specific geographical area that enabled a comprehensive understanding of runoff patterns, and sediment transport, facilitating targeted management strategies for sustainable land use and conservation practices within the micro watershed. The sub watershed (Figure 2.1) falling in the buffer zone of Mahan TPP is under the Mayar river, which is one of the streams of the Rihand. The micro watershed (Figure 2.2.) of the study area is under the Rampa river, which is a stream of the Mayar river.

FIGURE 2.1: SUB WATERSHED OF THE STUDY ARE

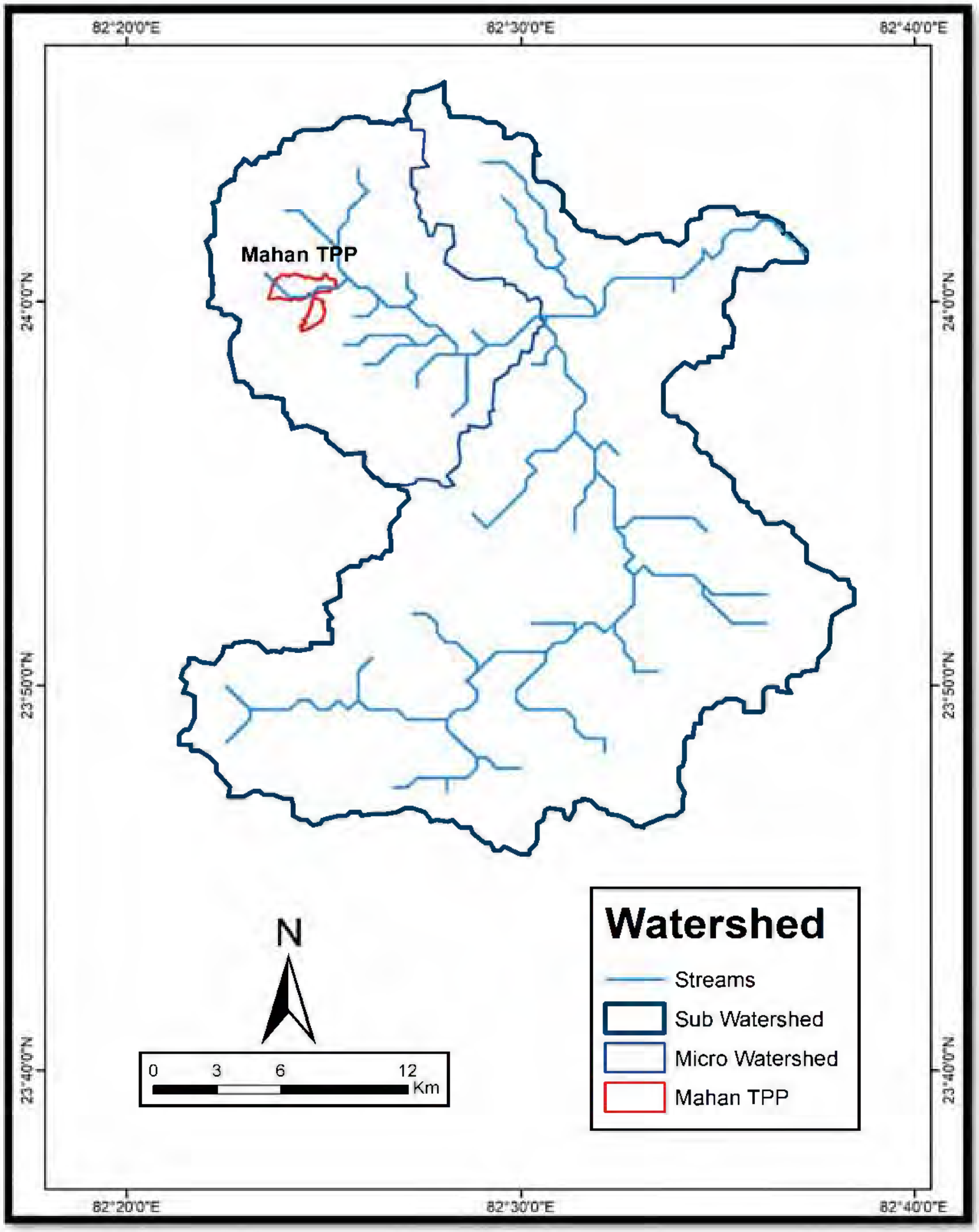


FIGURE 2.2: MICRO WATERSHED OF THE STUDY AREA

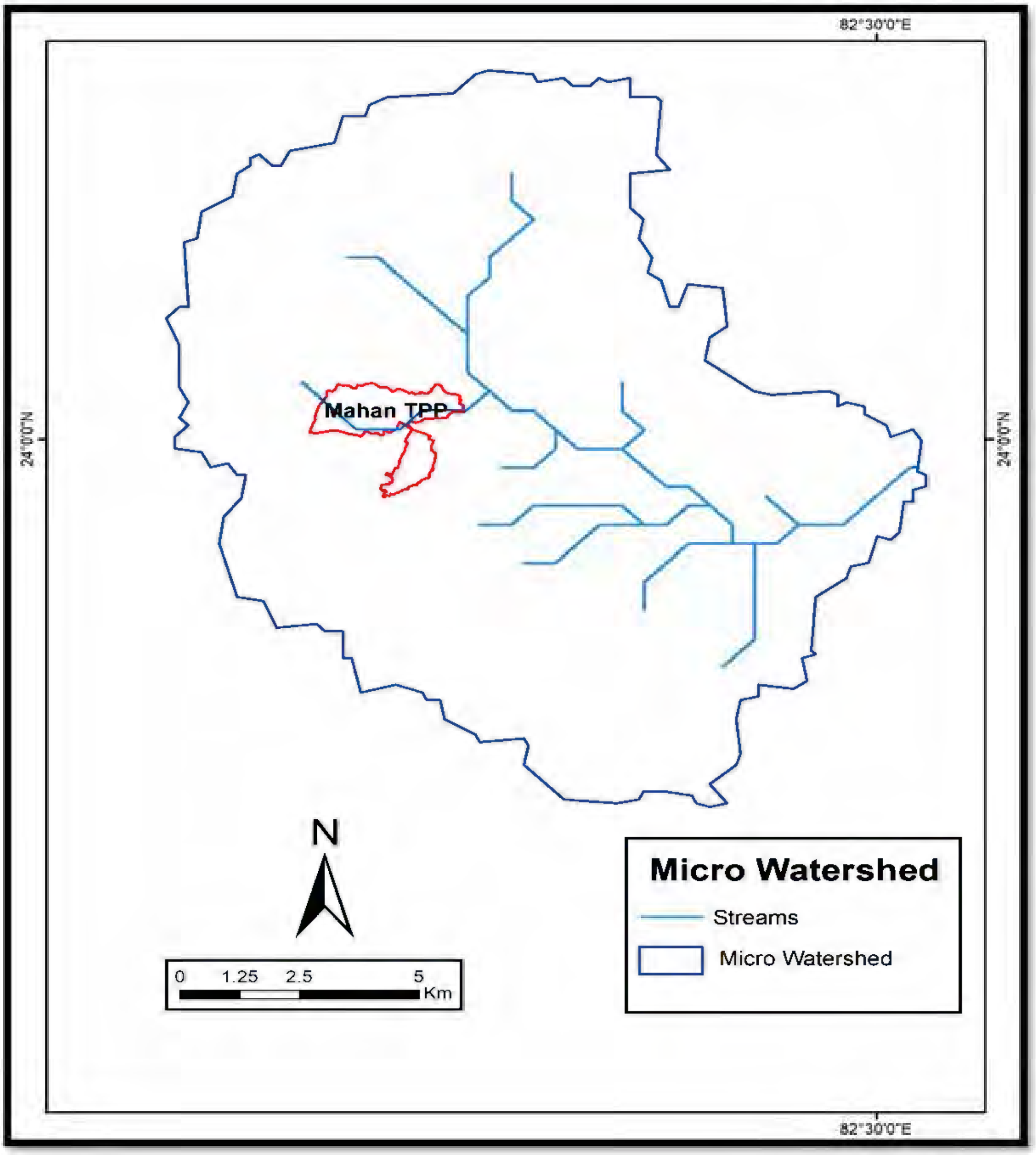


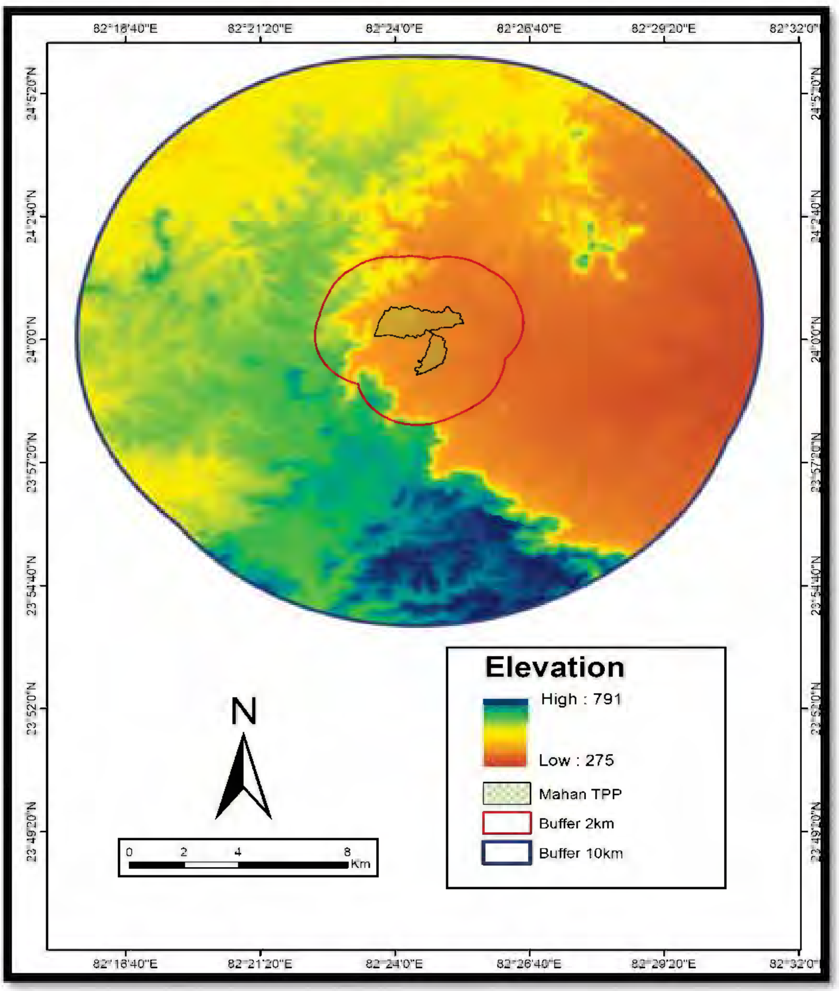
FIGURE 2.3: STREAM NETWORK WITHIN THE BUFFER ZONE OF MAHAN TPP

FIGURE 2.4: IDENTIFICATION OF WASTELAND AREAS FOR MICRO WATERSHED DEVELOPMENT AT SELECTED LOCATIONS WITHIN BUFFER ZONE

2.4 ELEVATION

Elevation plays a crucial role in micro watershed management plans as it determines the flow of water, influencing soil erosion, drainage patterns, and the distribution of vegetation. Higher elevations often serve as catchment areas for rainfall, channelling water into lower-lying areas where it can be utilized for agriculture, replenish groundwater, or domestic use. Additionally, elevation influences the suitability of land for various purposes, guiding water conservation structures planning efforts within micro watersheds to ensure sustainable development and natural resource conservation. In the 10 km buffer around the Mahan TPP where the highest elevation is 791 m in the southwestern side and the lowest elevation is 275 m in the eastern side (Figure 2.5).

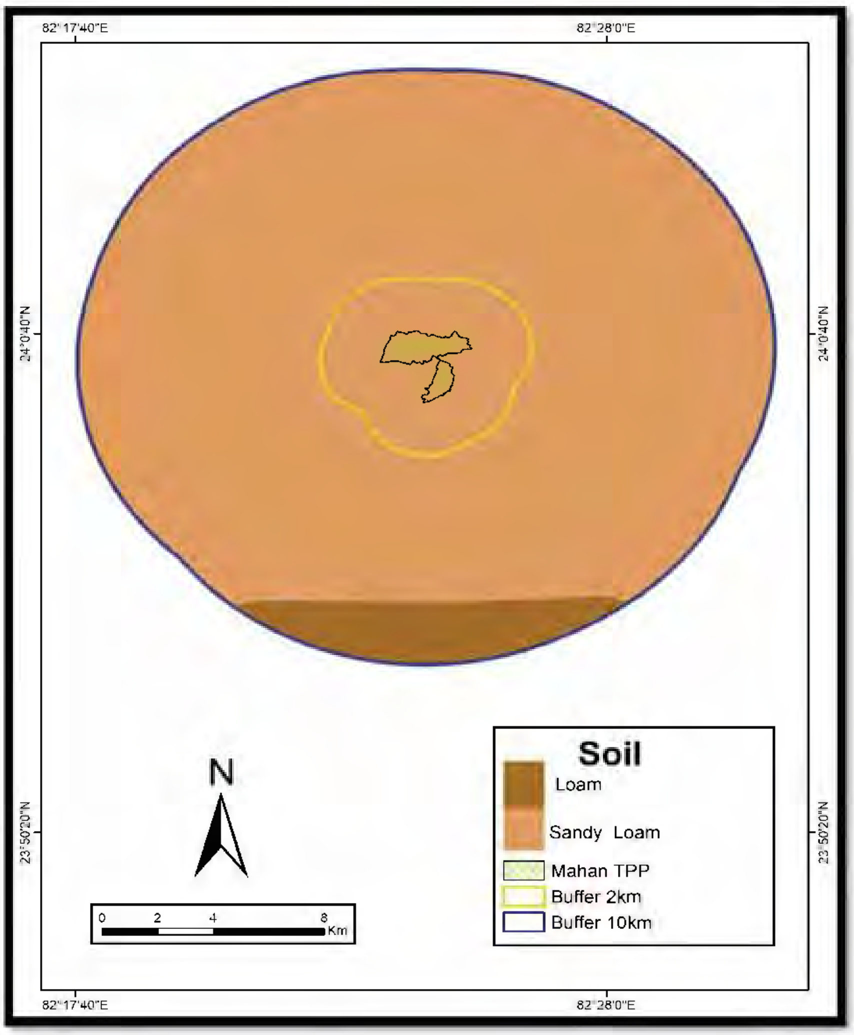
FIGURE 2.5: ELEVATION OF THE STUDY AREA



2.5 SOIL

The soil map of the study area reveals that it is predominantly composed of sandy loam and loam soils. Sandy loam soil, which constitutes more than 90% of the area, is characterized by its high permeability, allowing water to drain quickly due to its larger particle sizes and lower water retention capability. Loam soil, making up the remainder of the area, has a balanced mixture of sand, silt, and clay, offering moderate permeability that enables adequate water drainage while retaining essential moisture for plant growth. The soil map of the study area has been presented in figure 2.6.

FIGURE 2.6: SOIL OF THE STUDY AREA



IISWBM

2.6 LULC PATTERN

The land use/land cover characteristics of the area within 10 km of the Mahan TPP was analyzed to assess the prevailing land pattern within the buffer zone in order to identify suitable locations for development of groundwater plan. The data has been derived from the ESA Sentinel-2 imagery at 10 m resolution downloaded for the year 2023.

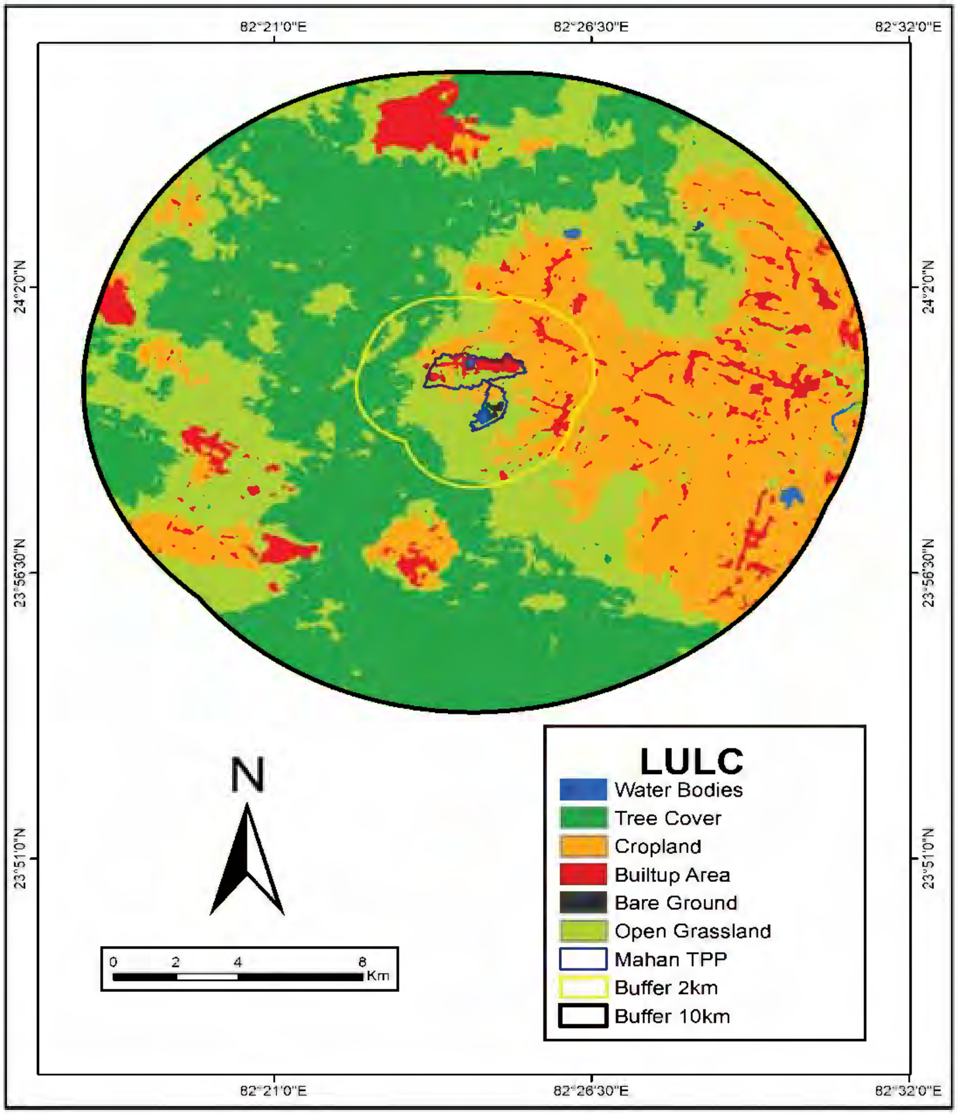
Table 2.1 and Figure 2.7 present the results of land use/land cover classification in the study area within 10 Km buffer zone of Mahan TPP. The analysis highlights that the tree cover comprises a significant portion of the study area, covering approximately 42% of the total area. Following this, open grasslands occupy nearly 110.28 km^2, constituting nearly 27% of the buffer zone. Croplands span approximately 106 km^2, representing nearly 26% of the total area. Conversely, the built-up area of settlements occupies a smaller proportion, accounting for 5.26% of the buffer zone. Additionally, water bodies and bare ground/wasteland cover minimal areas, with water bodies occupying 0.23% and bare ground/wasteland covering 0.06% of the buffer zone respectively.

TABLE 2.1: AREA STATISTICS OF LANDUSE-LANDCOVER CLASSES OF THE AREA WITHIN 10 KM FROM THE MEL TPP

LU-LC CLASSES	Pixel* Count	Area (Km^2)	Percent of Total Area
Water	9320	0.93	0.23
Tree Cover	1707057	170.71	41.67
Crop Land	1059557	105.96	25.86
Builtup Land	215332	21.53	5.26
Bare Ground	2444	0.24	0.06
Open Grassland	1102793	110.28	26.92
Total	**4096503**	**409.65**	**100**

* Spatial Resolution = 10 m.

FIGURE 2.7: LULC PATTERN OF THE STUDY AREA



3.0 GEO-MORPHOLOGICAL ASSESSMENT

"Geo" pertains to the Earth or geological features, while "morphology" refers to the study of the form and structure of objects or landscapes. Therefore, "geo-morphological assessment" involves the examination and analysis of the physical characteristics, topography, and geological features of an area. This assessment encompasses the study of landforms, soil types, rock formations, drainage patterns, and other geological elements that contribute to the overall landscape.

In the context of micro watershed development, understanding the geo-morphological features is paramount as the geological structure and composition of the land significantly affect water infiltration, storage, and movement within the watershed. Porous rock formations and permeable soils enhance groundwater recharge by allowing water to percolate through the subsurface efficiently, thereby increasing the availability of groundwater resources. In contrast, impermeable layers and geological faults can obstruct water flow, leading to surface runoff and potential erosion issues, which undermine water conservation efforts. Comprehensive geo-morphological assessments facilitate the identification of areas with high recharge potential and those prone to runoff or contamination, enabling the design of effective interventions such as check dams, contour bunding, and afforestation.

3.1 GEOLOGY

The analysis of geology of the Singrauli district reveals the occurrence of various rock formations as old as granites of the Achaean age to the Alluvium of Recent age. The other important formations outcropping in the district are the Deccan trap of cretaceous–Eocene, Gondwana's of Paleozoic to Mesozoic Sandstone, and other ranks of Vindhayans and Phyllites. Quartzites, Schist Gneisses and Granites of Archeans age (CGWB, 2013). The geological structure of Singrauli district is relatively stable, characterized by gentle folding and faulting. The region does not exhibit significant tectonic activity or seismicity compared to other parts of India.

Understanding the geology of the study area is crucial for assessing groundwater resources, and environmental impacts. The study area is part of Singrauli Tahsil under Singrauli District and is covered with recent alluvium, Deccan Trap, Gondwana, Vindhyan, and Archean rocks. The geological map of Singrauli district has been presented in Figure 3.1.

FIGURE 3.1: GEOLOGICAL MAP OF THE STUDY AREA

3.2 GEOMORPHOLOGY

The district as a whole constitutes a hilly terrain as most of the district is covered by kaimur hilly ranges. The district is divided into three physiographic divisions: -

(i) Kaimur hilly ranges

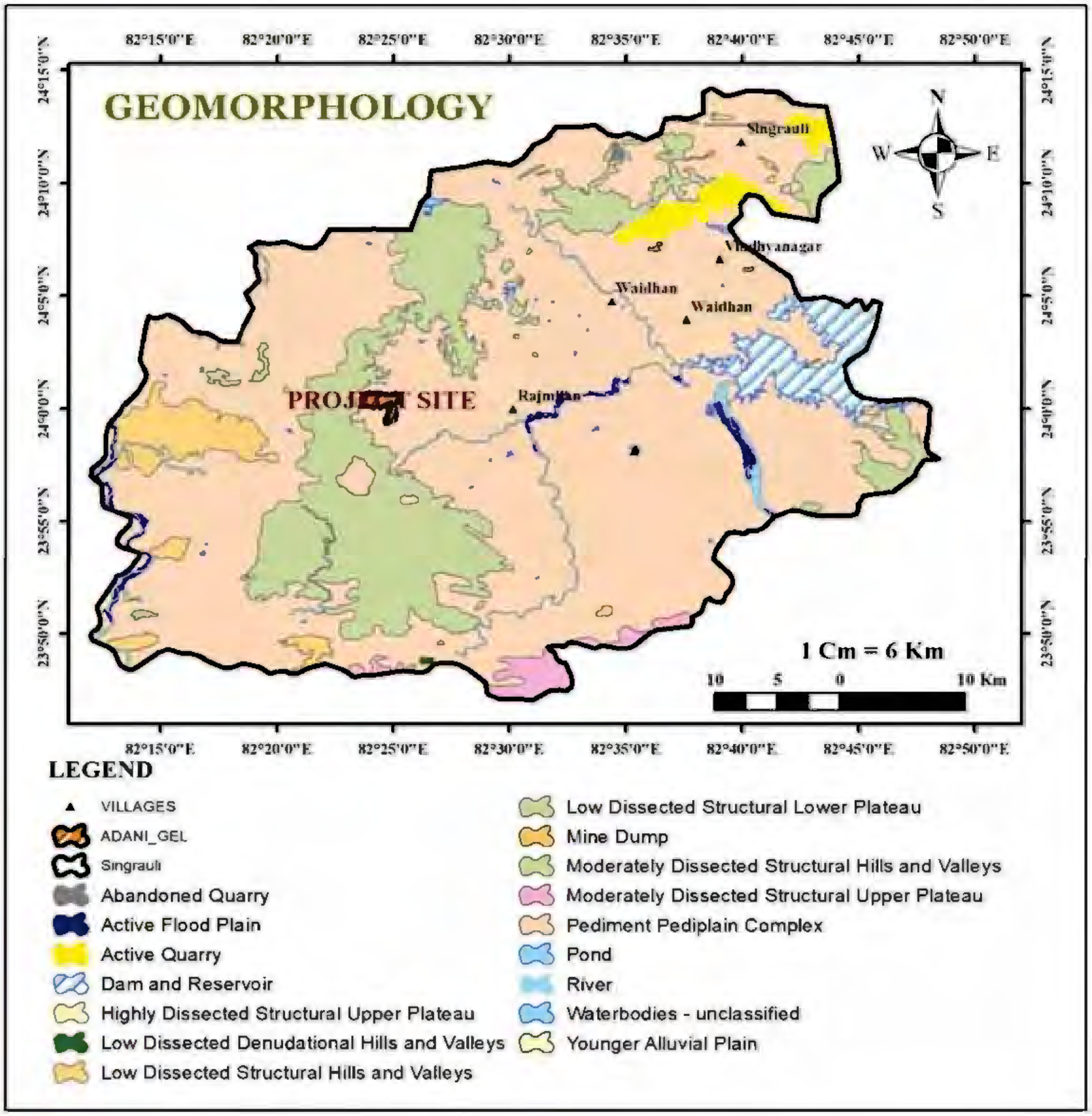
(ii) The Central part hilly ranges and

(iii) Southern hilly ranges

The district as a whole lie on the Son sub-basin of the Ganga basin. In the district, three main rivers flow along with several tributaries. The major rivers are the son, Gopal and Rihand. The Kaimur range stretched from NE and SW direction covers major part of the district. The central part of the district forms a series of hilly ranges. In the southern part of the district, the elevation of hilly ranges varies between 142 and 743 m above MSL. The general slope of the area is towards the Northeast.

The entire district is drained by the 3 major rivers ie. Son, Gopal, and Rihand along with their tributaries. The geomorphological map of Singrauli district has been presented in Figure 3.2.

FIGURE 3.2: GEOMORPHOLOGICAL MAP OF THE STUDY AREA

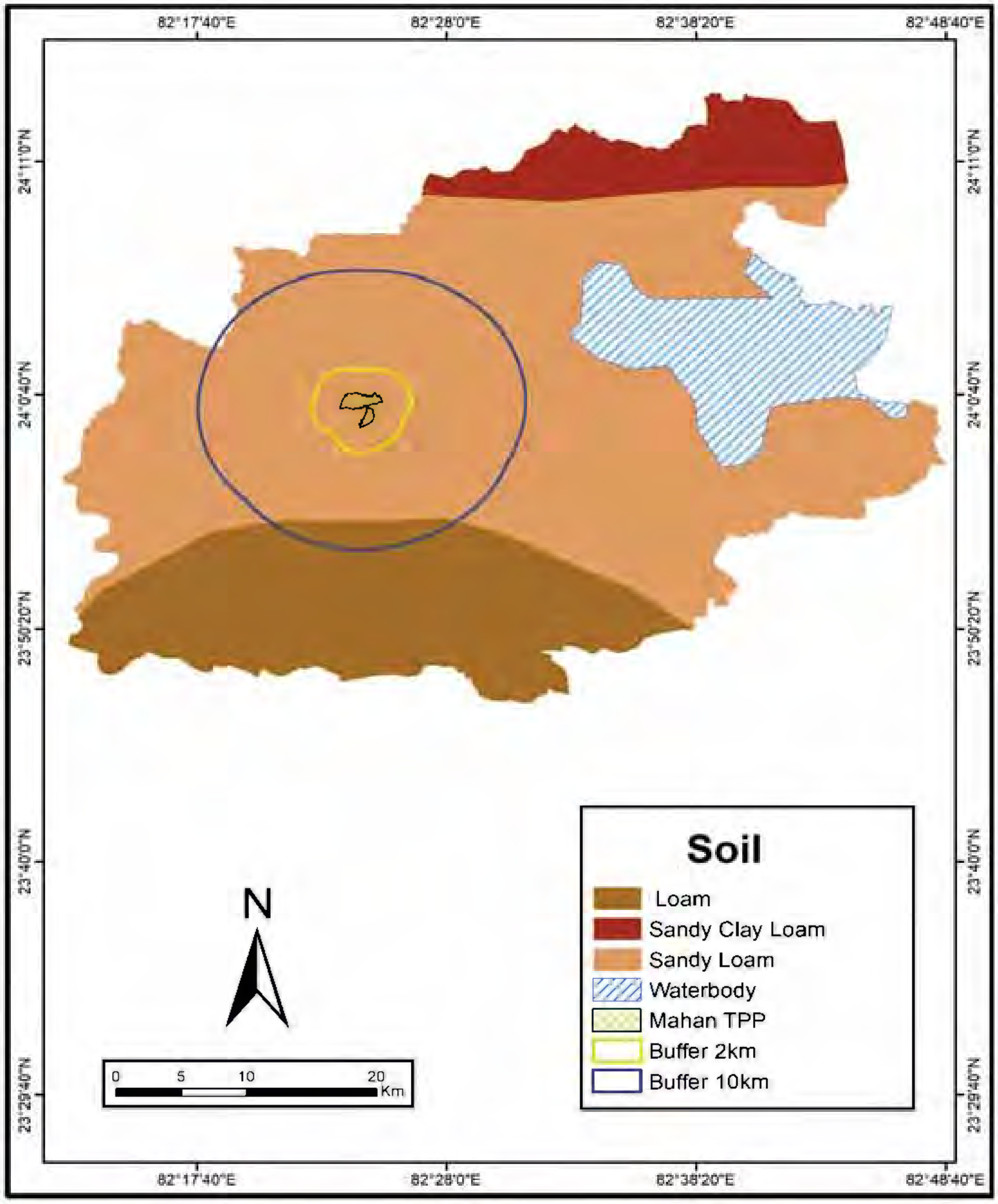


3.3 SOIL

The Singrauli region is majorly covered with alluvial soil, red sandy soil, yellow loamy Sandy soil, laterite soil, and red loam soil. The district comprises sedimentary, crystalline and metamorphic rocks, that weather into red soil. Similarly, the red colour of the laterite soil is more due to the diffusion of Iron compounds rather than due to the high proportion of Iron oxides. The alluvial soil is mostly restricted by along the banks of major rivers, whose thickness varies from few meters to 25 meters. (CGWB, 2013)

The study area is majorly covered with Sandy Loam and Loam soil (Figure 3.3).

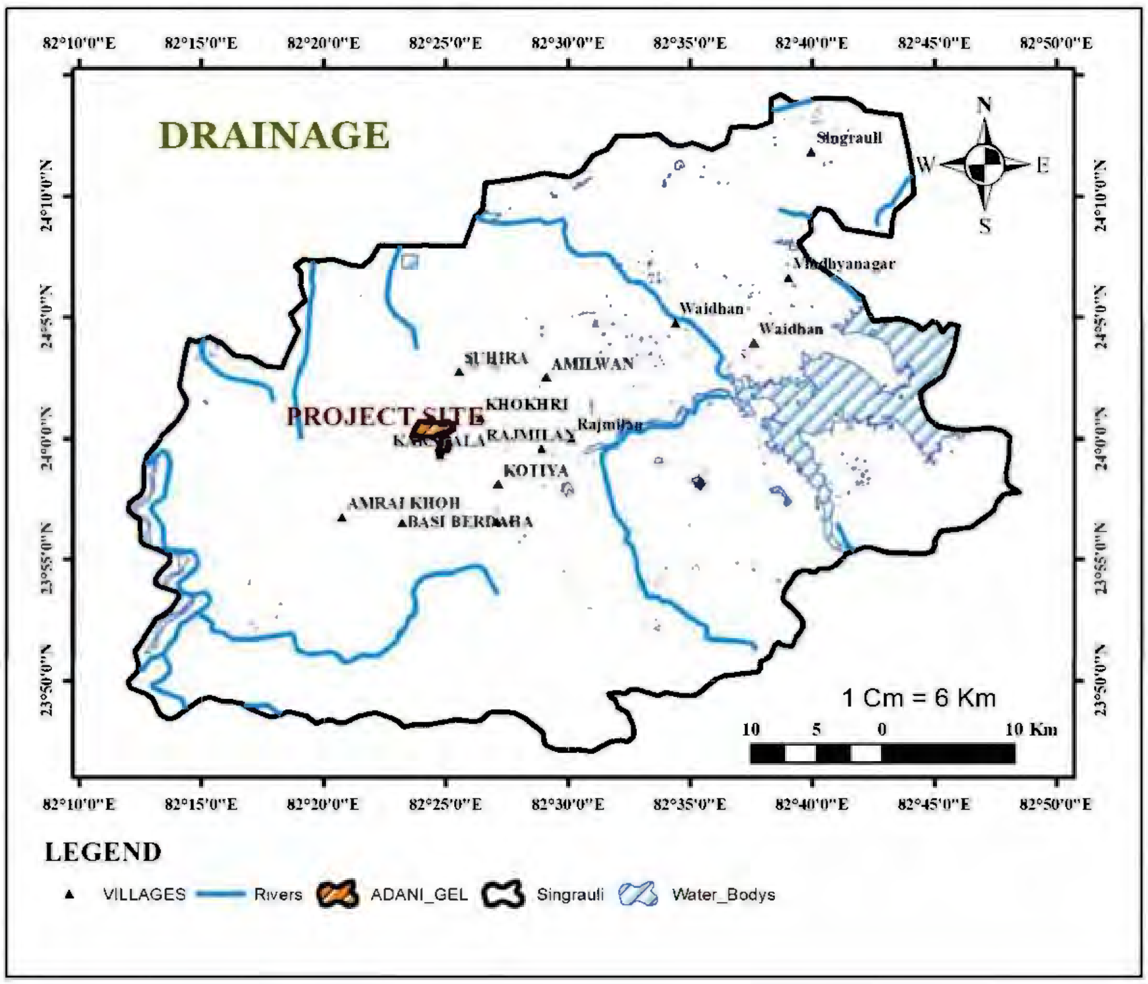
FIGURE 3.3: SOIL MAP OF THE STUDY AREA



3.4 DRAINAGE

The three main rivers flow along with several tributaries are the son, Gopal and Rihand. In the Southern part of the district. The elevation of hills varies between 142 and 722 m above MSL and it subsequently influence the drainage pattern in the area. The general slope of the area is towards Northeast. The entire district is drained by the above-mentioned 3 rivers and their tributaries in the Ganges drainage System. The pattern of drainage is dendritic in nature except the localized radial pattern in the hilly terrain (CGWB, 2022). The drainage map of the study area has been depicted in figure 3.4.

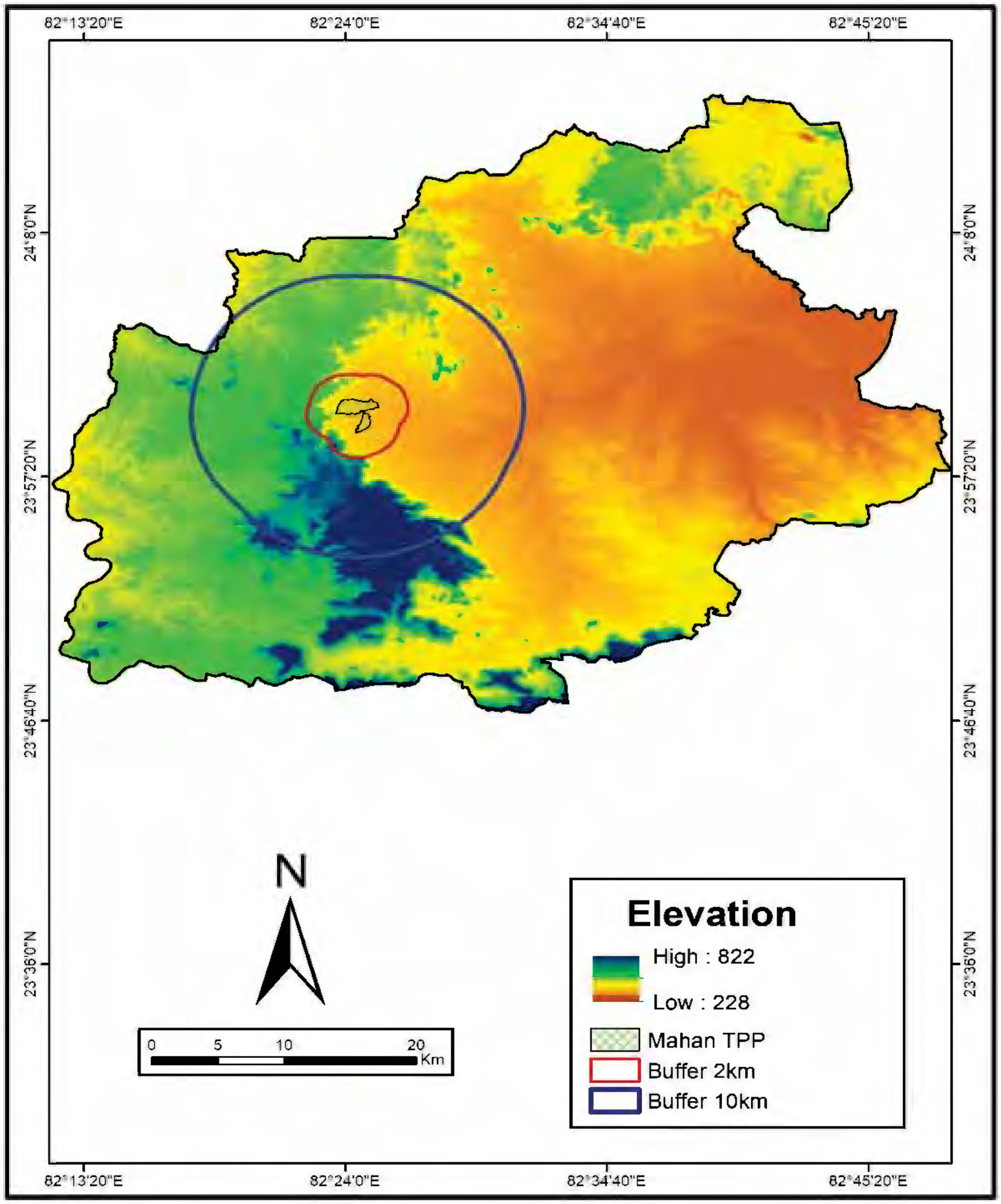
FIGURE 3.4: DRAINAGE MAP OF THE STUDY AREA



3.5 ELEVATION

The study area's Digital elevation model (DEM) was prepared using SRTM DEM data (Figure 3.4). The elevation of the study area varies from 228 m to 822 m above mean sea level and the slope is towards the northeast part of the study area.

FIGURE 3.4: ELEVATION MAP OF THE STUDY AREA



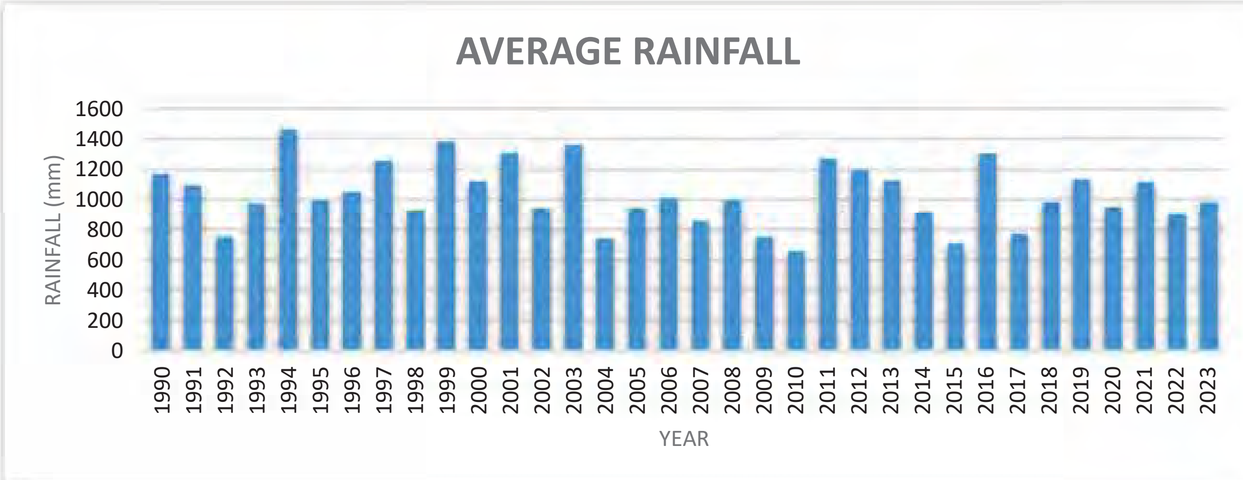
3.6 METEOROLOGY

Singrauli district experiences a subtropical climate characterized by hot summers, a monsoon season, and cool winters. The summer season in Singrauli is usually hot and dry. Temperatures during this period often soar, with daytime temperatures frequently exceeding 39°C. Hot, dry winds known as "loo" can sometimes blow, causing discomfort. Winter in Singrauli is relatively mild and pleasant. Daytime temperatures in winter usually range from 15°C to 25°C (59°F to 77°F), while nighttime temperatures can drop to around 5°C to 10°C (41°F to 50°F). Foggy conditions are common during the early morning, especially in December and January. The relative humidity varies between 29% during April and 83% during August. The average rainfall of the district is 1020 mm for the period 1990-2023. The micro meteorology and rainfall patterns of the Singrauli district are shown in table 3.1 and figure 3.4.

TABLE 3.1: MICRO METEOROLOGY OF THE OF THE SINGRAULI DISTRICT

Month	Min. Temperature		Max. Temperature		Humidity
January	10.6 °C	(51.1) °F	22.7 °C	(72.9) °F	62%
February	13.8 °C	(56.8) °F	26.9 °C	(80.4) °F	54%
March	18 °C	(64.3) °F	32.4 °C	(90.4) °F	40%
April	22.9 °C	(73.3) °F	38 °C	(100.4) °F	29%
May	26.3 °C	(79.3) °F	39.7 °C	(103.4) °F	34%
June	27.1 °C	(80.8) °F	35.9 °C	(96.7) °F	53%
July	25.1 °C	(77.2) °F	30.4 °C	(86.7) °F	81%
August	24.6 °C	(76.3) °F	29.8 °C	(85.6) °F	83%
September	23.8 °C	(74.9) °F	29.9 °C	(85.9) °F	82%
October	20.6 °C	(69) °F	29.4 °C	(84.9) °F	71%
November	16.2 °C	(61.1) °F	26.8 °C	(80.2) °F	62%
December	12.2 °C	(53.9) °F	23.4 °C	(74.1) °F	64%

FIGURE 3.4: AVERAGE ANNUAL RAINFALL OF SINGRAULI DISTRICT FROM 1990-2023



4.0 STRATEGIES & ACTION PLAN

Micro-Watershed development plays a pivotal role in conserving and restoring the ecological integrity of watersheds, which are vital for ensuring the sustainable management of water resources. This holistic approach encompasses a diverse array of strategies aimed at not only conserving but also enhancing the natural functions of watersheds.

Activities such as soil conservation, reforestation, and water management interventions are key components of watershed development efforts. Soil conservation measures, including terracing and contour plowing, help prevent soil erosion and sedimentation, thereby preserving soil fertility and improving water quality. Reforestation initiatives involve planting native tree species to restore degraded forest areas, which not only enhances biodiversity but also promotes groundwater recharge and regulates hydrological cycles. Additionally, water management interventions such as the construction of check dams and percolation ponds facilitate ground & surface water recharge, enhance infiltration, and mitigate the impacts of floods and droughts.

4.1 STRATEGIES FOR MICROWATERSHED DEVELOPMENT

4.1.1 Micro Watershed Development Scheme

A number of micro watershed development schemes are practiced in India. The selection of suitable techniques for artificial recharge depends on various factors, which includes:

- Quantum of non-committed surface run-off available.
- Rainfall pattern
- Land use and vegetation
- Topography and terrain profile
- Soil type and soil depth
- Thickness of weathered / granular zones
- Hydrological and hydro-geological characteristics
- Socio-economic conditions and infrastructural facilities available
- Environmental and ecological impacts of artificial recharge scheme proposed.

The following guidelines can be followed to select a site for an artificial micro watershed development scheme:

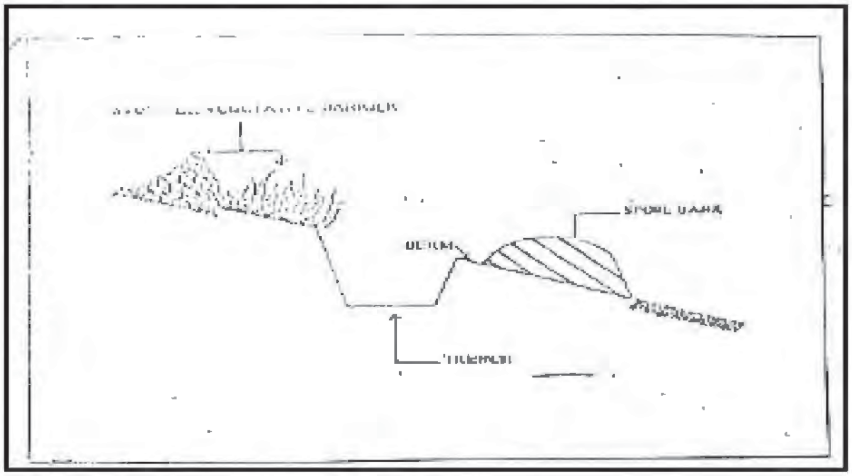
- Adequate space for surface storage is available.
- Water level is deep enough (> 8 m) and adequate sub-surface storage is available.
- Permeable strata are available at shallow/moderate depth.
- Adequate quantity of surface water is available for recharge.
- Adequate surface drainage density is present.
- Considering the geological and hydro-geological formations of the area, the following micro watershed development schemes are recommended:
- Contour Trenches.
- Gully Plugs, Nala Bunds, Check Dams.
- Recharge Pit/Recharge Shaft.

Contour Trenches

Contour trenches are rainwater harvesting structures, which can be constructed on hill slopes as well as on degraded and barren waste lands in both high- and low- rainfall areas. Cross section of a typical contour trench is shown in Figure 4.1**.** The trenches break the slope at intervals and reduce the velocity of surface runoff. The water retained in the trench will help in conserving the soil moisture and ground water recharge.

The size of the contour trench depends on the soil depth and normally 1000 to 2500 sq. cm cross sections are adopted. The size and number of trenches are worked out based on the rainfall proposed to be retained in the trenches. The trenches may be continuous or interrupted and should be constructed along the contours. Continuous trenches are used for moisture conservation in low rainfall area whereas intermittent trenches are preferred in high rainfall area. The horizontal and vertical intervals between the trenches depend on rainfall, slope and soil depth. In steeply sloping areas, the horizontal distance between the two trenches will be less compared to gently sloping areas. In areas where soil cover is thin, depth of trenching is restricted and more trenches at closer intervals need to be constructed. In general, the horizontal interval may vary from 10m in steep slopes to about 25 m in gentle slopes.

FIGURE 4.1: A TYPICAL SECTION OF CONTOUR BUNDS



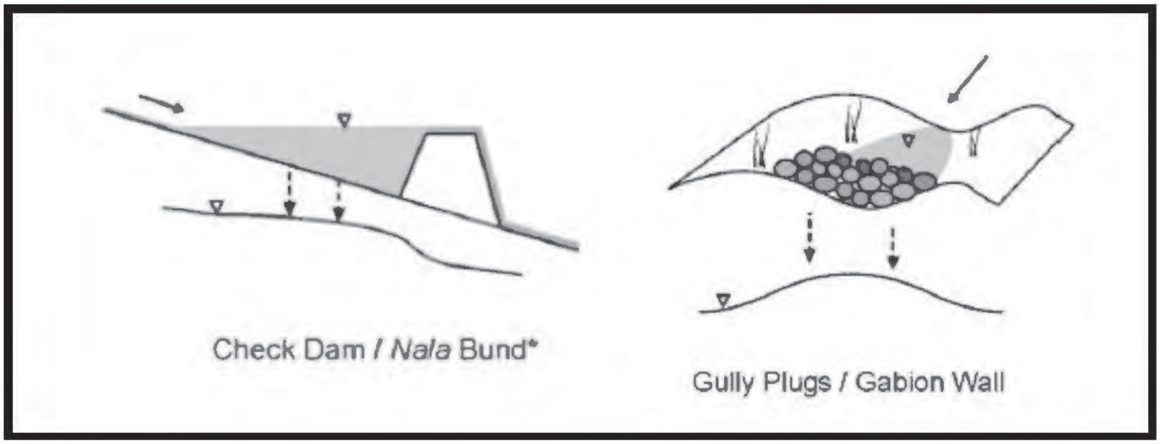
Gully Plugs, Nala Bunds and Check Dams

These structures are constructed across gullies, nalas or streams for impeding the flow of surface water in the stream channel and water is retained for a longer duration in the pervious soil or rock surface. As compared to gully plugs, which are normally constructed across 1st order streams, nala bunds and check dams are constructed across bigger streams, in areas having gentler slopes. These may be temporary structures such as brush wood dams, loose/ dry stone masonry check dams constructed with locally available material or permanent structures constructed using stones, brick and cement. Competent civil and agro-engineering techniques are to be used in the design, layout and construction of permanent check dams to ensure proper storage and adequate outflow of surplus water to avoid scours on the downstream side for long term stability of the dam. Gabion structure is also a kind of check dam constructed across small streams to conserve stream flows using locally available stones and a steel wire mesh, with practically no submergence beyond the stream course.

The site selected for check dam should have sufficient thickness of permeable soils or weathered material to facilitate recharge of stored water within a short span of time. The water stored in these structures is mostly confined to the stream course and the height is normally less than 2 m. These are designed based on stream width and excess water is allowed to flow over the wall. In order to avoid scouring from excess run off, water cushions are provided on the downstream side. To harness the maximum run off in the stream a series of such check dams can be constructed to have recharge on a regional scale.

A series of small bunds or weirs may be constructed across selected nala sections such that the flow of surface water in the stream channel is impeded and water is retained on pervious soil/rock surface for a longer duration. A nala bund acts like a mini percolation pond. A typical section of a check dam/Gulley Plugs is given in Figure 4.2**.**

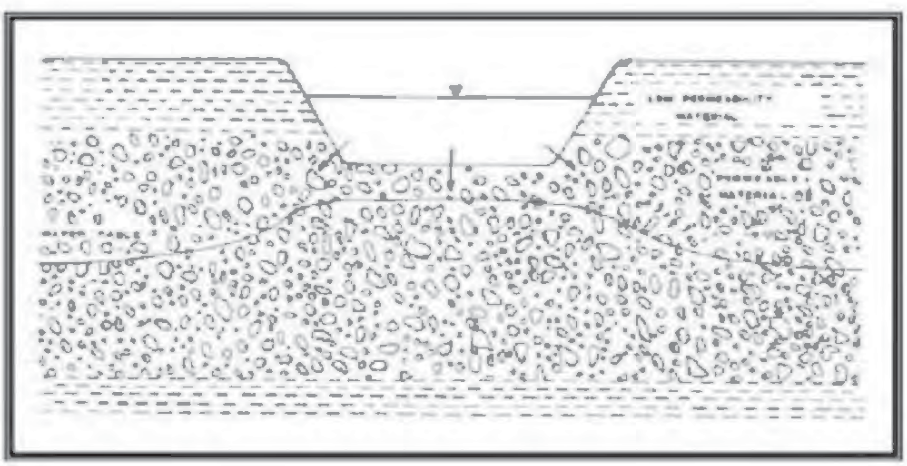
FIGURE 4.2: TYPICAL SECTION OF A CHECK DAM/GULLEY PLUGS



Recharge Pit/Recharge Shaft

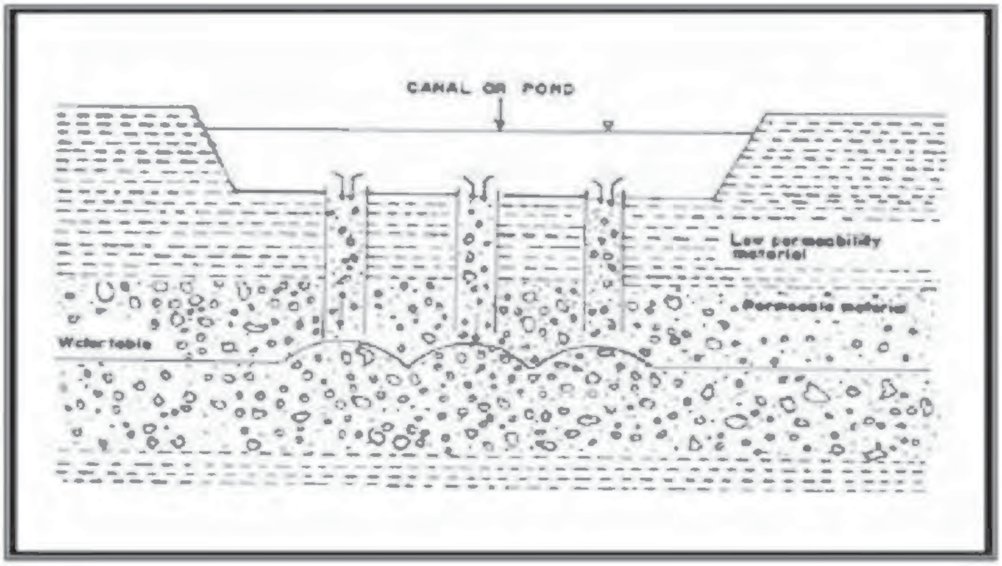
Recharge pits are normally excavated pits, which are sufficiently deep to penetrate the low-permeability layers overlying the unconfined aquifers (Figure 5.3). They are similar to recharge basins in principle, with the only difference being deeper and having restricted bottom area.

FIGURE 4.3: A TYPICAL SECTION OF A RECHARGE PIT



Recharge Shafts are similar to recharge pits but are constructed to augment recharge into phreatic aquifers where water levels are much deeper and the aquifer zones are overlain by strata having low permeability (Figure 4.4).

FIGURE 4.4: A TYPICAL SECTION OF A RECHARGE SHAFT



A comprehensive rainwater harvesting system is vital for sustainable water management. The system proposed to be installed within buffer zone of Mahan TPP would encompass various components to maximize rainwater capture and recharge groundwater levels along with the stream network in the buffer zone.

Surface runoff collection channels: Construction of surface runoff collection channels would be done that would involve creating channels or swales to redirect surface runoff from paved or compacted surfaces, such as roads and pathways, towards recharge structures. These channels would help to prevent erosion, reduce flooding, and facilitate ground and surface water replenishment by directing runoff to designated recharge areas.

Storage tanks: Storage tanks play a crucial role in rainwater harvesting systems by storing collected rainwater for later use or infiltration into the ground. Placement of properly sized storage tanks would ensure sufficient storage capacity to accommodate rainwater runoff during peak precipitation events, thereby maximizing groundwater recharge potential.

4.2 ACTION PLAN

The micro-watershed development plan can be tailored to address the specific environmental challenges and opportunities within the area that include:

1. Reforestation: Planting native tree species in the buffer zone to restore degraded forest areas and enhance vegetative cover. This would help reduce soil erosion, regulate water flow, and promote ground water recharge.

Miyawaki Plantation Technique

In the proposed development of micro watershed within the identified wasteland areas around Mahan TPP, the innovative Miyawaki technique is proposed for implementation as a measure for reforestation. The method involves densely planting native species in multiple layers to accelerate forest growth and biodiversity thereby promoting ground water recharge. By harnessing this technique, the wasteland areas can be transformed into lush green spaces teeming with diverse flora, contributing significantly to environmental restoration by reducing soil erosion and regulating water flow. The detail of the Miyawaki plantation technique is as follows:

Integrating the concepts of ecological successions, potential natural vegetation (PNV), cooperative processes of high-density plating in humus rich soils, Dr. Akira Miyawaki developed the ecological engineering technique popularly known as “Miyawaki method” in the early 1970s for the restoration of indigenous forests in Japan using native tree species. This crowd foresting technique built a dense and efficient forest ecosystem as equivalent as that of a 100–150-year-old forest in a short span of 20-30 years if developed in compliance with the recommended steps. Four stages of the Miyawaki foresting technique for development of a forest includes:

Initial Survey of the Locality:

The initial survey of the study area would be undertaken to develop an understanding about the soil characteristics of the site and the potential natural vegetation of the locality. According to different definitions PNV covers either the original vegetation or the subsequent vegetation established naturally in the area subsequent to any major environment al changes like soil erosion. The underlying idea is the planting native vegetation would help forest cover to get established even under no human interference in later stages of the forest development process.

Collection of Seeds:

The stage commences once the tree species for plantation have been identified. Identification of trees should be planned in such a way that the forest after establishment be a multilayered one. Hence, identified tree species are divided into four layers such as shrub, tree, sub tree and canopy layers and percentage of each tree species would be decided accordingly. Seeds of the selected vegetation are collected in large numbers from a natural forest locally or from a similar geo-climatic area and germinate them properly in a nursery bed. The seedlings would be transplanted at 2-3 leaves stage to grow in bags filled with potting mixture prepared using equal amount of soil, coir pith/wood chips, rice/wheat hull and dry cow dung. The plants would be kept under partial shade for a minimum period of 2-3 months before planting in the main field.

Preparation of the Planting Site:

The stage begins with loosening the soil by incorporating organic biomass like wood chips, coir pith, bagasse, rice or wheat hull etc. so that the soil holds more water. For this, the first step would be digging the soil up to one metre deep. Then, the soil to a depth of 50 cm would be taken out and filled with a mixture of soil (20-30 cm topsoil of the site), locally available organic biomass, and dry cow dung. Additionally, microorganisms isolated from a natural forest soil would be used to enhance the soil fertility of the new forest. This loosened fertile soil would help the samplings to grow fast with better spread of roots deep into the soil.

Plantation:

Plantation would be done densely where one square meter area accommodates at least 4 trees with different layers (1 canopy level,1 tree level, 1 sub tree level and 1 shrub level) for a multilayered forest.The site would be mulched using any organic mulch preferably rice/wheat straw to protect the soil from being eroded. As the soil is loose, saplings need to be supported with sticks to withstand conditions like wind, heavy rain etc. The planted site would be managed with timely irrigation and weeding in the first 2-3 years. Once the trees attain a height of 2 meters or more the forest would not require any human interference to grow further.

The subsequent section meticulously outlines a comprehensive, step-by-step process for implementing the Miyawaki plantation technique, providing detailed guidance for the successful development of green cover within the identified wasteland areas around Mahan TPP.

Step 1: Soil Analysis and Soil Preparation

Understanding the texture of the soil helps to analyse the water holding capacity of the soil, the capacity of root perforation, water infiltration, and retention of nutrients by the soil. This includes assessment of soil parameters like physical texture, organic carbon, nitrogen, soil pH, potassium, phosphorus and visible evidence of micro or macro fauna in the soil. This analysis helps to design natural methods for treatment of soil. This includes use of perforation material such as wheat, groundnut shells, corn husk, rice husk which will significantly improve perforation and help the roots to grow. Water retention materials like coco peat and sugarcane stock help the soil retain water and moisture. Addition of vermicompost, cow manure helps to improve the soil nutrient conditions. Addition of cultures of bacteria and mycorrhiza can also be decided based on the assessment results. Soils that are deficient in nitrogen would benefit immensely through Arbuscular Mycorrhizal Fungi (AMF) and nitrogen fixing bacteria like Rhizobium. AMF is available commercially and can even be cultured. Nitrogen fixing bacteria can be cultured and can also be added to the soil by planting nitrogen fixing leguminous plants. Soil texture also needs to be studied. Loamy soils are the most preferred as they contain a good mix of sand, clay and organic matter and provide the ideal balance of water, nutrients as well as drainage, thereby supporting good plant growth. At the end, it is essential to add a layer of mulch. This will protect and insulate the soil, thereby preventing excessive water loss due to evaporation. Some excellent options are dried grass, dried leaves, barley stalk, wheat stalk, rice straw, and corn stalk.

For preparation of the soil for afforestation, various biomass materials can be added which includes:

• **Ingredients for the Soil-**

(i) Adding perforator materials such as wheat, groundnut shells, corn husk, rice husk will significantly improve perforation and help the roots to grow.

(ii) Water retainers should be added next to help the soil retain water and moisture. Materials such as sugarcane stalk and cocopeat are recommended.

(iii) For the soil to receive nutrition, organic fertilizers such as vermicompost, cow manure can be used.

(iv) The final step would be to add a layer of mulch as it protects and insulates the soil. It also prevents sun rays to fall directly on the soil and ensures that the water in the soil does not evaporate. Some excellent options are dried grass, dried leaves, barley stalk, wheat stalk, rice straw, and corn stalk.

• Organic fertilizers- The ground requires fertilizer to provide nutrients for plant growth. Some organic fertilizers are cowpat, goat muck and vermicompost.

• Perforating materials- These materials are helpful for plants to penetrate their roots deeper into the ground. Rice husk, wheat husk, or groundnut shells can be an excellent resource to increase perforation.

• Water retainers- A ground must have significant water retention power to develop a forest. An afforest can add coconut coir and peat moss to strengthen the soil’s water retention power.

• Mulch- It is usually layered over the ground to protect it from the scorching sun. It is vital, especially for saplings, as their growth may be affected in dried soil. Afforests can use decaying leaves, dried bark, or even composts.

Step 2: Determination of Native Species and Floral Composition through Quadrat Survey

This step involves developing a database of the floral diversity through a quadrat survey in a native forest in the same agroclimatic zone as the site where the Miyawaki forest is aimed to be developed. Through this survey, the potential natural vegetation can be determined. The same also needs to be validated using secondary information such as the published flora of the region (in India, the Botanical Survey of India regularly updates the flora of different regions and the same should be referred to). The data (quantitative and qualitative), thus collected will help to develop the plant community composition that will be developed through the Miyawaki technique. The community composition should comprise of plants of all forms (trees, shrubs, herbs) in order to develop a natural forest. Species selection should be done in a manner that a mix of flowering, medicinal, timber, and fruiting species are chosen. While choosing the trees for the Miyawaki forest to be developed, emphasis should be given on selecting the 5 most dominant native trees (based on the results from the quadrat analysis). These trees will constitute around 50 percent of the floral diversity of the forest. The next abundant native species (based on the results from the quadrat analysis) will constitute 25-40 percent of the forest. The rest of the forest will be comprised of native species which have been found in the next level of abundance in the quadrat study.

The detailed step by step approach for the second step is as follows:

• Afforests must select the native plant species and identify their genus (deciduous or evergreen), height and influence on nature.

• Foresters must allocate those plants in layers, depending on all the above factors.

• 40 to 50 per cent of the total number of trees must comprise the most commonly found species in one's neighborhood. Foresters must choose at least 5 different genera that would be the significant species in that forest.

• Some moderately found native species will compose 25 to 40 per cent as supporting plants. Finally, some other minor species will constitute the rest of the forest.

• Afforests need to collect saplings of these species, which must be in a minimum height of 60 to 80 cm.

Step 3: Preparation of the Ground and Equip the Afforestation Area

The step involves meticulous preparation of the ground and equipping the afforestation area for optimal growth and development of the green belt. This crucial phase entails clearing the land of any debris or obstacles, ensuring a clean and uniform surface for planting. The soil is then carefully prepared through techniques such as loosening, aeration, and soil amendment to create a nutrient-rich substrate conducive to plant growth. Additionally, irrigation infrastructure may be installed to provide adequate water supply, essential for the establishment of young saplings. Furthermore, protective measures such as fencing or barriers may be implemented to safeguard the afforestation area from potential disturbances or encroachments. By meticulously preparing the ground and equipping the site with essential resources, it sets the stage for the successful implementation of the Miyawaki technique, facilitating robust growth and biodiversity enhancement within the green belt.

The subsequent section presents the detailed step by step approach for ground preparation and equipping the area proposed for afforestation.

• Before starting the planting process, afforests must inspect the ground to determine the possibilities and practicality of this project.

• The soil of this area must be clean from any debris and weed.

• It also must catch sunlight for at least 8-9 hours a day to start afforestation under the Miyawaki method.

• Foresters must install irrigation facilities, create 100 sq meter mounds and demark those before sowing.

Step 4: Undertaking Plantation

This is the most critical step for the successful establishment of a Miyawaki forest. The sub-steps that need to be followed are: In the plantation area, separate plantation bed area needs to be drawn out. The soil needs to be excavated for 3-4 feet. This excavated soil then needs to be mixed with the appropriate amounts of perforators, organic fertilizers and water retainers. The mixed soil should then be put back into the land. Care needs to be taken that the land does not get compressed at this stage and should be left aerated and loose. The levelled soil needs to be marked with chalk and pits (12”X12”) should be dug at every 1.5-2 feet, in a triangular manner. The saplings should then be placed in these pits, taking care that saplings of the same species are not planted next to each other. After the sapling is planted, 4-5 feet bamboo sticks should be inserted in the soil, close to the sapling. This will help prevent the sapling from drooping or bending in the first few months. Finally, a 5-7-inch-thick layer of mulch should be added to the soil (a minimum of half kg of mulch per tree needs to be added). For the first time, the saplings must be watered for an hour to make sure the mulching and the soil settle down. Tree density of 3trees/m^2 is ideal.

The subsequent section presents step by step approach for undertaking plantation.

● Outline the area to plant with chalk powder.

● Within the area of planting, draw out the plantation bed area and sperate the service area.

● Excavate the soil for about 3-4 feet and keep the excavated soil on the side.

● Mix the perforators, organic fertilizers, and water retainers, without any clumps. Ensure that they are mixed in the same ratios for each mound.

- Push back the mixed soil to fill the land. Ensure that the land is not compressed or walked upon. The idea is to leave the soil aerated and loose.

- Level the soil with hand tools.

- Mark the leveled soil with chalked powder for creating pits every 1.5-2 feet, in a triangular formation.

- Dig pits that are 12 inches wide and 12 inches deep.

- Place the saplings depending on the number of varieties you have and how your grid is created. For instance, if you have 30 species of trees, then mark the grid based on 30 pits.

- Before removing the saplings from their bags, dip the bags in a bucket that is filled with 20 part water, and 1 part Jeeva Amrut, or gaumutra, or coffee mix. Ensure that all the bubbles are settled before removing the sapling bags.

- Remove the sapling from the bag, place it in the pit, and loosely cover it with soil.

- Try not to plant two similar species next to each other and don't follow any pattern while planting. Maintain a 60cm distance between each sapling.

- After planting the saplings, insert 4-5 feet of bamboo sticks into the soil, close to the plant. These support sticks will ensure the saplings don't bend or droop during the first few months.

- Add a 5–7-inch layer of mulch in the soil. Consider at least half a kilo of mulch per tree. Tie it down with jute ropes to ensure the mulch doesn't fly around during strong winds. Tie the ropes on bamboo pegs that are nailed at the forest periphery. This will ensure that the rope is pressed down on the mulch.

- For the first time, the trees must be watered for an hour to make sure the mulching and the soil settle.

Step 5: Maintenance & Monitoring

The step involves critical tasks aimed at nurturing the newly planted saplings and facilitating their healthy growth. By meticulously levelling the soil and marking out pit locations, the groundwork is laid for the systematic planting of saplings. Careful preparation of saplings, including dipping them in a water-based solution for hydration, precedes their placement in the pits. Once planted, the saplings are secured with support sticks to prevent bending or drooping. Addition of mulch serves to retain moisture and provide essential nutrients to the soil, promoting optimal growth. Finally, watering the newly planted saplings ensures that they are adequately hydrated and settle into their new environment. These meticulous steps are essential for the successful establishment of a thriving green belt using the Miyawaki technique.

FIGURE 4.5: SCHEMATIC DIAGRAM OF MIYAWAKI PLANTATION TECHNIQUE

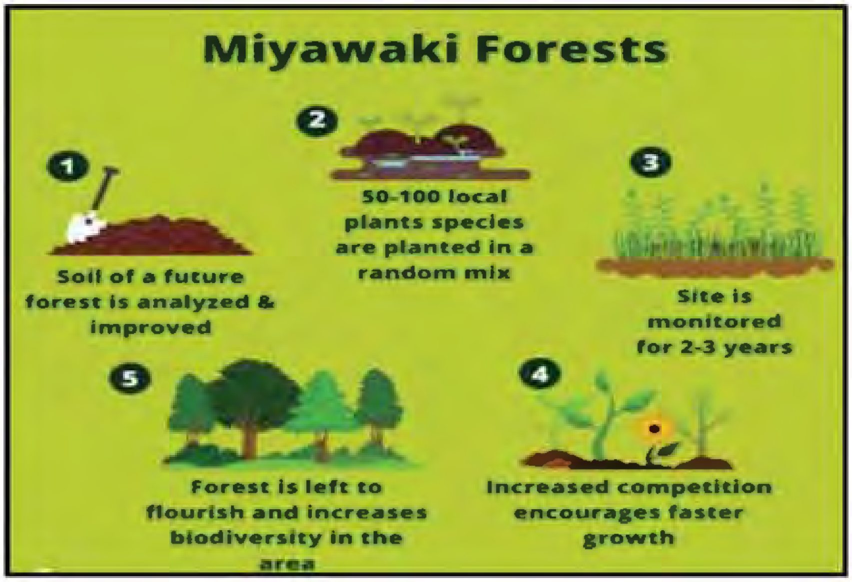


FIGURE 4.6: IMPLEMENTATION OF MIYAWAKI PLANTTAION TECHNIQUE

2. Soil conservation: Implementing soil conservation measures such as contour bunding, vegetative barriers, and mulching to prevent soil erosion and improve soil moisture retention.

This would contribute to enhancing the resilience of ecosystems and promoting sustainable land use practices.

3. Water management infrastructure: Constructing a variety of water management structures, such as check dams, percolation ponds, recharge wells, and deepening existing ponds, plays a crucial role in harvesting rainwater, controlling surface runoff, and facilitating groundwater recharge. These interventions are essential for mitigating the impacts of water scarcity and ensuring a reliable water supply for local communities and ecosystems.

- **Check dams**: These small barriers are built across streams and rivers to slow down water flow, allowing water to seep into the ground and recharge aquifers. They help in reducing soil erosion and increasing soil moisture content, benefiting agricultural lands and nearby vegetation. Table 4.1 presents the detail of check dams proposed to be constructed for micro-watershed development in Nagwa and other areas within the buffer zone of Mahan TPP.

TABLE 4.1: PROPOSED LOCATIONS FOR CONSTRUCTION OF CHECK DAMS (FY 2024-25)

S.No.	Check Dam	Location
1	Shiv Mandir, Nagwa	Nand Vihar,Nagwa
2	Dhobiyan Tola Nagwa	Nagwa

- **Percolation ponds**: These ponds are designed to capture and hold rainwater, enabling it to percolate slowly into the ground. By enhancing groundwater recharge, percolation ponds help maintain the water table and provide a sustainable source of water for various uses. Table 4.2 presents the detail of ponds proposed to be developed during 2024-25 within the vicinity of Mahan TPP.

TABLE 4.2: DETAIL OF LOCATIONS FOR PROPOSED DEVELOPMENT OF PONDS (FY 2024-25)

S.No.	Pond Name	Location	Area Covered (Cubic meter)
1	Dih baba Pokhara	Raila	3750
2	R&R Colony Pokhara	R&R Colony,Nagwa	1369
3	Bandhaura Shiv Mandir Pokhara	Bandhaura	1674

- **Recharge wells:** These wells are specifically constructed to facilitate the direct infiltration of rainwater into the underground aquifers. By channeling rainwater runoff into recharge wells, we can significantly improve groundwater levels and ensure long-term water availability. The proposed locations for installation of rainwater harvesting system (RWHS) within the study area has been presented in Table 4.3.

FIGURE 4.3: PROPOSED LOCATIONS FOR INSTALLATION OF RWHS (FY 2024-25)

S.No.	Name of Institution	Location
1	SSM School Nagwa	Nand Vihar, Nagwa
2	Primary Health Center,Nagwa	R&R Colony Nagwa

- **Pond deepening:** Deepening existing ponds increases their storage capacity, allowing them to capture and hold more rainwater during the monsoon season. This additional water can then percolate into the ground, contributing to groundwater recharge and providing a reliable water source during dry periods. Table 4.4 presents the detail of ponds identified for deepening within the buffer zone of Mahan TPP.

TABLE 4.4: DETAIL OF LOCATIONS FOR PROPOSED DEEPENING OF PONDS FY 2024-25

S.No.	Pond Name	Location	Praposed Area Covered (Cubic meter)
1	Gau Shala Pokhara,	Suhira	1200
2	Pokhari tola Pokhara	Amiliya	1200
3	Bazar Pokhara Karsua	Karsuaraja	1200
4	Talab Jamgarhi	Jamgarhi	1200
5	Dhobiyan Tola Pokhara	Nagwa	1200
6	Chhotaki Pokhara	Nagwa Gate	1200

Integration of watershed development plan into the management of the buffer zone of Mahan TPP would lead to the conservation of natural resources, promotion of ecological sustainability, and enhancement of community resilience in the surrounding area. Figure 4.5 depicts the potential areas identified for development of micro-watershed in the buffer zone.

FIGURE 4.7: PROPOSED LOCATIONS FOR DEVELOPMENT OF MICRO WATERSHED IN THE BUFFER ZONE OF MAHAN TPP

4.3 COST ESTIMATE

The estimated cost of reforestation, construction of check dams, groundwater recharge and deepening of ponds for development of micro watershed within 10 Km buffer zone of Mahan TPP has been calculated. The total estimated budget for the implementation of green belt development plan is **92.00 Lakhs INR.**

TABLE 4.5: BUDGET FOR MICRO WATERSHED DEVELOPMENT PLAN

Sl No.	Components	Budget (Rs. in Lakhs)
1	Cost of reforestation including maintenance for 5 years and establishment charges @ Rs 60,000/ha for 22.00 ha	13.00
2	Construction of check dams (2nos. @Rs 1500000)	30.00
3	Pond Deepening (6nos. @Rs 500000)	30.00
4	Rainwater Harvesting Structure (2nos. @750000)	15.00
5	Contingency	4.00
	Total	**92.00**

Annexure XII

PROPOSED EXPANSION OF BANDHAURA ULTRA SUPER CRITICAL THERMAL POWER PLANT BY ADDING 1600 (2x800) MW WITH EXISTING CAPACITY OF 1200 (2x600) MW AT VILLAGE BANDHAURA, TEHSIL MADA, DISTRICT SINGRAULI, MP BY MAHAN ENERGEN LTD.

Year-wise implementation Plan of focus & key areas identified and considered under CER

PROPOSED CER BUDGET PLAN

Sr. No	Key Area Identification under CER for addressing issued raised during Public Hearing	Proposed Expenditures year wise (Rs. In Crores)					Total Proposed Expenditures (Rs. In Crores)
		1st Year	2nd Year	3rd Year	4th Year	5th Year	
A	**Educational Initiatives**						
	Modernization and necessary construction of Saraswati Shishu Mandir/Higher Secondary School (Kg to XII Class), Nagawa village.	0.40	0.80	0.80	-	-	**2.0**
	Distribution of drinking water filter/Drinking water coolers in schools.	0.05	0.10	0.10	-	-	**0.25**
	Basic teaching and learning infrastructure support to Govt. Schools, Supporting in creation of assembly halls, prayer halls, classrooms, computer room, space for mid-day meals, playground, school boundary walls etc. for government school.	0.35	0.70	0.70	-	-	**1.75**
	Educational Vocational Guidance fair (EVGF) for career talk. Conducting Quiz competition for Students, Preparatory Coaching Classes for Navoday Entrance Examination.	0.10	0.20	0.20	-	-	**0.50**
	Community to provide awareness about education, health, hygiene, and good practices.	0.05	0.10	0.10	-	-	**0.25**
	Program for skill improvements of teaching staffs in govt. school.	0.05	0.10	0.10	-	-	**0.25**
	Sub Total	**1.0**	**2.0**	**2.0**	-	-	**5.0**

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B	**Community Health Initiatives**						
	Operation of Primary Health Centre at Nagawa, R & R Colony.	0.6	0.6	0.6	0.6	0.6	**3.0**
	Rural Medical Camps through Medical Team of Primary Health Centre @ 4 Nos. of camps per month (@ 60 patients per camp), Safe Menstrual Hygiene Management Awareness, Mega Health Camp, Cataract Screening & Operation.	0.2	0.2	0.2	0.2	0.2	**1**
	Promotion of awareness of malnutrition and anemia.	0.1	0.1	0.1	0.1	0.1	**0.5**
	Promotion of Poshan Vatika at backyard of villagers & Project Suposhan.	0.1	0.1	0.1	0.1	0.1	**0.5**
	Sub Total	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**5.0**
C	**Sustainable Livelihood and Women Empowerment**						
	Skill Development Centre (SDC) to make the youth for achieving their Goals in life by becoming Skilled Professionals.	0.3	0.3	0.3	0.3	0.1	**1.3**
	Development & Support for Drip irrigation in core zone villages.	0.2	0.2	0.2	0.2	0.1	**0.9**
	Sub Total	**0.5**	**0.5**	**0.5**	**0.5**	**0.2**	**2.2**
D	**Community Rural Infrastructure Development**						
	Repairing, widening & Maintenance of Existing roads in consultation with Gram Panchayats	0.5	0.5	0.5	0.5	0.5	**2.5**
	To provide facility for potable drinking water, RO Plants and water supply system through overhead tank in villages.	0.5	0.5	0.25	0.15	0.10	**1.5**
	Creation of clean and hygienic environment by proper drainage systems, community sanitation campaign etc.	0.5	0.5	0.25	0.15	0.10	**1.5**

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	Upgradation & Renovation of primary health centers. With toilet facilities etc.	0.5	0.5	0.5	0.5	0.5	**2.5**
	Provision of solar street lighting, green nurturing programs, implementation of Swachchh Bharat initiatives.	0.5	0.5	0.5	0.2	0.3	**2.0**
	Sub Total	**2.5**	**2.5**	**2.0**	**1.5**	**1.5**	**10.0**
E	**Maintenance of R & R Colony**						
	Maintenance and Repairing of R & R colony and existing Private Higher Secondary School.	1.5	1.5	1.5	0.5	0.5	**5.5**
	Maintenance of Primary Health Centre which is operational within the colony	1.5	1.5	1.5	0	0	**4.5**
	Sub Total	**3.0**	**3.0**	**3.0**	**0.5**	**0.5**	**10.0**
F	**Sports & Culture Development**						
	Promotion of sports for youths and women	0.1	0.1	0.1	0.05	0.05	**0.4**
	Cultural activities for villagers	0.1	0.1	0.1	0.05	0.05	**0.4**
	Sub Total	**0.2**	**0.2**	**0.2**	**0.1**	**0.1**	**0.8**
G	**Development of local youth & women for management & administration**						
	Team/ Leaders development at village level as coordinator for various programme and activities.	0.4	0.4	0.4	0.4	0.4	**2.0**
	Vehicles for emergency purpose for local villagers including private ambulances as per requirement	0.1	0.1	0.1	0.1	0.1	**0.5**
	Sub Total	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**2.5**
	Total (A+B+C+D+E+F+G)	**8.7**	**9.7**	**9.2**	**4.1**	**3.8**	**35.5**

Mahan Energen Limited

adani
Power

Ref: APL/MEL/MoEFCC/EC/0509/23
Date: 04.08.2023

To
The District Development Officer,/Collector
Waidhan, District Singrauli,
Madhya Pradesh

Sub.: Ministry of Environment, Forest & Climate Change (MoEFCC) has granted Environmental Clearance (EC) to Bandhaura Thermal Power Plant for Proposed expansion of 1600 (2×800) MW in addition to the existing 1200 (2x600) MW at Village Bandhaura, Tahsil Mada, District Singrauli, Madhya Pradesh.

Ref.: Environment Clearance vide letter no. **J-13011/56/2006-IA.II (T)** issued on dated **02.08.2023**

Dear Sir,

With refrance to the above mentioned subject we would like to inform you that Ministry of Environment, Forest & Climate Change (MoEFCC) has granted Environmental Clearance to Bandhaura Thermal Power Plant for Proposed 1600 (2×800) MW in addition to the existing 1200 (2x600) MW within existing plant boundary at Village Bandhaura, Tahsil Mada Singrauli District, in Madhya Pradesh vide letter no. **J-13011/56/2006-IA.II (T)** issued on dated **02.08.2023** and may also be seen at the Website of MoEF&CC at https://parivesh.nic.in/.

This is for your kind information and record please.

Thanking You

Yours faithfully,
for Mahaan Energen Limited.

(R N Shukla)
Authorized Signatory

Encl.: Copy of Environmental Clearance (EC).

CC **The Block Development Officer**
Bilaunji, Waidhan – Singrauli.
Zilla Panchayat / Zilla Parishad Office
Waidhan – Singrauli.
The Village Panchayat Office (list encl.)
Waidhan – Singrauli.
NGO (Local), if any

14/8/23
आवक शाखा
कलेक्टर जिला-सिंगरौली

Mahan Energen Ltd
(Formerly Essar Power MP Ltd)
Adani Corporate House
Shantigram, S G Highway
Ahmedabad 382 421
Gujarat, India
CIN: U40100DL2005PLC201961

Tel +91 79 2555 4444
Fax +91 79 2555 7177
www.adanipower.com

Registered Office: Lower Ground Floor, Hotel Conclave Boutique, A-20, Kailash Colony, New Delhi 110 048, Delhi, India

Received
11/08/23

11/8/23

adani
Power

Sub: Ministry of Environment, Forest & Climate Change (MoEFCC) has granted Environmental Clearance (EC) to Bandhaura Thermal Power Plant for Proposed expansion of 1600 (2x800) MW in addition to the existing 1200 (2x600) MW at Village Bandhaura, Tahsil Mada, District Singrauli, Madhya Pradesh.

Ref: MoEFCC Letter No. J-130011/56/2006-IA. II(T) dated 27.07.2023

RECEIPT:

Tehsil / Block: Singrauli

Sl. No.	Name of Gram Panchayat/ Mukhiya/Panchayat Samiti	Name, Sign with Seal, and date.
1	Sarpanch/Mukhiya/Sachiv Gram Panchyat- **Bandhura** Tahsil- Mada, Dist.- Singrauli	हीरामती सरपंच ग्राम पंचायत बंधौरा ज.पं. बैढ़न, जिला सिंगरौली
2	Sarpanch/Mukhiya/Sachiv Gram Panchyat- **Kheirahi** Tahsil- Mada, Dist.- Singrauli	सरपंच ग्राम पंचायत क्षेत्र खैराही जनपद पंचायत बैढ़न जिला–सिंगरौली (म० प्र०)
3	Sarpanch/Mukhiya/Sachiv Gram Panchyat- **Nagwa** Tahsil- Mada, Dist.- Singrauli	कुसुम सरपंच ग्राम पंचायत क्षेत्र नगवा जनपद पंचायत–बैढ़न जिला–सिंगरौली (म.प्र.)
4	Sarpanch/Mukhiya/Sachiv Gram Panchyat- **Suhira** Tahsil- Mada, Dist.- Singrauli	सरपंच ग्राम पंचायत क्षेत्र सुहिरा जनपद पंचायत बैढ़न जिला–सिंगरौली (म०प्र०)
5	Sarpanch/Mukhiya/Sachiv	

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	Gram Panchyat- **Raila** Tahsil- Mada, Dist.- Singrauli	सरपंच ग्राम पंचायत क्षेत्र रैला जनपद पंचायत वैढ़न जिला सिंगरौली (म.प्र.)
6	Sarpanch/Mukhiya/Sachiv Gram Panchyat- **Amiliya** Tahsil- Mada, Dist.- Singrauli	सरपंच ग्राम पंचायत क्षेत्र अमिलिया जनपद पंचायत वैढ़न जिला–सिंगरौली (म० प्र०)

Mahan Energen Ltd
(Formerly Essar Power MP Ltd)
Adani Corporate House
Shantigram, S G Highway
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Tel +91 79 2555 4444
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Registered Office: Lower Ground Floor, Hotel Conclave Boutique, A-20, Kailash Colony, New Delhi 110 048, Delhi, India

adani

Power

Ref: APL/MEL/MoEFCC/EC/0508/23
Date: 04.08.2023

To
The Regional Officer,
Madhya Pradesh Pollution Control Board
Regional Office, Waidhan,
Singrauli, Madhya Pradesh

Sub.: Ministry of Environment, Forest & Climate Change (MoEFCC) has granted Environmental Clearance (EC) to Bandhaura Thermal Power Plant for Proposed expansion of 1600 (2×800) MW in addition to the existing 1200 (2x600) MW at Village Bandhaura, Tahsil Mada, District Singrauli, Madhya Pradesh.

Dear Sir,

With refrance to the above mentioned subject we would like to inform you that Ministry of Environment, Forest & Climate Change (MoEFCC) has granted Environmental Clearance to Bandhaura Thermal Power Plant for Proposed 1600 (2×800) MW in addition to the existing 1200 (2x600) MW within existing plant boundary at Singrauli District, in Madhya Pradesh vide letter no. J-13011/56/2006-IA.II(T) issued on dated 02.08.2023 and may also be seen at the Website of MoEF&CC at https://parivesh.nic.in/.

This is for your kind information and record please.

Thanking You

Yours faithfully,
for Mahaan Energen Limited.

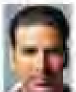
(R N Shukla)
Authorized Signatory

Encl.: Copy of Environmental Clearance (EC).

CC:
Integrated Regional Office,
Ministry of Environment, Forest & Climate Change
Kendriya Paryavaran Bhavan,
Bhopal (M.P) - 462016

स्टेट डिजी

OMG-2: शिवजी को काबिल बताने दिखाया, अक्षय को नोटिस



4 महीने में 10 हजार करोड़ जीएसटी कलेक्शन

स्कूल की छत का प्लास्टर गिरा, दो छात्र घायल

बाघ के शिकार के चार आरोपी पकड़ाए

मंत्री ने लिखी हटाने की नोटशीट, फिर भी नहीं हटाया

हार्टिकल्चर डायरेक्टर निधि ने 300 को दिया नोटिस, कर्मचारियों ने मांगा वीआरएस

हाईकोर्ट ने पूछा आदेश के बावजूद क्यों नहीं दिया वेतन

25 अनिवार्य प्रकरणों पर सुनवाई टली

बैतूल की डिप्टी कलेक्टर के इस्तीफे पर नियम के अनुरूप लें निर्णय

हिंदुत्व, विकास और भ्रष्टाचार के मुद्दे पर सीएम और पूर्व सीएम आमने-सामने

जो राम को काल्पनिक मानते थे, वे कथाएं करा रहे : सीएम

शिवराज इतिहास के सबसे भ्रष्ट मुख्यमंत्री : कमलनाथ

संत रविदास मंदिर के साथ 50 हजार करोड़ के बीना रिफाइनरी विस्तार प्रोजेक्ट का भी भूमिपूजन करेंगे मोदी

15 जिलों में नहीं हुई जरूरत की बारिश

इन चार जिलों में सामान्य से कम बारिश

चार जिले, जहां सबसे ज्यादा बारिश

रिश्वत लेते मेडिकल ऑफिसर गिरफ्तार

चयनित शिक्षकों ने सिर मुंडाकर किया विरोध, महिलाओं ने कटवाई चोटी

परिवहन चेकपोस्टों को बंद कर लागू होगा गुजरात मॉडल

महान एनर्जेन लिमिटेड

सार्वजनिक सूचना

... J-13011/94/2008-IA.II (T), ... 09.08.2023 ... तहसील माडा, जिला सिंगरौली, मध्य प्रदेश हेतु प्रदान की गई है।

इस तापीय परियोजना की मुख्य विशेषताएं इस प्रकार हैं-

विस्तार क्षमता: 1600 (2X800) मेगावाट

प्रौद्योगिकी - परियोजना ने बंधौरा टीपीपी/के लिए अल्ट्रा सुपर क्रिटिकल बॉयलर की नवीनतम तकनीक को अपनाया है।

भूमि - इस परियोजना के लिए मौजूदा संयंत्र सीमा के भीतर कुल भूमि की 920 एकड़ (372.3 हेक्टेयर) है।

कोयला - परियोजना के लिए 100% प्लांट लोड फैक्टर (पीएलएफ) के साथ 6.85 मिलियन टन प्रति वर्ष (एमटीपीए) कोयले की आवश्यकता होगी, जिसे धीरौली कोयला खदान/व्यापारी से प्राप्त किया जाएगा।

जल - परियोजना के लिए जल को प्रति वर्ष 36 मिलियन क्यूबिक मीटर (एमसीएम) पानी (4000 एम 3 / घंटा) की आवश्यकता होगी, जिसे रिहंद (गोविंद वल्लभ पंत सागर) जलाशय से प्राप्त किया जाएगा।

फ्लाई ऐश - फ्लाई ऐश अधिसूचना और उसके बाद के संशोधनों के अनुसार फ्लाई ऐश का उपयोग और निपटान किया जाएगा।

अनुपालन - पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय (एमओईएफसीसी), राज्य सरकार और राज्य प्रदूषण नियंत्रण बोर्ड (एसपीसीबी) द्वारा अधिसूचित निर्धारित शर्तों का पर्यावरण सुरक्षा मानकों के संबंध में हर छह महीने में सख्ती से पालन किया जाएगा और अनुपालन रिपोर्ट के साथ केंद्रीय प्रदूषण नियंत्रण बोर्ड (सीपीसीबी) को सूचित किया जाएगा।

इस परियोजना की कुल अनुमानित पूंजी लागत 12800.00 करोड़ रुपये है और 3488.27 करोड़ रुपये पर्यावरण संरक्षण कार्यों जैसे वर्षा जल संचयन, इलेक्ट्रोस्टैटिक प्रेसिपिटलेटर, चिमनी, धूल निष्कर्षण और दमन प्रणाली, सीवरेज संग्रह, उपचार और निपटान, ग्रीन बेल्ट, और भूनिर्माण, वर्षा जल संचयन, सौर ऊर्जा दोहन और पर्यावरण निगरानी की स्थापना पर खर्च किए जाएंगे। सीईआर के लिए 35.5 करोड़ रुपये खर्च किए जाएंगे।

पर्यावरण मंजूरी की सामान्य शर्त संख्या xiv के अनुसार पर्यावरण मंजूरी पत्र की प्रति एकीकृत क्षेत्रीय कार्यालय, भोपाल, राज्य प्रदूषण नियंत्रण बोर्ड (एमपीपीसीबी) के क्षेत्रीय कार्यालय और प्रधान कार्यालय और कंपनी की वेबसाइट https://www.adanipower.com पर उपलब्ध है। और पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय (एमओईएफसीसी) की वेबसाइट परिवेश पोर्टल https://parivesh.nic.in पर भी देखा जा सकता है।

पर्यावरण मंजूरी की प्रति संबंधित पंचायतों, जिला परिषद/नगर निगम, जिला विकास अधिकारी, खंड विकास अधिकारी, शहरी स्थानीय निकाय और स्थानीय एनजीओ को सौंपी गई है।

महान एनर्जेन लिमिटेड

AI Tech May Hit Women Harder, Need To Upskill

Workers in lower-wage jobs — which are disproportionately held by women — are up to 14 times more likely to need to change occupations than those in highest-wage positions, and most will need increased social-emotional and digital skills to do so successfully

India Lags In Gender Diversity In IT Graduates
(Higher score is lower diversity)

▶ In the US, a projected decrease of 3.7mn and 2mn jobs due to AI in office support and customer service, respectively, leaves women 1.5 times more likely to need to move into new occupations

▶ By extension, in India, a lack of gender diversity in IT graduates — which translates to fewer women with the required digital skills — may cause the AI wave to hit women harder

Maruti for preferential share issue to buy Suzuki's Guj unit

Won't Use ₹46,000Cr Cash Reserves, Cites Profitability Gains

AIMS MORE EFFICIENT FUNCTIONING

▶ Conserving cash and earning interest will be a better option to increase profitability, earnings per share and dividend, says Maruti Suzuki chairman R C Bhargava

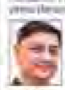
▶ Maruti board has approved termination of contract manufacturing agreement with Suzuki Motor Gujarat and acquiring of shares through allotment basis

▶ Suzuki's stake will rise from 56.4% to 58.2% after preferential share allotment

▶ Main aim of acquisition is to align production operations under a single management for smoother and more efficient functioning, says Bhargava

▶ Cash reserves had helped the company tide over difficult periods, Bhargava adds

Not time to press growth accelerator now: Sanyal



Govt now selective in levying dumping duty

Finmin Rejects 57% Of Recos In 3 Years, Most Cases Deal With Cheap Imports From China

TALE OF TWO PERIODS

▶ When it comes to cases rejected by the revenue department, in over half (43 of 80 rejected cases), China was a subject country

▶ The list included carbon black, caustic soda, flat rolled products of stainless steel, vitamin, nylon yarn and polyester yarn

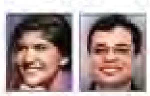
HDFC Ergo to utilise claims database to estimate costs

BACKED BY AI

Carlyle buys \$500mn stake in engg services co Quest

Tata Play, Isro commercial arm launch GSAT-24 satellite

Ananya Birla's fin co to buy Sachin Bansal's Chaitanya



'A rare founder who was always there for his team'

'I RIDE, THEREFORE I AM'

China's trade dives in blow to recovery

Mahan Energen Limited

Public Notice

The Ministry of Environment, Forest & Climate Change (MoEFCC) has granted Environmental Clearance (EC) vide letter no. **J-13011/16/2006-IA.II (T) issued date 02.08.2023 to Mahan Energen Limited for "Expansion of Bandhaura Thermal Power Plant by Addition 1600 (2x800) MW Capacity to the existing 1200 (2x600) MW in an area of 920 Acres at Village Bandhaura, Tehsil Mada, District Singrauli, Madhya Pradesh".**

The salient features of this thermal project are as follows:

Land - The total land requirement for this project is 920 Acres (372.3 ha) within the existing plant boundary.

Technology - The project has adopted latest technology of Ultra Super Critical Boilers for Bandhaura TPP.

Coal - The project will require 8.85 Million Tonnes Per Annum (MTPA) Coal with 100% Plant Load Factor (PLF), which will be sourced from Dhirauli Coal Mine / merchant.

Water - The water for the project will require 36 Million Cubic Meters (MCM) of water per year (4000 m3/hr), which will be drawn from the Rihand (Govind Vallabh Pant Sagar) Reservoir.

Fly Ash - Utilization and disposal of fly ash as per fly ash notification & subsequent amendments.

Compliance - The stipulated conditions notified by Ministry of Environment, Forest & Climate Change (MoEFCC), Government of India and State Pollution Control Board (MPPCB) will be strictly complied with every six months in respect of environmental safe guard/monitoring of environmental parameters and the Central Pollution Control Board (CPCB) also will be informed along with the compliance report.

The total estimated Capital Cost of the project is Rs. 12,800.00 Crores and Rs. 3488.27 Crores will be spent towards environmental protection such as installation of rainwater harvesting, Electrostatic Precipitator, Chimney, Dust extraction & suppression system, Sewerage collection, treatment & disposal, Green Belt & landscaping, Rainwater harvesting, Solar power harnessing and Environmental Monitoring etc. Rs. 39.5 Crores are proposed to spent for CER purpose.

The copy of Environmental Clearance letter as per General Condition No. xx of "Environmental Clearance is available with the Integrated Regional Office, Bhopal, Regional Office and Head Office of State Pollution Control Board (MPPCB) and Company's Website https://www.adanipower.com and may also be seen at website of Ministry of Environment, Forest & Climate Change (MoEFCC) Parivesh Portal https://parivesh.nic.in.

The copy of the Environmental Clearance is submitted to concerned Panchayats, Zila Parishad/ Municipal Corporation, District Development Officer, Block Development Officer, Urban local Body and the local NGO.

By Mahan Energen Limited

Annexure XV

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ECOLOGICAL ASSESSMENT AND WILDLIFE CONSERVATION & MANAGEMENT PLAN FOR PROPOSED PHASE-III EXPANSION OF MEL TPP AT SINGRAULI DISTRICT, M.P.

Document No.: GEEC/ES&FFCP-MEL/2024-25/001-Version: 1.1

Good Earth Enviro Care

October 2024

ECOLOGICAL ASSESSMENT AND WILDLIFE CONSERVATION & MANAGEMENT PLAN FOR PROPOSED PHASE-III EXPANSION OF MEL TPP AT SINGRAULI DISTRICT, M.P.

Submitted By

MAHAN ENERGEN LIMITED
SINGARAULI, MADHYA PRADESH

Executed By

GOOD EARTH ENVIRO CARE

In Association With

DEPARTMENT OF ENVIRONMENT MANAGEMENT
INDIAN INSTITUTE OF SOCIAL WELFARE
& BUSINESS MANAGEMENT
KOLKATA – 700 073

OCTOBER, 2024

FOREWORD

Mahan Energen Limited [MEL], a wholly owned subsidiary of Adani Power Limited (APL), is proposing to set up 2 x 800 MW (Phase-III) coal-based ultra- super critical Thermal Power Plant at Village Bandhaura, Khairahi and Karsualal of Waidhan Tehsil under Singrauli District of Madhya Pradesh. No additional Land is proposed to be acquired for the proposed expansion project. However, the setting up and operation of Mahan TPP may result in changes in ecological setting of project area. To fulfill the enviro-social obligation, MEL is planning to undertake measures for conservation and management of wildlife of core as well as buffer area of the proposed expansion project. Accordingly, MEL engaged Good Earth Enviro Care (GEEC), Kolkata to undertake a detailed Ecological Assessment study and formulationof site-specific Wildlife Conservation and Management Plan for Proposed Phase III Expansion of MEL TPP at Singrauli Madhya Pradesh.

The study presents results of the comprehensive field survey of flora and fauna within the influence zone of proposed Phase III Expansion of MEL TPP. The report provides an in-depth analysis ecological settingwithin the influence zone along with likely ecological impact of setting-up and operation of proposed expansion project. The report also present cost-effective wildlife conservation & managementplan (WLCMP) for minimizing the likely adverse impact during construction and O&M phase on local ecological setting including forest and wildlife of the project area. The estimated budget also has been worked out for implementation of proposed WLCMP.

This study would have not been possible without the constant support and guidance of Shri R. N. Shukla, Head Environment & Forest, Corporate Environment Group and other executives of APL and MEL, we are indebted to acknowledge their guidance and support.

The study has been carried out under the technical collaboration with ecological & wildlife experts of IISWBM (University of Calcutta) and University of Kalyani. We are indebted to acknowledge the guidance and proactive support extended by the faculty members and research scholars of Department of Environment Management, IISWBM, University of Calcutta & Department of Environmental Science, University of Kalyani in execution of the present study.

Kolkata | *Debasis Mondal*
September 30, 2024 | *Project Director, GEEC*

PROJECT PERSONNEL

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A Grade NABET Accredited Biodiversity Expert

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Environmental Scientist, GEEC

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Chief Scientist, GEEC

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EXECUTIVE SUMMARY

1.0 INTRODUCTION

Mahan Energen Limited – MEL is a subsidiary company of Adani Power Limited (APL) which has been formed to develop Phase–III by adding 1600 (2x800) MW Ultra Super Critical Thermal Power Plant at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh (Figure 1.1). The Project is proposed to be developed as an expansion of the existing 2800 (1200+1600) MW Ph-I & Ph-II within the existing plant premises of Mahan Thermal Power Plant and all the necessary infrastructure to cater the requirement of the enhanced capacity will be developed while also using the facilities of the existing plant.

In accordance with its mission of being enviro-socially responsible corporate entity with thrust on sustainable development, MEL aims to focus on implementing site specific wildlife conservation and management plan for Proposed Phase III Expansion of Mahan TPP at Singrauli Madhya Pradesh. To accomplish this mission, it is imperative to carry out ecological study that can facilitate in formulating a comprehensive short as well as long-term wildlife conservation & management plan.

The objectives of the study are as follows:

- To prepare inventory of flora and fauna found within the influence zone of the proposed Phase-III expansion (2x800 MW) of MahanThermal Power Project at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh;
- To undertake ecological study with in the influence zone of proposed Phase-III expansion of Mahan TPP;
- To identify threatened and endangered species of flora and fauna if any and prepare wildlife conservation and management plan for the same;
- To prepare site specific wildlife conservation and management plan.

The detailed scope of work for the proposed study is as follows:

- The study needs to cover and collect the Primary data from the field and Secondary data. Study need to be conducted in post-monsoon/winter season by the team experts.

- The detailed ecological assessment for the study area (core and buffer zone) i.e. 15 km radius from the proposed project area shall be carried out by Ecologist/ Forest/ Environment Professional.

- Identification and preparation of an inventory for flora and fauna in the study area. Species diversity, density, frequency relative abundance, cover will be defined based on field survey within 15 km radius of proposed power plant, Species Hierarchy such as family, Genus, species, relative abundance of wild animals & birds will be estimated and also focus on the rare, critical, threaten & endangered species, within the study area.

- If the study area has endangered flora and fauna, or an ecologically sensitive area, then a comprehensive wildlife conservation & management plan shall be prepared. The list of flora and fauna duly authenticated separately for the core and buffer zone and a statement specifying whether the study area forms a part of the migratory or wildlife corridor of any endangered fauna with conservation plan.

- Mapping of the Land Use and Forest, Vegetation types within the 15 km radius area from the proposed project site using GIS and remote sensing.

- Ecological status of the study area such as habitat type and its quality, species, diversity, rarity, fragmentation, ecological and study shall provide the nature and distribution of vegetation in and around the project area.

- Details of flora and fauna separately for core and buffer zone will be furnished based on field survey indicating the schedule of the fauna present. A conservation plan to be prepared in consultation with Chief Wildlife Warden along with delineation of necessary funds allocation for implementing the same.

- Observing the mammals, amphibians and reptiles, noting their calls, droppings, burrows, pugmarks and other signs. All the sampling location shall be marked and highlighted on Google Images.

- Recommendation on institutional mechanism for implementation of conservation plan, Suggestions/recommendation for social forestry green belt/plantation, etc.

- Consultant shall provide necessary technical support to the project proponent during presentation discussion or meeting with Government Official for further prepare site specific wildlife conservation & management plan with budget.

2.0 PROJECT DETAILS

The Project is conceptualized to be operated by utilizing coal from nearby commercial coal mines and water from the Rihand reservoir. For auxiliaries' viz.Coal Handing, Ash Handling and Plant Water System, it is proposed to utilize the latest technology with adequate margin to ensure high availability of the Project.

Land Area of about 1170 Acres (473.48 Ha) has been identified for the Project which includes the existing 2800 MW plant and land area for accommodation of coal stockyard, water reservoir, roads & green belt etc.

The basic requirements for setting up and operating a 2x800 MW coal-based thermal power Project are –

- Availability of adequate land suitable for setting up the Project keeping provision for expansion for utilizing the infrastructure developed in the initial phase.
- Availability of adequate quantity of water of appropriate quality on year-round basis.
- Ensured supply of fuel with effective transportation system to ensure the least delivered cost of fuel at the Project end.
- Power evacuation possibility to the grid at appropriate voltage level(s).
- Accessibility of site for start of construction, availability of construction water and power, availability of construction manpower, road connection to airport, seaport, etc.
- Connectivity to population centers with social amenities

3.0 APPROACH & METHODOLOGY

The state-of the art method have been used for ecological impact assessment study. The present study was exploratory in nature based on primary as well as secondary data. Following step wise approach was followed in order to achieve the conformity with the scope of work for baseline data collection

Step 1: Reconnaissance Survey**-** A reconnaissance survey was undertaken to understand the complexity of terrain, forestry, fisheries, wildlife with its habitat and approach for various locations of buffer zone of MTPP and potential areas for species enumeration.

Step 2: Secondary Data Collection- Available secondary data through published research papers, books and periodicals and PhD thesis from the area was reviewed and enlisted to confirm the presence of species. Secondary data was also collected on the historical surveys in the area. Management plan of the protected area was also reviewed. Consultation with the locals and forest officials were also made.

Step 3: Primary Data Collection-Primary surveys were undertaken to understand the actual baseline and analyse the impacts of the proposed project on the local environment and ecological baseline.

Step 4: Ecological Impact Assessment- Assessment of impact of the various construction and operation activities on the ecological baseline.

Step 5: Wildlife Conservation & Management Plan-Preparation of Wild Life Conservation & Management Plan for mitigation of major impacts of construction and operation activities.

4.0 LAND USE PATTERN

The core zone is covered in Survey of India 1: 50,000 scale toposheet no. 63 L/08 & 64 I/06 and 15 km buffer zone is covered in topo sheet no's 63 L/08 ,63 L/12, 64 I/06 & 64 I/09. The 15 km radius buffer zone from the core zone boundary i.e. Proposed Phase III Expansion of Mahan TPP project site, is mostly plain and hillocks in the North-east and south-western parts of the coveredin hilly terrain and reserved and protected forests buffer area. The minimum and maximum elevation ranges between 280m and 735m, above MSL. The core zone has elevation contourvalues in the range of 320m- 340m above MSL. The buffer zone is drained by streams, which areup to 5th order. The major rivers/Streams that are draining in the study area are Sukhra, Rampa, Laua River and Hurdul N.

The land use/land cover analysis has been carried out using Digital Image Processing and Digital Image Interpretation techniques. The Image Processing and Geographical Information Systems software have been used for the Spatial Analysis. Digital image processing was carried out to delineate various land use/land cover categories in the core and buffer zone viz. built-up area, crop area, forests, scrub forests, land with or without scrubs and water bodies by assigning necessary training sets, which were identified based on tone, texture, size, shape pattern and location information. Necessary care was taken to identify proper land use class, where there is conflict between the signatures of various classes. The interpreted map was verified on the ground at limited points and the final land use/land cover map was prepared.

5.0 INVENTORY OF FLORA & FAUNA

The state-of the art methods have been used to assess the ecological setting within the influence zone (core as well as buffer area) of Proposed Phase III Expansion of Mahan TPP at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh.

Among the flora, a few said to have ethnobotanical uses those could be conserved in village area of buffer zone with community support under CSR programme. However, among the faunal elements those are said to be threatened and endangered that could be conserved. As such a conservation plan was proposed in consultation with local officials of the forest department.

As per Champion's classification – dry deciduous forest and moist deciduous forest mixed with semievergreen forest patches. Sal (*Shorea robusta*) is the predominant natural species followed by Teak (*Tectona grandis*), Bamboos (*Dendrocalamus* sp.), Asan (*Terminalia tomentosa*), kendu (*Diospyros melaxoxylen*), Salai (*Boswellia serrata*), Dhaura (*Anogeissus latifolia*), and so on.

The overall terrain features showed the undulated areas with scattered mixed jungle and degraded forest patches including plantation area. This landscape supports the wide range of various faunal diversity. An inventory of butterfly, amphibian, reptiles, avifauna and mammals of the buffer zones of study area are presented.

In both the core and the buffer zone, there are sporadically distributed water bodies like swamps, ditches, ponds and streams of rivulets, A number of macrophytic angiosperms, fresh water fishes, molluscs and turtles are reported to exist in this area.

6.0 ASSESSMENT OF FOREST COVER

The state-of the art methods have been used to assess the forest cover within the influence zone (core as well as buffer area) of Proposed Phase III Expansion of Mahan TPP, at Singrauli District, Madhya Pradesh.

The Normalized Difference Vegetation Index (NDVI) of the study area was analysed on GIS platform using Landsat-8 data of May 23, 2021 (Figure 6.1). The analysis revealed the vegetation cover of the study area within 15 km radius of Mahan Thermal Power Plant. Out of 706.9 km^2 of the study area, around 545.2353 km^2 is having low vegetative cover that is approximately 77.13% of the entire study area.

Randomised quadrate method was used for analysis of Importance Value Index (IVI) and vegetation diversity richness within core as well as buffer zone of Mahan TPP.

IVI measures of how dominant a species in a given forest area. The importance value is calculated as the sum from (i) the relative frequency; (ii) the relative density; and (iii) the relative abundance.

Vegetation classification of the plant community of the study area was done using the Raunkier's Classification and the Whitford's Classification. In the Raunkier's classification, the plant community was classified on the basis of the frequency of the different plant species of the area. The Whitford's classification was done on the basis of the ratio of the species abundance to its frequency.

7.0 ECOLOGICAL IMPACT ASSESSMENT

The effect on biological environment can be divided into two parts, viz. the effect on flora and the effect on fauna. The main effect on flora may due to two main reasons, land acquisition and due to flue gas emissions. No additional land is required for the proposed Phase III Expansion of Mahan TPP within existing plant premises.

Following impacts are envisaged during the construction stage on the forest and wildlife of the project region:

- Impacts during survey and planning
- Impacts during vegetation clearance on approach roads
- Impacts during vegetation clearance on Project location
- Impacts during man and material transportation at Project location
- Impacts during storage of construction material
- Impacts during construction activities

The project area along the corridor of proposed coal and raw water showed a few forests and Jungle Jhari (Degraded Scrub Land) intermingled with village settlements and crop field. However, there are number water bodies and streams/rain fed rivers. Due to unique setting of undulated landform, faunal diversity of the landscape is fairly rich.

Following additional impacts are also envisaged during the Operation Phase:

- Mortality due to Electrocution and Collision of Avifaunal species
- Mortality due to Electrocution and Collision of arboreal mammalian species

8.0 WILDLIFE CONSERVATION & MANAGEMENT PLAN

"Mitigation Measures" refer to the actions that can be implemented to minimize the magnitude of the project related detrimental impacts on ecology in general and forest & wildlife of the project area. Mitigation can carry on along three possible courses of actions, either by changing actions (1) at source, (2) on path (3) or at the receiving end.

Based on the present study it is very clear that the prevailing physical environmental conditions of the project location and associated project activities predicted to impact upon some ecological attributes (flora & fauna) of the project area which are at local, shorter period mainly during construction phase and magnitude of low to moderate levels in many cases. Overall impact statement identified impacts in construction and operation phase.

The prime strategies proposed to be followed for mitigation of perceived adverse impacts includes:

(i) A comprehensive action plan would be launched immediately to strengthen the administration to combat illicit falling of trees, smuggling of forest produce, protection wildlife habitat and protection of wild flora and fauna in the area.

(ii) Wildlife camps can be set up at strategic locations with infrastructure such as communication equipment etc to effectively handle poaching of animals, smuggling of forest produce and also depredation caused by wild animals.

(iii) Some restoration measures required for soil and moisture conservation activities on the slope and also creation of water harvesting structures for supporting the natural forest regeneration.

(iv) Plantation activities through joint forest management should be taken up. Monitoring evaluation and motivation of the surrounding villagers through eco-club activities and through formation of Green Brigades will be carried out.

(v) Some budget provision should be kept for 10 years for implementation of above static activities mentioned in Action plan viz fire protection measures, watch and ward activities for poaching prevention, creation of water poles and salt lick zone, creation of underpass and some activities related to improvement of socio-economic benefits of forest villagers.

The proposed conservation plan for protection of degraded forest cover, medicinal and endemic, endangered plants (flora) and animals (fauna) is:

- Forest Conservation including Local Medical Plants
- Conservation of Wildlife Habitats and also Threatened Faunal elements
- In-Situ & Ex-Situ Conservation Plan
- Ecological Monitoring Plan

The cost of implementation for site specific Wildlife Conservation & Management Plan for the proposed Phase III Expansion of Mahan TPP is estimated considering different project specific activities as well as management actions through agencies. The overall cost estimated for implementation of Wildlife Conservation and Management Plan (WLCMP) to be implemented over a period of 10 years is approximately **147.02 Lakhs INR**.

1.0 INTRODUCTION

1.1 BACKGROUND

Mahan Energen Limited – MEL is a subsidiary company of Adani Power Limited (APL) Proposed Phase III expansion by adding 1600 (2x800) MW Ultra Super Critical Thermal Power Plant at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh (Figure 1.1). The Project is proposed to be developed as an expansion of the existing 2800 (1200+1600) MW Ph-I & Ph-II within the existing plant boundary of Thermal Power Plant and all the necessary infrastructure to cater the requirement of the enhanced capacity will be developed while also using the facilities of the existing plant.

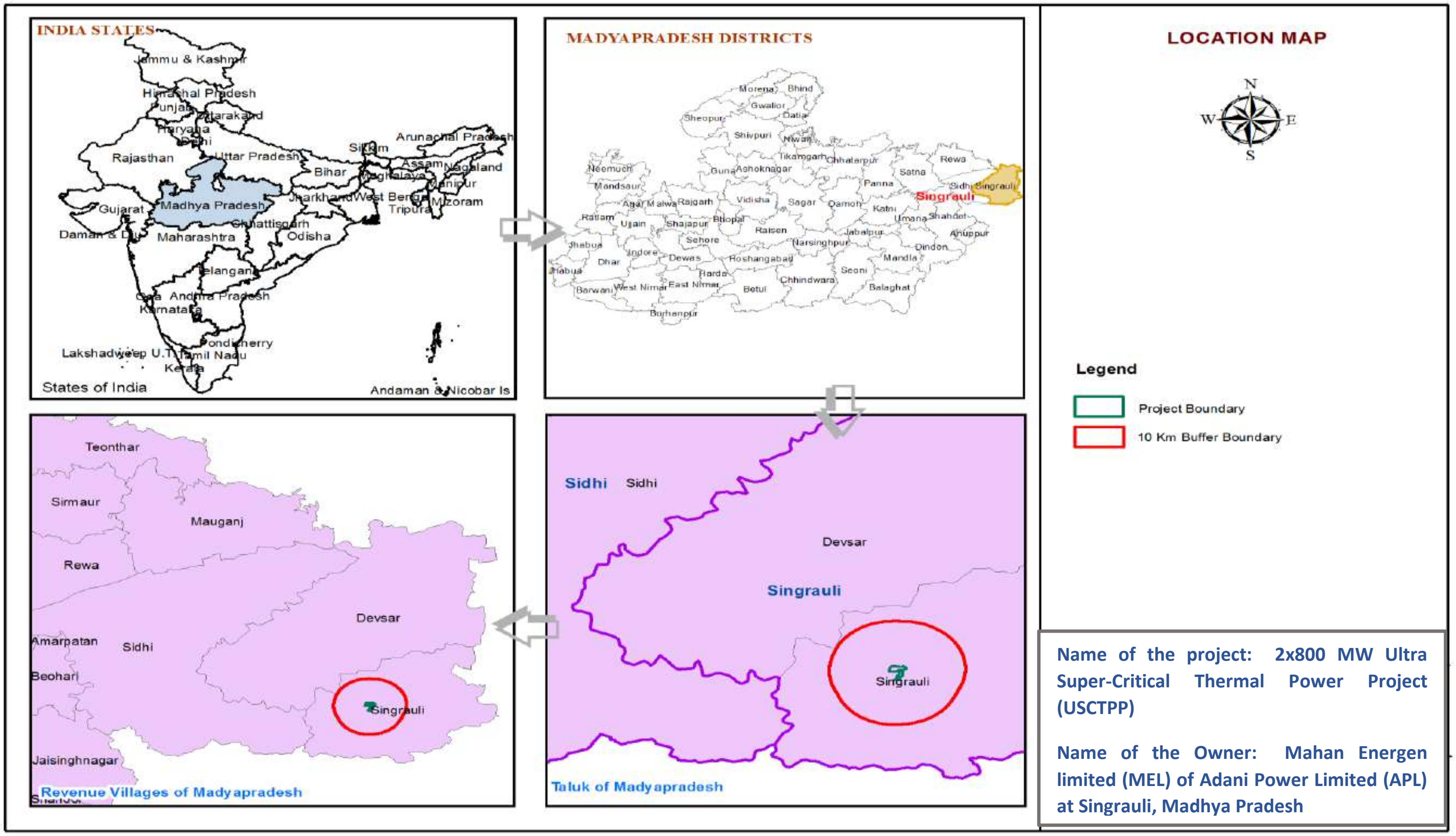
The Project is conceptualised to be operated by utilising coal from nearby commercial coal mines and water from the Rihand reservoir. For auxiliaries' viz.Coal Handing, Ash Handling and Plant Water System, it is proposed to utilise the latest technology with adequate margin to ensure high availability of the Project. Land Area of about 1170 Acres (473.48 Ha) has been identified for the Project which includes the existing 2800 MW plant and land area for accommodation of coal stockyard,water reservoir, roads & green belt etc.

As per ToR for Environmental Clearance conditions of the Ministry of Environment, Forest and Climate Change, Govt. of India, MEL is required to formulate the Ecological Assessment and Site-Specific Wildlife Conservation & Management Plan for phase III expansion of Mahan TPP.

The setting up and operation & maintenance of the phase III expansion Mahan TPP may result in changes in the ecological setup of the project area. A thorough understanding of issues, related to ecological as well as environmental factors, is absolutely important for formulating an appropriate wildlife conservation & management plan. A detailed inventorization of flora and fauna and ecological impact assessment will provide such an understanding.

In accordance with its mission of being enviro-socially responsible corporate entity with thrust on sustainable development, MEL aims to focus on implementing wildlife conservation and management plan for phase III expansion project of Mahan TPP at Singrauli. To accomplish this mission, it is imperative to carry out ecological study that can facilitate in formulating a comprehensive short as well as long-term wildlife conservation & management plan (Figure 1.2).

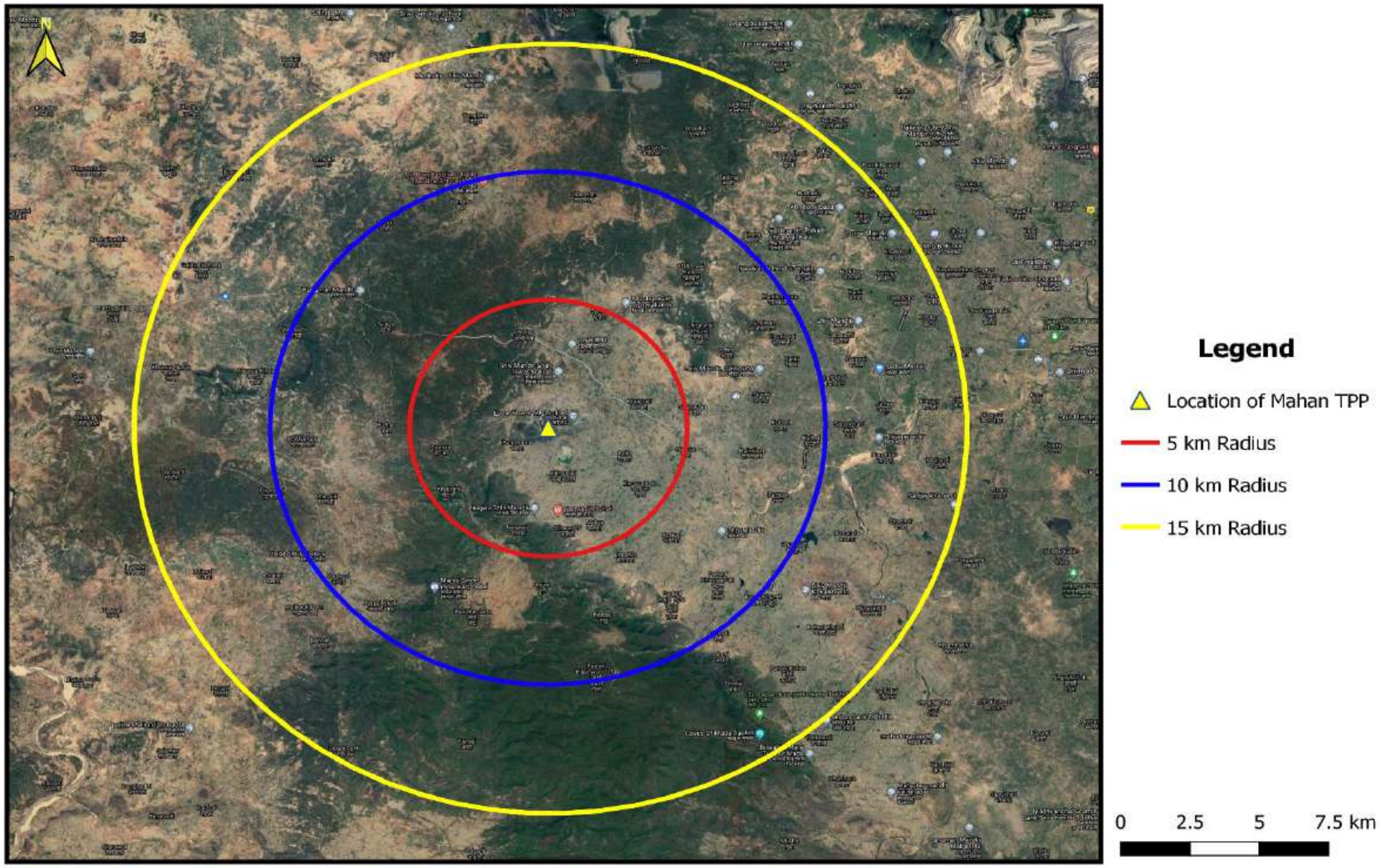
FIGURE 1.1: LOCATION OF PROPOSED PHASE- III EXPANSION OF MAHAN TPP AT SINGRAULI MADHYA PRADESH



Name of the project: 2x800 MW Ultra Super-Critical Thermal Power Project (USCTPP)

Name of the Owner: Mahan Energen limited (MEL) of Adani Power Limited (APL) at Singrauli, Madhya Pradesh

FIGURE 1.2: STUDY AREA SELECTED FOR ECOLOGICAL IMPACT ASSESSMENT OF PROPOSED PHASE- III EXPANSION OF MAHAN TPP AT SINGRAULI MADHYA PRADESH



1.2 OBJECTIVES OF THE STUDY

The objectives of the proposed study are as follows:

- To prepare inventory of flora and fauna found within the influence zone of the proposed expansion of Mahan TPP (Phase-III). To undertake ecological study with in the influence zone of proposed expansion project;
- To identify threatened and endangered species of flora and fauna if any and prepare conservation and management plan for the same;
- To prepare site specific wildlife conservation and management plan;

1.3 SCOPE OF THE STUDY

The scope of the study includes the undertaking of a reconnaissance survey. Based on the reconnaissance survey a framework would be evolved for undertaking time bound detailed field survey within the influence zone of the proposed expansion of Mahan TPP (Phase III). The detailed scope of work for proposed study is as follows:

1) The study needs to cover and collect the Primary data from the field and Secondary data. Study shall be conducted in post-monsoon/winter season by the team experts.

2) The detailed ecological assessment for the study area (core and buffer zone) i.e. 15 km radius from the proposed project area shall be carried out by Ecologist/ Forest/ Environment Professional.

3) Identification and preparation of an inventory for flora and fauna in the study area. Species diversity, density, frequency relative abundance, cover will be defined based on field survey within 15 km radius of proposed power plant, Species Hierarchy such as family, Genus, species, relative abundance of wild animals & birds will be estimated and also focus on the rare, critical, threatened & endangered species, within the study area.

4) If the study area has endangered flora and fauna, or an ecologically sensitive area, then a comprehensive Wildlife Conservation & Management Plan shall be prepared. The list of flora and fauna duly authenticated separately for the core and buffer zone and a statement specifying whether the study area forms a part of the migratory or wildlife corridor of any endangered fauna with conservation plan.

5) Mapping of the Land Use and Forest, Vegetation types within the 15 km radius area from the proposed project site using GIS and remote sensing.

6) Ecological status of the study area such as habitat type and its quality, species, diversity, rarity, fragmentation, ecological and study shall provide the nature and distribution of vegetation in and around the project area.

7) Details of flora and fauna separately for core and buffer zone will be furnished based on field survey indicating the schedule of the fauna present. Conservation plan to be prepared in consultation with Chief Wildlife warden along with delineation of necessary funds allocation for implementing the same.

8) Observing the mammals, amphibians and reptiles, noting their calls, droppings, burrows, pugmarks and other signs. All the sampling location shall be marked and highlighted on Google Images.

9) Recommendation on institutional mechanism for implementation of conservation plan, Suggestions/recommendation for social forestry green belt/plantation, etc.

10) Consultant shall provide necessary technical support to the project proponent during presentation discussion or meeting with Government Official for further prepare of Wildlife conservation with EMP budget.

1.4 STRUCTURE OF REPORT

The Ecological Assessment and Wildlife Conservation & Management Plan for proposed Phase-III expansion of Mahan TPP has been structured into eight Chapters as here under:

Executive Summary

Chapter 1 – Introduction: This chapter describes background of project and its components; objectives and scope of Ecological Assessment and Wildlife Conservation & Management Plan for proposed Phase-III expansion of Mahan TPP at Singrauli, Madhya Pradesh.

Chapter 2 – Project Description: This chapter present the brief detail of proposed Phase-III expansion of Mahan TPP at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh.

Chapter 3 – Methodology: This chapter describes the framework Ecological Assessment and formulation of Wildlife Conservation & Management Plan for proposed Phase-III expansion of Mahan TPP at Singrauli, Madhya Pradesh.

Chapter 4 – Land Use Pattern: This chapter presents the existing land use pattern with in core as well as buffer area of proposed Phase-III expansion of Mahan TPP at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, MadhyaPradesh.

Chapter 5– Inventory of Wildlife: This chapter describes the status of Wildlife as well as ecological setting with within the influence zone of proposed Phase-III expansion of Mahan TPP at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh.

Chapter 6– Assessment of Forest Cover: This chapter describes the status of forest cover through NDVI & IVI, etc with within the influence zone of proposed Phase-III expansion of Mahan TPP at Bandhaura, Khairahi, Karsualal and Nagwa Villages under Singrauli District, Madhya Pradesh.

Chapter 7 – Ecological Impact Assessment: This chapter presents likely ecological impact of proposed Phase-III expansion of Mahan TPP at Singrauli, MadhyaPradesh.

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Chapter 8 – Wildlife Conservation & Management Plan: This chapter present the Wildlife Conservation & Management Plan to be followed within the influence zone proposed Phase-III expansion of Mahan TPP at Singrauli, MadhyaPradesh. This chapter also present the budget estimate for implementation of proposed Wildlife Conservation & Management Plan for proposed Phase-III expansion of Mahan TPP at Singrauli, MadhyaPradesh.

2.0 PROJECT DETAILS

2.1 PROLOUGE

Mahan Energen Limited – MEL is a subsidiary company of Adani Power Limited (APL) which has been formed to develop Phase–III by adding 1600 (2x800) MW Ultra Super Critical Thermal Power Plant to Mahan TPP. The Project is proposed to be developed as an expansion of the existing 2800 (1200+1600) MW Ph-I & Ph-II within the existing plant boundary and all the necessary infrastructure to cater the requirement of the enhanced capacity will be developed while also using the facilities of the existing plant.

Given the anticipated demand for electricity in the country as well as Madhya Pradesh State and given the location of the project being close to coal fields, the company proposes to undertake expansion of the existing project by addition of 2 units of 800 MW each translating to a capacity addition of 1600 MW (Phase-III).

The Project would be developed taking into account the following intrinsic features:

- Land availability
- Fuel availability and transportation logistic
- Water availability and transportation to site
- Power evacuation from the Project
- Infrastructural availability and requirement of augmentation

For the main power block of 1600 MW Project and Unit size of 800 MW is favored in view of:

- Superior thermal efficiency with Ultra Supercritical steam parameters
- More environment-friendly technology

The Project is conceptualized to be operated by utilizing coal from nearby commercial coal mines and water from the Rihand reservoir. For auxiliaries' viz.Coal Handing, Ash Handling and Plant Water System, it is proposed to utilize the latest technology with adequate margin to ensure high availability of the Project.

Land Area of about 1170 Acres (473.48 Ha) has been identified for the Project which includes the existing 2800 MW plant and land area for accommodation of coal stockyard,water reservoir, roads & green belt etc.

2.2 PROJECT AT A GLANCE

Salient Features of the Proposed Expansion Project (Phase-III) of MEL are presented in subsequent sections:

General:

Project Authority (SPV)	:	Mahan Energen Limited
Project	:	Phase-III expansion of 2x800 MW Ultra Super-Critical ThermalPower Project.
Selected Location	:	Bandhaura, Nagwa, Karsualal and Khairahi village, Singrauli District, M.P.
Latitude and Longitude of the site	:	24°0'28.90"N latitude / 82°24'49.94"E longitude
Altitude	:	320 to 340 m.
Average RL	:	335 m.
Annual average rainfall	:	1132.7 mm
Nearest Major Town	:	Waidhan and Singrauli
Seismic Zone	:	Zone-III as per IS 1893
Access by Road	:	State Highway (SH14) is passing about 16 km from the site.
Access by Rail	:	Singrauli Station is located at 52 km from Project Site.
Access by Air	:	Nearest Airport is at Varanasi at a distance of 280 km.
Access by Sea	:	Nearest Seaport is at Dhamra at a distance of 770 km.

Preliminary Project Particulars:

Main Fuel	:	Coal from Commercial Coal Mines (GCV 3000-4200 Kcal /Kg)

Fuel Transportation	:	Through Long Belt conveyor (LBC) system
Water	:	From the Rihand Reservoir at 36 km from Site.
Land	:	1170 Acres (473.48 Ha) of land is available for the Power Project.
Layout Features	:	2 X 800 MW Ultra Super-Critical Units

Technical Features:

Power Generating Unit	:	Two units of 800 MW turbine generator sets fed by steam from coal fired P.F. boiler operating at Ultra Super-critical range.
Cooling System	:	Closed recirculating condenser cooling system with induced draft cooling tower.
Coal Handling System	:	Coal handling facility, which comprises receipt of coal from Mines through LBC system, with on-line existing & new crushing and stacking by existing & new stacker-cum-reclaimer in the existing & new coal yard and finally feeding the bunker level conveyors.
Ash Disposal System	:	Provision will be made for disposal of fly ash in dry form to adjacent Cement Plants/ Mine back filling. Provision will be made for disposal of ash in high concentration slurry form.
Power Evacuation	:	At 400 kV level to State Transmission Unit (STU)

Environmental Aspects	:	Elaborate arrangements for Flue gas desulphurization (FGD) and Selective Catalytic Reduction (SCR) systems complying with emission norms as per latest MoEF & CC. Independent steel wet flue for each unit, down-stream of FGD of suitable height as per MoEF & CC guidelines and an adequately designed electrostatic precipitator with more than 99.99% efficiency are envisaged. Wastewater quality to be maintained as per MoEF & CC notification. Zero Plant Discharge facility shall be present since the cooling water, blow down water, wastewater and ash water would be recycled back to the system after suitable treatment for reuse. For coal transportation from mines, pipe conveyor technology will be adopted to mitigate environmental concerns.
Rehabilitation Requirement	:	Nil

Other Facilities:

Township	:	Township with civic amenities would be developed.
Mode of Implementation	:	The project would be implemented on EPC concept.
Project Time Frame	:	54 months from Zero Date i.e. the date of 'Financial Closure' for Commercial Operation of Unit#5 and 60 months for Unit#6

FIGURE 2.1: VIEW OF MAHAN TPP AT SINGRAULI MADHYA PRADESH

2.3 BASIC REQUIREMENTS

The basic requirements for setting up and operating a 2x800 MW (Phase-III) coal-based thermal power Project are –

- Availability of adequate land suitable for setting up the Project keeping provision for expansion for utilizing the infrastructure developed in the initial phase.
- Availability of adequate quantity of water of appropriate quality on year-round basis.

- Ensured supply of fuel with effective transportation system to ensure the leastdelivered cost of fuel at the Project end.

- Power evacuation possibility to the grid at appropriate voltage level(s).

- Accessibility of site for start of construction, availability of construction water and power, availability of construction manpower, road connection to airport, seaport, etc.

- Connectivity to population centers with social amenities

This section discusses the requirements vis-à-vis the availability within the stipulated time frame of above basic elements of setting up the proposed Power Project.

2.3.1 Land - Requirement & Availability

The land requirement for a coal-based thermal power project can broadly be classified under the following four major heads: -

a. Main Plant Area
b. Ash Disposal Area
c. Housing Area
d. Other land area requirements for infrastructure facilities

A land area of about 1170 Acres (473.48 Ha) has been identified for the Project which includes the existing 2800 MW units, land area for accommodation of coal stockyard, water reservoir, roads, green verge, etc.

The land requirement envisaged for the Project considers installation of 2 x 800 MW conventional coal-based Ultra Super-Critical Thermal Power Project. The estimated space requirement considers raw water storage, cooling towers, coal received by overland pipe conveyor and alternatively by road, coal storage and handling facility, fuel oil system, 400 KV switchyard, water treatment facility & treated water storage, desulphurization plant, de-NOx system, green verge to satisfy MPCB/MoEF&CC norms, etc.

The proposed 1,600 MW Project is proposed as an expansion of the existing 2800 MW TPP at the site. The site has been identified based on following merits:

- The entire proposed expansion project (Phase III) would be within the existing plant premises ie. no additional land is required for the proposed expansion project.

- Environment clearance shall be obtained (i.e. for Phase III), as the site is not located in an environmentally fragile area and the existing 2800 MW units (Phase I & II) already have Environment Clearance.

- Assured year-round availability of water from Rihand Reservoir, located at a distance of 36 km from the site.

- Power can be evacuated to Madhya Pradesh state utilities through existing/proposed State Grid.

- The site can easily be connected to and is situated in close vicinity to severalcommercial coal mines. Nearest towns are Waidhan and Singrauli. Varanasi Airport is at a distance of 280 km. The State highway (SH14) is passing 16 km away from the proposed Project Site.

2.3.2 Water - Requirement & Availability

In a conventional fossil fuel-fired Thermal Power Project, water is used to meet the following basic consumptive requirements:

a. To meet the cooling requirement for steam condenser which acts as a heat sinkfor the thermodynamic cycle and other auxiliary cooling such as, bearing/lube oil coolers, compressors, generator stators, etc.

b. To meet the heat cycle make-up and other process requirements.

c. Flue Gas Desulfurization (FGD) and Selective Catalyst Reduction (SCR) system as per New MoEF&CC guidelines

d. For miscellaneous services viz.

- Fire fighting
- General services viz. A/C and ventilation, floor washing etc.
- Sealing and cooling water for equipment of ash handling system
- Dust extraction and dust suppression in coal yard
- Potable use in the Project and housing complex
- Transport media for ash in case of wet disposal of ash (under exigencyconditions)
- Horticulture

The total consumptive water requirement for 2X800 MW Project (Phase-III) capacity is 3196.08 m^3/hr (28 MCM/year). Water Allocation of 62 MCM/ Year has already been tied up from Rihand Reservoir through the Water Resources Department, State Government of Madhya Pradesh and is enough to cater to the operation of existing as well as expansion projects. Additional 28 MCM/year to be obtained from the Water resource department for expansion 2x800 MW units.

It is desirable that the water is free from high level of suspended and dissolved solids. The water is to be free of heat pollution at the intake point. The intake location and design have to ensure trouble-free operation throughout the year.

The site is located at a distance within 36 km from the Rihand Reservoir.

2.3.3 Fuel - Requirement, Availability & Transportation

The following features in system design are considered:

- Coal from commercial mines is envisaged.
- Height of coal stock is contained within 10 m.
- Crushed coal is stacked to avoid self-ignition.

Coal shall be transported through suitable conveyor system to the Project.

The present Project is being implemented by utilizing coal from nearby commercial coal mines. The Govt. of India has opened up the coal mining sector,allowing private sector to mine coal for any end use. There are several commercial coal mines situated within the vicinity of the plant and which are expected to commence coal production by the time the proposed 1600 MW project nears completion. Further, in view of the close vicinity of the mines, conveyor from mine to plant is the proposed mechanism for transportation of coal for the presently proposed power Project of 1600 MW, the maximum daily coal requirement @ TMCR would be about 22,002 TPD and annual fuel requirement is estimated at 6.0 -7.0 million MTPA at 85% plant load factor with Design Coal GCV of 3000-4200 K Cal/kg.

- Coal requirement for proposed 2x800 MW (Phase-III) shall be 6.85 million MTPA.
- Coal receipt through LBC- (Long Belt Conveyor System) system from nearby mines.

Based on further inputs, the actual consumption of coal for the Plant would be calculated in the DPR stage.

Auxiliary Fuel:

Auxiliary liquid fuels, viz. LDO / HSD would be required for start-up and flame stabilization at lower load. LDO / HSD is proposed to be cold start-up, warm up, startup/commissioning activities till stabilization at lower load (up to 30% BMCR).

Fuel Transportation:

The primary fuel for the proposed power Project i.e. Coal shall be sourced from commercial coal mines situated in close vicinity to the plant. Coal shall be transported through suitable long belt conveyor (LBC) system from mine to plant.

The secondary fuel for the proposed Power Project i.e. LDO/HSD shall be sourced from the refineries located nearer to the Project. As the quantity and frequency shall not be significant and distance is short, it is suggested that the required quantity shall be transported by road.

2.3.4 Power Evacuation

The power will be evacuated to nearby STU sub-station of MPPTCL at 400 kV level. The STU will be further informed to initiate study as power evacuation will be from MEL 400 kV ex-bus.

2.3.5 Other Infrastructural Facilities

Miscellaneous infrastructural requirements for setting up a power Project are:

- Access road
- Availability of housing for construction staff and finally operating personnel.
- Availability of market, health care, education facility, entertainment centre, etc
- Availability of skilled and unskilled manpower.
- Telecommunication facility.
- Other facilities like workshop, bank, post office, police station etc.

The nearest population centre is Waidhan at a distance of 35 km from theproposed power Project.With the implementation of the Power Project, the industrial infrastructure aroundthe area would also develop substantially.

The State Highway (SH14) is approx. 16 Km from the proposed Site.
Singrauli is well connected with Road as well as Rail network from all the majortowns in Madhya Pradesh.

All social infrastructures like education, health, transportation, communication andmarkets are available in the town situated at about 35 Km from the proposed Site.

Construction water for the Project shall be made available from existing in-plant water reservoirs. Construction water shall be provided at a single point to the concerned agency for further distribution.

Ammonia Requirement, Availability and Transportation

Ammonia (19% aqueous ammonia or 99.5% anhydrous ammonia) will be required as the reagent for SCR system to meet the requirement of NOx outlet emission.

If 19% aqueous ammonia will be used as a reagent, annual requirement will be around 24000 tons for 2x800 MW. In case anhydrous ammonia is used as a reagent, then annual requirement will be around 4650 tons. Type of ammonia to be used will be decided based on the recommendation from technology providerand the availability & transportation options.

Limestone Requirement, Availability and Transportation

- Limestone will be required for FGD system to meet requirement of SO_2 outlet emission.
- Annual requirement of limestone will be around 1,75,350 tons for 2x800 MW. Limestone source and mode of transport are under study.

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