

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN
FOR
GADARWARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)**

Tehsil: Gadarwara, District: Narsinghpur, Madhya Pradesh



VOLUME-I : MAIN REPORT

Project Proponent



NTPC Limited

(A Government of India Enterprise)

ToR Ref. No.: J-13012/125/2009-IA.II(T) Dated 30.09.2024

Baseline Monitoring Period : March 2024 to May 2024

ENVIRONMENT CONSULTANT:



GREENCINDIA CONSULTING PRIVATE LIMITED

605-611, Level-5, Sector-5, Shopprix Mall, Vaishali, Ghaziabad-201010

(QCI-NABET Certificate No. NABET/EIA/2326/RA 0297 Valid upto 22.02.2026)

APRIL 2025

NABET DISCLOSURE

DECLARATION BY EXPERTS CONTRIBUTING TO FINAL EIA REPORT FOR PROPOSED EXPANSION OF GADARWARA SUPER THERMAL POWER PROJECT, STAGE-II (2X800 MW) MW AT VILLAGE GANGAI, UMARIYA, MEHRAKHEDA, CHORBARHETA, DONGARGAON ETC., TALUKA GADARWARA DIST. NARSINGHPUR IN MADHYA PRADESH

I, hereby, certify that we were part of the team in the following capacity that developed the above EIA.

EIA CATEGORY : 1(d) Thermal Power Plant

Name of EIA COORDINATOR : Nandini Choudhury, Category A

Signature & Date :

Nandini Choudhury

Period of Involvement : FEBRUARY 2024 TO TILL DATE

Contact Information : 608-611, Level-5, Shopprix Mall, Vaishali, Ghaziabad, Email:

Sl. No.	Name of Expert	Functional Area	Task	Signature
1	Dr. Subinoy Mondal	Water Pollution-WP	<u>FEBRUARY 2024 TO TILL DATE</u> - Selection of Monitoring location for ground water and surface water - Assessment of Impact associated with the project operation activities - Preparing cost estimate for treatment of waste water. - Development of Water Management Plan.	<i>Subinoy Mondal</i>
2	Nandini Choudhury	Socio-economy-SE	<u>FEBRUARY 2024 TO TILL DATE</u> - Assessment of impact associated with the project. - Interpretation of primary and secondary data to derive socio-economic	<i>Nandini Choudhury</i>

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Name of Expert	Functional Area	Task	Signature
			status of study area and related stakeholders. - Assessment of social changes arising out of the project. - Suggesting measures to enhance the socio-economic status of the people living in and around the project.	
4	Dr. Sangeeta Verma	Ecology & Biodiversity-EB	<u>FEBRUARY 2024 TO TILL DATE</u> - Survey of existing flora & fauna in the study area - Assessment of impact associated with project - Selection of species for greenery development. - Preparation of conservation plan for scheduled species - Assistance during development of project management plan.	
		Soil Conservation-SC	<u>FEBRUARY 2024 TO TILL DATE</u> - Baseline data generation for soil sampling analysis and characterization of soil. - Assessment of fertility/productivity of soil. - Suggesting soil conservation measures.	
5	Nandini Choudhury	Land-use	<u>FEBRUARY 2024 TO TILL DATE</u> - Development of Land-use Map - Impact of project on surrounding land use - Assistance during development of project management plan.	

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

NABET DISCLOSURE

**Page
2**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Name of Expert	Functional Area	Task	Signature
			Suggestion of mitigation measures due to change in land uses by the project.	
6	Shyam Sunder	Air Pollution-AP	<u>JULY 2024 TO TILL DATE</u> - Assessment of impact associated with the project operation activities - Assessment of impact associated with vehicle movement operation - Development of management plan to control the air pollution & its mitigation.	
7		Air quality modeling-AQ	<u>JULY 2024 TO TILL DATE</u> - Developing micro-meteorological data for use in modeling. - Quantitative assessment of project impact associated with project activities using AERMOD.	
8		Solid & Hazardous Waste-SHW	<u>JULY 2024 TO TILL DATE</u> - Identifying source of waste generation. - Quantitative assessment of hazardous and industrial solid waste likely to be generated. - Development of management, handling and disposal techniques. - Suggesting measures for minimization of waste generation.	
9	Gokul Chandra Pattnaik	Risk & hazard-RH	<u>FEBRUARY 2024 TO TILL DATE</u> Assessment of risk likely to be generated from the project activities.	

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

NABET DISCLOSURE

**Page
3**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Name of Expert	Functional Area	Task	Signature
			- Preparation of emergency preparedness plan. - Development of disaster management plan for the project.	
10	Nirzar Ajay Lakhia	Geology-Geo	<u>FEBRUARY 2024 TO TILL DATE</u> Study of geological and rock structure of the study area based on secondary data and literature survey.	
11		Hydrogeology-HG	<u>FEBRUARY 2024 TO TILL DATE</u> - Study of hydrogeological study of the study area. - Study rainwater harvesting and groundwater fluctuation in the study area.	
12	Rahul Singh	Noise & Vibration	<u>FEBRUARY 2024 TO TILL DATE</u> Assessment of noise and vibration likely to be generated from the project activities. - Assessment of impact associated with project. - Assistance during development of project management plan.	

Declaration by the Head of the Accredited Consultant Organization

I, **Nandini Choudhury**, hereby, confirm that the above-mentioned experts were involved in preparation of **FINAL EIA REPORT FOR PROPOSED EXPANSION OF GADARWARA SUPER THERMAL POWER PROJECT, STAGE-II (2X800 MW) MW AT VILLAGE GANGAI, UMARIYA, MEHRAKHEDA, CHORBARHETA, DONGARGAON ETC., TALUKA GADARWARA DIST. NARSINGHPUR IN MADHYA PRADESH**. I also confirm that I shall be fully accountable for any misleading information mentioned in this statement.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Signature:

Nandini Choudhury



Name : Nandini Choudhury

Designation : Managing Director

**Name of the EIA Consultant : Greencindia Consulting Private Limited
Organization**

NABET Certificate No. & Issue Date : NABET/EIA/2326/RA 0297, August, 2023

Validity : Feb 22, 2026

Gadarwara EIA/EMP Report

by Turnitin LLC

Submission date: 15-April-2025 14:01 PM

Submission ID: 2587344484

File name: Final-EIA-EMP-report-15-4-2025.pdf (5.93M)

Word count: 140856

Character count: 750054

Gadarwara EIA/EMP Report

ORIGINALITY REPORT

11%

SIMILARITY INDEX

7%

INTERNET SOURCES

5%

PUBLICATIONS

2%

STUDENT PAPERS

PRIMARY SOURCES

1	environmentclearance.nic.in Internet Source	8%
2	www.enviscecb.org Internet Source	5%
3	tspcb.cg.gov.in Internet Source	2%
4	dhenkanal.odisha.gov.in Internet Source	1%
5	jkspcb.nic.in Internet Source	1%
6	vdocuments.mx Internet Source	< 1%
7	www.kspcb.gov.in Internet Source	< 1%
8	Submitted to Jawaharlal Nehru University (JNU) Student Paper	< 1%
9	ppcb.punjab.gov.in Internet Source	< 1%

10	Submitted to Indian School of Business Student Paper	<1 %
11	www.tnpcb.gov.in Internet Source	<1 %
12	pcb.ap.gov.in Internet Source	<1 %
13	tnpcb.gov.in Internet Source	<1 %
14	Submitted to University of Sheffield Student Paper	<1 %
15	Submitted to Visvesvaraya National Institute of Technology Student Paper	<1 %
16	pcbassam.org Internet Source	<1 %
17	www.adb.org Internet Source	<1 %
18	Submitted to University of Hull Student Paper	<1 %
19	kspcb.karnataka.gov.in Internet Source	<1 %
20	Submitted to University of Petroleum and Energy Studies Student Paper	<1 %

21	Submitted to Fiji National University Student Paper	<1 %
22	Gautam Kumar Das. "Forests and Forestry of West Bengal", Springer Science and Business Media LLC, 2021 Publication	<1 %
23	Submitted to Ain Shams University Student Paper	<1 %
24	gpcb.gujarat.gov.in Internet Source	<1 %
25	Basharat Mushtaq, Suhaib A. Bandh, Sana Shafi. "Environmental Management", Springer Science and Business Media LLC, 2020 Publication	<1 %
26	Mritiunjoy Mohanty, Runa Sarkar. "The Role of Coal in a Sustainable Energy Mix for India - A Wide-Angle View", Routledge, 2023 Publication	<1 %
27	S. Ananda Babu. "5 World Congress on Disaster Management", Routledge, 2023 Publication	<1 %
28	coastalresourcecentre.files.wordpress.com Internet Source	<1 %
29	Deborah V Chapman. "Water Quality Assessments - A guide to the use of biota,	<1 %

sediments and water in environmental
monitoring, Second Edition", CRC Press, 2019

Publication

30

businessdocbox.com

Internet Source

<1 %

31

Anji Reddy Mareddy. "EIA study planning and management", Elsevier BV, 2017

Publication

<1 %

32

docplayer.net

Internet Source

<1 %

33

www.ntpc.co.in

Internet Source

<1 %

34

"Hydrology and Water Resources of India",
Springer Nature, 2007

Publication

<1 %

35

mpcb.gov.in

Internet Source

<1 %

36

Joby Boxall, Čedo Maksimović. "Integrating
Water Systems", CRC Press, 2009

Publication

<1 %

37

Vyas, Payal Pradyuman. "Bioremoval of
Fluoride from Ground Water of Selected
Regions of Gujarat and Impact of Fluoride on
Certain Crop Plants.", Maharaja Sayajirao
University of Baroda (India), 2020

Publication

<1 %

38	Lucjan Pawlowski, Marzenna R. Dudzinska, Artur Pawlowski. "Environmental Engineering III", CRC Press, 2019 Publication	<1 %
39	Anji Reddy Mareddy. "Baseline data and environmental setting", Elsevier BV, 2017 Publication	<1 %
40	Bandi, Supriya. "A Study of Problems and Prospects of Small Scale Industries in Madhya Pradesh (With Special Reference to Indore 2005 to 2010).", Devi Ahilya Vishwavidyalaya, 2019 Publication	<1 %
41	Pranavkumar Bhangaonkar, Jayeshkumar Patel. "Assessment of Water Quality of Vishwamitri River to Explore Environmental Flow Requirements", International Journal of Scientific Research in Environmental Sciences, 2017 Publication	<1 %
42	Ramnarayan, Choudhury K.. "Development of Watershed Management Plan - A Case Study.", Bidhan Chandra Krishi Viswavidyalaya University (India), 2020 Publication	<1 %
43	Ziادلou, Dina. "Strategies for Digital Transformation Leadership in Healthcare	<1 %

Organizations toward Achieving Sustainable Development Goal 3 in the United Nations' Agenda by 2030.", Colorado Technical University, 2020

Publication

44

"Disaster Risk and Management Under Climate Change", Springer Science and Business Media LLC, 2024

Publication

<1 %

45

Ceschin, F, Vezzoli, C and Zhang, J. "Sustainability in design: now! Challenges and opportunities for design research, education and practice in the XXI century", Greenleaf Publishing, 2012.

Publication

<1 %

46

"Transforming Coastal Zone for Sustainable Food and Income Security", Springer Science and Business Media LLC, 2022

Publication

<1 %

47

N. Nahar, M. A. H. Lanon, B. Saha, M. R. Shaibur. "Assessment of physico-chemical properties of water of Gorai river at Kushtia town in 2014: a case study", Journal of Science, Technology and Environment Informatics, 2016

Publication

<1 %

48	Bachman, Rebecca Anne. "Reimagining the Amphibious City: From Health Data to Ecological Design in an Amazonian Informal Community.", University of Washington, 2020 Publication	<1 %
49	Shomar, B.H.. "Trace elements in major solid-pesticides used in the Gaza Strip", Chemosphere, 200610 Publication	<1 %
50	"Environmental Processes and Management", Springer Science and Business Media LLC, 2020 Publication	<1 %
51	Laad, Priyanka. "Physico-Chemical & Bacteriological Studies of Omkareshwar Dam Reservoir at River Narmada With Special Emphasis on Human Health.", Devi Ahilya Vishwavidyalaya, 2019 Publication	<1 %
52	Keskin, Fatih. "Hydrological Model Study in Yuvacik Dam Basin by Using GIS Analysis.", Middle East Technical University (Turkey), 2024 Publication	<1 %
53	S. Ananda Babu. "5World Congress on Disaster Management - Disaster Risk Management", Routledge, 2022	<1 %

-
- 54 Sumanta Prakash Shee, Ramkrishna Maiti. "Land Acquisition, Industrialization and Livelihoods", Springer Science and Business Media LLC, 2022 $<1\%$
Publication
-
- 55 "Groundwater Resources Development and Planning in the Semi-Arid Region", Springer Science and Business Media LLC, 2021 $<1\%$
Publication
-
- 56 Umesh Chandra Chaube, Ashish Pandey, Vijay P. Singh. "Canal Irrigation Systems in India", Springer Science and Business Media LLC, 2023 $<1\%$
Publication
-
- 57 da Silva, Ana Catarina Torres. "Impact of Covid-19 Pandemic on Air Quality in Portugal", Universidade do Porto (Portugal), 2024 $<1\%$
Publication
-
- 58 John Glasson, John Glasson, Riki Therivel, Riki Therivel, Andrew Chadwick. "Introduction To Environmental Impact Assessment", Routledge, 2019 $<1\%$
Publication
-
- 59 Pancholi, Dinesh A.. "Study of geoenvironmental problems due to lignite $<1\%$

mining and thermal power plant at
Panandhro, District Kachchh, Gujarat.",
Maharaja Sayajirao University of Baroda
(India),

Publication

60

Abhay Kumar Soni, Ishwardas L. Muthreja,
Rajendra R. Yerpude. "Principles and Practice
in Mining Engineering", CRC Press, 2023

Publication

<1 %

61

C. Channarayappa, D.P. Biradar. " Soil Basics,
Management, and Rhizosphere Engineering
for Sustainable Agriculture", CRC Press, 2018

Publication

<1 %

62

K. M. Baharul Islam, Zafar Mahfooz Nomani.
"Environment Impact Assessment - Precept &
Practice", CRC Press, 2021

Publication

<1 %

63

Mary K. Theodore, Louis Theodore. "
Environmental Management", CRC Press,
2009

Publication

<1 %

64

Environmental Deterioration and Human
Health, 2014.

Publication

<1 %

65

Nabiyeva, Gulnara Nuridinovna. "Geographic
Information Systems (GIS) as a Tool for

<1 %

Sustainable Community Development.", University of California, Davis, 2020

Publication

66

J. Brad Stephenson. "The Engineering Geology and Hydrology of Karst Terrains", Taylor & Francis, 2020

Publication

<1 %

67

Liyaqat Ayoub, RUKSHANDA HANIF, MUNAZAH YAQOOB, JAMEELA RASOOL, WASEEM AHMAD WAR. "Exploring the Rich Diversity of Insect Pollinators in Cucumber, Cucumis sativus L.", Springer Science and Business Media LLC, 2024

Publication

<1 %

68

Submitted to Savitribai Phule Pune University

Student Paper

<1 %

69

docslib.org

Internet Source

<1 %

70

T.M. Aggarwal. "Environmental Control in Thermal Power Plants", CRC Press, 2021

Publication

<1 %

71

Bidyut Chakrabarty, Prakash Chand Kandpal. "Public Administration in India", Routledge, 2024

Publication

<1 %

72

H. C. O. Unegbu, D. S. Yawas, B. Dan-asabe, A. A. Alabi. "Assessing the Environmental and Economic Benefits of Solar Energy Integration in Nigerian Construction", Springer Science and Business Media LLC, 2024

Publication

<1 %

73

Saxena, Jini. "Impact of Malls on Small Shop Keepers and Vendors: An Economic Analysis of Grocery, Food and Apparel Segment in Pune City.", Devi Ahilya Vishwavidyalaya, 2019

Publication

<1 %

74

Ashok K. Rathoure. "Zero Waste - Management Practices for Environmental Sustainability", CRC Press, 2019

Publication

<1 %

75

Dave, Roopkishan Sohan Lal. "Disaster Management and Emergency Response: A Comparative Study of Managerial Structures, Systems and Processes in Gujarat (India) and California (USA).", Proquest, 2015.

Publication

<1 %

76

Iyyanki V. Muralikrishna, Valli Manickam. "Environmental Impact Assessment and Audit", Elsevier BV, 2017

Publication

<1 %

77

Karlheinz Spitz, John Trudinger. "Mining and the Environment - from Ore to Metal", CRC

<1 %

- 78 Lawrence K. Wang, Yung-Tse Hung, Howard H. Lo, Constantine Yapijakis. "Waste Treatment in the Process Industries", CRC Press, 2019 $<1\%$
- Publication
-

- 79 Sacchidananda Mukherjee, Debashis Chakraborty. "Environmental Scenario in India - Successes and predicaments", Routledge, 2013 $<1\%$
- Publication
-

- 80 Biplab Lohochowdhury, Divya Giridhar, Arvind Kumar Pal, Archan Mitra. "Environmental Information Policy in India feed Pro-Environment Industry Operation: A Case Study of EIA Report on Proposed Integrated Steel Complex Site, Halakundi, Karnataka", Macromolecular Symposia, 2023 $<1\%$
- Publication
-

- 81 Leo Stander, Louis Theodore. "Environmental Regulatory Calculations Handbook", Wiley, 2007 $<1\%$
- Publication
-

- 82 Saha, Somnath. "An Appraisal of Water Quality in the Surat – Bharuch Industrial $<1\%$

Region, South Gujarat", Maharaja Sayajirao
University of Baroda (India), 2024

Publication

83

Xin, Neo En. "Data Driven Particulate Matters Prediction in Klang Valley Using Machine Learning Techniques.", University of Malaya (Malaysia)

Publication

<1 %

84

vdocument.in

Internet Source

<1 %

85

Barry Dalal-Clayton, Barry Sadler.
"Sustainability Appraisal - A sourcebook and reference guide to international experience",
Routledge, 2014

Publication

<1 %

86

Mkhonto, Prince Dominican Maphisa.
"Atmospheric Dispersion Modelling Study of a Township Within a Declared National Priority Area.", University of Johannesburg (South Africa), 2021

Publication

<1 %

87

Pali, Priyanka. "Potential for Climate Change Mitigation Through Low Carbon Investment in Indian Roads and Railways - An Assessment of Obstacles and Opportunities for the Asian Development Bank", The University of Manchester (United Kingdom), 2020

Publication

<1 %

88	Samuel D. Faust, Osman M. Aly. "Chemistry of Water Treatment", CRC Press, 2018	<1 %
	Publication	

89	Anji Reddy Mareddy. "EIA practice in India", Elsevier BV, 2017	<1 %
	Publication	

90	Bhokarkar, Sonal P.. "Carrying Capacity Based Study of Kim River Watershed, South Gujarat: With Special Reference to Its Status on Water & Ecological Foot-Prints and Suggested Remediation", Maharaja Sayajirao University of Baroda (India), 2020	<1 %
	Publication	

91	Frank R. Spellman. "Handbook of Water and Wastewater Treatment Plant Operations", CRC Press, 2025	<1 %
	Publication	

92	Kadam, Avinash Mahadeo. "Wastewater Purification Using Constructed Soil Filter", Indian Institute of Technology, Bombay (India), 2021	<1 %
	Publication	

93	Linda C.S. Gundersen, Richard B. Wanty. "Field Studies of Radon in Rocks, Soils, and Water", CRC Press, 2020	<1 %
	Publication	

94 Philip Wexler, Jan van der Kolk, Asish Mohapatra, Ravi Agarwal. "Chemicals, Environment, Health - A Global Management Perspective", CRC Press, 2019 <1 %
Publication

95 R. N. Bhargava, V. Rajaram, Keith Olson, Lynn Tiede. "Ecology and Environment", Routledge, 2019 <1 %
Publication

96 Sairam Bhat, . "Environmental Law and Policy in India", Routledge, 2024 <1 %
Publication

Exclude quotes Off

Exclude matches Off

Exclude bibliography On



CIN: U93000UP2011PTC047863, 2011-12

ARN: AA090417023350J, PIN: 09AAECG4958Q1ZQ

(An ISO:9001 QMS, ISO: 14001 EMS & OHSAS: 18001 H&S MS Certified by BSI)

QCI-NABET Accredited Environment Consultant

Registered Office: 607-611, Level-5, Shopprix Mall, Sector-5, Vaishali, Ghaziabad-201010,
Landline-0120-4111527, 4291470, 4296535

Email id: information@greencindia.com

Project Office: 10, Armstrong Avenue, Opposite Bank of India, Bidhan Nagar, Durgapur-12, Voice Contact: 9930136376

QCI-NABET APPROVED SECTORS

Certificate No. NABET/EIA/2326/RA 0297, Valid up to February, 2026

MINING, THERMAL POWER PLANTS, CHEMICAL FERTILIZERS, RIVER VALLEY, HYDEL, DRAINAGE & IRRIGATION PROJECTS, CEMENT PLANT, COAL WASHERIES, METALLURGICAL INDUSTRIES, AIRPORTS, INDUSTRIAL ESTATE PLANNING, HIGHWAYS & RAILWAYS, COMMON MUNICIPAL SOLID WASTE MANAGEMENT, BUILDING & LARGE CONSTRUCTION PROJECTS AND TOWNSHIP & AREA DEVELOPMENT PROJECTS

Undertaking

Subject: Gadarwara Super Thermal Power Plant, Stage-II (2x800) MW at village Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon etc., Tehsil Gadarwara, District Narsinghpur of Madhya Pradesh.

This is to inform you that we, M/s Greencindia Consulting Pvt. Ltd. has undertaken the Environmental Impact Assessment Study for the subject job, as per the EIA Notification, 2006 amended till date in compliance with the Terms of Reference issued by Ministry of Environment, Forest and Climate Change, vide its letter File No: J-13012/125/2009-IA.II(T) dated 30th September, 2024. We hereby undertake that prescribed TORs have been complied with and the data submitted are factually correct to the best of our knowledge.

For Greencindia Consulting Private Limited

(Nandini Choudhury)

Managing Director

Ref. No.:CC:EE:9572:2025:EIA

Date:15.04.2025

UNDERTAKING BY PROJECT PROPONENT

NTPC Limited has complied with all the prescribed Terms of Reference (ToR) issued by Ministry of Environment, Forest & Climate Change (MoEF&CC) vide letter no J-13012/125/2009-IA.II(T) dated 30.09.2024 for Expansion of Gadarwara Super Thermal Power Project from 1600MW (2x800 MW, Stage-I) to 3200MW by addition of 1600MW (2x800 MW, Stage-II) in an area of 910.706 Ha located at village Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon etc., Gadarwara Tehsil, Narsinghpur District, in Madhya Pradesh.

We undertake that the necessary updation with respect to EAC observations has been incorporated in the revised EIA/EMP report. The information and data provided in the Final EIA report and submitted to the Ministry of Environment, Forests & Climate Change are factually correct, and project proponent is fully accountable for the same.

For NTPC Limited.

Authorized Signatory



(Rajesh Malik)
AGM & Group Head (Env't. Engg.)

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



TABLE OF CONTENT

1. INTRODUCTION	1-1
1.1 BACKGROUND & INTRODUCTION	1-1
1.2 IDENTIFICATION OF PROJECT AND PROPONENT	1-2
1.2.1 THE PROJECT.....	1-2
1.2.2 THE PROJECT PROPONENT	1-4
1.3 LOCATION OF THE PROJECT	1-4
1.4 DEMAND JUSTIFICATION.....	1-8
1.4.1 DEMAND SUPPLY	1-8
1.4.2 PEAK DEMAND AND ENERGY REQUIREMENT FORECAST FOR 2029-30	1-10
1.4.3 SAUBHAGYA' SCHEME	1-11
1.4.4 CONCLUSIONS	1-12
1.5 PURPOSE OF THE REPORT	1-12
1.6 SCOPE OF THE STUDY	1-13
1.7 PROCESS OF OBTAINING THE ENVIRONMENT CLEARANCE.....	1-14
1.7.1 STAGE (1).....	1-15
1.7.2 STAGE (2).....	1-15
1.7.3 STAGE (3).....	1-15
1.7.4 STAGE (4).....	1-16
1.8 ENVIRONMENT LEGISLATIONS.....	1-16
1.8.1 POLLUTION STANDARDS	1-18
1.9 STATUTORY CLEARANCE	1-18
1.10 ORGANISATION & CHAPTERIZATION OF REPORT	1-19
2. PROJECT DESCRIPTION.....	2-1
2.1 PROJECT FEATURES	2-1
2.2 BASIC RESOURCE- REQUIREMENT, SOURCE AND AVAILABILITY	2-6
2.2.1 LAND REQUIREMENT AND AVAILABILITY	2-6
2.2.2 FUEL REQUIREMENT AND SOURCE.....	2-7
2.2.3 WATER REQUIREMENT AND SOURCE	2-9
2.2.4 POWER EVACUATION	2-10
2.3 PROJECT COST.....	2-10
2.4 TECHNOLOGY & PROCESS DESCRIPTION	2-10

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



2.5	TURBINE AND ITS AUXILIARIES	2-14
2.5.1	STEAM TURBINE.....	2-14
2.5.2	CONDENSER.....	2-14
2.5.3	AIR EXTRACTION SYSTEM	2-14
2.5.4	LUBE OIL SYSTEM.....	2-14
2.5.5	TURBINE CONTROL FLUID SYSTEM.....	2-15
2.5.6	GLAND STEAM SEALING SYSTEM	2-15
2.5.7	GOVERNING / REGULATION SYSTEM	2-15
2.5.8	HP/LP BYPASS.....	2-15
2.5.9	REGENERATIVE FEED HEATING CYCLE	2-16
2.5.10	HP & LP HEATERS.....	2-16
2.5.11	DEAERATOR	2-16
2.5.12	BOILER FEED PUMPS	2-16
2.5.13	CONDENSATE EXTRACTION PUMPS	2-17
2.5.14	TURBINE HALL EOT CRANES.....	2-17
2.5.15	EOT CRANE FOR BOILER FEED PUMP	2-17
2.5.16	ON-LINE INTEGRATED BLADE VIBRATION MONITORING SYSTEM	2-17
2.5.17	DEAERATOR LEVEL CONTROL STATION.....	2-17
2.6	PLANT WATER SYSTEM.....	2-17
2.6.1	MAKE-UP WATER SYSTEM	2-17
2.6.2	EQUIPMENT COOLING WATER (ECW) SYSTEM & AUX COOLING SYSTEM.....	2-20
2.6.3	AUXILIARY WATER SYSTEMS	2-20
2.6.4	WATER TREATMENT SYSTEMS.....	2-20
2.6.5	FIRE PROTECTION SYSTEM	2-22
2.7	FUEL HANDLING SYSTEM	2-24
2.7.1	COAL HANDLING SYSTEM.....	2-24
2.7.2	FUEL OIL HANDLING SYSTEM	2-24
2.7.3	BIOMASS HANDLING SYSTEM.....	2-24
2.8	LIMESTONE & GYPSUM HANDLING SYSTEM.....	2-25
2.9	ASH HANDLING SYSTEM.....	2-25
2.9.1	BOTTOM ASH REMOVAL SYSTEM.....	2-25
2.9.2	FLY ASH HANDLING SYSTEM.....	2-25
2.9.3	ASH SLURRY DISPOSAL SYSTEM.....	2-26

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



2.9.4	ASH WATER SYSTEM.....	2-26
2.9.5	ASH WATER RECIRCULATION SYSTEM	2-26
2.9.6	ASH CLASSIFICATION AND BAGGING SYSTEM	2-27
2.9.7	MILL REJECT SYSTEM	2-28
2.9.8	ASH DYKE	2-28
2.10	POLLUTION CONTROL SYSTEM.....	2-30
2.10.1	AIR POLLUTION CONTROL SYSTEM.....	2-30
2.10.2	WATER POLLUTION CONTROL SYSTEM	2-33
2.10.3	NOISE POLLUTION	2-33
2.10.4	SOLID WASTE MANAGEMENT	2-34
2.10.5	AFFORESTATION AND GREEN BELT DEVELOPMENT	2-34
2.10.6	SUSTAINABLE DEVELOPMENT MECHANISM (SDM).....	2-35
2.10.7	POST OPERATIONAL MONITORING PROGRAMME	2-37
2.10.8	INSTITUTIONAL SET-UP.....	2-37
2.11	SEISMIC CONSIDERATION	2-38
2.12	ASSESSMENT OF NEW & UNTESTED TECHNOLOGY FOR THE RISK OF TECHNOLOGICAL FAILURE	2-38
3.	BASELINE ENVIRONMENT	3-1
3.1	INTRODUCTION.....	3-1
3.2	STUDY AREA AND PERIOD	3-1
3.3	METHODOLOGY ADOPTED	3-3
3.4	REGIONAL AND LOCATIONAL SETTING	3-3
3.4.1	PROJECT LOCATION.....	3-3
3.4.2	SITE CONNECTIVITY	3-6
3.4.3	ENVIRONMENT SENSITIVITY	3-6
3.5	LAND USE AND LAND OWNERSHIP	3-9
3.5.1	LAND USE/ LAND COVER DETAILS OF THE STUDY AREA	3-9
3.6	PHYSICAL ENVIRONMENT	3-16
3.6.1	TOPOGRAPHY.....	3-16
3.6.2	DRAINAGE.....	3-17
3.6.3	GEOLOGY	3-20
3.6.4	HYDROGEOLOGY UNITS AND AQUIFER.....	3-23
3.6.5	VULNERABILITY OF STUDY AREA	3-27

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.6.6	SOIL QUALITY	3-28
3.7	CLIMATOLOGY AND METEOROLOGY	3-41
3.7.1	IMD METEOROLOGICAL DATA.....	3-41
3.7.2	METHODOLOGY OF DATA GENERATION.....	3-46
3.8	AIR ENVIRONMENT.....	3-49
3.8.1	FREQUENCY AND PARAMETERS OF MONITORING	3-49
3.8.2	INSTRUMENT USED FOR SAMPLING	3-49
3.8.3	SAMPLING AND ANALYTICAL TECHNIQUE.....	3-49
3.8.4	SELECTION OF SAMPLING LOCATIONS	3-49
3.8.5	INSTRUMENTS USED FOR SAMPLING AND ANALYTICAL TECHNIQUES	3-52
3.8.6	AMBIENT AIR QUALITY RESULT	3-52
3.8.7	OBSERVATION.....	3-56
3.9	NOISE ENVIRONMENT.....	3-60
3.9.1	FREQUENCY AND PARAMETERS OF SAMPLING.....	3-60
3.9.2	INSTRUMENT USED FOR SAMPLING	3-60
3.9.3	SELECTION OF MONITORING LOCATIONS.....	3-61
3.10	WATER ENVIRONMENT	3-66
3.10.1	FREQUENCY AND PARAMETERS	3-66
3.10.2	SAMPLE COLLECTION TECHNIQUE.....	3-66
3.10.3	SAMPLING LOCATIONS.....	3-66
3.10.4	ANALYSIS OF WATER QUALITY	3-69
3.10.5	COMPARATIVE STUDY.....	3-94
3.11	TRAFFIC SCENARIO.....	3-98
3.12	TERRESTRIAL ECOLOGICAL SURVEY AND BIODIVERSITY STUDY	3-101
3.12.1	FOREST TYPE.....	3-101
3.12.2	FLORAL STUDY	3-103
3.12.3	PHYTO-SOCIOLOGICAL STUDY	3-106
3.12.4	FAUNAL STUDY	3-113
3.12.5	FAUNAL STATUS	3-114
3.12.6	AQUATIC ECOLOGY.....	3-116
3.13	SOCIAL ENVIRONMENT	3-121
3.13.1	DEMOGRAPHIC CHARACTERISTICS OF THE STUDY AREA	3-121
3.13.2	VULNERABLE GROUP	3-122

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.13.3	LITERACY RATE.....	3-123
3.13.4	WORK PARTICIPATION.....	3-124
3.13.5	INFRASTRUCTURE	3-126
3.13.6	CONCLUSION OF STACKHOLDER CONSULTATION.....	3-128
4.	IMPACTS ASSESSMENT & MITIGATION MEASURES	
4.1	INTRODUCTION.....	4-1
4.2	IDENTIFICATION OF ACTIVITIES AND ITS IMPACT	4-3
4.3	OVERALL IMPACTS & MITIGATION MEASURES	4-5
4.4	IMPACT ON AIR QUALITY	4-20
4.4.1	AIR POLLUTION MODELLING	4-20
4.5	IMPACT ON WATER RESOURCES-SURFACE & GROUND WATER	4-39
4.6	IMPACT ON NOISE LEVELS.....	4-41
4.7	IMPACT ON ECOLOGICAL RESOURCES.....	4-44
4.8	IMPACT ON SOCIO-ECONOMIC ENVIRONMENT	4-50
4.9	IMPACT ON TRAFFIC.....	4-50
4.9.1	Ash Transportation Routes and Fugitive Dust Mitigation Measures.....	4-52
4.10	CUMULATIVE ASSESSMENT STUDY.....	4-53
4.10.1	Introduction.....	4-53
4.10.2	Background.....	4-55
4.10.3	Objective.....	4-55
4.10.4	CIA Study Area.....	4-56
4.10.5	General description of the buffer area.....	4-59
4.10.6	Existing Condition of VECs.....	4-63
4.10.7	Assessment of cumulative impact of VECs.....	4-63
4.10.8	Management of Cumulative Impacts.....	4-65
4.10.9	Conclusions.....	4-66
5.	ANALYSIS OF ALTERNATIVE TECHNOLOGIES.....	5-1
5.1	INTRODUCTION.....	5-1
5.2	SITE ALTERNATIVES	5-1
5.3	TECHNOLOGY ALTERNATIVE.....	5-1
5.3.1	DESCRIPTION OF EACH ALTERNATIVE.....	5-1

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



5.3.2	Comparative ANALYSIS OF TECHNOLOGIES	5-3
5.3.3	SELECTED TECHNOLOGY - ULTRA-SUPER CRITICAL TECHNOLOGY	5-3
5.3.4	AIR COOLED CONDENSER SYSTEM.....	5-4
6.	ENVIRONMENT MONITORING PROGRAMME	6-1
6.1	NEED FOR ENVIRONMENT MONITORING	6-1
6.2	ENVIRONMENT MONITORING PROGRAMME	6-1
6.3	WASTEWATER QUALITY MONITORING.....	6-6
6.4	DATA ANALYSIS.....	6-7
6.5	REPORTING SCHEDULE.....	6-7
6.6	EMERGENCY PROCEDURES	6-7
6.7	INFRASTRUCTURE.....	6-7
6.8	ENVIRONMENT MONITORING COST.....	6-15
7.	ADDITIONAL STUDIES.....	7-1
7.1	INTRODUCTION.....	7-1
7.2	PUBLIC HEARING & CONSULTATION.....	7-1
7.2.1	PROCEEDINGS DETAILS.....	7-2
7.2.2	NEWSPAPER ADVERTISEMENT.....	7-5
7.2.3	PUBLIC HEARING PHOTOGRAPHS.....	7-5
7.3	CORPORATE ENVIRONMENT RESPONSIBILITY	7-55
7.4	RISK ASSESSMENT	7-57
7.4.1	COMPONENT-1 IDENTIFICATION OF CONTAMINANTS/HAZARDS	7-58
7.4.2	COMPONENT-2 ESTIMATION OF AMOUNT OF CONTAMINANTS	7-59
7.4.3	COMPONENT-3: ESTIMATION OF THE CONCENTRATION OF CONTAMINANTS	7-59
7.4.4	HAZARDS FROM LDO HANDLING & STORAGE	7-60
7.4.5	MITIGATION MEASURES OF FIRE & EXPLOSION HAZARDS.....	7-65
7.4.6	PROJECT SPECIFIC MITIGATION MEASURES.....	7-72
7.5	DISASTER MANAGEMENT PLAN	7-73
7.5.1	INDUSTRIAL DISASTERS	7-73
7.5.2	NATURAL DISASTERS.....	7-79
7.6	OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT PLAN	7-82
7.6.1	CONSTRUCTION & ERECTION PHASE	7-83
7.6.2	OPERATION & MAINTENANCE PHASE	7-83

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



7.6.3	OCCUPATIONAL HEALTH MONITORING, AWARENESS AND TRAINING...	7-85
7.6.4	ASSESSMENT OF ENDEMIC DISEASES OF ENVIRONMENTAL ORIGIN.....	7-85
7.7	NTPC SAFETY POLICY & PRACTICES.....	7-88
7.8	NTPC SAFETY FRAMEWORK.....	7-89
7.9	COMPONENT 1. SAFETY POLICY AND OBJECTIVES.....	7-90
7.10	SAFETY TRAINING FOR AGENCY WORKERS.....	7-91
7.11	CORPORATE SOCIAL RESPONSIBILITY.....	7-93
7.12	HYDROGEOLOGY STUDIES.....	7-94
7.13	WATER SHED DEVELOPMENT PLAN.....	7-97
7.13.1	Action Plan.....	7-98
7.14	BIODIVERSITY CONSERVATION PLAN & WILDLIFE MANAGEMENT PLAN..	7-100
7.15	STUDY ON WATER INTAKE FROM OF NARMADA RIVER FOR GADARWARA STPP.....	7-103
8.	PROJECT BENEFITS.....	8-1
8.1	INTRODUCTION.....	8-1
8.2	IMPROVEMENT IN PHYSICAL INFRASTRUCTURE & COMMUNITY DEVELOPMENT.....	8-1
8.3	IMPROVEMENT IN SOCIAL INFRASTRUCTURE.....	8-2
8.4	EMPLOYMENT POTENTIAL.....	8-2
8.5	CORPORATE ENVIRONMENT RESPONSIBILITY.....	8-3
9.	COST BENEFIT ANALYSIS.....	9-1
9.1	INTRODUCTION.....	9-1
9.2	STAGES OF COST-BENEFIT ANALYSIS.....	9-1
9.3	IDENTIFYING IMPACTS OF THE PROJECT.....	9-1
9.4	EVALUATION OF ENVIRONMENTAL COSTS/IMPACTS.....	9-2
9.5	EVALUATION OF BENEFITS.....	9-3
9.6	COST BENEFIT ANALYSIS RATIO.....	9-5
9.7	INFERENCE.....	9-6
10.	ENVIRONMENT MANAGEMENT PLAN.....	10-1
10.1	EMP IMPLEMENTATION, INSPECTION AND MONITORING.....	10-1
10.1.1	COMPONENTS OF EMP.....	10-1
10.1.2	INSITUTIONAL ARRANGEMENTS.....	10-1
10.2	ENVIRONMENTAL MONITORING PROGRAMME.....	10-2

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



10.3	LABORATORY	10-2
10.4	FLUE GAS DESULPHURIZATION SYSTEM (FGD)	10-2
10.5	ZERO LIQUID DISCHARGE (ZLD)	10-2
10.6	SOLID WASTE MANAGEMENT	10-3
10.7	ASH DYKE.....	10-3
10.7.1	ASH UTILISATION PLAN	10-6
10.8	SOCIAL ENHANCEMENT MEASURES.....	10-9
10.8.1	SOLAR POWER HARNESSING	10-9
10.8.2	TRAINING.....	10-11
10.8.3	WELFARE ACTIVITIES & FACILITIES FOR EMPLOYEES	10-11
10.8.4	GREENBELT.....	10-12
10.8.5	RAINWATER HARVESTING.....	10-19
10.9	COST OF ENVIRONMENT MANAGEMENT MEASURES.....	10-23
10.10	EXISTING ENVIRONMENT MANAGEMENT MEASURES	10-25
10.11	MEASURES FOR PREVENTION AND CONTROL OF AIR POLLUTION AT NTPC GADARWARA STPP.....	10-27
11.	SUMMARY AND CONCLUSION.....	11-1
11.1	INTRODUCTION.....	11-1
11.2	THE PROJECT PROPONENT.....	11-1
11.3	LOCATION OF THE PROJECT	11-2
11.4	DEMAND JUSTIFICATION.....	11-2
11.5	PURPOSE OF THE REPORT	11-2
11.6	SCOPE OF THE STUDY	11-2
11.7	PROCESS OF OBTAINING ENVIRONMENTAL CLEARANCE	11-2
11.8	PROJECT DESCRIPTION	11-2
11.9	BASELINE ENVIRONMENT	11-9
11.9.1	PHYSICAL ENVIRONMENT.....	11-10
11.10	SOCIAL ENVIRONMENT:	11-15
11.11	INFRASTRUCTURE	11-15
11.12	IMPACTS ASSESSMENT & MITIGATION MEASURES.....	11-16
11.13	ANALYSIS OF ALTERNATIVE TECHNOLOGIES	11-17
11.14	ENVIRONMENTAL MONITORING PROGRAMME	11-17
11.15	ADDITIONAL STUDIES.....	11-18

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



11.16 COST BENEFIT ANALYSIS	11-21
11.17 ENVIRONMENT MONITORING PLAN	11-22
12. DISCLOSURE OF CONSULTANT.....	12-1
12.1 INTRODUCTION TO THE TEAM.....	12-1
12.2 PROJECT AREAS OF EXPERTISE	12-2
12.3 ACHIEVEMENT OF THE COMPANY	12-2
12.4 TEAM INVOLVED.....	12-3
12.5 ACCREDITED LABORATORY	12-6

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



TABLES

Table 1.1: Details of the Project.....	1-2
Table 1.2: Geographical co-ordinates.....	1-7
Table 1.2 A: The geographical co-ordinates of all four corners of the site.....	1-7
Table 1.3: All India Installed Capacity (Fuel-Wise)	1-8
Table 1.4: All India power generation over previous five years	1-10
Table 1.5: Peak Demand and Energy requirement forecast for 2029-30	1-10
Table 1.6: Baseline Study Parameters & their frequency	1-13
Table 1.7: Project Categorization.....	1-15
Table 1.8: List of Environment Legislations.....	1-16
Table 1.9: List of Statutory Clearance.....	1-18
Table 2.1: Project Design Features	2-1
Table 2.2: Land details for Gadarwara STPP (Stage-I & Stage-II).....	2-6
Table 2.3: Coal Characteristics for Gadarwara STPP.....	2-8
Table 2.4: Year-wise planttaion details.....	2-34
Table 2.5: Sustainable Development Goals.....	2-36
Table 3.1: Co-ordinates of the Project Site	3-4
Table 3.2: Environmental Sensitivity Locations	3-6
Table 3.3: Land Use of Study Area	3-9
Table 3.4: Geological successions of Narsinghpur district.....	3-20
Table 3.5: Soil Sampling Locations	3-29
Table 3.6: Analytical Technique for Soil Sample	3-32
Table 3.7: Physico-chemical parameters of soil samples.....	3-33
Table 3.8: Soil classification for pH	3-35
Table 3.9: Conductivity of the Soil Sample collected from the project site and study area	3-36
Table 3.10: Average available water content for various soil textural classes	3-38
Table 3.11: Classification of NPK as per ICAR	3-39
Table 3.12: Classification of Organic Matter as per ICAR.....	3-40
Table 3.13: Meteorological Data of Narsinghpur IMD from 1991-2020	3-41
Table 3.14: Instruments, Parameters and Frequency of Meteorological Monitoring at Site	3-46
Table 3.15: Onsite Meteorology Data	3-47
Table 3.16: Air Monitoring Locations	3-50
Table 3.17: Sampling & Analysis Methodology.....	3-52
Table 3.18: Results of Ambient Air Quality Data	3-53
Table 3.19: Ambient Noise Quality Standards as per CPCB	3-61
Table 3.20: Description of noise sampling locations	3-61
Table 3.21: Noise parameters recorded at different locations.....	3-64
Table 3.22: Description of sampling locations for surface water and ground water	3-66
Table 3.23: Parameter wise Water Sampling Procedure, Sample Size and Storage/Preservation ...	3-69
Table 3.24: Standard National and International Analytical Procedure and Methods for Different Water Quality Parameters.....	3-70
Table 3.25: Physico-chemical characterisation of surface water, March.2024.....	3-71
Table 3.26: Physico-chemical characterisation of surface water, April.2024	3-73

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.27: Physico-chemical characterisation of surface water, May.2024	3-74
Table 3.28: Water Quality Criteria as per CPCB	3-75
Table 3.29: Physico-chemical characterisation of ground water samples, March.2024	3-79
Table 3.30: Physico-chemical characterisation of ground water samples, April.2024	3-80
Table 3.31: Physico-chemical characterisation of ground water samples, May.2024	3-82
Table 3.32: Description of ground water sampling locations at Hotspot areas.....	3-88
Table 3.33: Physico-chemical characterisation of Ground water	3-90
Table 3.34: Existing Traffic Scenario	3-98
Table 3.35: Existing Level of Service	3-98
Table 3.36: Inventory of Trees, Shrubs, Herbs and Climbers recorded from the study area	3-103
Table 3.37: Co-ordinates of Terrestrial and Aquatic Ecology Study	3-108
Table 3.38: Phyto-sociological analysis of trees in PSS 1 location	3-108
Table 3.39: Phyto-sociological analysis of shrubs in PSS 1 location	3-108
Table 3.40: Phyto-sociological analysis of herbs in PSS 1 location	3-109
Table 3.41: Phyto-sociological analysis of trees in PSS 2 location	3-109
Table 3.42: Phyto-sociological analysis of shrubs in PSS 2 location	3-109
Table 3.43: Phyto-sociological analysis of herbs in PSS 2 location	3-109
Table 3.44: Phyto-sociological analysis of trees in PSS 3 location	3-110
Table 3.45: Phyto-sociological analysis of shrubs in PSS 3 location	3-110
Table 3.46: Phyto-sociological analysis of herbs in PSS 3 location	3-110
Table 3.47: Phyto-sociological analysis of trees in PSS 4 location	3-110
Table 3.48: Phyto-sociological analysis of shrubs in PSS 4 location	3-111
Table 3.49: Phyto-sociological analysis of herbs in PSS 4 location	3-111
Table 3.50: List of Animals in the study area	3-114
Table 3.51: Inventory of Phytoplanktons from study area.....	3-117
Table 3.52: Inventory of zooplanktons recorded from the study area	3-119
Table 3.53: Inventory of macro invertebrates recorded from study area	3-120
Table 3.54: Demographic Profile of the Study Area.....	3-121
Table 3.55: Demographic Features of the Study Area	3-121
Table 3.56: Vulnerable Group	3-122
Table 3.57: Literacy Rate	3-123
Table 3.58: Occupational Structure of the Study Area	3-124
Table 3.59: Educational Facilities in the Study Area	3-126
Table 3.60: Health Facilities in the Study Area	3-126
Table 3.61: Banking & Post Office Facilities in the Study Area	3-127
Table 3.62: Drinking Water Facilities in the Study Area.....	3-127
Table 3.63: Stakeholder consultation in the Study Area.....	3-128
Table 4.1: Environment Impact Identification Matrix for Construction Phase.....	4-1
Table 4.2: Environment Impact Identification Matrix for Operation Phase	4-2
Table 4.3 :Description of identifiable impacts during Construction Phase	4-3
Table 4.4: Description of identifiable impacts during Operation Phase	4-4
Table 4.5: Identification of Impacts & Mitigation Measures-Construction Phase	4-6
Table 4.6: Identification of Impacts & Mitigation Measures-Operation Phase	4-11
Table 4.7: Details of Stack Emissions of expanded plant	4-23

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 4.7A: Details of Stack Emissions for Existing with FGD and Proposed Project without Control measures.....	4-24
Table 4.8: Resultant Ambient Air Quality GLC during Operation of proposed project in $\mu\text{g}/\text{m}^3$ with FGD.....	4-25
Table 4.8A: Resultant Ambient Air Quality GLC during Operation of proposed project in $\mu\text{g}/\text{m}^3$ (Existing with FGD & Proposed without FGD).....	4-26
Table 4.8B: Additional Air Quality Control Measures.....	4-27
Table 4.9 Wastewater generation, Treatment and disposal (m^3/hr)	4-39
Table 4.10 Source Noise Levels from Proposed Plant.....	4-42
Table 4.11 Predicted Incremental Noise Levels at the Plant Boundaries	4-43
Table 4.12 Year-wise plantation details	4-45
Table 4.13: Break-up of Plantation Area.....	4-46
Table 4.14: Existing Level of Service	4-50
Table 4.15: Level of Service after Project Expansion.....	4-51
Table 4.16 Emission norms for Heavy Diesel vehicles	4-51
Table 4.17 Comparison between Pollution Load before and after Project Scenario	4-51
Table 4.18 Action plan for controlling fugitive dust.....	4-52
Table 4.19 List of Industries.....	4-55
Table 4-20 List of VECs.....	4-56
Table 4-21 Cumulative impact and mitigation measures.....	4-68
Table 5.1: Adverse impacts of each alternative.....	5-3
Table 6.1: Environment Monitoring Program during Construction Phase	6-2
Table 6.2: Environment Monitoring Program during Operation Phase	6-2
Table 6.3: Wastewater monitoring schedule	6-6
Table 6.4: General Equipment's Required for Environment Monitoring Laboratory.....	6-10
Table 6.5: Environment Monitoring Cost	6-15
Table 7.1: Details of Public hearing Advertisement.....	7-1
Table 7.2: Issues raised during Public Hearing with Project.....	7-7
Table 7.3: Action plan to resolve the issues raised during Public Hearing of proposed Stage -II (Activities under Public Hearing and Written Demands given by Sarpanchs & Individuals-CD).....	7-52
Table 7.4: Activity wise capital budget provision for Public Hearing issues for Gadarwara STPP for Stage-II, (CD - Capital nature).....	7-55
Table 7.5: Potential Hazards	7-58
Table 7.6: Flammability Classification Criteria.....	7-59
Table 7.7: Preliminary Hazard Assessment for Power Plant: Environmental Factors.....	7-60
Table 7.8: On-Site Hazardous Chemicals	7-64
Table 7.9: Chemicals and Risk hazards with Mitigation measures	7-64
Table 7.10: Risk categories with impact, mitigation measures and timeline.....	7-65
Table 7.11: Identification of Hazards and Potential/Probable Locations of Occurrence.....	7-74
Table 7.12: Personnel protective Equipment.....	7-83
Table 7.13: Yearly CSR Expenditure	7-93
Table 7.14: Proposed plan for Watershed Management.....	7-99
Table 7.15: Action plan for Biodiversity Assessment study.....	7-101

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 8-1: CSR-CD Activities undertaken by Gadarwara STPP (From 2014-15 to 2023-24)	8-4
Table 8-2: Yearly CSR Expenditure	8-4
Table 8-3: Proposed CSR/CER Budget (in lakhs) for Gadarwara	8-4
Table 9-1: Impacts of the Proposed Stage – II project during construction & operation phase	9-2
Table 9-2: Environmental Costs/Impacts	9-2
Table 9-3: Evaluation of benefits from the proposed Stage – II Project	9-3
Table 10.1: Details of existing Ash Dyke	10-4
Table 10.2: Details of proposed Ash Dyke	10-6
Table 10.3: Ash Utilization Report from 2019-20 up to 2023-2024	10-6
Table 10.4: Ash Utilization Plan from FY 2024-25 to FY 2032-33	10-8
Table 10.5: Solar Rooftop on various buildings of Under Stage-I	10-10
Table 10.6: Tree Plantation from 2014-15 up to 2023-2024	10-13
Table 10.7: Green Belt details	10-15
Table 10.8: Green Belt Development Plan from 2024-25 up to 2030-2031	10-17
Table 10.9: Recharge potential of the Project Area	10-20
Table 10.10: Rainwater harvesting action plan	10-23
Table 10.11: Environment Management Cost Provisions	10-24

FIGURES

Figure 1.1: Location Map for the Proposed Project	1-5
Figure 1.2: Coordinate Map for the Proposed Project	1-6
Figure 1.3: Power Generation from all sources over previous seven years	1-9
Figure 1.4: Coal Based power generation over previous seven years	1-9
Figure 1.5: Peak Demand and Energy requirement forecast for 2029-30	1-11
Figure 1.6: Study area map	1-21
Figure 2.1: Plant Layout (Existing & Proposed)	2-5
Figure 2.2: Process Diagram for Coal Based Thermal Power Plant	2-13
Figure 2.3: Water Balance Diagram	2-19
Figure 2.4: Ash Water Recirculation	2-27
Figure 2.5: Existing Ash Pond	2-29
Figure 2.6: Proposed Ash Pond	2-30
Figure 2.7: Organization Structure of Environment Management Group	2-38
Figure 3-1: 10km buffer zone on Toposheet	3-2
Figure 3-2: Coordinates of Project Site	3-5
Figure 3-3: Location Connectivity of Project Site	3-6
Figure 3-4: Environmental-sensitivity Map of 15 km radius of project site	3-8
Figure 3-5: Statistical Representation of Land use of study area	3-10
Figure 3-6: Land use of Study Area	3-11
Figure 3-7: Contour Map of Study Area	3-12
Figure 3-8: False Colour Composite map of Study Area	3-13
Figure 3-9: Digital Elevation Model map of Study Area	3-15
Figure 3-10: Physiography Map	3-17

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 3-11: Drainage of Study Area	3-18
Figure 3-12: Slope Map of Study Area	3-19
Figure 3-13: Geomorphology Map Madhya Pradesh	3-21
Figure 3-13A: Geological and Mineral map of Madhya Pradesh.....	3-22
Figure 3-14: Hydrogeology Map of Madhya Pradesh	3-24
Figure 3-15: Depth to water level Pre-monsoon district Narsinghpur.....	3-26
Figure 3-16: Depth to water level Post-monsoon district Narsinghpur	3-26
Figure 3-17: Earthquake Hazard Map of Madhya Pradesh	3-27
Figure 3-18: Wind Hazard map of Madhya Pradesh	3-28
Figure 3-19: Soil sampling for location photographs	3-30
Figure 3-20: Soil Sampling Locations	3-31
Figure 3-21A: pH of the soil sample.....	3-35
Figure 3-22: Availability of Soil Nutrients (NPK) status with pH class	3-36
Figure 3-23: Conductivity of the Soil sample.....	3-37
Figure 3-24: Textural triangle showing 12 classes with black dots pointing to the classified soil sample. (Reprinted from USDA-NRCS, 1999).....	3-37
Figure 3-25: Gravitational, plant-available and plant-unavailable water content for various soil texture	3-38
Figure 3-26: Organic Carbon & Organic Matter status of soil samples	3-40
Figure 3-27: Temperature as per IMD	3-43
Figure 3-28: Rainfall as per IMD.....	3-44
Figure 3-29: Relative Humidity as per IMD.....	3-44
Figure 3-30: Wind Rose Diagram	3-45
Figure 3-31: Wind Rose Diagram (Pre-Monsoon).....	3-48
Figure 3-32: Air Sampling Locations	3-51
Figure 3-33: 98 percentile of PM10 in $\mu\text{g}/\text{m}^3$	3-56
Figure 3-34: 98 percentile of PM2.5 in $\mu\text{g}/\text{m}^3$	3-56
Figure 3-35: 98 percentile of Sulphur Dioxide (SO_2) in $\mu\text{g}/\text{m}^3$	3-57
Figure 3-36: 98 percentile of Nitrogen Dioxide (NO_2) in $\mu\text{g}/\text{m}^3$	3-58
Figure 3-37: 98 percentile of Carbon Monoxide (CO) in mg/m^3	3-58
Figure 3-38: Ambient Air quality monitoring	3-60
Figure 3-39: Noise Monitoring Locations	3-62
Figure 3-40: Noise levels recorded at the monitoring stations	3-63
Figure 3-41: Noise sample collection for summer season	3-65
Figure 3-42: Ground water sample collection for one season	3-67
Figure 3-43: Water sampling locations	3-68
Figure 3-44: Surface water sample collection for Pre-monsoon season.....	3-78
Figure 3-45: pH of the GW sample of study area	3-84
Figure 3-46: EC & TDS of the GW sample of study area	3-84
Figure 3-47: Correlation between EC & TDS	3-85
Figure 3-48: TH, Ca^{2+} & Mg^{2+} of the GW sample	3-85
Figure 3-49: Correlation between pH & Alkalinity	3-86
Figure 3-50: Fluoride concentration of the GW samples.....	3-86
Figure 3-51: Groundwater Sampling Locations at Hotspot (Hand Pump).....	3-89

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 3-52: Traffic Density Map.....	3-100
Figure 3-53: Forest cover map of Madhya Pradesh.....	3-102
Figure 3-54: Terrestrial & Aquatic Ecology Study Locations	3-107
Figure 3-55: Terrestrial Ecology Study.....	3-112
Figure 3-56: Demographic Profile of Study Area.....	3-122
Figure 3-57: Vulnerable Population in the Study Area	3-123
Figure 3-58: Literacy Rate in the Study Area	3-124
Figure 3-59: Category of workers in the Study Area	3-125
Figure 3-60: Public Consultation in Study Area	3-129
Figure 4-1: SO ₂ Incremental Ground Level Concentration (Max. GLC 6.66 μ g/m ³ at 1.10 km in SSE direction).....	4-28
Figure 4-2: NO ₂ Incremental Ground Level Concentration @100 mg/Nm ³ (Max. GLC 5.87 μ g/m ³ at 1.10 km in SSE direction).....	4-29
Figure 4-3: NO _x Incremental Ground Level Concentration @300 μ g/m ³ (Max. GLC 17.6 μ g/m ³ at 1.10 km in SSE direction).....	4-30
Figure 4-4: PM ₁₀ Incremental Ground Level Concentration (Max. GLC 1.76 μ g/m ³ at 1.10 km in SSE direction).....	4-31
Figure 4-5: PM _{2.5} Incremental Ground Level Concentration (Max. GLC 0.58 μ g/m ³ at 1.10 km in SSE direction).....	4-32
Figure 4-1A: SO ₂ Incremental Ground Level Concentration (Max. GLC 62.1 μ g/m ³ at 1.82 km in SE Direction) without control measures.....	4-34
Figure 4-2A: NO ₂ Incremental Ground Level Concentration @100 mg/Nm ³ (Max. GLC 2.82 μ g/m ³ at 0.9 km in SE Direction) without control measures	4-35
Figure 4-3A: NO _x Incremental Ground Level Concentration @300 μ g/m ³ (Max. GLC 8.45 μ g/m ³ at 1.82km in SE Direction) without control measures	4-36
Figure 4-4A: PM ₁₀ Incremental Ground Level Concentration (Max. GLC 0.845 μ g/m ³ at 1.82 km in SE Direction) without control measures	4-37
Figure 4-5A: PM _{2.5} Incremental Ground Level Concentration (Max. GLC 0.286 μ g/m ³ at 0.90 km in SE Direction) without control measures	4-38
Figure 4-6 Noise Dispersion Contours	4-44
Figure 4-7 Ash transportation route map.....	4-53
Figure 4-8 Difference in ESIA & CIA.....	4-54
Figure 4-9 Environmental-sensitivity Map of 15 km radius of project site.....	4-58
Figure 4-10 98 Percentile of PM ₁₀ in μ g/m ³	4-59
Figure 4-11 98 Percentile of PM _{2.5} in μ g/m ³	4-60
Figure 4-12 98 Percentile of Sulphur Dioxide (SO ₂) in μ g/m ³	4-61
Figure 4-13 98 percentiles of Nitrogen Dioxide (NO ₂) in μ g/m ³	4-61
Figure 4-14 Carbon Monoxide (CO) in mg/m ³	4-61
Figure 6-1 Infrastructure at Plant.....	6-9
Figure 7-1 Structure of Disaster Management Team	7-76
Figure 7-2: Structure of Disaster Management Team.....	7-76
Figure 7-3: First information chart and incident information	7-77

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 8-1 CD Activities at Village Dongargaon	8-5
Figure 8-2 Girl Empowerment Mission	8-6
Figure 8-3 CSR-CD Activities in nearby villages.....	8-7
Figure 8-4 CSR-CD Activities in nearby villages.....	8-8
Figure 8-5 CSR-CD Activities in nearby villages.....	8-9
Figure 10.1: Plantation of saplings	10-13
Figure 10.2: Plantation Plan.....	10-18
Figure 10.3: Environment Management System	10-25
Figure 11.1: Study Area Map.....	11-11

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT
AND ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: M/s NTPC Ltd. (A Government of India Enterprise)



ANNEXURES

Annexure No.	Particulars
Annexure-1.1	Gadarwara STPP Stage-II ToR
Annexure-1.2	Environmental Clearance
Annexure-1.3	Amendments in EC
Annexure-1.4	IRO certified EC compliance and Action taken report
Annexure-1.5	Request letter for review/closure of IRO observation
Annexure-1.6	Copy of CTE for Stage-I
Annexure-1.7	Emission Consent Order for Stage-I & Discharge Consent Order for Stage-I
Annexure-1.8	Hazardous Waste Authorization for Stage-I
Annexure-1.9	Bio-Medical Waste Authorization
Annexure-1.10	Site visit by EAC sub-committee
Annexure-1.11	Letter for HFL of River
Annexure-2.1	Coal Linkage SLC MOM 13.02.2024
Annexure-2.2	Coal Linkage CIL Letter 20.06.2024
Annexure-2.3	Coal Analysis
Annexure-2.4	Radio Activity in Coal
Annexure-2.5	Water Allocation Govt. of MP 19.05.2008 to 19.02.2024
Annexure 2.5A	Certificate regarding maintaining of minimum environmental flow in the river
Annexure-2.6	Water balance chart
Annexure-2.7	Layout Plan
Annexure-2.8	Land Acquisition
Annexure-3.1	Certificate regarding no nation park, wildlife sanctuary, distance from the protected area
Annexure-3.2	List of flora & fauna authentication
Annexure-3.3	Test Report of Soil
Annexure-3.4	Test Report of Ambient Air Quality
Annexure-3.5	Test Report of Noise
Annexure-3.6	Test Report of Water
Annexure 3.7	104 observations (annual average as well as 24 hrs)
Annexure 3.8	Storm Water Management Plan Map

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT
AND ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: M/s NTPC Ltd. (A Government of India Enterprise)



Annexure No.	Particulars
Annexure-4.1	Break-up of the existing and proposed Greenbelt/ plantation
Annexure-4.2	ETP and STP report
Annexure-7.1	Public hearing Minutes
Annexure-7.2	Hydrogeological Report
Annexure-7.3	Watershed Development Gadarwara
Annexure-7.4	Details of court cases-Gadarwara STPP
Annexure-7.5	Vision Doc Gadarwara II
Annexure-7.6	Biodiversity Conservation Plan & Wildlife Management Plan
Annexure-7.7	Biodiversity Analysis Report
Annexure-7.8	Impact of water intake due to Gadarwara STPP on ecology of Narmada River
Annexure-8.1	Gadarwara CSR- CD activities
Annexure-10.1	NTPC-Environment-Policy-2022
Annexure-10.2	Manpower Details
Annexure-10.3	MoU letters for Ash Utilization and Annual Ash compliance report
Annexure-10.4	Ek Ped Maa ke Naam Campaign
Annexure-10.5	Action Plan for Afforestation in Nearby villages
Annexure-10.6	Action plan for development of Green Belt
Annexure-12.1	NABET Disclosure
Annexure-12.2	NABL Certificate

ToR Compliance

ToR Compliance of Gadarwara STPP, village Gangai, Mehrakheda, Chorbarheta, Dongergaon etc, Sub District Gadarwara, District Narsinghpur, Madhya Pradesh, Vide letter no. **File No: J-13012/125/2009-IA.II(T) dated 30/09/2024 by MoEF&CC.**

S. No.	Conditions	Reply
	Specific	
1.	[B] Disaster Management	
1.1	A Disaster Management Plan shall be prepared and incorporated in the EIA/EMP report.	Disaster Management Plan regarding on-site and off-site disasters are given in Chapter 7, Section 7.5.
2.	[C] Socio-economic Study	
2.1	The Public Health Delivery Plan including the provisions for drinking water supply for the local population shall be in the EIA/EMP Report. The status of the existing medical facilities in the project area shall be discussed. Possibilities of strengthening of existing medical facilities, construction of new medical infrastructure etc. will be explored after assessing the needs of the labour force and local populace.	A 25-bedded Jeevan Jyoti Hospital of NTPC Gadarwara has been provided with facilities for all routine and emergency services for all its beneficiaries. In addition, a Plant First AID Centre is also available in the plant premises. The hospital provides OPD, IPD, Pathology, and X-Ray services, 24x7 emergency services to the displaced people at concessional rates at the rate of 20% of non-entitled charges for OPD. Apart from this, from time to time, rural medical camps (with free medicine distribution), specialty camps (anemia identification, NCD screening, etc.), health awareness camps (common diseases, prevention of anemia, etc.), free TB testing (National TB Control Program), breast cancer awareness and screening, anemia identification and iron distribution camps, menstrual hygiene awareness and sanitary kit distribution are organized in the nearby villages. Apart from the above, NTPC Gadarwara is also going to initiate mobile health vans under community responsibility. Essential basic medical facilities are provided at Jeevan Jyoti Hospital in NTPC Gadarwara. In addition, NTPC regularly organizes health camps and distribution of free medicines in project affected villages. Gadarwara STPP has taken following initiatives for ensuring Drinking water supply and related infrastructure: 1. Supply of Water coolers, 2. Water supply pipeline to local population, 3. Purchase & Installation Water ATMs, 4. Construction of shed for Water ATM, 5. Installation & opening of Pyau (water), 6. Potable Water arrangement for labours through PAPs and 7. Installation of industrial water cooler for Railway station. Further, various initiatives related to Drinking water supply for the local population have been proposed under Stage-II is given in Table 7.3, Chapter 7.

ToR Compliance

S. No.	Conditions	Reply
		Details of existing medical facilities in the study area are given in Chapter 3, Section 3.13.5. Provisions regarding Development of Health Infrastructure, conducting Medical Camps etc are being done and also envisaged under proposed expansion project. Budget for CSR/CER activities for year 2025-26 is 489.56 Lakhs and 2026-2027 is 618.96 Lakhs has been given in Chapter 8, Table 8.3. Further provision regarding preventive health care and sanitation have been made for compliance to issues raised in public hearing and budget for the same is given in Chapter 7, Table 7.3 and 7.4.
2.2	Public consultation (Public Hearing and Written submission) shall be conducted as per the provisions of EIA Notification, 2006 and as amended. As per the Ministry's OM dated 30.09.2020, to address the concern raised during the Public Hearing, the Project Proponent is required to submit the detailed activities proposed with year wise budgetary provision (Capital and recurring) for 10 years. Activities proposed shall be part of EMP. Tentative no. of project affected families (if any) shall be identified and accordingly appropriate Rehabilitation & Resettlement plan shall be prepared. The recommendation Socio-economic study may also be considered while planning the activities & budget.	Details of public hearing proceedings with written submissions have been included in Annexure-7.1 of Final EIA Report. The action plan to address the issues raised in the Public Hearing contains budgetary provisions and estimated timelines for completion of the works. Responses for repeating or issues of same nature have been integrated through references. The above details have been included in chapter 7 section 7.2, table 7.2, 7.3 and 7.4. The activities proposed to address the issues raised in public hearing have been incorporated in Environment Management Plan given at section 10.9.1 Chapter-10. In line with MoEF&CC OM dated 30.9.2020, the costs of the activities proposed to address issues raised in Public Hearing are additional to the Environmental Protection and Conservation measures and shall be restricted to the affected area around the project. Activities like supply of drinking water, health and sanitation, construction and repair of infrastructure for schools/roads/drains, plantation etc. have been proposed which are in compliance to MoEF&CC office memorandum. Other activities like pollution control measures, Water Conservation, Rainwater harvesting, Solar PV etc. have been covered in EMP budget given at Table 10.11. Socio-economic study and stakeholder consultation details have been given in Chapter 3 Section 3.13.6 & Table 3.63. Proposed activities and budget provisions have been covered in provisions for Public Hearing issues, Community Development and Corporate Social Responsibility budget heads. Activities proposed for EMP have been given in Chapter 10, Table 10.11.
2.3	A need based Social Impact Assessment Study shall also be carried out and an action plan on its	A Socio-economic survey and stakeholder consultation in the 10 km has been carried out during month of March 2024 to May 2024.

ToR Compliance

S. No.	Conditions	Reply
	recommendations may also be submitted with budgetary provisions.	Budgetary provision is given Chapter 7, Table 7.3 and 7.4 and Chapter 8, Table 8.3 based on the issues raised during social study.
2.4	Demographic details in 10 km area shall be submitted.	There are 125 villages and the population is 143280 in 10 km of the project boundary. Demographic details in 10 km area are given in Chapter 3, Section 3.13
3.	[D] Miscellaneous	
3.1	Plot the wind rose diagram using the typical meteorological year (TMY) data for the period considered for the study. The monitoring units shall be deployed in the field based on the coverage area ratio and direction of the wind. A mathematical model shall be developed for the local site rather than using the standard model available in software for both air & water quality modelling.	Weather station (Automatic Weather Station SSEC AWS 10W) has been installed at site and wind rose has been plotted based on the data. Secondary data has also been considered from IMD Narsinghpur & IMD Bhopal. A mathematical model has been used to locate the monitoring stations. A Coverage Factor concept was used for determining the location of AAQ monitoring stations. A large number of stations were identified as potential monitoring stations all around the project. Wind rose diagram is given in Chapter 3, Figure 3-31 . Secondary data of IMD for the period 1991-2020 and one site meteorological data March 2024 to May.2024 have been analyzed for determination of weather parameters. Air Quality modelling has been done using AERMOD Ver 9.9.1.
3.2	PP shall align its activities to one/few of the Sustainable Development Goals (SDG) and start working on the mission of net zero by 2050. PPs shall update the same to the EAC.	The activities of proposed project have been aligned with Sustainable Development Goals (SDG) and details given in Chapter-2, Section 2.10.6 . NTPC is committed to inclusive development and will further strengthen its activities for improvement in education, sanitation and health, livelihood, rural infrastructure, plantation drives and rural sports. The CER activities are aligned with majority of the SDG goal like Goal no. 3 – good health and well-being, 4 – quality education, 5 – gender equality, 6 – clean water and sanitation, 8- Decent Work and Economic Growth, 9- industry, innovation and infrastructure, 10- Reduced Inequalities, 13-Climate Action, 14- Life Below Water, 15- Life on Land, 17- Partnerships for the Goals. Existing and Proposed CER and CSR activities are aligned with SDGs. Details given in Chapter 7, Table 7.3 and 7.4 and Chapter 8, Table 8.3 . NTPC has taken initiatives for reduction of emissions and increasing the future capacity additions through renewable sources like solar, wind, hydro etc.
3.3	PP shall submit the EIA/EMP report after the plagiarism check using authenticated plagiarism software.	Plagiarism check using authenticated plagiarism software has been done and given in Final EIA/EMP Report.
3.4	Detailed description of all the court cases including all directions given by	There are 17 court cases pending of which mostly are related to land acquisition related to Gadarwara STPP

ToR Compliance

S. No.	Conditions	Reply
	the apex and currents status of them shall submit.	Stage-I. Details like Summary & List of court cases are given in Annexure 7.4 .
3.5	PP should provide in the EIA Report details of all the statutory clearances, permissions, no objection certificates, consents etc. required for this project under various Acts, Rules and regulations and their status or estimated timeline after grant of EC.	Details of all the statutory clearances, permissions, no objection certificates, consents etc. given in Annexure 1.2 to 1.9 for Stage-I. All applicable statutory clearances, permissions, no objection certificates, consents etc. shall be taken before start of the construction and/or operation of Stage-II as per the norms. Details of statutory clearances, permissions, no objection certificates, consents etc. has been given in Table 1.9, Chapter 1 .
3.6	The PP should submit the photograph of monitoring stations & sampling locations. The photograph should bear the date, time, latitude & longitude of the monitoring station/sampling location. In addition to this PP should submit the original test reports and certificates of the labs which will analyze the samples.	Geo-tagged photographs of the monitoring locations with date, time, latitude & longitude of the monitoring station/sampling location are provided in Chapter 3, Figure 3.19, 3.38, 3.39, 3.42, 3.44, 3.55 and 3.60 . The original test reports and certificates of the labs which has analyze the samples are given in Annexure 3.3-3.6 .
3.7	PP should clearly bring out the details of the manpower to be engaged for this project with their roles /responsibilities/designations. In addition to this PP should mention the number and designation of persons to be engaged for the implementation of environmental management plan (EMP). The capital and recurring expenditure to be incurred needs to be submitted.	Permanent manpower to be employed during construction and operation phases are approx. 96 and 186 respectively. The number of temporary work-force to be employed during construction phase by the EPC contractors would be much higher (about 2000-2500 during peak deployment). Details given in Chapter 8, Section 8.4 . Manpower details with general roles /responsibilities are given in Annexure 10.2 . Environment Management Group has been established at Gadarwara STPP for ensuring effective implementation of the EMP. The head of site EMG is directly reporting to the Head of the Project/Plant. A capital cost provision of 2015.44 Cr towards environmental protection measures/EMP and the recurring cost of Rs. 40.16 Cr per annum is proposed. Details given in Chapter 10, Table 10.11 .
3.8	PP should submit the year-wise, activity wise and time bound budget earmarked for EMP, occupational health surveillance, and activities proposed to address the issues raised during Public Hearing. The capital and recurring expenditure to be incurred needs to be submitted.	Details of year-wise, activity wise time bound budget earmarked for issues raised during Public Hearing is given in Chapter 7, Table 7.2, 7.3 & 7.4 . Budgetary provisions of Rs.1150 Lakhs for public hearing issues and Community Development works. Provisions regarding regular CSR/CER activities for year 2025-26 is Rs.489.56 Lakhs and 2026-2027 is Rs.618.96 Lakhs which is given at Chapter 8, Table 8.3 . A capital cost provision of 2015.44 Cr towards environmental protection measures/EMP and the recurring

ToR Compliance

S. No.	Conditions	Reply
		cost of Rs. 40.16 Cr per annum is proposed. Details given in Chapter 10, Section 10.11.
3.9	Activities shall be prepared based on the issues arise during previous public hearing conducted and fresh written submission with defined timeline and budgetary provisions.	Details of issues raised in Public Hearing and action plan with budgetary provision has been addressed in Chapter 7, Section 7.1 and Table 7.2, 7.3 and 7.4 in Final EIA/EMP Report.
3.10	Aerial view video of project site and transportation route proposed for this project shall be recorded through drone and be submitted.	Aerial view video of project site and transportation route proposed for the project has been prepared through drone and shall be submitted and shown during the EAC presentation.
3.11	The PP should ensure that only NABET-accredited consultants shall be engaged for the preparation of EIA/EMP Reports. PP shall ensure that the accreditation of the consultant is valid during the collection of baseline data, preparation of EIA/EMP report and the appraisal process. The PP and consultant should submit an undertaking the information and data provided in the EIA Report and submitted to the Ministry are factually correct and the PP and consultant are fully accountable for the same.	NABET-accredited consultant, M/s. Greencindia Consulting Private Limited, Ghaziabad has been engaged for preparation of EIA/EMP Reports. The present accreditation of the consultant is valid upto 22.02.2026. Certificate for the same is attached as Annexure no. 12.1. Undertakings of PP and consultant have been included in EIA Report.
3.12	PP should provide in the EIA Report details of the statutory clearances, permissions, no objection certificates, consents etc. required for this project under various Acts, Rules and regulations and their status or estimated timeline after the grant of EC.	Copies of all the statutory clearances, permissions, no objection certificates, consents etc. required for this project under various Acts, Rules and regulations are given in Annexures 1.2-1.9. Details of statutory clearances, permissions, no objection certificates, consents etc. has been given in Table 1.9, Chapter 1. Required clearances like Consent to Establish, Consent to Operate etc. for the proposed project shall be obtained from the concerned regulatory authorities before the commissioning of the operations.
3.13	The budget to be earmarked for the various activities shall be decided after perusal of the Standard EC Conditions published by the Ministry.	Activity wise EMP budget has been prepared in line with the standard EC conditions and the same is given in Chapter 10, Table 10.11
3.14	All the certificates viz. Involvement of Forest land, distance from the protected area, and list of flora & fauna should be duly authenticated by the Forest Department. The Certificate should bear the name, designation, official seal of the person signing the certificate and dispatch number.	There is no additional land acquisition and no involvement of forest land for the proposed project. Certification from divisional forest officer regarding no involvement of forest land, distance from the protected area, and list of flora & fauna is enclosed as Annexure 3.1.

ToR Compliance

S. No.	Conditions	Reply												
4.	Specific Conditions													
4.1	A Cumulative Environmental Impact Assessment study of all the existing and proposed projects in the 10-km radius of the proposed project shall be conducted and the same shall be included in the EIA/EMP report. Details of industrial units present in 10 Km radius of the power plant shall be submitted.	Existing Gadarwara STPP Stage I (2*800 MW) these under operation which has been considered in cumulative environmental impact assessment. There are no major industries within 10 Km radius except one sugar mill at a distance of 7.51 Km. However, Cumulative Impact Assessment has been incorporated in the section 4.10, chapter 4 of Final EIA Report. Details regarding Impact on air quality due to movement of vehicles including ash transportation vehicles/dumpers has been given at section 4.9 in compliance to Specific ToR No. 4.1.												
4.2	Detailed Impact assessment shall be carried out due to change in source of coal along with proper mitigation measure and EMP budget.	Presently coal supply for Gadarwara STPP Stage-II (2x800 MW) is planned from MCL & SECL coal mines vide letter dated 20.06.2024. Report of coal analysis study is given in Annexure 2.4. <table border="1"> <thead> <tr> <th>Parameters</th><th>Units</th><th>Range</th></tr> </thead> <tbody> <tr> <td>Ash Content</td><td>%</td><td>29-43</td></tr> <tr> <td>Sulphur</td><td>%</td><td>0.3-0.55</td></tr> <tr> <td>GCV</td><td>Kcal/Kg</td><td>3200-4450</td></tr> </tbody> </table> Proper mitigation measure and EMP budget has been given in Chapter 10, Table 10.11. Impact Assessment shall be carried out in future if the coal source is changed, as per prevailing norms of the MoEF&CC.	Parameters	Units	Range	Ash Content	%	29-43	Sulphur	%	0.3-0.55	GCV	Kcal/Kg	3200-4450
Parameters	Units	Range												
Ash Content	%	29-43												
Sulphur	%	0.3-0.55												
GCV	Kcal/Kg	3200-4450												
4.3	Impact of release of cooling tower water on marine life need to be studied by reputed govt. institute and measures implemented.	Air-Cooled Cooling systems and Zero Liquid Discharge (ZLD) system has been envisaged in the proposed project. Hence, there shall be no discharge outside the plant premises.												
4.4	Brine disposal and Management plan shall be studied and to be incorporated in EIA/EMP study.	The reject from RO plant shall be utilized in coal handling plant for dust suppression etc. All other effluent will be reused, recycled to maintain Zero Liquid Discharge (ZLD) system.												
4.5	Radioactivity studies along with coal analysis to be provided (sulphur, ash percentage and heavy metals including Pb, Cr, As and Hg). Details of auxiliary fuel, if any including its quantity, quality, storage, etc should also be given.	Report of coal analysis study is given in Annexure 2.3. Radioactivity studies has been conducted alongside coal analysis. Reports has been attached as Annexure no. 2.4 <table border="1"> <thead> <tr> <th>Parameters</th><th>Units</th><th>Range</th></tr> </thead> <tbody> <tr> <td>Uranium (U-238)</td><td>Bq/kg</td><td>3.7 to 14.9</td></tr> <tr> <td>Thorium (Th-232)</td><td>Bq/kg</td><td>3.1 to 42.2</td></tr> </tbody> </table> Two new LDO tanks with a capacity of 2500 KL each are planned, and a containment dyke for LDO storage is envisaged. Details given in Chapter 2, Section 2.2.2.1 and 2.2.2.2	Parameters	Units	Range	Uranium (U-238)	Bq/kg	3.7 to 14.9	Thorium (Th-232)	Bq/kg	3.1 to 42.2			
Parameters	Units	Range												
Uranium (U-238)	Bq/kg	3.7 to 14.9												
Thorium (Th-232)	Bq/kg	3.1 to 42.2												

ToR Compliance

S. No.	Conditions	Reply
4.6	A comparative chart shall be prepared with changes observed from the previous baseline study and present baseline study.	Comparative study and chart with previous baseline study is given in Chapter 3, section 3.10.5 .
4.7	Certified compliance report shall be submitted along with ATR and comments of RO on the existing EC.	Certified compliance report for Gadawara STPP Stage-I has been given by Regional Office (RO) of the MoEF&CC and Action taken report on CCR is attached as Annexure 1.5 . Gadawara STPP vide letter dated 22/01/2025 and 20/02/2025 has further requested IRO for comments on Action Taken Report and closure of observation.
4.8	PP should submit the detailed plan in tabular format (year-wise for the life of the project) for concurrent afforestation and green belt development in and around the project site. The PP should submit the number of saplings to be planted, names of native species, area to be covered under afforestation & green belt, location of plantation, target for survival rate and budget earmarked for the afforestation & green belt development. In addition to this, PP should show on a surface plan (5- year interval for life of project) of suitable scale the area to be covered under afforestation & green belt clearly mentioning the latitude and longitude of the area to be covered during each 5 years. The capital and recurring expenditure to be incurred needs to be submitted. Plantation plan should be prepared in such a way that 80% of the plantation to be carried out in first 5 years and for the remaining years the proposal for gap filling. The seedling of height not less than 2 meters to be selected and accordingly cost of plantation needs to be decided. In addition to this, plantation in the safety zone at project boundary the plantation should be planned in such a way that it should be completed within 2 years only.	Gadawara STPP has carried out Greenbelt Development / Plantation on 150 Acres as per EC for Stage-I. NTPC Gadawara has carried out plantation on 7.740 Ha inside the main plant premises and 58.628 Ha adjacent to the main plant and periphery. Approx. 83,639 trees have been planted under Gadawara STPP Stage-I. Further, 90.412 Ha of greenbelt is proposed adjacent to the main plant boundary and periphery. Total green belt area of 156.780 Ha has been identified within main plant premises out of which 66.368 Ha. green belt development has been completed and green belt on 90.412 Ha. is proposed under Stage-II. The greenbelt shall have 3-tier plantation as per the CPCB guidelines with re-densification & strengthening of existing greenbelt. Afforestation efforts have been undertaken around the plant site. NTPC Gadawara has carried out plantation on 181.17 Ha outside the plant premises in consultation with State Forest Department. Approx. 4,50,000 trees have been planted under Gadawara STPP Stage-I. Additional afforestation initiatives will continue to be implemented across all feasible areas surrounding the project site in consultation with Madhya Pradesh Rajya Van Vikas Nigam Limited (MPRVNL). This includes the identification and utilization of any available spaces for planting trees and promoting green cover to enhance environmental sustainability and biodiversity in the region. Detail plan regarding afforestation and green belt development in and around the project site has been prepared and given in Table 4.12 & 4.13, Chapter 4 and Chapter 10, Table 10.7. A plan of afforestation & greenbelt development clearly mentioning the latitude and longitude of the area with survival and budget provisions has been prepared and given in Annexure 4.1. The same has been submitted to Forest Dept. for consultation and finalization.

ToR Compliance

S. No.	Conditions	Reply																												
		An expenditure of Rs. 248.63 lakhs is estimated for the next 7 years. A layout plan for plantation & green belt is given at Chapter 10, Table 10.7 & Figure 10.2.																												
4.9	Action plan for development of three tier plantation programme (33 % of total project cover area) along the periphery of the project boundary shall be provided. Plan shall be dully approved by the local forest department. PP shall submit concurrent plantation plan.	NTPC Gadarwara has carried out plantation on 7.740 Ha inside the main plant premises and 58.628 Ha adjacent to the main plant and periphery. Approx. 83,639 trees have been planted under Gadarwara STPP Stage-I. Further, 90.412 Ha of greenbelt is proposed adjacent to the main plant boundary and periphery. Total green belt area of 156.780 Ha has been identified within main plant premises out of which 66.368 Ha. green belt development has been completed and green belt on 90.412 Ha. is proposed under Stage-II. The greenbelt shall have 3-tier plantation as per the CPCB guidelines with re-densification & strengthening of existing greenbelt. Action Plan has been submitted to forest department for necessary approval. Copy enclosed as Annexure 10.6. Details given in Table 4.12 & 4.13, Chapter 4 and Chapter 10, Table 10.7 and Figure 10.2																												
4.10	Biodiversity analysis of the surrounding area to be done through any reputed Government institutions.	Biodiversity analysis of the surrounding area has been done by Biodiversity and Wildlife Conservation Laboratory, Department of Zoology, University of Lucknow, Lucknow, Uttar Pradesh and attached as Annexure 7.7																												
4.11	A detailed plan needs to be submitted for undertaking extensive green plantation within 10 km radius of the plant focusing on water reservoir, school, hospital and other institutional area and same need to be incorporated in EIA/EMP report.	A detailed plan undertaking extensive green plantation within 10 km radius of the plant focusing on water reservoir, school, hospital and other institutional area has been prepared and is under consultation with concerned authorities for approval/implementation. As enclosed as Annexure 10.5.																												
4.12	Detailed action plan shall be prepared for maintenance of air pollution control equipment for proposed and existing units and shall be incorporated in EIA/EMP report.	Details of air pollution control equipment for proposed and existing units is given in Chapter 6, Section 6.2.																												
4.13	Details of Ash management of 5-year plan for 100 % ash utilization for proposed project shall be submitted. MoU signed for ash utilization with companies shall be submitted.	Ash production and ash utilization (AU) details over the years has shown an increasing trend. <table><tr><th>FY in Year</th><th>Ash Production (LMT)</th><th>Total AU (LMT)</th><th>Total AU (%)</th></tr><tr><td>FY 2019-20</td><td>2.88</td><td>0.02</td><td>0.69</td></tr><tr><td>FY 2020-21</td><td>9.44</td><td>0.78</td><td>8.26</td></tr><tr><td>FY 2021-22</td><td>16.85</td><td>6.35</td><td>37.66</td></tr><tr><td>FY 2022-23</td><td>19.59</td><td>14.30</td><td>73.00</td></tr><tr><td>FY 2023-24</td><td>21.10</td><td>23.03</td><td>111.69</td></tr><tr><td>FY 2024-25</td><td>21.72</td><td>17.85</td><td>82.19</td></tr></table>	FY in Year	Ash Production (LMT)	Total AU (LMT)	Total AU (%)	FY 2019-20	2.88	0.02	0.69	FY 2020-21	9.44	0.78	8.26	FY 2021-22	16.85	6.35	37.66	FY 2022-23	19.59	14.30	73.00	FY 2023-24	21.10	23.03	111.69	FY 2024-25	21.72	17.85	82.19
FY in Year	Ash Production (LMT)	Total AU (LMT)	Total AU (%)																											
FY 2019-20	2.88	0.02	0.69																											
FY 2020-21	9.44	0.78	8.26																											
FY 2021-22	16.85	6.35	37.66																											
FY 2022-23	19.59	14.30	73.00																											
FY 2023-24	21.10	23.03	111.69																											
FY 2024-25	21.72	17.85	82.19																											

ToR Compliance

S. No.	Conditions	Reply
		Plan for 100% Fly ash utilization for next 08 years including existing units and expansion units has been given in Annexure-10.3. Details of Ash management of existing (last 5 years) and proposed project is given in Chapter 10, Table 10.2. Signed MoU for ash utilization is given in Annexure 10.3.
4.14	Details of Dry Ash handling system along with the supplementary coal handling system shall be submitted.	A pneumatic conveying system, using either vacuum or pressure, will transfer dry fly ash from electrostatic precipitator hoppers. In a vacuum system, ash will move to buffer hoppers near the ESP, while in a pressure system, it will go to Intermediate Silos. From these, ash will be conveyed to a classification and bagging system, then to main storage silos with HCSD silos and loading facilities. Each unit will have five screw-type air compressors, refrigerant air dryers, and air receivers. User industries will collect the dry fly ash from main silos using tankers. Unutilized ash will be disposed of in concentrated form by the HCSD system into the ash dyke. Details given in Chapter 2, Section 2.9 Coal handling system given in Chapter 2, Section 2.7.1. Dry Ash handling system details given in Chapter 2, Section 2.9.2.
4.15	HFL data for Shakkar River & Sitarewa River along with the action plan for conservation of the same shall be submitted as the said rivers are flowing at a distance of 0.6 km in North-East towards North and 0.9 km South- West towards North direction of the project site.	Shakkar River & Sitarewa River are flowing at a distance of 0.6 km in North-East towards North and 0.9 km South West towards North direction respectively from the project site. Further, the Sitarewa river is merging into Shakkar river at a confluence point 4.5 km downstream of the project site in NW direction. Water Resource Department vide letter dated 15/10/2024 has given certificate regarding HFL level of Shakkar river at Gadarwara which is 332.47m recorded on 08.09.1999. The high flood data for 25 years has been issued by the authority and certificate is attached as Annexure-1.11 in compliance to OM dated 14.02.2022. The above referred letter also mentions that there is no location on Sitarewa river and only nearest location available on Shakkar river is Gadarwara. Hence, data of highest flood level of location Gadarwara river has been provided by Narmada Mandal Central Water Commission Bhopal. Project site elevation is at higher elevation of approx. 380 m as compared to elevation of Shakkar river which is approx. at 352 m and elevation of Sitarewa River which is approx. at 359m which shows there is considerable elevation difference between project site and rivers.

ToR Compliance

S. No.	Conditions	Reply
		An action plan for River Conservation has been prepared under Watershed Development plan and covered in the study report given as Annexure-7.3 of Final EIA Report.
4.16	Proper protection measures like HDPE lining, appropriate height of bund and adequate distance between the proposed Ash pond and water body (minimum 60 meters) etc. shall be planned to reduce the possibility of mixing leachate with any freshwater body for under-construction ash pond. A high-density Slurry disposal plan shall be prepared. No additional ash dyke area beyond the earmarked area of 326.277 ha is permitted.	For proposed new ash dyke, HDPE lining system is envisaged in OFL and Bentonite blended lining in ash storage lagoons following the imperviousness requirements as per “CEA and CPCB Guidelines for Design, Construction, O&M and Annual certification of Coal Ash Ponds-June 2023”. Also, the ash dyke stability design will be done by NTPC in line with “CEA and CPCB Guidelines for Design, Construction, O&M and Annual certification of Coal Ash Ponds-June 2023”. As per the MOEF&CC notification dated December 30, 2022, new or expanded thermal power plants must use 0.1 hectares per MW for ash dykes. For Stage-II, ash pond has been proposed in an area of 99.0 Ha. of land adjacent to Stage-I is well within the norms. The ash disposal plan includes two ash storage lagoons and one common Overflow lagoon will be accommodated in 99 Ha. Approx. 15% of ash pond area is occupied by dyke embankment, ash slurry pipeline corridor in dyke area, peripheral road for maintenance all along the periphery of the dyke, peripheral drain, AWRS & SWPH system facilities etc. for safe operation of dykes. Provision of High Concentration Slurry Disposal (HCSD) with silos and ash dyke has been envisaged. Details given in Chapter 2, Section 2.9.8.
4.17	Pond and ground water quality (10 locations within 2 km radius of the plant boundary) shall be studied and report be submitted along with EIA/EMP. Action plan for Ground water monitoring stations on all hotspots like schools/hospitals within 2 km radius of the plant boundary be submitted. Baseline Study for Heavy metals in Groundwater, Surface water and soil to be carried out and incorporated in EIA/EMP report.	Pond and groundwater quality samples were collected from the hotspots such as schools and hospitals located within 2 km radius from the TPP boundary The analysis details are provided in Tables 3.32 and 3.33. It was observed that all water samples collected within 2 km radius are well within the acceptable limits of IS 10500:2012. Details given in Chapter 3, Section 3.10.4.4. Action plan for Ground water monitoring stations on all hotspots like schools/hospitals within 2 km radius of the plant boundary has been given in Chapter 6, Table 6.5. Baseline Study for Heavy metals in Groundwater, Surface water and soil is carried out and incorporated in in Chapter 3 of EIA/EMP report.
4.18	Details pertaining to water source, treatment and discharge should be provided.	The Source of water for the Gadarwara Project is from River Narmada (25 Km). WRD, Govt. of Madhya Pradesh vide letter dated 19.05.2008 accorded water availability confirmation for 125 Cusecs from River Narmada to the project. However, as the capacity expansion at Gadarwara STPP was not

ToR Compliance

S. No.	Conditions	Reply
		envisaged by the year 2018-19, NTPC surrendered excess water allocation to WRD. Subsequently, WRD, Govt. of Madhya Pradesh vide its letter dated 09.09.2021 reduced the water allocation of the project from 125 Cusecs to 62.72 Cusecs. The consumptive water requirement for Stage-I (2x800 MW) having water cooled condenser is 48 Cusecs. Therefore, surplus water of 14.72 Cusecs is available with Gadarwara STPP. The project shall be provided with Air Cooled Condenser (ACC) and makeup water requirement for Stage-II having ACC would be about 48,000 KLD (2,000 m³/hr.) which is approx. 19.6 Cusec. As the project is a Zero Liquid Discharge project so, no water will be discharged to any waterbody. Details given in Chapter 2, Section 2.6. Details of water consumption and treatment system given in water balance diagram and enclosed as Annexure no. 2.6.
4.19	Liquid Discharge plan shall be submitted so as treated water can be use by the nearby people.	Details of water consumption and treatment system given in water balance diagram and enclosed as Annexure no. 2.6. To meet water demands, make-up water will be sourced from the existing supply and pumped to a Raw Water reservoir. A Make-up Water Pump will be installed at Stage-I's intake pump house, transporting water to the reservoir. A separate Raw Water Pump house has been envisaged for Stage-II. The system will include necessary instrumentation, PLC controls, and safety features to ensure efficient and reliable operation there by ensuring Zero Liquid Discharge (ZLD). Liquid effluent treatment plan details given in Chapter 2, Section 2.6.4.6. Treated wastewater envisaged to be reused recycled within the plant premises to maintained ZLD.
4.20	PP shall submit action plan for using treated Sewage/Domestic wastewater for its operations.	Effluent management will be a key focus, aiming to optimize water systems to minimize intake water needs and achieve zero wastewater discharge. For the better efficiency, COC of 5.0 has been envisaged for the proposed Aux. Cooling System. Effluent Treatment systems like Coal Slurry Settling Pits, Oil Water Separator Pits, Neutralization for DM Effluent, Sewage Treatment Plant etc. has been envisaged for treatment of the wastewater and reuse/recycling in plant premises ensuring Zero Liquid Discharge. Treated sewage water is proposed to be utilized in the Horticulture/Gardening works inside

ToR Compliance

S. No.	Conditions	Reply
		plant and township premises. Details given in Chapter 2, Section 2.10.2.
4.21	Project Proponent to conduct Environmental Cost Benefit Analysis for the project in EIA/EMP Report.	Cost Benefit Analysis for the project is 1:1.99. Details given in Chapter 9.
4.22	An action plan shall be prepared for Water shed development within 10 km radius of the plant boundary in consultation with reputed government institution and incorporated in EIA/EMP report.	Water shed development Plan within 10 km radius of the plant boundary has been prepared by Department of Forestry, Wildlife & Environmental Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) and summary given in Chapter 7, Section 7.13 and Final report is enclosed as Annexure 7.3.
4.23	PP should clearly bring out that what is the specific diesel consumption ~ (Liters/Tonne of total material handled) and steps to be taken for reduction of the same. The year-wise target for reduction in the specific diesel consumption needs to be submitted. PP shall also explore the possibility of using e-vehicles/LNG/CNG-based machinery and trucks for the operation and transportation of Coal and ash.	Specific diesel consumption reduction has been achieved during last two years. Details for the same are given in Section 2.2.2.2, Chapter 2. NTPC has deployed 21 nos. battery operated/ e-vehicles in various O&M functions and shall further explore use of E-vehicles/battery operated vehicles for the proposed expansion project. Coal is being supplied by Electric locos of Indian Railway. Ash is being transported through pipelines to the ash dyke. Further, rail loading facility is being developed for ash transportation through Indian railways. All the above efforts shall further reduce the oil consumption in operations as well as material handling like coal, ash, other goods etc.
4.24	PP shall provide the details of transportation of fly ash from the plant, transportation route etc. Further, carry out a traffic study for at least one month and provide the impact of transportation along with the mitigation measures.	Transportation of fly ash is being carried out by road through bulkers. Further, rail loading facility is being developed for ash loading and transportation. Existing Traffic density assessment was conducted at T1: Road Junction near 220KV substation, Chichli, T2: SH 22, Panari and T3: SH 22, Gadarwara. The existing traffic conditions shows A Level of service at T1 & T2 and B Level of service at T3, which implies a zone of stable flow. Impact of the road transportation and mitigation measures is provided in Table 4.6, Figure 4.7 showing the transportation route map in Chapter 4 of EIA report.
4.25	PP shall submit the action plan to adhere to the Plastic Waste Management Rules 2016 and to adhere Ministry's OM dated 18/07/2022.	Gadarwara STPP has implemented a comprehensive ban on single-use plastic across its premises, including both the plant and the township. This has been achieved through awareness programs, distribution of jute bags and banning of plastic at shopping markets. Vendors at nearby market places have also been discouraged to use single use plastic.
4.26	Details on renewable energy (solar plant) proposed to be installed as energy conservation measures shall be submitted.	Solar PV for Roof Top of various Buildings has been installed with a capacity of 1083.84 KW. Further 1125 KW of roof top solar PV is proposed on TG building under Stage-II.

ToR Compliance

S. No.	Conditions	Reply
4.27	PP shall provide the details of wastewater treatment facilities to be installed within its capacity, timeline and budget.	Wastewater treatment facilities already installed for Stage I and same has been proposed for Stage II. Capacity of proposed ETP is of 9240 KLD, with budget of 7.0 Cr capital and 0.14 Cr recurring has been proposed in Chapter 10, Table 10.11.
4.28	The input parameters for the AAQ modelling and the influence of various combinations of these on the AAQ must be reported in the EIA/EMP Report. In addition to the Wind Rose diagram collected for one season during the preparation of the E.I.A., wind rose diagram for all seasons must be provided using secondary data from sources such as IMD/CPCB etc.	The input parameters for the AAQ modelling and the influence of various combinations of the AAQ has been mentioned in Chapter 4, Section 4.4.1.3. One season (March 2024 to May 2024) wind rose has been given in Chapter 3, Figure 3.30 , whereas wind rose for all seasons provided using secondary data i.e IMD station Narsinghpur is also mentioned in Chapter 3, Figure 3.29.
4.29	NTPC shall take all necessary steps to control the Air Quality and take additional mitigation measures for both existing and proposed expansion to maintain the Ambient Air Quality values within the limits.	Various air quality control measures like High efficiency ESP, FGD, Low NOx burners & Separated Over Fire Air system for NOx control, Dust Extraction System, Dry Fog Dust Suppression System, Sprinklers and online monitoring systems for stack emissions/ambient air quality/effluent quality and plantation in and around the plant and township areas have already implemented in the existing units of Gadarwara STPP Stage-I (2x800MW). Besides the above, installation of additional Air Quality control measures have been undertaken under Stage-I: • Flue Gas Desulphurization (under implementation) • Sprinklers in Coal Handling, Ash dyke area, Internal & External Roads • Thick Plantation • Water tankers for ash transportation routes • Regular maintenance and overhauling of the system. Additional ambient air quality mitigation measures for both existing and proposed expansion have been given in Chapter 4, Table 4.6.
4.30	PP shall submit point wise compliance to all the points as mentioned in the Site-visit report submitted by the EAC Sub-committee as a separate annexure to the EIA/EMP report.	Point wise compliance of EAC site visit report comments are given in Annexure 1.10.
4.31	PP is advised to implement the 'Ek Ped Maa Ke Naam' Campaign which was launched on 5th June 2024 on the occasion of the World Environment Day to increase the forest cover across the Country. This plantation drive is other than Green belt development. An	NTPC has undertaken campaign to implement mass tree plantation under 'Ek Ped Maa Ke Naam' in addition to regular plantation activities. An action plan in this regard has been attached as Annexure 10.4.

ToR Compliance

S. No.	Conditions	Reply
	action plan in this regard shall be submitted.	
Standard Terms of Reference for (Thermal Power Plants)		
1.	Statutory compliance	
1.1	The proposed project shall be given a unique name in consonance with the name submitted to other Government Departments etc. for its better identification and reference.	Gadarwara Super Thermal Power Project, Stage-II (2x800 MW) is a unit name given to the proposed project in alignment with Stage-I project.
1.2	Vision document specifying prospective long term plan of the project shall be formulated and submitted.	Vision document is given in Annexure 7.5 .
1.3	Latest compliance report duly certified by the Regional Office of MoEF&CC for the conditions stipulated in the environmental and CRZ clearances of the previous phase(s) for the expansion projects shall be submitted.	The latest Certified EC Compliance Report vide letter no. 4-10/2013(Env) dated 28.06.2024 has been provided by Regional Office, Bhopal. NTPC has submitted status report along with action plan/taken report vide letter no.GW/EMG/MoEF&CC/2024/02 dated 19.07.2024 against the observations reported by the Regional Office, which is attached as Annexure 1.5 .
2.	Details of the Project and Site	
2.1	The project proponent needs to identify minimum three potential sites based on environmental, ecological and economic considerations, and choose one appropriate site having minimum impacts on ecology and environment. A detailed comparison of the sites in this regard shall be submitted.	A detailed comparison of the sites has been done during the implementation of Gadarwara STPP Stage I. Since this is an expansion project, no further land acquisition is involved in the project. All the activities/facilities will be accommodated within the land under possession of NTPC.
2.2	Executive summary of the project indicating relevant details along with recent photographs of the proposed site (s) shall be provided. Response to the issues raised during Public Hearing and the written representations (if any), along with a time bound Action Plan and budgetary allocations to address the same, shall be provided in a tabular form, against each action proposed.	Executive summary is given in Chapter 11 . Details of public hearing along with a time bound Action Plan and budgetary allocations has been incorporated in Chapter 7, Table 7.2, 7.3 and 7.4 in Final EIA Report.
2.3	Harnessing solar power within the premises of the plant particularly at available roof tops and other available areas shall be formulated and for expansion projects, status of implementation shall also be submitted.	Solar PV for Roof Top of various Buildings has been installed with a capacity of 1083.84 KW at Stage I Gadarwara STPP. Further roof top solar PV of 1125 KW is proposed to be installed at TG building under Stage-II.

ToR Compliance

S. No.	Conditions	Reply
		Details are incorporated in Section 10.9.1, Table 10.13, Chapter 10 in Final EIA Report.
2.4	The geographical coordinates (WGS 84) of the proposed site (plant boundary), including location of ash pond along with topo sheet (1:50,000 scale) and IRS satellite map of the area, shall be submitted. Elevation of plant site and ash pond with respect to HFL of water body/nallah/River and high tide level from the sea shall be specified, if the site is located in proximity to them.	Geographical Coordinates of the project site are in Chapter 1, Figure 1.2 of the EIA report. Location of proposed project site and Ash pond on Satellite map and Toposheet is given in Figure 1.2 and Figure 1.6 respectively in Chapter 1 of the EIA report. Shakkar River & Sitarewa River are flowing at a distance of 0.6 km in North-East towards North and 0.9 km South West towards North direction respectively from the project site. Further, the Sitarewa river is merging into Shakkar river at a confluence point 4.5 km downstream of the project site in NW direction. Water Resource Department vide letter dated 15/10/2024 has given certificate regarding HFL level of Shakkar river at Gadarwara which is 332.47m recorded on 08.09.1999. The high flood data for 25 years has been issued by the authority and certificate is attached as Annexure-1.11 in compliance to OM dated 14.02.2022.
2.5	Layout plan indicating break-up of plant area, ash pond, green belt, infrastructure, roads etc. shall be provided.	Plant layout plan of the Project showing plant area, ash pond, green belt and others are shown in Chapter 2, Figure 2.1 and Land breakup of the Project is given in Table 2.2 in Chapter 2 of the EIA report.
2.6	Land requirement for the project shall be optimized and, in any case, not more than what has been specified by CEA from time to time. Item wise break up of land requirement shall be provided.	This is an expansion project, and proposed to be accommodated within the available area without any additional land acquisition. As per the MOEF&CC notification dated December 30, 2022, new or expanded thermal power plants must use 0.1 hectares per MW for ash dykes. For Stage-II, ash pond has been proposed in an area of 99.00 Ha. of land adjacent to Stage-I is well within the norms. Land breakup of the existing and proposed project is mentioned in Table 2.2 in Chapter 2 of the EIA report.
2.7	Present land use (including land class/kism) as per the revenue records and State Govt. records of the proposed site shall be furnished. Information on land to be acquired including coal transportation system, laying of pipeline, ROW, transmission lines etc. shall be specifically submitted. Status of land acquisition and litigation, if any, should be provided.	For the existing stage I plant, the land acquired is now industrial use. No additional land acquisition required for Gadarwara STPP Stage-II. Litigation details has been provided in Annexure 7.4.

ToR Compliance

S. No.	Conditions	Reply
2.8	If the project involves forest land, details of application, including date of application, area applied for, and application registration number, for diversion under FCA and its status should be provided along with copies of relevant documents.	This project does not involve any forest land.
2.9	The land acquisition and R&R scheme with a time bound Action Plan should be formulated and addressed in the EIA report.	Not applicable as no resettlement and rehabilitation is involved in the stage II expansion project.
2.10	Satellite imagery and authenticated topo sheet indicating drainage, cropping pattern, water bodies (wetland, river system, stream, nallahs, ponds etc.), location of nearest habitations (villages), creeks, mangroves, rivers, reservoirs etc. in the study area shall be provided.	Satellite imagery is given in Figure 3.2 , Toposheet map indicating drainage, cropping pattern, water bodies (wetland, river system, stream, nallahs, ponds etc.), location of nearest habitations (villages), creeks, mangroves, rivers, reservoirs etc. is given in Figure 3.1 and detailed land-use map is given in Figure 3.6 of Chapter 3
2.11	Topography of the study area supported by toposheet on 1:50,000 scale of Survey of India, along with a large scale map preferably of 1:25,000 scale and the specific information whether the site requires any filling shall be provided. In that case, details of filling, quantity of required fill material; its source, transportation etc. shall be submitted.	Toposheet map supported by toposheet on 1:50,000 scale of Survey of India is given in Chapter 1, Figure 1.6 . No filling is required in the site.
3.	Ecology biodiversity and Environment	
3.1	A detailed study on land use pattern in the study area shall be carried out including identification of common property resources (such as grazing and community land, water resources etc.) available and Action Plan for its protection and management shall be formulated. If acquisition of grazing land is involved, it shall be ensured that an equal area of grazing land be acquired and developed and detailed plan submitted.	Majority of the land in the study area <i>i.e.</i> , buffer zone of the power plant is agricultural area covering 35621.40 Ha. (69.40%) Forest land 2.17% (1114.69 Ha), fallow land 4.45% (2283.38 Ha etc. of the total study area. Detailed land use map is given in Figure 3.6 of Chapter 3 . Action plan for protection and management of the common property resources is detailed budget for CSR/CER for year 2025-26 is 489.56 Lakhs and 2026-2027 is 618.96 Lakhs. Details given in common property resources Chapter 8, Section 8.3 . No acquisition of land is involved in this proposed expansion project.
3.2	Location of any National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes/ wildlife corridor, if any, within 10 km of the project site	There is no National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes / wildlife corridor within 10 km of the project site. Certificate for the same is enclosed as Annexure 3.1 .

ToR Compliance

S. No.	Conditions	Reply
	shall be specified and marked on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.	
3.3	A mineralogical map of the proposed site (including soil type) and information (if available) that the site is not located on potentially mineable mineral deposit shall be submitted.	Mineralogical map of the district study is enclosed as Figure 3.13A of Chapter 3 in Final EIA report.
3.4	The water requirement shall be optimized (by adopting measures such as dry fly ash and dry bottom ash disposal system, air cooled condenser, concept of zero discharge) and in any case not more than that stipulated by CEA from time to time, to be submitted along with details of source of water and water balance diagram. Details of water balance calculated shall take into account reuse and re-circulation of effluents.	In Stage II of Gadarwara STPP air cooled condenser will be used to optimize the water requirement. For Stage II STPP, water requirement will be 48,000 KLD as compared to water requirement of 1,12,200 KLD in Stage-I. Concept of zero liquid discharge is also there and measures are taken for dry fly ash and dry bottom ash disposal system. Details given in Chapter 2, Section 2.6 . Water balance diagram is enclosed as Annexure 2.6 .
3.5	Water body/Nallah (if any) passing across the site should not be disturbed as far as possible. In case any Nallah / drain is proposed to be diverted, it shall be ensured that the diversion does not disturb the natural drainage pattern of the area. Details of proposed diversion shall be furnished duly approved by the concerned Department of the State.	There are few ravines towards S to W of the site, according to the drainage map, a ravine/gully, rivulet, or seasonal stream passes through the ash dyke area. This has been suitably channelized within the stormwater drainage plan prepared for the plant/ ash pond. The storm water management plan for the plant/ash pond is attached as Annexure 3.8
3.6	It shall also be ensured that a minimum of 500 m distance of plant boundary is kept from the HFL of river system/ streams etc. and the boundary of site should also be located 500 m away from railway track and National Highways.	Site is located at more than 5 km distance from SH-22 and more than 18 km distance from SH-44. Distance from the railway track of railways is about 4.10 km from the boundary of the plant site. HFL of Shakkar River is 332.47 m and letter from WRD, Narmada division, Bhopal dated 15/10/2024 is enclosed as Annexure 1.11 .
3.7	Hydro-geological study of the area shall be carried out through an institute/ organization of repute to assess the impact on ground and surface water regimes. Specific mitigation measures shall be spelt out and time bound Action Plan for its implementation shall be submitted	Detailed hydrogeological study of the project site and surrounding 10 km study was conducted by National Institute of Hydrology (NIH), Roorkee. Final report is enclosed as Annexure-7.2 . This report details a comprehensive study involving geological mapping, soil infiltration tests, and hydrological assessments to understand the study area's surface and groundwater dynamics.
3.8	Detailed Studies on the impacts of the ecology including fisheries of the	Impact on ecology is addressed in Section 4.3, Table 4.5 and 4.6 of Chapter-4 of the Final EIA report. Gadarwara

ToR Compliance

S. No.	Conditions	Reply
	River/Estuary/Sea due to the proposed withdrawal of water / discharge of treated wastewater into the River/Sea etc shall be carried out and submitted along with the EIA Report. In case of requirement of marine impact assessment study, the location of intake and outfall shall be clearly specified along with depth of water drawl and discharge into open sea.	STPP has carried out a detailed study regarding the impact of withdrawal of water from River Narmada (Given at Annexure-7.7.) The plant will be operated on Zero Liquid Discharge (ZLD) concepts due to which there will be no discharge of waste water outside the plant premises. Hence, there will be no impact on aquatic ecology. Marine impact is not applicable.
3.9	Source of water and its sustainability even in lean season shall be provided along with details of ecological impacts arising out of withdrawal of water and taking into account inter-state shares (if any). Information on other competing sources downstream of the proposed project and commitment regarding availability of requisite quantity of water from the Competent Authority shall be provided along with letter / document stating firm allocation of water.	The Water Resources Department (WRD), Government of Madhya Pradesh, in a communication dated 19.05.2008, has granted a commitment of 125 cubic feet per second (Cusecs) from River Narmada which was reduced to 62.72 cusecs. Water Resources Dept. Govt of Madhya Pradesh vide order dated 19.02.2024, accorded allocation of 12.32 Cusec water for Stage-II (2x800MW) from river Narmada. Total requirement of water for Stage-II (2x800MW) is 2000 m ³ /Hr (19.6 Cusec). Details given in Chapter 2, Section 2.6. Water allocation letters issued by Water Resources Dept, MP are enclosed as Annexure 2.5 and Certificate regarding maintaining of minimum environmental flow in the river is enclosed as Annexure 2.5A.
3.10	Detailed plan for rainwater harvesting and its proposed utilization in the plant shall be furnished. In addition, wherever ground water is drawn, PP shall submit detailed plan of Water charging activity to be undertaken.	The rainwater harvesting details are given in Chapter 10, section 10.8.3. To harvest rainwater from roof top 21 Nos Recharge shafts have been constructed in Township (8 Nos) and Plant (13 Nos). Total Recharge potential is 1,94,397 Cum. Additional 28 Nos. Recharge shafts open area Recharge Pit locations have been identified in Township Area. Details given in Chapter 10, Section 10.8.3. No extraction of groundwater has been envisaged for the proposed project.
3.11	Feasibility of near zero discharge concept shall be critically examined and its details submitted.	The Zero Liquid Discharge (ZLD) shall be adopted based on maximum recycle/reuse of waste water thereby reducing and optimizing the quantities of water requirement and effluent generation to the extent feasible. Wastewater treatment facilities like Neutralization pit, oil separator, clarifier, STP etc has been envisaged with ZLD. Details given in Chapter 4, Section 4.5 and water balance diagram enclosed as Annexure 2.6. Utilization of domestic effluent after treatment in STP conforming to prescribed standards shall be used for horticulture purposes to the extent possible.
3.12	Optimization of Cycles of Concentration (COC) along with other	Provision of ACC has been envisaged. Aux. cooling tower shall be operated at 5 Cycles of Concentration (COC).

ToR Compliance

S. No.	Conditions	Reply
	water conservation measures in the project shall be specified.	Waste water treatment facilities like Neutralization pit, oil separator, clarifier, STP etc has been envisaged with ZLD. Details given in Chapter 4, Section 4.5 and water balance diagram enclosed as Annexure 2.6 . Besides that, rainwater harvesting system and other measures are envisaged in the proposed project.
3.13	Plan for recirculation of ash pond water and its implementation shall be submitted.	Provision of ash water re-circulation system has been envisaged. Water balance diagram is enclosed as Annexure 2.6 .
3.14	Detailed plan for conducting monitoring of water quality regularly with proper maintenance of records shall be formulated. Detail of methodology and identification of monitoring points (between the plant and drainage in the direction of flow of surface / ground water) shall be submitted. It shall be ensured that parameter to be monitored also include heavy metals. A provision for long-term monitoring of ground water table using Piezometer shall be incorporated in EIA, particularly from the study area.	Water samples were collected monthly during the study period and analyzed for various physio-chemical, biological, and heavy metal parameters. Sample collection followed IS standard procedures, with on-site analysis for temperature, turbidity, color, electrical conductivity, TSS, and TDS using a handy sampler. Other parameters were analyzed in the laboratory according to Standard Methods for the Examination of Water and Waste Water (APHA & IS standards). All the other details are also covered in Chapter 3, Section 3.10 . Provision for long-term monitoring of ground water table has been envisaged and details given in Chapter-6, Table-6.5 .
3.15	Hazards Characterization: Past incidents of hazard events within 10km radius of project area with detailed analysis of causes and probability of reoccurrence	No reports of major incidents have been found in the recent years. Proper mitigation measures have been provided to ensure safety at workplaces. ALOHA® is the hazard modelling program within the CAMEO® software suite, widely used for planning and responding to chemical emergencies and approved by the USEPA. In this study, ALOHA® is applied to the site in Gadarwara, India Hazard classification is done on Chapter 7, Section 7.4 .
4.	Environmental Baseline study and mitigation measures	
4.1	One complete season (critical season) site specific meteorological and AAQ data (except monsoon season) as per latest MoEF&CC Notification shall be collected along with past three year's meteorological data for that particular season for wins speed analysis and the dates of monitoring shall be recorded. The parameters to be covered for AAQ shall include PM10, PM2.5, SO2, NOx, CO and Hg. The location of the monitoring stations should be so decided so as to take into consideration the upwind direction, pre-dominant	One season data (March 2024 to May 2024) has been collected and incorporated in EIA Report. IMD data from 1991 to 2020 has been obtained from the Meteorological Station in Narsinghpur. Detailed analysis for the same has been given in EIA Report. The monitoring stations are decided considering the upwind direction, pre-dominant downwind direction, other dominant directions, habitation and sensitive receptors. There is at least one monitoring station each in the upwind and in the pre - dominant downwind direction at a location where maximum ground level concentration is likely to occur.

ToR Compliance

S. No.	Conditions	Reply
	downwind direction, other dominant directions, habitation and sensitive receptors. There should be at least one monitoring station each in the upwind and in the pre - dominant downwind direction at a location where maximum ground level concentration is likely to occur.	Ambient air quality monitoring was conducted at ten locations with a frequency of two samples per week from March 2024 to May 2024. The monitored parameters included PM10, PM2.5, SO ₂ , NO _x , CO, O ₃ , Hg and all other parameters as per NAAQS, 2009. Details are covered in Chapter 3, Section 3.7, 3.8.
4.2	In case of expansion project, air quality monitoring data of 104 observations a year for relevant parameters at air quality monitoring stations as identified/stipulated shall be submitted to assess for compliance of AAQ Standards (annual average as well as 24 hrs).	The air quality monitoring data of 104 observations a year for relevant parameters at air quality monitoring stations for compliance of AAQ Standards (annual average as well as 24 hrs) list has been given in Chapter 3 Table 3.18 and list is attached as Annexure 3.7. However, one seasonal air quality monitoring report is provided in Chapter 3, Section 3.8
4.3	A list of industries existing and proposed in the study area shall be furnished.	There is a one Sugar Mill present within 10km of Gadarwara STPP. Details given in Chapter 4.
4.4	Cumulative impacts of all sources of emissions including handling and transportation of existing and proposed projects on the environment of the area shall be assessed in detail. Details of the Model used and the input data used for modelling shall also be provided. The air quality contours should be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The wind rose and isopleths should also be shown on the location map. The cumulative study should also include impacts on water, soil and socioeconomics.	Ground Level Concentration of pollutants released from existing stacks and proposed stacks has been modelled. US EPA approved AERMOD Ver 9.9.1 View dispersion model, developed by Lakes Environmental has been used for the project. The wind rose and isopleths have been shown on the location map. The details of cumulative impact assessment study are given in Chapter 4, Section 4.4. Details of effluent & domestic wastewater generation, method of treatment, ETP & STP etc. have been incorporated in section 4.5, Chapter-4 of Final EIA Report. Details regarding impact on water quality and soil quality due to existing and expansion project are given in section 4.4.3, Chapter-4. The proposed expansion project is envisaged with Air-Cooled Condenser (ACC) where water requirement is reduced to 2,000 m³/hr only. The impact on water resources shall be insignificant as wastewater generating within the project site will be treated in the ETP & STP and will be recycled & reused following the Zero Liquid Discharge (ZLD) concept.
4.5	Radio activity and heavy metal contents of coal to be sourced shall be examined and submitted along with laboratory reports.	The radioactivity and heavy metal analysis of coal have been studied. The reports are attached as Annexure 2.3 and 2.4.
4.6	Fuel analysis shall be provided. Details of auxiliary fuel, if any,	Coal Analysis report is attached as Annexure 2.3. Details of auxiliary fuel is given in Chapter 2, Section 2.2.2.2

ToR Compliance

S. No.	Conditions	Reply												
	including its quantity, quality, storage etc should also be furnished.													
4.7	Quantity of fuel required, its source and characteristics and documentary evidence to substantiate confirmed fuel linkage shall be furnished. The Ministry's Notification dated 02.01.2014 regarding ash content in coal shall be complied. For the expansion projects, the compliance of the existing units to the said Notification shall also be submitted	Details of fuel requirement and its linkage is given in Chapter 2, Section 2.2.2 and subsection 2.2.2.1 Details of coal source, distance, transportation in tabular format is given below and also included in EIA Report section 2.2.2 at page 2-6. Coal supply for Gadawara STPP Stage-II (2x800 MW) is planned from MCL & SECL vide CIL letter dated 20.06.2024 with transportation by rail. <table border="1"> <thead> <tr> <th>Parameters</th><th>Stage-I (2x800MW)</th><th>Stage-II (2x800MW)</th></tr> </thead> <tbody> <tr> <td>Coal source</td><td>SECL, NCL & WCL (as per Stage-I EC condition)</td><td>MCL & SECL (as per CIL letter dtd 20.06.2024)*</td></tr> <tr> <td>Approx. distance (coal source to power plant), km</td><td>NCL:540km SECL:500km to 650 km WCL:470km to 640 km</td><td>MCL: 740km to 1000km SECL: 500km to 650km</td></tr> <tr> <td>Mode of transportation etc.</td><td>Rail</td><td>Rail</td></tr> </tbody> </table> * The linkage sources are tentative based on the above-mentioned CIL letter dated. 20.06.2024. Two (2) numbers of 2500 KL LDO tank has been envisaged as auxiliary fuel. LDO shall be sourced from the refineries located nearer to the Project by road tankers/railway wagons.	Parameters	Stage-I (2x800MW)	Stage-II (2x800MW)	Coal source	SECL, NCL & WCL (as per Stage-I EC condition)	MCL & SECL (as per CIL letter dtd 20.06.2024)*	Approx. distance (coal source to power plant), km	NCL:540km SECL:500km to 650 km WCL:470km to 640 km	MCL: 740km to 1000km SECL: 500km to 650km	Mode of transportation etc.	Rail	Rail
Parameters	Stage-I (2x800MW)	Stage-II (2x800MW)												
Coal source	SECL, NCL & WCL (as per Stage-I EC condition)	MCL & SECL (as per CIL letter dtd 20.06.2024)*												
Approx. distance (coal source to power plant), km	NCL:540km SECL:500km to 650 km WCL:470km to 640 km	MCL: 740km to 1000km SECL: 500km to 650km												
Mode of transportation etc.	Rail	Rail												
4.8	Details of transportation of fuel from the source (including port handling) to the proposed plant and its impact on ambient AAQ shall be suitably assessed and submitted. If transportation entails a long distance it shall be ensured that rail transportation to the site shall be first assessed. Wagon loading at source shall preferably be through silo/conveyor belt.	Gadawara STPP is linked to the Indian Railway network. Coal supply for Gadawara STPP Stage-II (2x800 MW) is planned from MCL & SECL vide CIL letter dated 20.06.2024 with transportation by rail. Augmentation of existing railway siding to accommodate additional rakes for Gadawara STPP Stage-II (2x800 MW) coal transportation, shall be done. The secondary fuel for the proposed Power Project i.e. LDO shall be sourced from the refineries located nearer to the Project by railway wagons/road tankers. Details of fuel linkage is given in Chapter 2, Section 2.2.2.3.												
4.9	For proposals based on imported coal, inland transportation and port handling and rail movement shall be examined and details furnished. The approval of the Port and Rail Authorities shall be submitted.	Coal supply for Gadawara STPP Stage-II (2x800 MW) is planned from MCL & SECL through Rail.												
4.10	Details regarding infrastructure facilities such as sanitation, fuel,	Infrastructure facilities such as sanitation, restrooms, medical facilities, safety during construction phase etc. to												

ToR Compliance

S. No.	Conditions	Reply
	restrooms, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase should be adequately catered for and details furnished.	be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase should be adequately catered for and details shall be furnished with half yearly compliance report.
5.	Environmental Management Plan	
5.1	EMP to mitigate the adverse impacts due to the project along with item - wise cost of its implementation in a time bound manner shall be specified.	A capital cost provision of 2015.44 Cr towards environmental protection measures/EMP and the recurring cost of Rs. 40.16 Cr per annum is proposed. Details given in Chapter 10, Table 10.8.
5.2	A Disaster Management Plan (DMP) along with risk assessment study including fire and explosion issues due to storage and use of fuel should be prepared. It should take into account the maximum inventory of storage at site at any point of time. The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be invariably provided. Provision for mock drills shall be suitably incorporated to check the efficiency of the plans drawn.	Details of Disaster Management Plan (DMP) along with risk assessment study are given in Chapter 7, Section 7.5.
5.3	The DMP so formulated shall include measures against likely Fires/Tsunami/Cyclones/Storm Surges/ Earthquakes etc, as applicable. It shall be ensured that DMP consists of both On-site and Off-site plans, complete with details of containing likely disaster and shall specifically mention personnel identified for the task. Smaller version of the plan for different possible disasters shall be prepared both in English and local languages and circulated widely.	Details of DMP formulated including measures against likely Fires/Tsunami /Cyclones /Storm Surges/ Earthquakes etc, as applicable is given in Chapter 7, Section 7.5. It is ensured that DMP consists of both On-site and Off-site plans, complete with details of containing likely disaster and shall specifically mention personnel identified for the task.
5.4	Details of fly ash utilization plan as per the latest fly ash Utilization Notification of GOI along with firm agreements / MoU with contracting	Ash production and ash utilization (AU) details over the years has shown an increasing trend.

ToR Compliance

S. No.	Conditions	Reply			
	parties including other usages etc. shall be submitted The plan shall also include disposal method/ mechanism of bottom ash along with monitoring mechanism.	FY in Year	Ash Production (LMT)	Total AU (LMT)	Total AU (%)
		FY 2019-20	2.88	0.02	0.69
		FY 2020-21	9.44	0.78	8.26
		FY 2021-22	16.85	6.35	37.66
		FY 2022-23	19.59	14.30	73.00
		FY 2023-24	21.10	23.03	111.69
		FY 2024-25	21.72	17.85	82.19
		Plan for 100% Fly ash utilization for next 08 years including existing units and expansion units. Has been given in Chapter 10, Section 10.8 . MoU with contracting parties is attached as Annexure 10.3 . Regular review of Ash Management is being carried out at Project Level, Regional Level and Corporate Level.			
6.	Green belt development				
6.1	Detailed scheme for raising green belt of native species of appropriate width (50 to 100 m) and consisting of at least 3 tiers around plant boundary not less than 2000 tree per ha with survival rate of more than 85% shall be submitted. Photographic evidence must be created and submitted periodically including NRSA reports in case of expansion projects. A shrub layer beneath tree layer would serve as an effective sieve for dust and sink for CO ₂ and other gaseous pollutants and hence a stratified green belt should be developed.	NTPC Gadarwara has carried out plantation on 7.740 Ha inside the main plant premises and 58.628 Ha adjacent to the main plant and periphery. Approx. 83,639 trees have been planted under Gadarwara STPP Stage-I during period (2015-2024). Further, 90.412 Ha of greenbelt is proposed adjacent to the main plant boundary and periphery. Approx. 2,26,025 trees will be planted under Stage-II for upcoming 7 years (2025-2032). Action plan for greenbelt development is provided in Table 4.12 & 4.13 and Chapter 10, Table 10.7 of EIA report. Also enclosed as Annexure 4.1.			
6.2	Over and above the green belt, as carbon sink, plan for additional plantation shall be drawn by identifying blocks of degraded forests, in close consultation with the District Forests Department. In pursuance to this the project proponent shall formulate time bound Action Plans along with financial allocation and shall submit status of implementation to the Ministry every six months.	Time bound action plan has been prepared for afforestation on degraded forest area i.e 20 Ha. in consultation with forest department is given in section 10.8.4, Chapter 10 and Chapter 4. Enclosed as Annexure 4.1. Time bound action plan along with financial allocation has been prepared for Afforestation in Nearby villages which is enclosed as Annexure 10.5.			
7.	Socio-economic activities				
7.1	Socio-economic study of the study area comprising of 10 km from the plant site shall be carried out through a reputed institute / agency which shall	Socio-economic study of the study area comprising of 10 km from the plant site is done. There are 125 villages and the population is 143280 in 10 km of the project boundary in 10 km area. Details given in Chapter 3, Section 3.13			

ToR Compliance

S. No.	Conditions	Reply
	consist of detail assessment of the impact on livelihood of the local communities.	
7.2	Action Plan for identification of local employable youth for training in skills, relevant to the project, for eventual employment in the project itself shall be formulated and numbers specified during construction & operation phases of the Project.	Permanent employment during construction phase is 96 and 186 approx. during operation phases respectively. The number of workforces employed during construction phase by the EPC contractors would be much higher (about 2000-2500 during peak deployment). Details are given in Chapter 8, Section 8.4
7.3	If the area has tribal population, it shall be ensured that the rights of tribals are well protected. The project proponent shall accordingly identify tribal issues under various provisions of the law of the land.	In study area Scheduled Tribe population is observed to be 10.4%. During previous years, PP has invested on education facility for tribal school in Chichli, Tailaya School. Details of CSR-CD given at Annexure 8.1 . Further Budget for CSR-CD activities with budget is given in Chapter 8, Table 8.3 for the proposed expansion project.
7.4	A detailed CER plan along with activities wise break up of financial commitment shall be prepared in terms of the provisions OM No. 22-65/2017-IA.III dated 30.09.2020. CER component shall be identified considering need based assessment study and Public Hearing issues. Sustainable income generating measures which can help in upliftment of affected section of society, which is consistent with the traditional skills of the people shall be identified.	The CER plan prioritizes education by focusing on girls' education, education, healthcare, infrastructure, employment, and community development based. Community health efforts include organizing awareness camps, emphasizing safe drinking water and hygiene, and informing communities about NTPC's health initiatives. Rural infrastructure development will strengthen schools, community halls, and other essential structures. Afforestation and tree plantation initiatives aim to promote environmental sustainability. Skill development programs address unemployment by offering training in technology and management, sourcing local workers, and upgrading ITIs to enhance skills in various trades. CSR-CD expenditures details are given in Chapter 8, Table 8.1 . The same has been attached in Annexure 8.1 . Budget for CSR/CER for year 2025-26 is 489.56 Lakhs and 2026-2027 is 618.96 Lakhs has been given in Chapter 8, Table 8.3 . The year-wise, activity wise time bound budget earmarked for Public Hearing issues has been covered in Chapter 7, Section 7.1 in Final EIA/EMP Report.
7.5	While formulating CER schemes it shall be ensured that an in-built monitoring mechanism for the schemes identified are in place and mechanism for conducting annual social audit from the nearest	CSR-CD activities and expenditures details are given in Chapter 8, Table 8.1 and 8.3 . The same has been attached in Annexure 8.1 . Monitoring mechanism for CSR-CD activities has been established. Status of implementation shall be prepared and submitted to the concerned authorities from time to time.

ToR Compliance

S. No.	Conditions	Reply
	government institute of repute in the region shall be prepared. The project proponent shall also provide Action Plan for the status of implementation of the scheme from time to time and dovetail the same with any Govt. scheme(s). CER details done in the past should be clearly spelt out in case of expansion projects.	Awareness programme for workers and surrounding areas shall be undertaken under CSR/CER works has been given in Chapter 8, Table 8.3.
7.6	R&R plan, as applicable, shall be formulated wherein mechanism for protecting the rights and livelihood of the people in the region who are likely to be impacted, is taken into consideration. R&R plan shall be formulated after a detailed census of population based on socio economic surveys who were dependant on land falling in the project, as well as, population who were dependant on land not owned by them.	Not applicable as this project does not include any additional land acquisition.
7.7	Assessment of occupational health and endemic diseases of environmental origin in the study area shall be carried out and Action Plan to mitigate the same shall be prepared	Occupational health monitoring includes pre-employment checks, routine examinations, and training. The plant will focus on improving hygiene and sanitation, drinking water and conducting medical camps etc. Additional measures include enhancing waste management, building infrastructure, and educating the community to improve overall health and safety. Details given in Chapter 7, Section 7.6.
7.8	Occupational health and safety measures for the workers including identification of work related health hazards shall be formulated. The company shall engage full time qualified doctors who are trained in occupational health. Health monitoring of the workers shall be conducted at periodic intervals and health records maintained. Awareness programme for workers due to likely adverse impact on their health due to working in non-conductive environment shall be carried out and precautionary measures like use of personal equipments etc. shall be provided. Review of impact of various health measures undertaken at intervals of two to three years shall be	Occupational health monitoring includes pre-employment checks, routine examinations, and training. The plant will focus on improving hygiene and sanitation, drinking water and conducting medical camps etc. Additional measures include enhancing waste management, building infrastructure, and educating the community to improve overall health and safety. Details given in Chapter 7, Section 7.6. Awareness programme for workers and surrounding areas shall be undertaken under the CSR-CD activities. Further budget for CD and CSR/CER works has been given in Chapter 7, Table 7.3 and 7.4 & Chapter 8, Table 8.3.

ToR Compliance

S. No.	Conditions	Reply
	conducted with an excellent follow up plan of action wherever required.	
8.	Corporate Environment Policy	
8.1	Does the company has a well laid down Environment Policy approved by its Board of Directors. If so, it may be detailed in the EIA report.	Yes. NTPC has a well-laid comprehensive Environmental Policy published in 2022. The intent of this policy is to meet environmental expectations and provide actionable guidance, as NTPC strives to foster a culture of excellence and challenges itself for continual improvement. Enclosed as Annexure-10.1 .
8.2	Does the Environment Policy prescribe for standard operating process/ procedures to bring into focus any infringement/ deviation / violation of the environmental or forest norms / conditions. If so, it may be detailed in the EIA.	Yes. Well-defined Standard Operating Procedures (SOPs) are in place as part of Environment policy. A Risk Management Committee comprises of members from senior functionaries of management as per provisions of Companies Act 2013 and subsequent amendments has been constituted to establish system for reporting environment related parameters, deviations and constraints to management. Environmental risks perceived shall be reviewed through risk management mechanism for appropriate action. Concerned group shall oversee compliance assurance of operating stations through reviews and appraisals.
8.3	What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions. Details of this system may be given.	An institutional arrangement for Environment Management System is given in NTPC Environmental Policy, 2022 enclosed in Annexure 10.1 . Environmental Management Group at Site will ensure the compliance of environmental clearance conditions of proposed project is attached as Annexure 10.2 and section 10.1.2 .
8.4	Does the company has compliance management system in place wherein compliance status along with compliances / violations of environmental norms are reported to the CMD and the Board of Directors of the company and / or shareholders or stakeholders at large. This reporting mechanism should be detailed in the EIA report.	Further, as per listing arrangement with SEBI, a reporting system of Environment risks as well as non-compliance or violation of environment norms, if any, is in place under Enterprise Risk Management Committee as well as higher management. NTPC Environmental Policy is enclosed as Annexure 10.1 .
9.	Miscellaneous	
9.1	All the above details should be adequately brought out in the EIA report and in the presentation to the Committee.	All the details incorporated in the Final EIA Report. Further details shall be presented during the EAC presentation.

ToR Compliance

S. No.	Conditions	Reply
9.2	Details of litigation pending or otherwise with respect to project in any Court, Tribunal etc. shall invariably be furnished.	Details of litigation/court cases with respect to Gadarwara project are provided in Annexure-7.4 .
9.3	In case any dismantling of old plants are envisaged, the planned land use & land reclamation of dismantled area to be furnished.	No dismantling has been envisaged.
10.	Additional Tor For Coastal Based Thermal Power Plants Projects (Tpps)	
10.1	Low lying areas fulfilling the definition wetland as per Ramsar Convention shall be identified and clearly demarcated w.r.t the proposed site.	Not Applicable
10.2	If the site includes or is located close to marshy areas and backwaters, these areas must be excluded from the site and the project boundary should be away from the CRZ line. Authenticated CRZ map from any of the authorized agencies shall be submitted.	Not Applicable
10.3	The soil levelling should be minimum with no or minimal disturbance to the natural drainage of the area. If the minor canals (if any) have to be diverted, the design for diversion should be such that the diverted canals not only drains the plant area but also collect the volume of flood water from the surrounding areas and discharge into marshy areas/major canals that enter into creek. Major canals should not be altered but their embankments should be strengthened and desilted.	Not Applicable
10.4	Additional soil required for levelling of the sites should as far as possible be generated within the site itself in such a manner that the natural drainage system of the area is protected and improved.	Not Applicable
10.5	Marshy areas which hold large quantities of flood water to be identified and shall not be disturbed.	Not Applicable
10.6	No waste should be discharged into Creek, Canal systems, Backwaters, Marshy areas and seas without appropriate treatment. Wherever	Not Applicable

ToR Compliance

S. No.	Conditions	Reply
	feasible, the outfall should be first treated in a Guard Pond and then only discharged into deep sea (10 to 15 m depth). Similarly, the Intake should be from deep sea to avoid aggregation of fish and in no case shall be from the estuarine zone. The brine that comes out from Desalinization Plants (if any) should not be discharged into sea without adequate dilution.	
10.7	Mangrove conservation and regeneration plan shall be formulated and Action Plan with details of time bound implementation shall be specified, if mangroves are present in Study Area.	Not Applicable
10.8	A common Green Endowment Fund should be created by the project proponents out of EMP budgets. The interest earned out of it should be used for the development and management of green cover of the area.	Not Applicable
10.9	Impact on fisheries at various socio economic level shall be assessed.	Not Applicable
10.10	An endowment Fishermen Welfare Fund should be created out of CER grants not only to enhance their quality of life by creation of facilities for Fish Landing Platforms / Fishing Harbour / cold storage, but also to provide relief in case of emergency situations such as missing of fishermen on duty due to rough seas, tropical cyclones and storms etc.	Not Applicable
10.11	Tsunami Emergency Management Plan shall be prepared wherever applicable and Plan submitted prior to the commencement of construction work.	Not Applicable
10.12	There should not be any contamination of soil, ground and surface waters (canals & village pond) with sea water in and around the project sites. In other words necessary preventive measures for spillage from pipelines, such as lining of Guard Pond used for the	Not Applicable

ToR Compliance

S. No.	Conditions	Reply
	treatment of outfall before discharging into the sea and surface RCC channels along the pipelines of outfall and intake should be adopted. This is just because the areas around the projects boundaries could be fertile agricultural land used for paddy cultivation.	

1. INTRODUCTION

1.1 BACKGROUND & INTRODUCTION

NTPC Limited, a Government of India enterprise, stands as India's largest power generating company, established in November 1975 with the aim of coordinating and advancing thermal power development nationwide. Recognized as a "Navratna" by the Government of India in 1997 and subsequently as a "Maharatna" in 2010, NTPC has evolved into a diversified entity venturing into hydro, solar, coal mining, power trading, equipment manufacturing, power distribution, and renewable energy. The company is also exploring nuclear power development.

Presently, NTPC Group operates coal, gas, solar, hydro and wind projects, boasting an installed capacity of 76,074 MW, making it the leading power generator in India. Additionally, NTPC Group has around various projects under construction across various locations in the country, along with expanding ventures into coal mining, power equipment manufacturing and trading, positioning itself as an Integrated Power Major in the evolving power sector.

Gadarwara STPP Stage-I (2x800 MW) has been established and both the units are under commercial operation. NTPC now intends to expand the capacity of the project by adding 2x800 MW units based on Air Cooled Condenser (ACC) system under Stage-II thereby making the total capacity as 3,200 MW. Main Plant and ash dykes of Gadawara STPP Stage-II (2x800MW) are proposed to be located within the available area and no additional land is proposed to be acquired.

Environmental Clearance for Gadawara STPP Stage-I (2x800 MW) was accorded by MOEF&CC vide letter no. J-13012/125/2009-IA. II(T) dated 22nd March, 2013. Gadawara STPP Stage-I (2x800 MW) has been established and both the units have been commissioned on 01.06.2019 & 01.03.2021 respectively and are under commercial operation. Subsequent amendments in EC have been done are enclosed as **Annexure 1.3 & Annexure 1.4**.

Madhya Pradesh Pollution Control Board (MPPCB) had granted Consent to Establish (CTE) vide letter no. 5602/TS/MPPCB/2014 dated 02-09-2014 is enclosed as **Annexure 1.6**. Subsequently, MPPCB has granted Consent to Operate (CTO) which is valid up to 30.09.2026 is enclosed as **Annexure 1.7**.

The Certified EC Compliance Report vide letter no. 4-10/2013(Env) dated 28.06.2024 has been provided by Regional Office, Bhopal. Gadawara STPP has submitted status report along with action plan/taken report vide letter no. GW/EMG/MoEF&CC/2024/02 dated 19.07.2024 against the observations reported by the Regional Office is enclosed as **Annexure 1.5**.

During the meeting held under the chairmanship of Hon'ble Minister of Power and NRE on 27.09.2023 to review the capacity addition up to 2031-32, Ministry of Power vide Office Memorandum dated 25.10.2023, has identified Gadawara STPP Stage-II (2x800 MW) ultra-super critical project as candidate thermal power project (in planning likely to be commissioned by FY 2031-32) under brownfield project category of NTPC.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



A total of 910.706 hectares of land is available with NTPC Gadarwara out of which 56.146 Ha has not been acquired but the land is under Right of Use (ROU) or for makeup water pipeline. Approximately 621.474 hectares of land has been utilized to accommodate Gadarwara STPP Stage-I project components i.e. Main Plant, Ancillary Facilities, Ash Disposal Area, Railway Corridor and Township etc. The remaining 289.232 hectares of land is proposed to be used for development of Gadarwara STPP Stage-II (2x800 MW) project components i.e. Main Plant, Ancillary Facilities and Ash Disposal.

1.2 IDENTIFICATION OF PROJECT AND PROPONENT

1.2.1 THE PROJECT

The current proposal aims to establish Gadarwara STPP Stage-II (2x800 MW) as a regional power project to meet the growing energy requirement of the country.

Table 1.1: Details of the Project

Particulars	Details		
Location	The Gadarwara Super Thermal Power Project (Gadarwara STPP) is situated near village Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon etc., Tehsil Gadarwara, in Narsinghpur District of Madhya Pradesh.		
Co-ordinates	Point	Latitude	Longitude
	A	22°52'34.18"N	78°50'30.68"E
	B	22°51'24.50"N	78°50'31.31"E
	C	22°51'10.92"N	78°51'16.39"E
	D	22°51'10.47"N	78°52'26.94"E
	E	22°51'39.23"N	78°52'26.57"E
	F	22°52'0.26"N	78°52'56.87"E
	G	22°52'01.01"N	78°51'47.60"E
	H	22°52'24.12"N	78°51'46.77"E
	I	22°52'40.47"N	78°52'53.26"E
	J	22°53'17.34"N	78°53'15.79"E
	K	22°54'16.82"N	78°52'12.34"E
	L	22°54'46.58"N	78°52'57.37"E
	M	22°54'40.57"N	78°51'20.65"E
	N	22°54'16.85"N	78°51'47.74"E
	O	22°53'17.97"N	78°53'14.20"E
	P	22°52'44.46"N	78°52'55.55"E
	Q	22°52'40.82"N	78°52'7.70"E
	R	22°52'37.72"N	78°51'44.13"E
	S	22°52'29.48"N	78°51'1.59"E
Site Elevation (Approx) / Topography	Site elevation 354-380 m. The topography of ash dyke area is undulating terrain due to ravines however main plant area is plain.		
	Existing	Proposed	Total
Plant Capacity	1600 MW	1600 MW	3200 MW

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Particulars	Details		
	(2x800 MW)	(2x800 MW)	(1600+1600) MW
Adopted Technology	Super Critical Technology	Ultra Super Critical Technology	Super Critical & Ultra Super Critical
Land Area	621.474 Ha	289.232 Ha	910.706 Ha
Greenbelt Area	66.368 Ha	90.412 Ha	156.780 Ha (33% area green belt considering total area of main plant and ash dyke (473.570 Ha.))
Land Type & Ownership	Land already in possession of NTPC. The proposed expansion is within the existing plant boundary.		
Main Fuel/ Coal Consumption	7.56 MTPA (with GCV of 3704 kcal/kg and 90% PLF)	6.10 MTPA (with GCV of 4450 Kcal/kg at 90% PLF)	13.66 MTPA
Source of Fuel	Standing Linkage Committee (Long-Term) in its meeting held on 03.01.2024 have recommended for the grant of coal linkage to the project. Coal allocation for the Stage-II has been recommended by SLC (LT) in its meeting held on 03.01.2024. Coal India Ltd., vide letter dated 20.06.2024 has tentatively allocated coal from MCL & SECL coal mines.		
Coal Transportation	The transportation of coal from the coal mines to the power plant is envisaged by Indian Railways. For handling additional rakes for Stage-II, augmentation of existing railway siding will be required.		
Water Requirement	1,12,200 KLD	48,000 KLD	Max. 1,60,200 KLD
Water Cooling System	Water Cooled Condenser System	Air Cooled Condenser System	-
Water Source	The source of water for the project is Narmada River located about 25 Km from the site. WRD, Govt. of Madhya Pradesh, vide letter dated 09.09.2021 have accorded water commitment of 56 Million Cubic Meter from River Narmada to the Gadarwara project. Additional allocation of 11 Million Cubic Meter has also been done by WRD, Bhopal vide letter dated 19.02.2024. Adequate quantity		

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Particulars	Details
	of water allocation is available for meeting the water requirement of the Gadarwara STPP Stage-II (2x800MW).
Nearest Town (Road Distance)	Gadarwara town lies around 09 Km from the project location in North-West direction.
Railway Connectivity	The nearest railway station is Gadarwara, which is part of the Central Railway and 09 km away from the site
Nearest Sea port	Nearest Seaport is at Kakinada Sea Port, in Andhra Pradesh 760km away from the site on South-East direction.
Nearby Airport	The closest commercial airport is Jabalpur, positioned about 115 Km away
Approach Road	The site can be accessed via a well-constructed road that spans 10 Km and connects to State Highway No. 22 and SH-44.
Water bodies	Shakkar River, 0.60 Km, NE and Sita Rewa River, 0.9 Km, W
Reserved / Protected forests	Chhawargaon Reserve Forest, 4.33 Km, S and Bargaon PF, 9.80 Km, S
Archeological monument of national importance and defence installation	No archeological monument of national importance and defence installation within the 10 km Study area.
National Parks/ Wildlife Sanctuaries etc.	Satpura Tiger Reserve, Approx.25 Km
Interstate boundary	Uttar Pradesh at 145 Km, N & Maharashtra at 135, S
Nearest industries	Shakti Sugar Mill Plant, 7.51 Km, NNW
Seismicity	Zone III: Moderate Damage Risk Zone
<i>Note: All distances mentioned above are aerial distances from the boundary of proposed power plant.</i>	

1.2.2 THE PROJECT PROPONENT

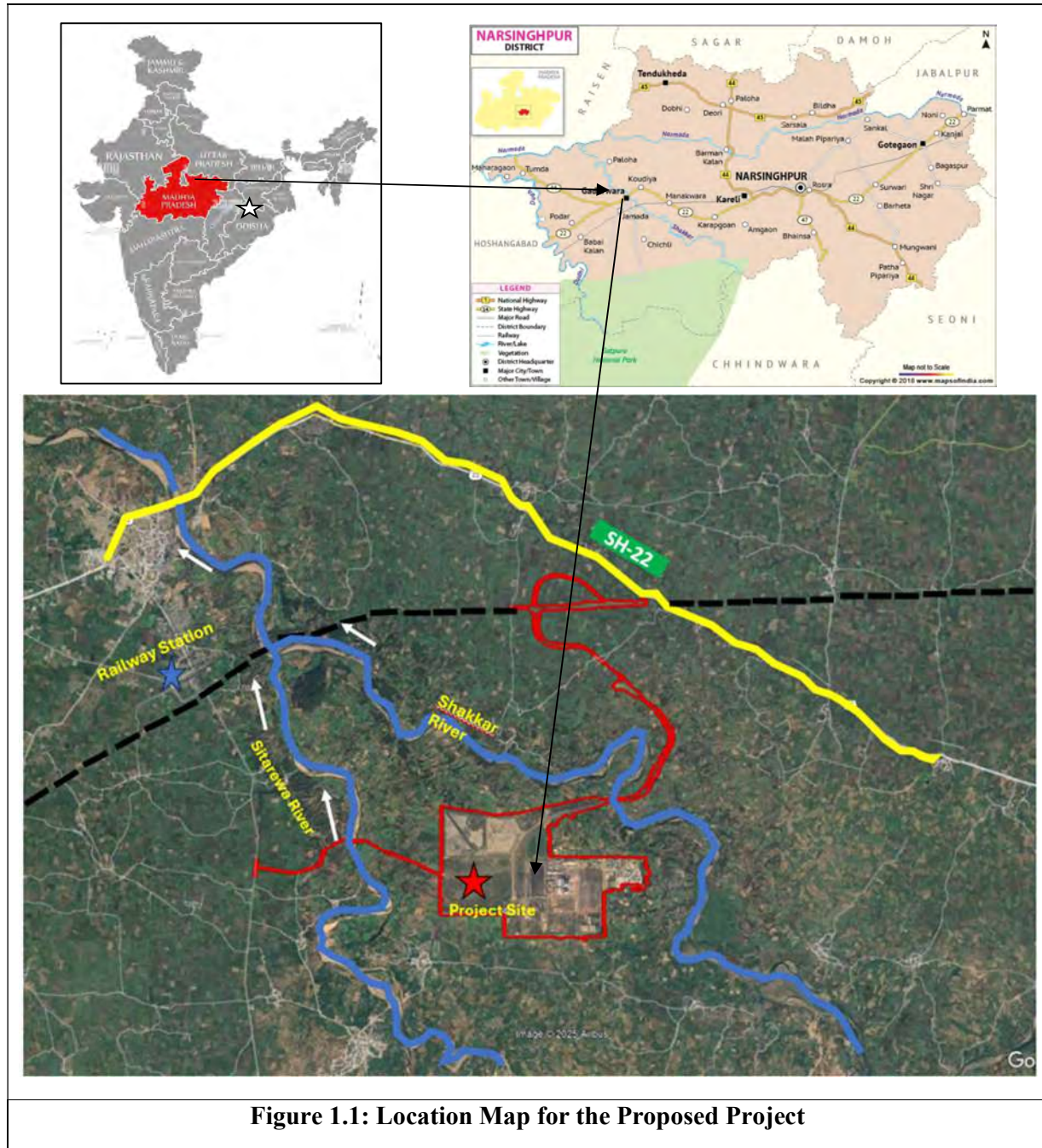
The proposed project Gadarwara STPP, Stage-II shall be constructed and operated by NTPC Limited, a Govt. of India Enterprises.

1.3 LOCATION OF THE PROJECT

The Gadarwara Super Thermal Power Project (Gadarwara STPP) is situated approximately aerial distance of 18.4 Km from bank of the Narmada River near village Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon etc., Tehsil Gadarwara, in Narsinghpur District of Madhya Pradesh state having a Latitude of 22° 51' 15" North to 22° 52' 34" North and Longitude of 78° 50' 30" East to 78° 52' 52" East, respectively. The proposed project is an expansion of existing Gadarwara STPP Stage-I (2X800 MW) by addition of two units of 800 MW with Ultra-Super Critical technology having Air Cooled Condenser system, within the existing available land at the project site. The details of the proposed locations are provided in **Table 1.1** and the location map is given as **Figure 1.2**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

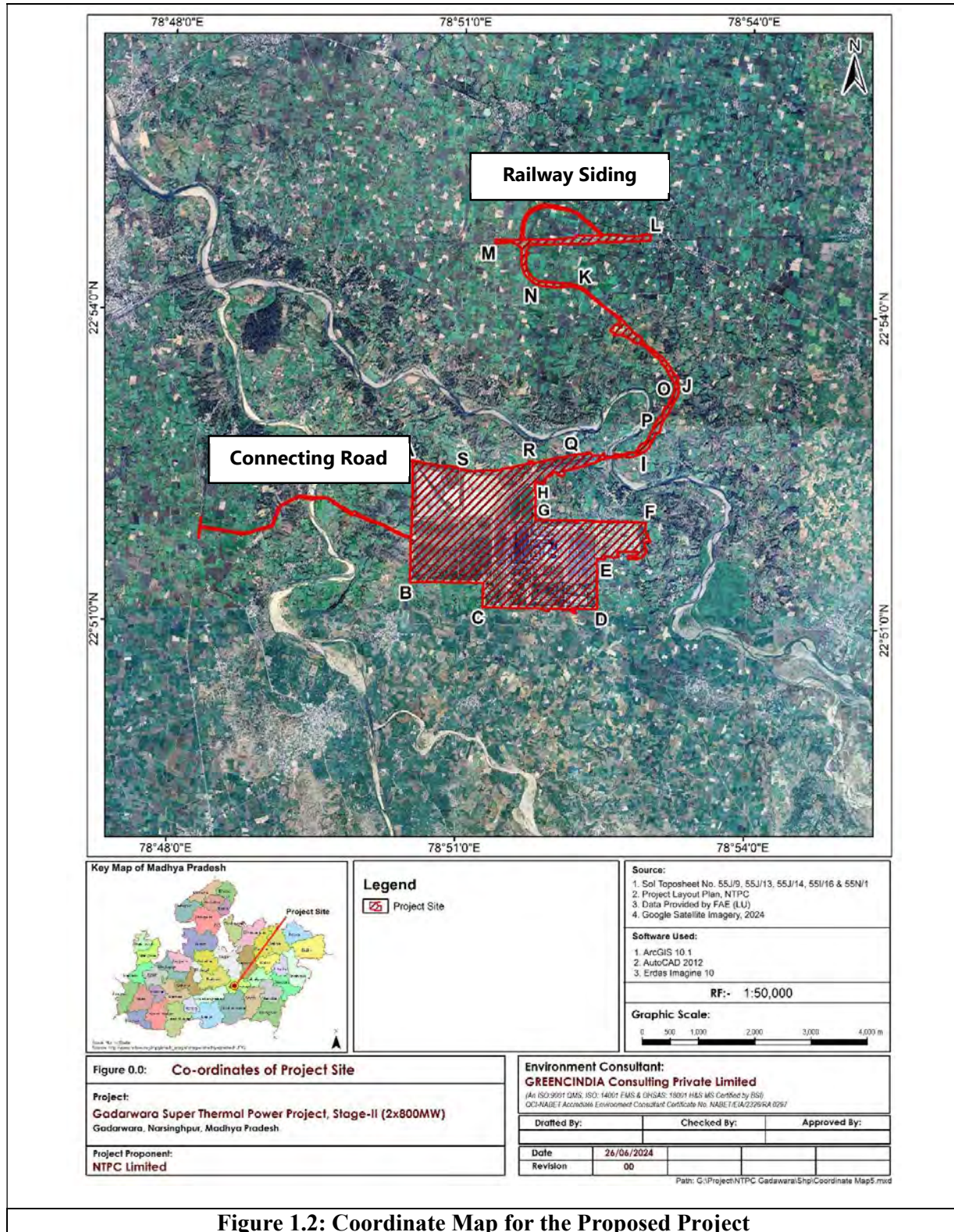


Figure 1.2: Coordinate Map for the Proposed Project

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 1.2: Geographical co-ordinates

Point	Latitude	Longitude
A	22°52'34.18"N	78°50'30.68"E
B	22°51'24.50"N	78°50'31.31"E
C	22°51'10.92"N	78°51'16.39"E
D	22°51'10.47"N	78°52'26.94"E
E	22°51'39.23"N	78°52'26.57"E
F	22°52'0.26"N	78°52'56.87"E
G	22°52'01.01"N	78°51'47.60"E
H	22°52'24.12"N	78°51'46.77"E
I	22°52'40.47"N	78°52'53.26"E
J	22°53'17.34"N	78°53'15.79"E
K	22°54'16.82"N	78°52'12.34"E
L	22°54'46.58"N	78°52'57.37"E
M	22°54'40.57"N	78°51'20.65"E
N	22°54'16.85"N	78°51'47.74"E
O	22°53'17.97"N	78°53'14.20"E
P	22°52'44.46"N	78°52'55.55"E
Q	22°52'40.82"N	78°52'7.70"E
R	22°52'37.72"N	78°51'44.13"E
S	22°52'29.48"N	78°51'1.59"E

Table 1.2 A The geographical co-ordinates of all four corners of the site

Main Plant	
Latitude	Longitude
22° 52' 13" N	78° 51' 36" E
22° 52' 00" N	78° 52' 26" E
22° 51' 15" N	78° 52' 20" E
22° 51' 16" N	78° 51' 23" E
Township	
22° 51' 00" N	78° 52' 29" E
22° 51' 59" N	78° 52' 51" E
22° 51' 45" N	78° 52' 52" E
22° 51' 40" N	78° 52' 27" E
Ash Dykes Existing	
22° 52' 34" N	78° 50' 30" E
22° 52' 27" N	78° 51' 23" E
22° 52' 00" N	78° 51' 20" E
22° 52' 00" N	78° 50' 32" E
Ash Dykes Proposed	
22° 51' 59" N	78° 50' 31" E
22° 51' 37" N	78° 50' 31" E
22° 51' 37" N	78° 51' 21" E
22° 52' 00" N	78° 51' 21" E

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



1.4 DEMAND JUSTIFICATION

Electricity is a crucial component of a country's infrastructure, essential for economic growth. The proposed Gadarwara STPP Stage-II is planned as a base load power station to fulfil the electricity demand of the Central Region as well as other regions of the country.

1.4.1 DEMAND SUPPLY

All India Installed Capacity (Fuel-Wise) as on 31.12.2024.

Table 1.3: All India Installed Capacity (Fuel-Wise)

Category		Installed Generation Capacity (MW)
Fossil Fuel (A)	Coal	2,12,413.01
	Lignite	6,620
	Gas	24818.21
	Diesel	589.20
	Total (A)	2,44,440.42
Non-Fossil Fuel	Hydro (B)	46,968.17
	Wind, Solar & Other RE	
	Wind	48,163.16
	Solar	97864.72
	Bio-Mass power/Cogen.	10,728.21
	Waste to Energy	619.94
	Small Hydro Power	5,100.55
	Total Wind, Solar & Other RE (C)	1,62,476.58
	RES (incl. Hydro) (B+C) = D	2,09,444.75
	Nuclear (E)	8180
	Total Non-Fossil Fuel: (D+E)	2,17,624.75
	Total Installed Capacity (A+D+E)	4,62,065.16

Based on data gathered by the Central Electricity Authority (CEA) as on 31.12.2024¹, power generation has shown an increase over the past years, as outlined below

The electricity generation target (Including RE) for the year 2024-25 has been fixed as 1900 Billion Unit (BU). i.e. growth of around 9.3% over actual generation of 1738.828 BU for the previous year (2023-24). The generation during 2023-24 was 1738.828 BU as compared to 1624.465 BU generated during 2022-23, representing a growth of about 7.04%.

¹ https://cea.nic.in/wp-content/uploads/installed/2024/12/IC_Dec_2024_allocation_wise.pdf

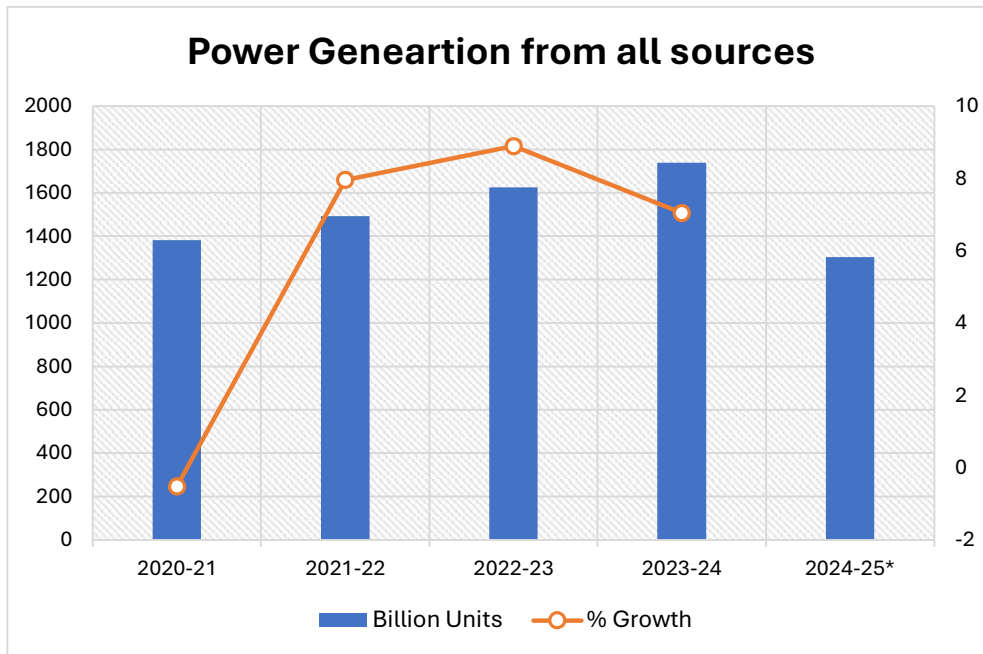


Figure 1.3: Power Generation from all sources over previous five years

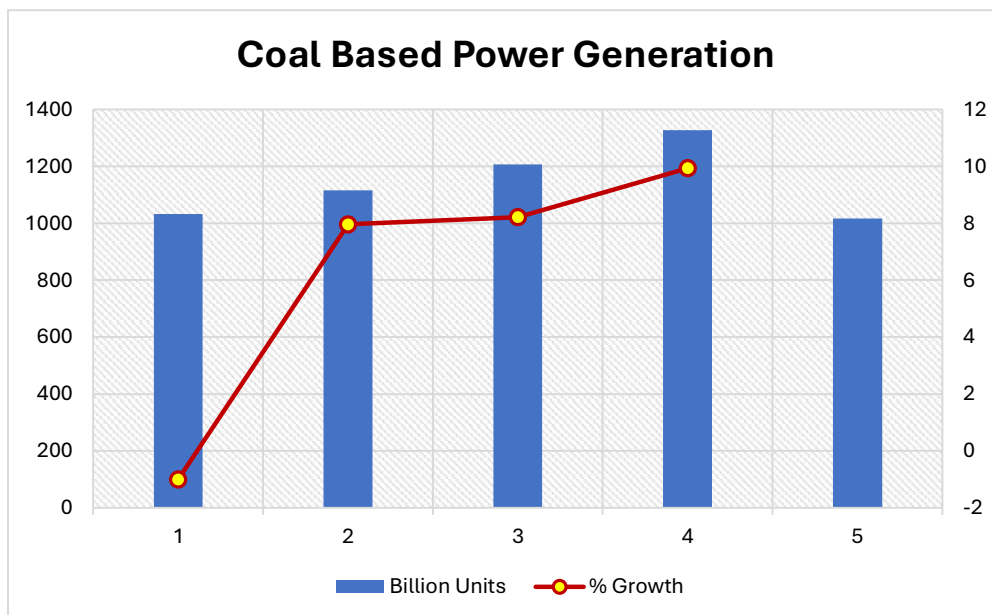


Figure 1.4: Coal Based power generation over previous seven years

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 1.4: All India power generation over previous five years

Year	Power Generation from all sources		Coal Based Power Generation	
	Billion Units	% Growth	Billion Units	% Growth
2020-21	1381.855	-0.52	1032.51	-1.0
2021-22	1491.859	7.96	1114.71	7.96
2022-23	1624.465	8.89	1206.21	8.21
2023-24	1738.828	7.04	1326.09	9.93
2024-25*	1190.440	-	1016.75	--

** Up to Dec 2024 (Provisional), Source: CEA*

1.4.2 PEAK DEMAND AND ENERGY REQUIREMENT FORECAST FOR 2029-30

The studies have incorporated the projections from the 20th Electric Power Survey (EPS) regarding peak electricity demand and electrical energy requirement for the country. The table below presents the projected region-wise and national peak electricity demand (in gigawatts, GW) and electrical energy requirement (in billion units, BU) for the year 2029-30.

Table 1.5: Peak Demand and Energy requirement forecast for 2029-30

Region	Peak Demand (GW)	Electrical Energy Requirement (BU)
Northern	116.7	707.55
Western	107	713.08
Southern	97.4	547.4
Eastern	45.7	282.26
North-Eastern	5.8	29.35
All India	334.8*	2279.64

** Summation of all regional peaks to all India peak may differ due to diversity factor*

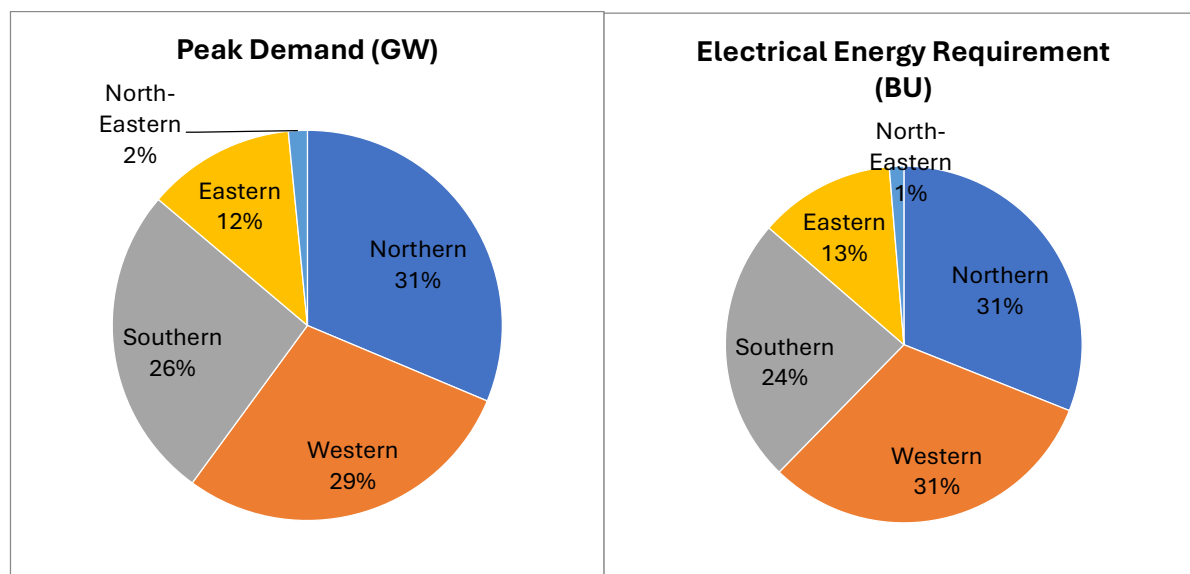


Figure 1.5: Peak Demand and Energy requirement forecast for 2029-30

According to a recent study conducted by the Central Electricity Authority (CEA) on the optimal generation capacity mix for the year 2029-30, the estimated total installed capacity for India in 2029-30 is projected to be 8,17,254 megawatts (MW).

Fuel Type	Capacity (MW) by 2029-30
Hydro	60,977
PSP	10,151
Small Hydro	5,000
Coal + Lignite	2,66,911
Gas	25,080
Nuclear	18,980
Solar	2,80,155
Wind	1,40,000
Biomass	10,000
Total	8,17,254

According to the Central Electricity Authority (CEA), the likely installed capacity for Coal & Lignite based power generation is estimated to be 266.9 GW by end of year 2029-30, which was about 217 GW by February 2024.

1.4.3 SAUBHAGYA' SCHEME

The Government of India (GOI) initiated the Pradhan Mantri Sahaj Bijli Har Ghar Yojana – Saubhagya in October 2017 with the aim of achieving universal household electrification. This program seeks to provide electricity connections to all willing unelectrified households in rural areas and all willing poor households in urban areas across the country. Since the launch of Saubhagya, a total of 2.86 crore households have been electrified up to 31.12.2023.

1.4.4 CONCLUSIONS

Electricity is a cornerstone of national infrastructure, driving economic development and enhancing quality of life. The proposed Gadarwara STPP Stage-II aims to support this growth by providing a significant boost to the power supply for the country. As of December 2024, India's total installed power generation capacity stands at 4,62,065.16 MW, with substantial contributions from both fossil fuels and renewable sources.

The Central Electricity Authority (CEA) has observed a consistent increase in power generation, with notable growth in both overall and coal-based electricity production over recent years. Projections for 2029-30 indicate that India's installed capacity could reach approximately 8,17,254 MW, with significant expansions in solar and wind energy, alongside traditional coal and hydro power.

Programs like the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya) have been instrumental in expanding electricity access, achieving significant milestones in household electrification. These developments underscore the crucial role of electricity in supporting India's economic progress and the need for continued expansion and diversification of the energy sector to meet future demands.

1.5 PURPOSE OF THE REPORT

As per Environment Impact Assessment Notification dated 14th September 2006, and amended from time to time, commissioning or operation of thermal power plants (>500 MW) falls under category 'A' under project type 1(d) and requires prior Environmental Clearance (EC) from MoEF&CC before the commencement of ground activity.

In line with the said Notification, Terms of Reference (ToR) application for Environmental Clearance (EC) was filed to MOEF&CC vide proposal no. IA/MP/THE/465459/2024 dated 09.03.2024. The proposed project was listed for its consideration in 7th Expert Appraisal Committee (EAC) (Thermal) Meeting which was scheduled on 19.03.2024 and vide MoM dated 10.04.2024, the proposal was deferred for site visit by EAC sub-committee and additional information submission. Copy of ADS reply and compliance status to recommendation by EAC site visit enclosed as **Annexure 1.10 & Annexure 1.11**. A presentation was made to the Expert Appraisal Committee (Thermal), MoEF&CC in the 12th Expert Appraisal Committee (EAC) meetings held on 29.08.2024 MoEF&CC has examined the proposal in accordance with the provisions contained in the Environment Impact Assessment (EIA) Notification, 2006 & further amendments there to and based on the recommendations of the EAC, accorded Standard Terms of Reference (TOR) along with Specific/additional ToR vide TOR Identification No. TO24A0601MP5220209N, File No: J-13012/125/2009-IA.II(T) Dated 30.09.2024 to NTPC Ltd. for expansion of Gadarwara Super Thermal Power Project, Stage-II (2x800 MW) (**A copy of MOEF&CC Approved TOR is enclosed as Annexure-1.1**). Based on the TOR conditions stipulated by MoEF&CC, the present EIA/EMP report has been prepared. This report has been prepared for assessing the environmental impacts on the study area (10-km radius around the plant) due to the proposed power plant on the basis of approved ToR issued by MoEF&CC. The TOR compliance is enclosed as **Annexure 1.2**. This includes a cumulative Impact Assessment Study, considering a buffer area of 10 km, to assess the potential impacts of the proposed expansion activities. Final EIA-EMP Report including ToR Compliances, Public Hearing minutes with budget and timeline and all other related documents have been included in the Final EIA Report and submitted along with EC application.

1.6 SCOPE OF THE STUDY

NTPC Limited has appointed M/s Greencindia Consulting Private Limited (formerly GIS Enabled Environment & Neo-graphic Centre), Ghaziabad to prepare the Environment Impact Assessment report for the proposed expansion project to facilitate & obtain Environment Clearance for the same from Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India. The report is prepared for various environmental components including air, noise, water, land and biological components along with parameters of human interest which may be affected and to prepare an EIA&EMP for mitigating adverse impacts. The steps involved in conducting the EIA&EMP Study are as follows:

- Conduct literature review, collate and compile secondary data including socio-economic data from published literature / government publications.
- Undertake environmental monitoring through field sampling so as to establish the baseline environmental status of the study area.
- Identify existing pollution source and load due to various activities in the ambient levels.
- Identify the basic environmental status including the meteorological parameters and socioeconomic environment of the proposed study area.
- Predict incremental levels of pollutants in study area due to the proposed plant activities.
- Evaluate the predicted impact on the various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact methodologies.
- Prepare an environmental management and monitoring plan outlining the measures for improving the environmental quality for environmentally sustainable development.
- Prepare Risk Assessment and Disaster Management Plan and undertake Additional studies if required.

Table 1.6: Baseline Study Parameters & their frequency

Attributes	Parameters	Source and Frequency
Ambient Air Quality	Particulate Matter (PM ₁₀ , PM _{2.5}), SO ₂ , NO _x	24 hourly samples twice a week for one season at 10 locations.
	All the parameters as per NAAQS, 2009	Once in a month at 10 locations
Meteorology	Wind speed and direction, temperature, relative humidity and rainfall	Near project site continuous for one season with hourly recording and from secondary sources of IMD station at Narsinghpur.
Water quality	Physical, Chemical and Bacteriological parameters	Samples have been collected at 12 groundwater (including locations within 2 km radius of site). In addition, Ground and Surface water sampling done at 6 locations each once in season.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Attributes	Parameters	Source and Frequency
Ecology	Existing terrestrial and aquatic flora and fauna within 10-Km radius circle.	Primary Survey conducted by ecological experts. Secondary data have been collected from the Forest Department.
Noise levels	Noise levels in dB(A)	At 10 locations data monitored once for 24 hours during study season
Soil Characteristics	Physical and chemical parameters	Grab sample once at 10 locations
Land use of India topo-sheet and latest satellite imagery	Trend of land use change for different categories	Based on Survey of India topo-sheet and latest satellite imagery
Socio-Economic aspects	Socio-economic and demographic characteristics, worker characteristics	Based on primary limited survey and secondary sources data like primary census abstracts of Census of India 2001 & 2011.
Need-assessment & CSR/CER Plan	Village-level information Village Level Survey	Village Level Survey and Public Consultation for villages within 10-km radius
Hydrology	Drainage area and pattern, nature of streams, aquifer characteristics, recharge and discharge areas	Based on data collected from secondary sources as well as hydrology, hydro-geology study report prepared separately
Risk Assessment and Disaster Management Plan	Identify areas where disaster can occur by fires and explosions and release of toxic substances	Based on the findings of Risk Modelling done for the risk associated with LDO storage, Ammonia and Risk assessment for hazardous chemicals.

1.7 PROCESS OF OBTAINING THE ENVIRONMENT CLEARANCE

As per the EIA Notification 2006, projects are classified into Category A or Category B projects based on spatial extent of potential impacts on human health and natural and man-made resources. 'Category A' projects require prior environmental clearance by the Expert Appraisal Committee, MoEF&CC, and Government of India while Category B projects have to get prior environmental clearance from the State Level Expert Appraisal Committee. The environmental clearance process for new projects will comprise of a maximum of four stages. The four stages in sequential order are:

- Stage (1) Screening (only for Category 'B' projects and activities)

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



- Stage (2) Scoping
- Stage (3) Public Consultation
- Stage (4) Appraisal

1.7.1 STAGE (1)

Screening: It refers to the definite assignment of environmental category to projects or activities where the same is not completely specified. In case of Category 'B' projects scrutiny of application is done at State level to categorize project in 'B1' or 'B2'. The 'B2' projects do not require detailed EIA study and preparation of EIA Reports. Since the present project comes under category 'A' so it doesn't need screening.

Table 1.7: Project Categorization

Project or Activity		Category with threshold limit		Conditions if any
		A	B	
1 (d)	Thermal Power Plants	≥ 500 MW (coal/lignite/naphtha & gas based);	Not required as the project falls in Category A	General Condition shall apply Note: 1. Thermal Power plants up to 25 MW based on biomass or non-hazardous municipal solid waste using auxiliary fuel such as coal, lignite / petroleum products up to 15% are exempt. 2. Thermal power plants using waste heat boilers without any auxiliary fuel are exempt.

1.7.2 STAGE (2)

Scoping: It refers to the process by which the Expert Appraisal Committee (for Category 'A' projects) and State Level Expert Appraisal Committee (for Category 'B1' projects), determines detailed and comprehensive Terms of Reference (TOR) for all Greenfield or expansion projects. The ToR addresses all relevant environmental concerns for the preparation of an Environment Impact Assessment (EIA) report in respect of the project or activity for which prior Environmental Clearance is sought.

1.7.3 STAGE (3)

Public Consultation: It refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate. The public consultation takes part in two steps: Public Hearing and written responses.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



1.7.4 STAGE (4)

Appraisal: This process refers to the detailed scrutiny of the application for Environmental Clearance, EIA Report and other related documents by the Expert Appraisal Committee or State-level Expert Appraisal Committee

1.8 ENVIRONMENT LEGISLATIONS

The environmental regulations, legislations and policy guidelines and control measures that may impact the project are the responsibility of various Government agencies. The principal environmental regulatory agency in India is the MoEF&CC, Govt. of India. MoEF&CC formulates environmental policies and also accords Environmental Clearance for different category projects.

Many State and Central legislations have a bearing on environment but regulation on environment protection are being notified time to time. These legal enactments can be broadly classified in the terms of focus areas, viz. pollution control, natural resources and linkages between pollution and natural resources. The important environment legislations related to Environmental Clearance for Expansion of projects are briefly described in the **Table 1-8**.

Table 1.8: List of Environment Legislations

Name	Scope and Objectives	Key Areas	Operational Agencies
Water (Prevention and Control of Pollution) Act 1974	To provide for prevention & control of water pollution and enhancing water quality	Control of sewage and industrial effluent discharges	Central and State Pollution Control Boards
Air (Prevention and Control of Pollution) Act 1981	To provide for prevention and control of air pollution	Controls emission and air pollutants	Central and State Pollution Control Boards
Forest Conservation Act 1980	To halt rapid deforestation and resulting in environmental degradation	Restriction on de-reservation & using forest for non-forest purpose	Central Government
Environment Protection Act 1986; Environment Protection Rules 1989.	To provide for protection and improvement of environment	An umbrella legislation; supplements pollution laws	Central Govt. MoEF&CC, can delegate power to Department of Environment, CPCB and SPCB's/PCB's
Noise Pollution (Prevention & Control) Rules 2000	To control and take measures for abatement of noise and ensure that level remain within standard	Noise in urban area and around industrial sites	Central Government, nodal agencies MoEF&CC, State governments

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Name	Scope and Objectives	Key Areas	Operational Agencies
Wildlife Protection Act 1972	To provide for protection of wild animals, birds and plants; and for matters connected therewith	Wildlife protection in forest areas	Central Govt.
Hazardous Waste Management and Handling Rules 2016	To impose restrictions and prescribe procedures for management, handling and disposal of hazardous waste	Any facility producing hazardous waste	Central and State Pollution Control Boards
Public Liability Insurance Act, 1991	To provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto.	To provide public liability insurance during risk material handling	Central Government, Nodal Agencies MoEF&CC, State Govt.
Plastic waste Management (Amendment) Rules, 2024	To impose restrictions and prescribe procedures for management, handling and disposal of plastic waste	To apply every waste generator	Central & State Pollution Control Boards
E-Waste (Management) Rules, 2024	To impose restrictions and prescribe procedures for management, handling and disposal of E-waste	To apply everyone who generates e-waste	Central & State Pollution Control Boards
Solid waste management rule, 2016 and latest amendment, 2022	To impose restrictions and prescribe procedures for management, handling and disposal of solid waste	To apply every waste generator	Central & State Pollution Control Boards
Battery Waste Management Rules, 2022	To impose restrictions and prescribe procedures for	To apply everyone who generates batteries waste	Central & State Pollution Control Boards

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Name	Scope and Objectives	Key Areas	Operational Agencies
and their amendments	management, handling and disposal of battery waste		
Ash Utilisation Notification, 2021 and their amendments	To impose restrictions and prescribe procedures for Management & Utilization of Fly Ash	To apply every coal or lignite based thermal power plant (including captive or co-generating stations or both)	Central & State Pollution Control Boards

1.8.1 POLLUTION STANDARDS

The MoEF&CC is the nodal agency to set up policy, guidelines, and standards for the protection of environment, along with Central Pollution Control Board (CPCB). This includes air, noise, water, solid waste, e-waste, battery waste and hazardous waste standards etc. NTPC Gadawara shall follow all the acts, its rules, pollution/emission standards and guidelines prescribed by MoEF&CC & MPPCB as applicable.

1.9 STATUTORY CLEARANCES

The list of statutory clearances, NOC, approvals of existing (2x800 MW) and proposed (2X8000 MW) Gadawara Super Thermal Power Project, Stage-II is given in Table-1.9.

Table 1.9: List of Statutory Clearance

S. No.	Statutory Clearance	Issuing Authority	Letter No	Date of Issue	Remarks
1.	Terms of Reference (ToR) accord to Gadawara STPP, Stage-II	MoEF&CC	File No: J-13012/125/2009-IA.II(T)	30/09/2024	Annexure 1.1
2.	Environmental Clearance	MoEF&CC	J-13012/125/2009-IA.II (T)	22/03/2013	Annexure 1.3
3.	Amendment in EC	MoEF&CC	J-13012/125/2009-IA.II (T)	01/09/2017 07/02/2019 22/10/2019 11/08/2020 & 24/12/2021	Annexure 1.4
4.	IRO certified EC compliance and Action taken Report	MoEF&CC	4-10/2013 (Env)	28/06/2024	Annexure 1.5
5.	Consent to Establish (CTE), Stage I	MPPCB, Bhopal	5602/TS/MPPCB/2014	02/09/2014	Annexure 1.6
6.	Consent to Operate (CTO), Stage-I	MPPCB, Bhopal	AW-60741	22/07/2024	Annexure 1.7
7.	Authorization for Hazardous & Other	MPPCB, Bhopal	H-54161	14/09/2021	Annexure 1.8

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Statutory Clearance	Issuing Authority	Letter No	Date of Issue	Remarks
	Wastes (Management & Transboundary Movement)				
8.	Authorization for Bio-Medical Waste (Management & Transboundary movement)	MPPCB, Bhopal	AWB-109081	20/01/2023	Annexure 1.9
9.	Letter for HFL of River	Department of water Resources, Bhopal	N.M.B./A.Sha-03/2023/1287-88	15/10/2024	Annexure 1.12
10	Coal Linkage SLC	Ministry of Coal	No. CPD-23O14 I 7 I 2023-CPD	13/02/2024	Annexure 2.1
11	Coal Linkage CIL	Coal India Limited	CIL/M&S/SHAKT I B(1)/283	20/06/2024	Annexure 2.2
12	Water Allocation Permission for Stage-I	Water Resources Department, Govt. of Madhya Pradesh	3482/13/2008 & वृ.प.नि.मं./31/तक/रा.स्त-152/2008/481, Bhopal	19/05/2008 09/09/2021	Annexure 2.5
	Water Allocation Permission for Stage-II	Water Resources Department, Major Project Control Board	वृ.प.नि.मं./31/तक/रा.स्त-152/2008/61, Bhopal	19/02/2024	

1.10 ORGANISATION & CHAPTERIZATION OF REPORT

The chapters of the Final EIA&EMP Report are based on EIA Notification, 2006 & amendments.

Chapter 1: Introduction: The present chapter gives brief outline of the project and its proponent, power scenario in India, brief description of the nature, size, and location of the project and its importance, and extent of the EIA study, including the scope of the study.

Chapter 2: Project Description: The description of the power generation process and the various features of the proposed power plant incorporating utilities, water, fuel requirements are described in this chapter.

Chapter 3: Description of the Environment: This chapter presents the methodology and finding of the field studies covering physical, biological and socio-economic environments, carried out to ascertain the baseline environmental condition of the study area. It includes the information regarding physical condition, water and air environment, soil characteristics, noise level, ecology and the socio-economic status of the area.

Chapter 4: Impacts Assessment & Mitigation Measures: This chapter provides details of the impact assessment of the project during construction and operational phase. It expresses the impacts of the proposed project on the various components of environment. The mathematical modelling exercise

pertaining to prediction of ground level concentration of air pollutants have also been dealt in this chapter. Mitigation measures are suggested along with the impact prediction.

Chapter 5: Analysis of Alternatives: This chapter describes systematic comparisons of feasible alternatives for the proposed project site, technology, and operational alternatives. Alternatives have been compared in terms of their potential environmental impacts, suitability under local conditions, and institutional training and monitoring requirements.

Chapter 6: Environmental Monitoring Programme: The monitoring of environmental parameters in construction as well as operation phase of the project for assessing the impact and the organization structure, which will be responsible for environment monitoring have been detailed in this chapter.

Chapter 7: Additional Studies: This chapter provides details of the additional studies conducted as per the stipulation of the ToR as well as the details of the public hearing. The risk assessment included in this chapter provides information regarding the activities associated with the project likely to pose a risk to man, environment or property. Computation of risk assessment has been covered in this chapter. It also provides details regarding precautionary measure to be taken. This section also presents a brief outline of Wildlife Conservation Plan and Biodiversity Plan, Hydrogeology Study and Watershed plan conducted separately as per the requirement of this study.

Chapter 8: Project Benefits: This chapter includes the benefits likely to accrue and improve the physical & social infrastructures for the local community in particular and region in general.

Chapter 9: Environmental Cost Benefit Analysis: This chapter evaluates the economic pros and cons of projects affecting the environment by comparing costs like pollution with benefits such as improved air quality.

Chapter 10: Environment Management Plan: This chapter deals with the management plan and enhancement measures incorporating recommendations to mitigate the adverse impact likely to occur on environmental parameters during construction and operation phase. Post project monitoring and organization structure for environment management have been also provided in the chapter.

Chapter 11: Summary & Conclusion: This chapter will constitute the summary & conclusion of the EIA & EMP Report

Chapter 12: Disclosure of the Consultant Engaged: The detailed profile of the consultants along with their capabilities and experience are highlighted in this chapter.

Chapter 13: Cumulative Assessment Study: This chapter addresses the combined impact of the proposed project and other potential sources of environmental pollution, as well as their management strategies.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

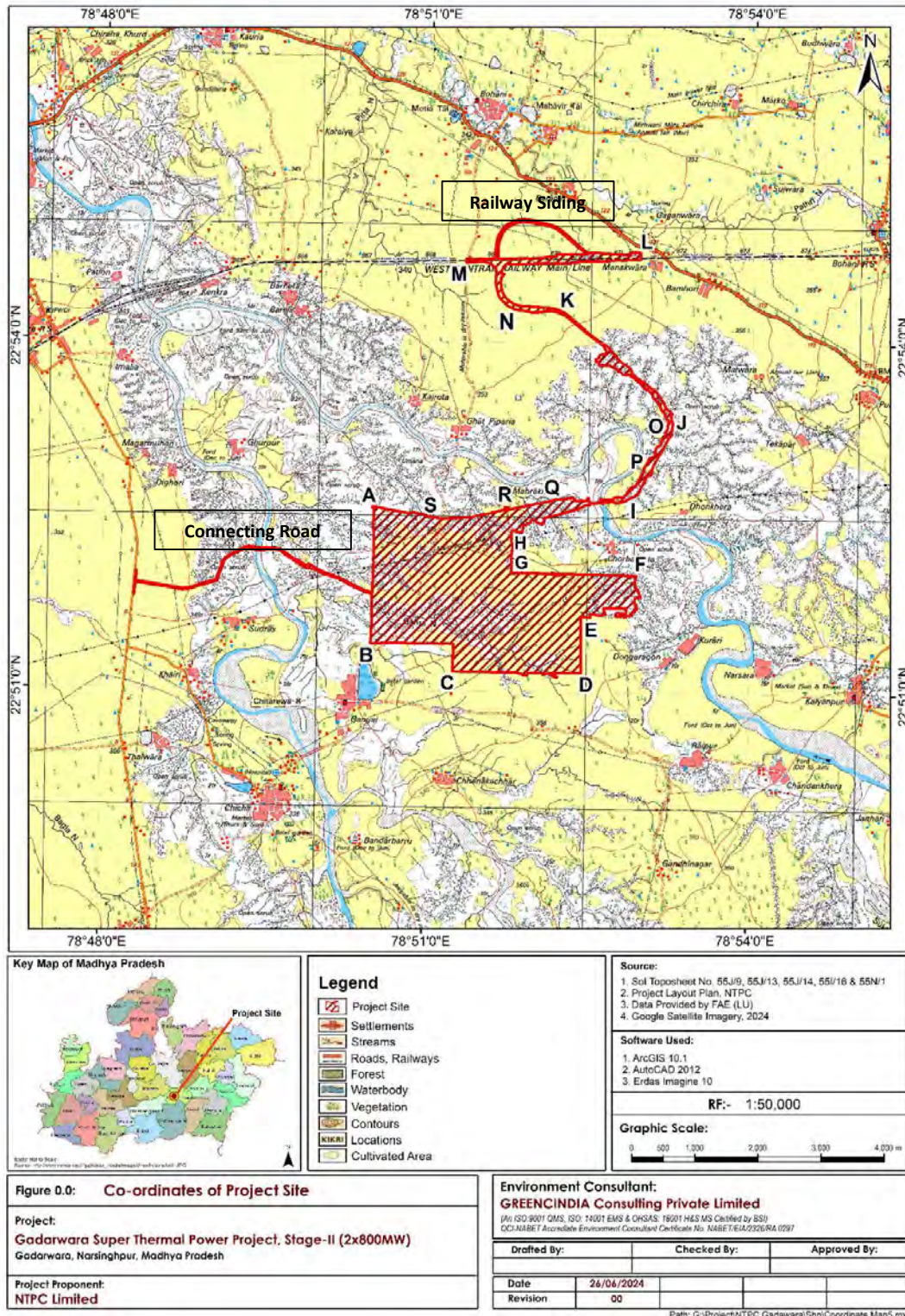


Figure 1.6: Study Area Map

2. PROJECT DESCRIPTION

2.1 PROJECT FEATURES

Stage-I (2x800MW) has been established and both the units are under commercial operation. NTPC now intends to expand the capacity of the project by adding 2x800 MW units based on air cooled condenser system under Stage-II thereby making the total capacity as 3,200 MW. Main Plant and ash dykes of Stage-II (2x800MW) are proposed to be located within the available area and no additional land is proposed to be acquired.

During the meeting held under the chairmanship of Hon'ble Minister of Power and NRE on 27.09.2023 to review the capacity addition up to 2031-32, Ministry of Power vide Office Memorandum dated 25.10.2023, has identified Gadarwara STPP Stage-II (2x800 MW) ultra-super critical project as candidate thermal power project (in planning likely to be commissioned by FY 2031-32) under brownfield project category of NTPC.

NTPC is planning to expand the Gadarwara Super Thermal Power Plant by adding 1600 MW (2x800 MW) of Ultra Super Critical Technology to the existing 1600 MW (2x800 MW) capacity within the current plant boundary in Village Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon etc., Tehsil Gadarwara District Narsinghpur in Madhya Pradesh. Details of the project features and related information are provided in **Table 2.1**, and the layout for the existing and proposed plant is illustrated in **Figure 2.1**.

Table 2.1: Project Design Features

Item	Main Design Parameters
Capacity & Unit Configurations:	<u>Under Operation:</u> Stage-I: 1600 MW (2x800 MW) Super Critical Technology <u>Proposed Expansion:</u> Stage-II: 1600 MW (2x800 MW) Ultra Super Critical Technology
Location of the Project	The project is proposed near village Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon etc., Tehsil Gadarwara, in Narsinghpur District of Madhya Pradesh State having a Latitude of 22° 52' 34" North to 22° 52' 10" North and Longitude of 78° 50' 30" East to 78° 52' 52" East, respectively.
Land	A total of 910.706 hectares of land is available with NTPC Gadarwara out of which 56.146 Ha has not been acquired but the land is under Right of Use (ROU) or for makeup water pipeline. Approximately 621.474 hectares of this land has been utilized for Stage-I. The remaining 289.232 hectares of land is allocated for Stage-II Units, Ancillary Facilities and Ash Disposal Area.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Item	Main Design Parameters
	Out of total project area of 910.706 Ha., an area of 56.146 Ha has not been acquired but the land is under Right of Use (ROU) or for makeup water pipeline.
Primary Fuel & Requirement	Gadarwara STPP Stage-I operates with Super Critical Technology. The annual coal requirement for Stage-I is estimated at 7.56 million tonnes, based on a Gross Calorific Value (GCV) of 3704 kcal/kg and a Plant Load Factor (PLF) of 90%. Gadarwara STPP Stage-II Ultra Super Critical Technology, offering higher efficiency compared to Super Critical Technology. The coal requirement for the project is estimated to be about 6.10 MTPA corresponding to 90% PLF considering GCV of 4450 Kcal/Kg.
Fuel Transportation	Coal transportation from mines to the power plant will be managed by Indian Railways. To accommodate additional rakes for Stage-II, the current railway siding will need augmentation.
Auxiliary Fuel	Light Diesel Oil (LDO) shall be used for initial start-up, low load operation and as secondary fuel for pulverized coal flame stabilization at the startups/ low load operations. Necessary oil supply scheme with pumps filters and valves will be provided. The burners, air registers etc., will have independent pneumatic drives and the entire operation of purging, insertion, air and fuel sequencing shall be automatic. Ignition of oil shall be directly by igniters. LDO system shall be sized for 30% BMCR capacity of the Steam Generators. Steam Generator will be so designed that oil firing for flame stabilization will not be required beyond 40% TMCR.
Water Requirement	The water requirement for Stage-I of the project is approximately 1,12,200 KLD (4,675m³/hour). It is based on Water Cooled Condenser (WCC). For the Gadawara STPP Stage-II (2x800 MW) project, the water requirement is expected to be around 48,000 KLD (2,000m³/hour) which is approx. 19.6 Cusec. It is proposed to be based on Air Cooled Condenser (ACC) system.
Source of Water	The Source of water for the Gadawara Project is from River Narmada (25 Km). WRD, Govt. of Madhya Pradesh vide letter dated 19.05.2008 accorded water availability confirmation for 125 Cusecs from River Narmada to the project. However, as the capacity expansion at Gadawara STPP was not

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Item	Main Design Parameters
	envisaged by the year 2018-19, NTPC surrendered excess water allocation to WRD. Subsequently, WRD, Govt. of Madhya Pradesh vide its letter dated 09.09.2021 reduced the water allocation of the project from 125 Cusecs to 62.72 Cusecs. The consumptive water requirement for Stage-I (2x800 MW) having water cooled condenser is 48 Cusecs. Therefore, surplus water of 14.72 Cusecs is available with Gadawara STPP. The project shall be provided with Air Cooled Condenser (ACC) and makeup water requirement for Stage-II having ACC would be about 48,000 KLD (2,000 m³/hr.) which is approx. 19.6 Cusec. In view of capacity expansion at Gadawara STPP under Stage-II, WRD, Govt. of Madhya Pradesh vide letter dated:19.02.2024 have allocated additional 12.32 Cusecs of water, which is sufficient to meet the entire requirement of the Stage-II. Enclosed as Annexure 2.5.
Power Generating Unit	Gadawara STPP Stage-II will be a pulverized coal-fired thermal power project Ultra Super Critical boiler technology. The plan includes building and operating two units, each with a capacity of 800 MW.
Cooling System	Gadawara STPP Stage-I utilizes a close cycle water cooling system with cooling towers for the condenser and auxiliary cooling. In Gadawara STPP Stage-II, an Air-Cooled Condenser (ACC) System has been envisaged with aux. CT to significantly reduce water consumption.
Coal Handling System	Coal handling facility, which comprises receipt of coal through Rail, with crushing and stacking by stacker-cum-reclaimer in the coal yard and finally feeding the bunker level conveyors.
Ash Disposal System	The ash produced by the project generally comprises 80% fly ash and 20% bottom ash. High Concentration Slurry Disposal (HCSD) System is proposed for Fly Ash Disposal System. The fly ash shall be extracted in dry form from the electrostatic precipitator hoppers. This dry ash shall either be taken by buffer hoppers for its onward transportation in dry form for utilization or shall be slurried in wetting units for its ultimate disposal in ash disposal area using HCSD system. The bottom ash shall be extracted in dry form. It is envisaged to have a disposal system sized for 100% generation of ash. The ash management scheme for fly ash and bottom ash involves dry collection of fly ash, supply of ash to

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Item	Main Design Parameters
	entrepreneurs for utilisation, promoting ash utilisation and safe disposal of unused ash.
Power Evacuation	It is proposed to consider step up voltage for the Stage-II project as 765 kV in line with Stage-I. Under Stage-I, two numbers of 765 kV Double Circuit line (to Jabalpur pooling station and Warora Pooling station) have been implemented for connectivity and evacuation of power from Stage-I. These 2 numbers of 765 kV D/C lines (Jabalpur and Warora) are sufficient for evacuation of power from Stage-II also. The issue of power evacuation of the proposed project shall be taken up with appropriate Transmission Utility (STU and CTU) as per regulatory provision.
Rehabilitation Requirement	Nil. Proposed Expansion is within the existing plant boundary.
Seismological Information	Zone-III (Moderate Risk Zone)
Project Time Frame	Commercial Operation Date (COD) of the first 800 MW unit of Gadawara STPP Stage-II will be approx. 60 months from the Investment approval and subsequent units after an interval of 9 months thereafter.

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

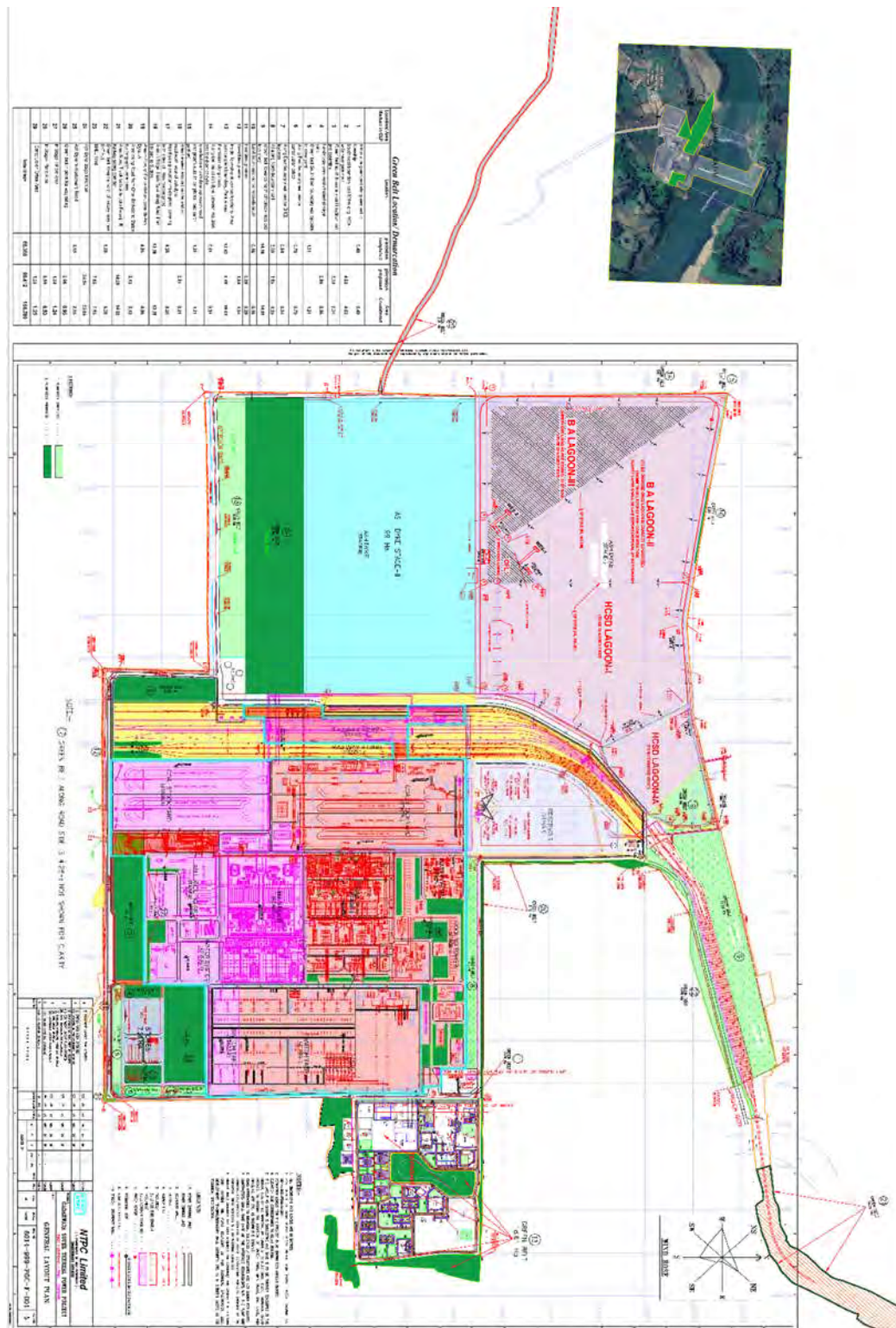


Figure 2.1: Plant Layout (Existing & Proposed)

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



2.2 BASIC RESOURCE- REQUIREMENT, SOURCE AND AVAILABILITY

2.2.1 LAND REQUIREMENT AND AVAILABILITY

A total of 910.706 hectares of land is available with NTPC Gadawara out of which 56.146 Ha has not been acquired but the land is under Right of Use (ROU) or for makeup water pipeline. It included the existing 2x800 MW unit, land area for accommodation of coal stockyard, water reservoir, township and roads, green belt etc. The land requirement envisaged for the expansion project considers installation of 2x800 MW pulverized coal based Ultra Super-Critical Thermal Power Project. Detailed land breakup is furnished in Table 2.2.

Table 2.2: Land details for Gadawara STPP (Stage-I & Stage-II)

S.N.	Description	Area Utilised for Stage-I, Ha.	Area Proposed for Stage-II, Ha.	Total Area, Ha. (St-I & St-II)
A	Main Plant	127.990	81.820	209.81
B	Ash Pond	157.020	99.000	256.02
C	Greenbelt area within main plant	7.740	0.000	7.740
D	Total area considered for Greenbelt calculation (A+B+C)	292.750	180.820	473.570
E	Greenbelt area adjacent to main plant (on NTPC Land)	58.628	90.412	149.040
F	Total Greenbelt Area Provision (C+E) (7.740+149.040=156.780 Ha ~33.1% of 473.570 Ha.)			156.780
G	Others- (Railway Corridor/ Siding/ Misc. areas i.e., Outside Roads, Reservoir, Township, misc. facilities etc.)	213.950	18.000	231.950
H	Total Land Acquired (D+E+G)	565.328	289.232	854.560
I	ROU Land for Pipeline (Ownership with Farmers)	56.146		56.146
J	Total Land with ROU (H+I)	621.474	289.232	910.706

Out of total project area of 910.706 Ha. an area of 56.146 Ha has not been acquired but the land is under Right of Use (ROU) or for makeup water pipeline.

**Existing plantation for Stage I has been developed on 163.9Acre (66.367 ha) as per stage I EC requirement. Further 90.412 Ha. has been identified for development of 33% area a green belt considering total area of main plant and ash dyke (473.570 Ha.).*

Total land area break up for Stage-I and Stage-II has been reworked to increase the area of green belt. Stage-I ash pond has been developed on 157.02 Ha.

In the Environment Clearance of Stage-I, the total land requirement for ultimate capacity was envisaged as 805.33 Hectares (1990 Acres). However, during actual construction phase, several technical difficulties were observed regarding constraint of land. Accordingly, further 49.216 Ha. of land had to be acquired in phases. Hence, the total area acquired by NTPC Gadawara is 854.560 Ha.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Additional land acquisition is mainly attributed to the following reasons:

1. Change in track length as suggested by the consultant M/s Konkan Railways in line Indian Railways standards for construction of ROR line and crossing station on the land of villages Baranjh, Bohani, Manakwara.
2. Some land had also been acquired to construct the approach road to the Raw water pump house near River Narmada (at Kakra Ghat), which was not envisaged during initial phase.
3. Few farmers had approached District Administration with a request to get their land patches acquired by NTPC which is not enough for cultivation due to the smaller size of the remaining land which were subsequently acquired in view of the LARR Act.
4. Few patches of Pvt. and Govt. land were also acquired to construct the Main Road which was not included in the original requirement.

In addition to the above, 56.146 Ha. land comprising of 6.71 Ha. Govt. Land and 49.447 Ha. Pvt. Land has been considered under Right of Use and the ownership of the same are not with NTPC Gadarwara.

The land mentioned in the TOR for the proposed project is 910.706 Ha considering 854.560 Ha. acquired land and 56.146 Ha ROU Land.

Detail related to total land acquired as enclosed as **Annexure 2.8**.

2.2.2 FUEL REQUIREMENT AND SOURCE

2.2.2.1 COAL

Gadarwara STPP Stage-I Super Critical Technology. The annual coal requirement for Stage-I was calculated at 7.56 Million Tonnes Per Annum (MTPA) based on a Gross Calorific Value (GCV) of 3704 kcal/kg and a Plant Load Factor (PLF) of 90%. Raw coal serves as the primary fuel, sourced likely from the SECL, WCL, NCL. **Annexure 2.1 and 2.2.**

Parameters	Stage-I (2x800MW)	Stage-II (2x800MW)
Coal source	SECL, NCL & WCL (as per Stage-I EC condition)	MCL & SECL (as per CIL letter dtd 20.06.2024)*
Approx. distance (coal source to power plant), km	NCL: 540 km SECL: 500 km to 650 km WCL: 470 km to 640 km	MCL: 740 km to 1000 km SECL: 500 km to 650 km
Mode of transportation etc.	Rail	Rail

** The linkage sources are tentative based on the above-mentioned CIL letter dated. 20.06.2024.*

The coal requirement for the project is estimated to be about 6.10 MTPA corresponding to 90% PLF considering GCV of 4450 Kcal/Kg. SLC (LT) in a meeting held on 03.01.2024, has recommended for grant of coal linkage. Coal India Ltd. vide letter dated 20.06.2024 has tentatively allocated Coal from MCL & SECL coal mines. This coal will be instrumental in meeting the energy requirements of the project, ensuring a reliable and sustainable source of fuel for power generation. **Annexure 2.3 & Annexure 2.4.**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 2.3: Coal Characteristics for Gadarwara STPP

Coal Specifications	Proposed (2x800 MW)
Ash (%)	29- 43
GCV (kcal/kg)	3200-4450
Sulphur (%)	0.3-0.55
Radioactive Analysis	
Uranium (U-238) Bq/kg	3.7 to 14.9
Thorium (Th-232) Bq/kg	3.1 to 42.2
Heavy metal Analysis	
Hexavalent Chromium, mg/kg	7.82-14.70
Total Chromium, mg/kg	15.86-28.33
Zn, mg/kg	68.47-91.21
Pb, mg/kg	9.63-16.76
As, mg/kg	1.22-2.08
Cd, mg/kg	BLQ-0.17
Hg, mg/kg	BLQ
Cu, mg/kg	26.47-38.22
Fe, mg/kg	8909.74-13471.74
Se, mg/kg	1.31-2.31

2.2.2.2 AUXILIARY FUEL

Light Diesel Oil (LDO) will be utilized for initial start-up, low-load operation, and as a secondary fuel for stabilizing the pulverized coal flame during start-ups and low-load operations. The necessary oil supply system, including pumps, filters, and valves, will be provided. Each burner and air register will be equipped with independent pneumatic drives, enabling automatic operation for purging, insertion, and fuel and air sequencing. Ignition of the oil will be carried out directly by igniters. The LDO will be transported through road tankers.

The specific oil consumption for Light Diesel Oil (LDO) has shown a consistent reduction over the last two years. This improvement highlights the effectiveness of ongoing efforts to optimize fuel usage and enhance operational efficiency. Additionally, a focused plan has been implemented to achieve further reductions in specific oil consumption, demonstrating a strong commitment to sustainability and resource efficiency. The proposed units are envisaged to have ultra super technology which shall further reduce specific diesel oil consumption.

Year-wise reduction in the specific diesel consumption (LDO)		
Description	FY 2022-23	FY 2023-24
Specific Diesel Oil consumption (ml/KWH)	0.81	0.47

NTPC Gadarwara STPP has deployed 21 nos. battery operated/ e-vehicles in various O&M functions and shall further explore use of E-vehicles/battery operated vehicles for the proposed expansion project.

Coal is being supplied by Electric locos of Indian Railway. Ash is being transported through pipelines to the ash dyke. Further, rail loading facility is being developed for ash transportation through Indian railways.

All the above efforts shall further reduce the oil consumption in operations as well as material handling like coal, ash, other goods etc.

2.2.2.3 FUEL TRANSPORTATION

Gadarwara STPP is linked to the Indian Railway network via Gadawara railway station (09 Km from site). The coal requirement for Gadawara Stage-I (2x800 MW) is approximately 7.56 million tons per annum (TPA) at a 90% Plant Load Factor (PLF). The coal is sourced from various coal mines, including SECL, WCL, and NCL. For Gadawara Stage-II (2x800 MW), the coal requirement is estimated to be around 6.10 million TPA at a 90% PLF. The allocation was recommended by the Standing Linkage Committee (Long-Term) in a meeting held on 03.01.2024. Coal India Ltd., vide letter dated 20.06.2024 has tentatively allocated coal from MCL & SECL coal mines. Augmentation of existing railway siding is necessary to accommodate additional rakes for Stage-II coal transportation. **Annexure 2.1 & Annexure 2.2.**

The secondary fuel for the proposed Power Project i.e. LDO shall be sourced from the refineries located nearer to the Project by road tankers/railway wagons.

2.2.3 WATER REQUIREMENT AND SOURCE

In a conventional fossil fuel-fired thermal power Project, water is used to meet the following basic consumptive requirements: -

- a) To meet Aux. cooling requirement.
- b) To meet the heat cycle make-up and other process requirements.
- c) Flue Gas Desulfurization (FGD) system as per 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 exigency condition)
 - Horticulture

Gadarwara Super Thermal Power Plant (STPP) Stage-I employs a Water-Cooled Condenser System (WCC) integrated with Cooling Towers, necessitating a substantial water demand of approximately 1,12,000 KLD (4,675m³/ hour).

Conversely, for Gadawara STPP Stage-II, an Air-Cooled Condenser (ACC) System is proposed, significantly reducing the water requirement. The projected water demand for Gadawara STPP Stage-II 2x800 MW expansion, is estimated at around 48,000 KLD (2,000 m³/hour) with AWRS.

The site is located at a distance approx. 0.9 km from Sitarewa River & approx.0.60 Km from Shakkar River which are tributaries of Narmada River. The Water Resources Department (WRD), Government

of Madhya Pradesh, in a communication dated 19.05.2008, has granted a commitment of 125 Cusecs. However, due to delay in Stage-II, the allocation was reduced to 62.72 cusecs from River Narmada to the Gadawara project. Now, for development of Gadawara STPP Stage-II (2x800 MW), Water Resources Dept. Govt of Madhya Pradesh vide order dated 19.02.2024, accorded allocation of 12.32 Cusecs water for Gadawara STPP Stage-II (2x800 MW), from river Narmada. Total water requirement for Gadawara STPP Stage-II (2x800 MW) is 2000 m³/hr which will be met from available water allocation. Water allocation letters and Water Balance Diagram given as **Annexure 2.6**.

2.2.4 POWER EVACUATION

It is proposed to consider step up voltage for the Stage-II project as 765 kV in line with Stage-I. Under Stage-I, two numbers of 765 kV Double Circuit line (to Jabalpur pooling station and Warora Pooling station) have been implemented for connectivity and evacuation of power from Stage-I. These 2 numbers of 765 kV D/C lines (Jabalpur and Warora) are sufficient for evacuation of power from stage-II also.

The issue of power evacuation of the proposed project shall be taken up with appropriate Transmission Utility (STU and CTU) as per regulatory provision.

2.3 PROJECT COST

The estimated Cost of the proposed Expansion Project is Rs. 20,445.69 Crores. The specific project cost appears to be Rs. 12.78 Crores per MW based on the estimated Project Cost.

2.4 TECHNOLOGY & PROCESS DESCRIPTION

The Steam Generators (SG) shall be ultra-supercritical once through type, water tube, direct pulverised coal fired, top supported balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation. The gas path arrangement shall be single pass (tower type) or two pass type having 279 Kg/cm² (abs) pressure at super heater outlet and SH/RH outlet temperature of 603°C/603-613°C.

It is envisaged to co-fire 20% of torrefied biomass pellets or 10% of non-torrefied biomass pellets along with coal in the steam generator

In a coal-based thermal power plant, the fuel (coal) undergoes a series of conversions to produce electricity. Initially, the chemical energy stored in coal is transformed into thermal energy through combustion. This thermal energy is then utilized to generate mechanical energy by driving a turbine. Finally, the mechanical energy is converted into electrical energy via a generator. The process flow of power generation in a coal-based thermal power plant is illustrated in **Figure 2.2** and involves the following sequential steps:

Coal Preparation and Combustion:

- Coal is transferred to coal bunkers from the coal handling plant via conveyor belts.
- It is then ground into a fine powder in pulverizing mills and mixed with air.
- The coal-air mixture is blown into the boiler by a fan, where it burns, releasing thermal energy.

Steam Generation and Turbine Rotation:

- High-quality demineralized water, known as boiler feed water, used in the boiler tubes.
- The heat from combustion converts boiler feed water into steam at high pressure and temperature.
- The steam is directed through nozzles onto turbine blades, causing the turbine to rotate.
- The rotating turbine drives a generator, producing electrical energy.

Ash Handling:

- During combustion, non-combustible parts of coal form ash.
- About 20% of ash forms lumps, known as bottom ash, which are collected in ash pits.
- Bottom ash is quenched with water, ground, and disposed of or sold.
- The remaining 80% of ash, called Fly Ash, is carried with flue gas collected in ESP for further disposal.

Flue Gas Treatment and Ash Collection:

- Flue gas, along with Fly Ash, passes through electrostatic precipitators (ESPs) for ash removal.
- Remaining flue gases are treated in Flue Gas Desulphurisation (FGD) System and released through a chimney.
- Ash collected in ESP hoppers is conveyed to dry ash storage silos for disposal or sale to end users.

Steam Condensation and Reuse:

- Steam, after passing through turbines, is condensed back into water in Air Cooled Condenser.
- Condensed water is reused as boiler feed water for steam generation.
- Condensing steam lowers the temperature at the turbine exit, enhancing turbine efficiency.

Accessories and Support Systems:

The technology and process description of Air-Cooled Condenser (ACC) is as follows:

- **Fin Tube Bundles:** The ACC includes fin tube bundles, which are crucial components for heat exchange. These bundles enhance heat transfer efficiency by increasing the surface area for air cooling.
- **Steam Distribution Manifold:** This part of the ACC system ensures proper distribution of steam to the condenser for heat exchange. It directs steam flow efficiently through the condenser tubes.
- **Condensate Collection Headers:** Condensate collection headers gather the condensed steam (water) after it has released its heat in the condenser tubes. These headers facilitate the movement of condensed water to the collection tank.
- **Condensate and Non-condensable Removal Piping:** This piping system is responsible for removing both condensed water and non-condensable gases (such as air) from within the condenser envelope to maintain optimal performance.

- **Hot Well (Condensate Collection Tank):** The hot well serves as a collection tank for the condensed water (condensate) gathered from the condenser. It helps in separating any remaining non-condensable gases from the water.
- **Supporting Structure:** The ACC comes with a robust supporting structure designed to hold and secure all its components in place, ensuring stability and longevity.
- **Steam Duct and Expansion Joints:** The steam duct connects the turbine exhaust flange to the condenser, allowing steam to flow into the condenser for cooling. Expansion joints accommodate thermal expansion and contraction, maintaining the integrity of the ducting system.
- **Anchors and Hangers:** Anchors and hangers support and stabilize the ducting system, preventing excessive movement and stress on the components.
- **HP-LP Bypass Steam Dumping Device:** This device provides a means to divert high-pressure (HP) and low-pressure (LP) steam away from the condenser, allowing for operational flexibility and control.
- **Fans, Gearboxes, Couplings:** These components drive the air movement within the ACC, enhancing cooling efficiency. Gearboxes and couplings transmit power from motors to fans.
- **Vibration Monitoring System (VMS):** The VMS continuously monitors vibrations in the ACC system, detecting any abnormal conditions that could indicate potential issues or failures.
- **Motors and Associated Controls:** Motors power the fans and other moving components of the ACC. Associated controls regulate their operation for optimal performance.
- **Maintenance Platforms and Access Stairways:** These are provided to facilitate safe and easy access for maintenance and inspection purposes.
- **Cleaning/Washing System for Heat Transfer Surface:** A suitable cleaning or washing system is integrated to maintain the efficiency of the heat transfer surface by removing debris, dirt, or contaminants.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

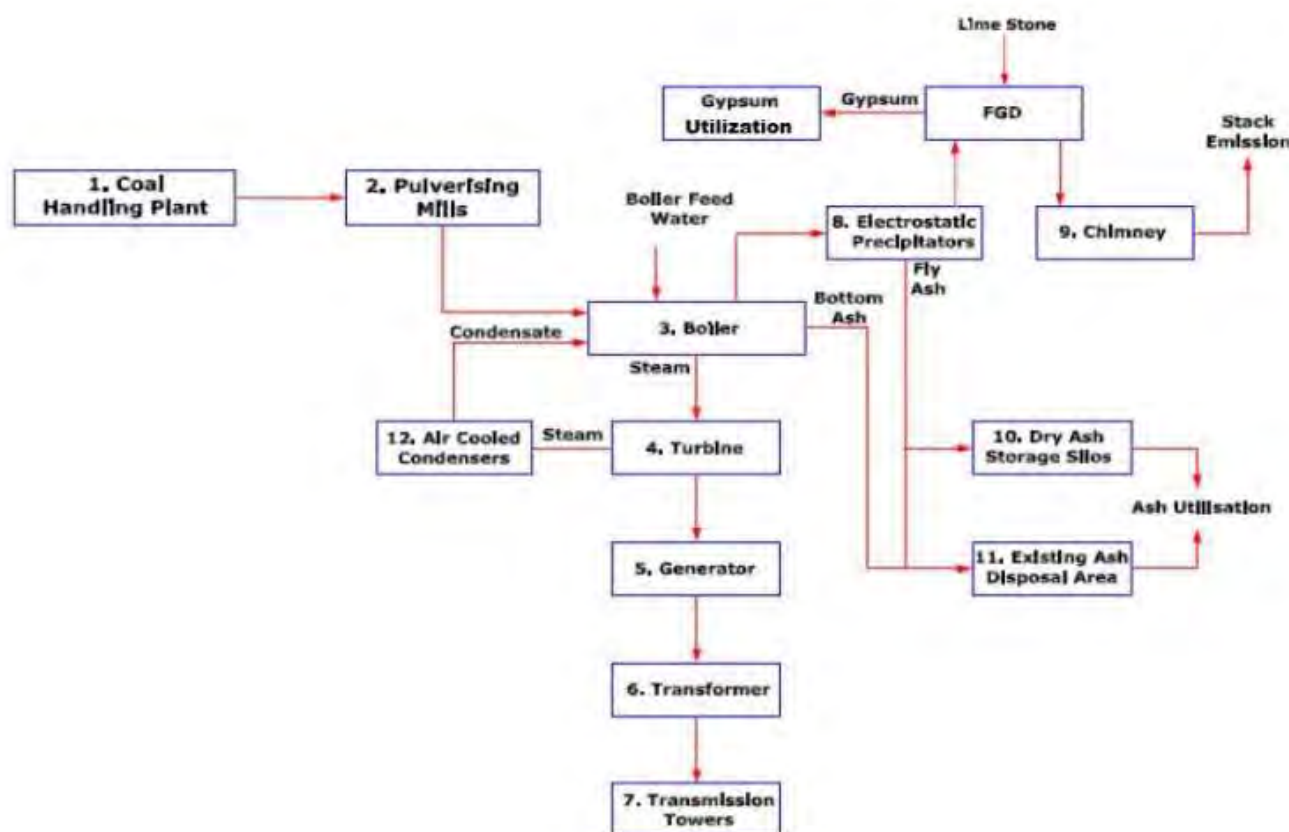


Figure 2.2: Process Diagram for Coal Based Thermal Power Plant

2.5 TURBINE AND ITS AUXILIARIES

Each 800 MW TG unit scope includes the steam turbine and its systems: lube oil, control fluid, condensers, HP & LP bypass, feed heating, condensate pumps, boiler feed water pumps, turbine run-up system, instrumentation, supervisory devices, protection systems, testing system, and EOT cranes in the turbine hall.

2.5.1 STEAM TURBINE

The steam turbine will be a tandem compound, single reheat, regenerative, condensing design with separate HP, IP, and LP casings or combined HP-IP and separate LP casings, directly coupled with the generator for indoor installation. The plant is intended for base load operation with flexibility for two-shift and cyclic modes. The turbine will facilitate quick start-up and loading to full capacity, operating in variable pressure or modified sliding pressure modes. Design specifications include optimizing HRH temperature and ensuring turbine protection against water induction, with details specified for maximum continuous and variable working output capacities.

2.5.2 CONDENSER

For Stage-II, dry cooling will be used with a direct air-cooled condenser featuring inclined roof-like finned cooling tubes. Each module includes a roof and fan for air circulation. Tubes will be carbon steel due to cost efficiency over stainless steel. The condenser's hot well will store condensate for 5 minutes of turbine operation. Design follows Heat Exchange Institute (HEI) standards for Air Cooled Condensers (ACC), optimizing surface area based on site data. The ACC includes fin tube bundles, steam distribution manifold, condensate collection headers, and all necessary accessories for efficient operation.

2.5.3 AIR EXTRACTION SYSTEM

Each unit will include 2x100% vacuum pumps, motors, accessories, piping, valves, fittings, duplex filter, and instrumentation for condenser air evacuation. Additionally, a startup air evacuation system with pumps and accessories will be provided. These vacuum pumps remove air and non-condensable gases from the steam condenser during operation, complying with the latest HEI requirements.

2.5.4 LUBE OIL SYSTEM

Each turbine generator will feature a comprehensive self-contained lubrication oil system that meets the bearings' needs, turbine turning gear requirements during startup and shutdown, and jacking oil requirements during gear operation. The system will also supply oil to generator seals under emergency conditions if applicable. Key components include:

- A main oil pump (MOP) driven by the turbine for bearing lubrication and emergency seal oil, with additional AC auxiliary oil pumps (AOP) for turbine startup, shutdown, and standby.
- Alternatively, two 100% AC oil pumps (AOP) can be provided for bearing lubrication and emergency seal oil, capable of startup, shutdown, and standby operations.
- A DC motor-driven emergency oil pump (EOP) to meet bearing lubrication needs during emergencies.
- AC and DC motor-driven jacking oil pumps (as applicable) with interlocks to prevent operation until proper oil pressure is established.

- Each unit's lube oil tank will have sufficient capacity, equipped with non-corrodible strainers, level measuring devices, and necessary accessories.
- Oil coolers with adequate capacity for lubricating oil cooling, using demineralized water as the cooling medium.
- Permanent connection of a lube oil purification unit to continuously purify 20% of the total oil charge per hour.
- Centralized lube oil storage and purification system with tanks, transfer pumps, and backup capabilities for maintenance.
- All piping, fittings, valves, and components in contact with lubricating oil will be made of stainless steel to ensure durability and corrosion resistance.

2.5.5 TURBINE CONTROL FLUID SYSTEM

The turbo-set's governing and control system will include a self-contained control fluid system using fire-resistant fluid to minimize fire risks. Components will consist of a reservoir for fluid storage, AC motor-driven pumps for fluid circulation, and coolers for fluid cooling. Each turbo-set will have a purification unit for continuous fluid cleaning. Stainless steel components will be used for all parts in contact with the control fluid.

2.5.6 GLAND STEAM SEALING SYSTEM

Each turbine generator set and turbine drives for Boiler Feed Pumps (BFPs) will feature an automatic gland sealing steam supply system. High Pressure (HP) and Intermediate Pressure (IP) turbine shaft glands will be sealed to prevent steam escape, while Low Pressure (LP) turbine glands will prevent atmospheric air leakage. Seal steam will be used in labyrinth glands with spring backing. During start-up and low loads (up to 40% load), seal steam will come from the auxiliary steam header via a regulating valve. Above 40% load, HP and IP turbines will self-seal, cutting off auxiliary steam. Excess leak-off steam will condense in a gland steam condenser and return to the cycle, aided by 2x100% capacity vapor exhausters positioned above the TG Hall roof.

2.5.7 GOVERNING / REGULATION SYSTEM

The turbine will feature throttle or nozzle-controlled type governing. Its governing and protection system will include an electrohydraulic governor with appropriate backup, meeting manufacturer standards. This system will ensure precise speed control, stability, and safety across all operating conditions, with an adjustable steady-state regulation of +3% to +8% of the rated speed and a dead band not exceeding 0.06% of the rated speed.

2.5.8 HP/LP BYPASS

The HP and LP Bypass stations will meet key operational needs:

- Enabling quick startup of the steam generator from cold, warm, and hot conditions.
- Allowing parallel operation with the turbine during significant load changes.
- Facilitating house load operation followed by complete external load throw-off.
- Maintaining steam generator operation to prevent fire out after full load rejection. The HP/LP Bypass system will be designed for approximately 65% of BMCR steam flow capacity (exact

size to be determined) with rated main steam parameters at valve upstream. The LP bypass will match steam inlet conditions (pressure and temperature) of HRH line at around 60% TMCR.

2.5.9 REGENERATIVE FEED HEATING CYCLE

The regenerative feed heating plant is designed to handle various operating conditions, including load fluctuations and operational changes like HP-LP Bypass. Condensate is pumped from the condenser through LP heaters to the deaerator, with flow regulation to support load cycling. In the deaerator, condensate is heated to saturation before entering the boiler feed pump to match steam generator needs. The feed water is further heated in two sets of 50% capacity HP heaters before entering the boiler.

2.5.10 HP & LP HEATERS

The regenerative feed heating cycle will include LP heaters, drain coolers, a deaerator, and HP heaters optimized for feed heating. A minimum configuration will consist of 4 LP heaters, 1 deaerator, and 3 HP heaters. Feed water will be heated by turbine extraction steam from inter-stage tap-offs and cold reheat lines. The deaerator will operate with variable pressure using turbine extraction steam. Each feed water heater will handle drains from the preceding heater. The design will comply with standards like Heat Exchanger Institute, ASME, IBR, featuring U-tube heat exchangers with stainless steel tubes, and HP heaters will include a de-superheating zone.

2.5.11 DEAERATOR

The design will include a Spray-cum-tray deaerator with an integral direct contact vent condenser, either mounted on a horizontal storage tank or accommodated inside the Feed Storage Tank as standard practice. Stainless steel cladding above the Low-Low level is required for compliance with HEI standards. Alternatively, a Spray type STORK with two disc-type spray control valves will ensure effective deaeration of incoming condensate and HP heater drains, removing dissolved oxygen and carbon dioxide. The feed water storage tank will have a minimum capacity of 6 minutes of TMCR flow between normal and low-low levels, with a 0.66 filling factor. The deaerator will operate smoothly across all load conditions, maintaining dissolved oxygen levels below 0.005ml/litre in the feed water outlet.

2.5.12 BOILER FEED PUMPS

The proposal includes installing 2x50% turbine-driven and 1x30% motor-driven boiler feed pumps per unit, with booster pumps on a common shaft. Each pump is tailored to meet steam generator needs, ensuring two turbine-driven pumps handle full load with the motor-driven pump as backup. Pumps can manage feed water at pH 8.5-9.5 and 210°C. The design features horizontal, centrifugal pumps with a removable barrel casing for ease of maintenance, including a recirculation control valve for pump protection during low flow. Automatic operation is prioritized, activating standby pumps in case of primary pump failure or low discharge pressure. Turbine-driven pump flow is regulated by turbine control valve, while motor-driven pumps use hydraulic coupling for speed control, with warm-up provisions for standby pumps as needed.

2.5.13 CONDENSATE EXTRACTION PUMPS

Each unit will be equipped with three motor-driven condensate extraction pumps, each at 50% capacity, with two in operation and one on standby. These pumps, designed for condensate extraction service, will handle condensate from the condenser and feed heater drains during maximum unit output, discharging through specified systems to the Deaerator. They are engineered to accommodate adverse operational conditions, including HP & LP bypass and HP heater outages during peak loads with minimum variable frequency drive speeds.

2.5.14 TURBINE HALL EOT CRANES

Two electric overhead travelling cranes will be installed in the turbine hall to facilitate the erection and maintenance of turbo-generators and associated equipment. Each crane will have a lifting capacity of at least 105% of the heaviest component's weight (excluding the generator stator), with an auxiliary hook capacity of at least 20 tons. Additionally, tandem operation of two cranes will enable handling of the generator stator, with combined lifting capacity meeting the stator's weight requirements, including necessary lifting accessories.

2.5.15 EOT CRANE FOR BOILER FEED PUMP

Each unit will be equipped with an Electrically Operated Travelling crane (Double Girder Type) in the BC bay for Boiler Feed Pump (BFP) erection and maintenance. The crane's main hook capacity will exceed 10% of the heaviest component's weight or 25 tons, whichever is higher. The EOT crane will include lifting beams and slings for equipment maintenance.

2.5.16 ON-LINE INTEGRATED BLADE VIBRATION MONITORING SYSTEM

If free-standing blades are included for the last or penultimate stage of low-pressure turbines, the bidder must supply an integrated blade vibration monitoring system. This system will use non-contact sensors like eddy current or inductive types to detect and monitor blade health, focusing on vibration amplitude and frequency for these critical turbine stages.

2.5.17 DEAERATOR LEVEL CONTROL STATION

Each unit will be equipped with a deaerator level control station to manage condensate water flow. This includes a 30% capacity pneumatically operated low-load control valve, motor-operated gate valves upstream and downstream, and a 100% capacity motor-operated regulating valve. Deaerator level will be controlled by a variable frequency drive system for condensate extraction pumps, with a pneumatically operated condensate control valve utilized during low-load operation to maintain deaerator levels.

2.6 PLANT WATER SYSTEM

Gadarwara STPP Stage-II (2x800MW) proposes an Air-cooled condenser (ACC) System, which significantly reduces the water demand. The estimated water requirement for Gadawara-II, an expansion project generating 2x800 MW, is around 48,000 KLD (2000 m³/hour) with an ash water recirculation system.

2.6.1 MAKE-UP WATER SYSTEM

Make-up water (MuW) for the project shall be drawn from Narmada reservoir which is at a distance of around 25 Km from the plant. Stage- II MuW pumps will be installed in existing Stage-I MuWPH and no

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



separate pump house is envisaged. Further, existing Stage-I MuW switchgear & control room building will be used for Stage-II.

The water from MuWPH to in-plant reservoir shall be pumped through 1 number MS/DI pipe. Right-of-way (ROW) has been considered for the MuW Pipeline. Culverts, nallah crossing etc., shall be suitably provided on the MUW pipe corridor at locations of minor road crossing or under drainage. However, for state/national highway and rail crossings, the work shall be carried out by concerned authority on deposit work basis.

Auxiliary Cooling Tower

Auxiliary Cooling Tower has been envisaged for auxiliary cooling water requirements of the project as Air Cooled Condenser is envisaged for Stage-II. A water balance diagram is provided in **Figure 2.3** and **Annexure 2.6**.



2.6.2 EQUIPMENT COOLING WATER (ECW) SYSTEM & AUX COOLING SYSTEM

A closed circuit cooling water system will be implemented for unit auxiliaries of the steam generator and turbine generator. Demineralized (DM) water will circulate in the primary cooling water circuit to cool various unit auxiliaries and plant and instrument air compressors. These station auxiliaries will be further cooled in a secondary circuit using plate-type heat exchangers. The closed-circuit ECW (Essential Cooling Water) system will utilize DM water in the primary circuit. A recirculating type ACW (Auxiliary Cooling Water) system with an Auxiliary Cooling Tower (Aux CT) will be employed in the secondary circuit to cool the primary DM water. The ECW system will meet the cooling water demands of the turbine generator (TG), steam generator (SG), and their respective auxiliaries, including station auxiliaries. The primary cooling circuits for TG and SG will operate independently, while the secondary cooling water circuit will be shared between both primary systems.

Makeup water for the closed-loop primary circuit will come from normal makeup pumps located in the DM plant and emergency makeup from condensate transfer pumps, both feeding into an overhead storage tank. Secondary cooling water from the Auxiliary Cooling Tower (Aux CT) will be pumped by auxiliary cooling water pumps through plate-type heat exchangers and back to the Aux CT. Hot water from the ACW system of the units will return through common hot water header pipes to the Aux CT for further cooling. To minimize clarified water consumption, the cycle of concentration in the ACW system will not be less than 5. Blowdown from the ACW system to maintain proper concentration in the closed system will be directed to the Ash handling system, Coal Handling Plant (CHP) for dust suppression, and ACW chemical treatment, with excess water discharged to the Combined Monitoring Basin (CMB) for further treatment in the Wastewater Treatment Plant.

2.6.3 AUXILIARY WATER SYSTEMS

The plant will feature a comprehensive water distribution system for potable and service water needs. Potable water will be distributed via a dedicated pipe network from overhead storage tanks, with sufficient pumps to meet plant demand. For cleaning purposes, a separate pipe network covering the entire plant area will be established, utilizing service water drawn from designated tanks through service water pumps. Additionally, specific systems like ACW Makeup, DM water makeup, Boiler fill pumping, Air-preheater wash, HVAC makeup, and FGD Process water & Gypsum wash systems will be integrated based on operational requirements to ensure optimal water supply and management throughout the plant.

2.6.4 WATER TREATMENT SYSTEMS

The project's water treatment system includes several components designed to ensure water quality throughout various stages of the process. These components consist of a Water Pretreatment Plant, Water Demineralization Plant, Chlorine Dioxide Plant, Condensate Polishing Plant, Air Cooled Water (ACW) Treatment Plant, and Effluent Treatment Plant (ETP). Each of these plants serves a specific function within the overall water treatment process to maintain optimal operational conditions and environmental compliance.

2.6.4.1 WATER PRE-TREATMENT PLANT

The pretreatment plant will be designed to eliminate suspended and colloidal matter from the raw water supply. Separate pretreatment facilities will be dedicated to meeting the needs of the ACW (Auxiliary Cooling Water) system and the Demineralization (DM) Plant. A centralized chemical house will store

necessary chemicals like lime, alum, and coagulant aid, with individual chemical preparation tanks and dosing pumps allocated for each pretreatment system.

For the ACW system, the pretreatment setup will include an aerator cum stilling chamber, two reactor-type clarifiers, and two 100% gravity filters. Meanwhile, the DM Plant's pretreatment configuration will feature an aerator cum stilling chamber, a reactor-type clarifier, and two 100% gravity filters. Both systems will be equipped for dosing alum, lime, coagulant aid, chlorine dioxide, etc.

After clarification, water will be directed to storage tanks or filters based on requirements. Clarified water will be pumped to various systems including HVAC makeup, FGD (Flue Gas Desulfurization) process water, FGD Gypsum wash, and Service water. Additionally, the ACW system's makeup water will be supplied either by pumps or gravity.

Filtered water from the gravity filters will flow into respective reservoirs and then be pumped to the DM plant and potable water system. The installation will include necessary hoists, cranes, and weighing scales for handling equipment and chemicals. Comprehensive instrumentation, interlocks, controls, and panels will ensure safe and reliable operation of the water pretreatment plant.

2.6.4.2 WATER DEMINERALIZATION PLANT

The Demineralization (DM) plant will be configured to fulfil the water needs of the steam cycle, closed circuit auxiliary systems, and stator water cooling system. The DM plant can be either two streams based on Ion-Exchange technology or three streams using a combination of Ultrafiltration (UF), Reverse Osmosis (RO), and Mixed Bed (MB) processes.

For Ion Exchange-based systems, the setup will include Activated Carbon Filter, Cation Exchangers, Degasser System (comprising towers, tanks, pumps, and blowers), Anion Exchangers, Mixed Bed Exchanger, and Polishing Ultrafiltration (UF). RO-based DM streams will consist of UF systems, micron cartridge filters, RO systems, degassers, and MB units.

Cation resins will be regenerated using hydrochloric acid, while anion resins will use sodium hydroxide. Regeneration facilities will feature bulk acid and alkali storage tanks, preparation systems, measuring tanks, and dosing equipment. The plant will operate semi-automatically with PLC-based controls.

Three DM water storage tanks will store the demineralized water, and one neutralization pit will be available to adjust pH levels and discharge effluent water. The system will allow interconnection between Stage-I and Stage-II DM water storage tanks with requisite pumps, piping, valves, and fittings for seamless operation.

2.6.4.3 CHLORINE DI-OXIDE PLANT

Two separate Chlorine Dioxide (ClO_2) plants will be installed for the Air-Cooled Water (ACW) system and the pretreatment plant. The ACW- ClO_2 system will consist of two ClO_2 generators, while the PT- ClO_2 system will include one ClO_2 generator and one sodium chlorate generator. Each system will be equipped with chemical storage tanks, unloading systems, instrumentation, panels, chlorine dioxide leak sensors, and other necessary components for efficient operation and safety.

2.6.4.4 CONDENSATE POLISHING PLANT

To maintain feed water purity, a condensate polishing plant will be integrated into the feed water cycle downstream of condensate extraction pumps, following standard practice. Each turbine-generator (TG) unit will feature service vessels comprising Cation and Mixed Bed Vessels. Cartridge pre-filters will be installed for each Condensate Polishing Unit (CPU), utilizing strongly acidic cation and strongly basic anion resins suitable for condensate polishing. An external regeneration system with two regeneration streams will facilitate resin regeneration and reuse. Resins from the service vessels will be transferred to the regeneration vessel for regeneration and reuse. Additional resin will be procured for startup. Separate facilities for acid, alkali, deionized water storage, and wastewater neutralization will support external regeneration.

2.6.4.5 ACW TREATMENT SYSTEM

A comprehensive chemical treatment program involving acid dosing and the use of scale and corrosion inhibitors is planned for the ACW (Auxiliary Cooling Water) system to manage water chemistry effectively. Acid and chemical storage tanks, along with dosing pumps, will be installed as part of this treatment system. The plant will also feature neutralization pits, disposal pumps, corrosion measurement equipment, and instrumentation for interlocks and controls to ensure safe and reliable operation.

2.6.4.6 LIQUID EFFLUENT TREATMENT SYSTEM

Liquid effluents will be managed according to the following design principles:

- i) Filter backwash water from the PT Plant will be recycled to the DM clarifier.
- ii) Clarifier sludge will be pumped to the ash handling system for reuse; a dry ash system will be used to achieve zero liquid discharge.
- iii) Waste effluents from neutralization pits will be neutralized before being pumped to the ash handling system or discharged for further treatment.
- iv) ACW system blow-down will be reused in various plant systems; excess blow-down will undergo further treatment.
- v) Coal settling and clarifying systems will remove particles from coal handling plant waste, with decanted water reused for dust suppression.
- vi) Service water effluents will be treated in clarifiers and sent back for reuse; excess water will undergo further treatment.
- vii) A wastewater treatment plant will be provided for treating wastewater and reusing it in the plant.
- viii) FGD wastewater treatment will be implemented for ash conditioning and coal dust suppression in a dry ash handling system.

2.6.5 FIRE PROTECTION SYSTEM

The power station will be equipped with a comprehensive fire detection and protection system based on the guidelines of TAC (India), IS: 3034, NFPA-850, or equivalent standards. Various protective measures are planned:

Fire Water Supply System: Fire water will be sourced from ACW blow down and raw water lines, with backup storage in steel tanks. Horizontal centrifugal pumps in the fire water pump house (FWPH)

and pump houses will be driven by electric motors or diesel engines, complying with TAC regulations. Foam system water will be sourced from the hydrant network.

Automatic Pressurization System: Jockey pumps driven by electric motors will maintain pressure in the fire water pumping station.

Hydrant System: The entire power plant will be covered by a hydrant system, including main plant buildings, boiler area, turbine and auxiliaries, coal handling plant, switchyard, air cooled condenser, biomass handling plant, pump houses, and miscellaneous buildings.

Automatic High Velocity Water Spray System: Transformers, turbine oil tanks, purifiers, generator seal oil systems, boiler burner fronts, and fuel oil stations will be equipped with automatic high velocity water spray systems featuring QB detectors, deluge valves, projectors, and instrumentation.

Automatic Medium Velocity Water Spray System: Cable vaults, galleries, ESP control rooms, FGD buildings, cable trestles, coal conveyors, biomass conveyors, crusher house, and stacker reclaimers will have medium velocity water spray systems with detectors, valves, nozzles, and instrumentation.

Fixed Foam System: Bladder tank foam proportioning systems will be installed for fuel oil tanks, comprising foam bladder tank assemblies, foam makers, discharge outlets, and interconnection piping.

Inert Gas Extinguishing System: Central Control Room (CCR), Control Equipment Room (CER), Programmer Room, and UPS Room will be protected by an inert gas extinguishing system following NFPA-2001 standards.

Portable and Mobile Extinguishers: Various types of portable extinguishers (pressurized water, carbon dioxide, foam, dry chemical powder) will be strategically placed throughout the plant.

Instrumentation and Control System: The fire detection and protection system will feature comprehensive instrumentation and control for safe operation.

Fire Protection for Biomass Silos: Gaseous-based fire protection systems will be installed for biomass storage silos.

These measures aim to ensure the safety and integrity of the power station, covering all critical areas with advanced fire detection, suppression, and control systems in adherence to industry standards and regulations.

2.6.5.1 FIRE DETECTION AND ALARM SYSTEM

Microprocessor based analogue, addressable type Fire detection and Alarm system shall be provided to cover the complete power plant. Following types of fire detection shall be employed.

1. Multi sensor type smoke detection system, CO detectors
2. Linear heat sensing cable detector.
3. Quartzoid bulb heat detection system.
4. Infra-red type heat detectors (for all coal/Biomass conveyors)

2.7 FUEL HANDLING SYSTEM

2.7.1 COAL HANDLING SYSTEM

The proposed design incorporates a coal handling plant with adequate capacity (approx. 2400 MTPH), featuring parallel double-stream belt conveyors (one operational and one standby) to manage receiving, unloading, crushing, and conveying of coal to boiler bunkers. Additionally, it includes facilities for stacking and reclaiming coal from the crushed coal stockyard.

Coal received via underground RCC hoppers from wagon tipplers and the Track Hopper will be transported to the crusher house for coal sizing to (-) 20mm. From the crusher house, crushed coal will either be directly conveyed to coal bunkers using a series of conveyors or stacked onto crushed coal stockpiles via stacker-reclaimers. Motorized travelling trippers will feed crushed coal into the raw coal bunkers of the boilers.

The coal handling plant will be equipped with a comprehensive dust suppression and service water system. Ventilation systems will be installed for underground buildings/tunnels, MCC rooms, and bunker buildings. A centralized main control room (DDCMIS based) will facilitate control and monitoring of plant operations. Wagon tippler control rooms adjacent to the wagon tipplers and the main control room will manage receiving and unloading operations for BOX-N and BOBR wagon rakes respectively.

The Stage-II CHP will be interconnected with Stage-I CHP to ensure efficient coordination and operation between the two stages of the coal handling plant.

2.7.2 FUEL OIL HANDLING SYSTEM

LDO unloading and storage system shall be designed to handle LDO. LDO shall be used for initial start-up, coal flame stabilization and low load operation of the steam generator while firing coal.

Light Diesel oil (LDO) will be brought to the power plant either by railway wagons. LDO may also be supplied through road tankers. The oil will be unloaded from railway wagons/tankers and will be pumped by the existing unloading pumps to the storage tanks. Fuel oil pressurizing pumps shall draw the oil from the storage tanks by gravity.

Two (2) numbers of 2500 KL LDO tank has been envisaged in-line with Stage-I. Connection from existing unloading pump discharge header up to new LDO tank to be provided.

Oil-water separator pit shall be provided.

2.7.3 BIOMASS HANDLING SYSTEM

Biomass will arrive in the form of biomass pellets via road transport. Upon arrival, biomass will be unloaded using a truck tippler and biomass receiving unit (BRU). After unloading, the biomass will be stored in storage silos or bins using a bucket elevator. From the storage silo or bin, the biomass will be blended with coal and conveyed together via coal conveyors to the bunkers for further processing and utilization.

2.8 LIMESTONE & GYPSUM HANDLING SYSTEM

2.8.1.1 LIMESTONE HANDLING SYSTEM

A separate standard limestone handling system proposed earlier as an alternative to interconnection with existing systems is deleted from scope to optimize the project cost. As of now only interconnection with existing silo to day silo(s) is proposed. While using the Stage I Limestone Handling System for Stage II also, the storage capacity for limestone would be slightly more than 4 days (including capacity of day silos) usages of both the stages. Estimated Limestone requirement for the proposed Gadawara Stage-II plant would be approx. 200 TPD.

2.8.1.2 GYPSUM HANDLING SYSTEM

Gypsum produced by the FGD system is removed by conveyors of adequate capacity to a covered storage shed and shall be transported by road through trucks. Estimated Gypsum generation from the proposed Gadawara Stage-II plant would be approx. 350 TPD.

2.9 ASH HANDLING SYSTEM

The bottom ash and economizer ash shall be extracted and disposed of in dry form. From the bottom ash hopper of boiler, the sole mode of ash extraction shall be in the form of dry bottom ash. In case of non-utilization of bottom ash and coarse ash, it shall be disposed of from bottom ash silos in lean slurry form to ash dyke.

The fly ash shall be conveyed in dry form from electrostatic precipitator hoppers. This dry ash is taken to buffer hoppers or intermediate silos for its onward transportation in dry form to storage silos near plant boundary for utilization. Facility of fine ash collection and classifier & bagging of ash also envisaged.

In case of non-utilization of fly ash, fly ash is conveyed to HCSD silos for onward disposal through HCSD (High Concentration Slurry Disposal). The HCSD slurry further disposed off to existing ash dyke.

Ash collected from Air pre-heater, Duct Hopper shall be conveyed in dry form pneumatically up to BA IM silo for further transportation to Bottom Ash silo. In case of non-utilization of ash in dry form, it shall be further disposed in lean slurry into ash dyke.

2.9.1 BOTTOM ASH REMOVAL SYSTEM

Extraction of Bottom Ash, Economizer Ash, and Air Preheater Ash in Dry Form with Wet Disposal: Bottom ash is collected in dry bottom ash hoppers. Economizer and air preheater ash (including duct hopper ash if applicable) are conveyed in dry form to an intermediate bottom ash silo, through mechanical conveying systems (for bottom ash) and pneumatic conveying system (for other coarse ash). The collected ash in the intermediate silo is then transported to main bottom ash silos for dry ash utilization near the plant boundary. In case of non-utilization, it is converted to lean slurry and disposed to the ash dyke in wet form. A dry bottom ash conveyor system, utilizing troughed conveyors, is used to transport ash from the intermediate silo to the main silo.

2.9.2 FLY ASH HANDLING SYSTEM

Fly ash collected from ESP hoppers shall be handled in dry form. The system will be designed to handle entire fly ash collected in ESP hoppers.

Pneumatic conveying system (either vacuum or pressure system) shall be employed for conveying of fly ash from the electrostatic precipitator hoppers. This dry ash shall be taken to buffer hoppers in vacuum conveying systems. The dry ash buffer hoppers shall be located adjacent to the ESP.

Dry fly ash from above buffer hoppers shall be transported to the HCSD silos or fine and coarse ash silos through the pressure conveying system. From HCSD silo, the fly ash conveyed to the existing dyke in slurry mode. From coarse and fine ash silos, it is transported to terminal silo by second stage pressure conveying system. Hence, staged pneumatic systems shall be envisaged for conveying Fly Ash from ESP hoppers to the main storage silos via Buffer Hoppers.

Alternatively, Dry fly ash from ESP hoppers shall be transported to the HCSD silos or fine and coarse ash silos through the first stage pressure conveying system. From HCSD silo, the fly ash conveyed to existing dyke in HCSD slurry mode. From coarse and fine ash silos, it is transported to terminal silo by second stage pressure conveying system. Hence, two stage pneumatic systems (for extraction & transportation) shall be envisaged for conveying Fly Ash from ESP hoppers to the main storage silos.

The user industries shall take the dry fly ash from the main storage silos either in closed tankers or in covered tankers by Road. The silos shall also have a rail loading facility.

Ash classification (coarse ash & fine ash) and Bagging system is also envisaged to enhance the utilization potential.

2.9.3 ASH SLURRY DISPOSAL SYSTEM

The ash pond area is proposed to be located within the periphery on the southern side of the existing ash dyke of Stage I.

In case of bottom ash slurry handling required if bottom ash not utilized in dry form, there shall be one (1) working stream and two (2) standby streams for slurry disposal. All the pumping streams shall be provided with its individual disposal pipes.

In case of fly Ash slurry handling, fly ash shall be disposed off in HCSD mode. All the pumping streams shall be provided with its individual disposal pipes.

2.9.4 ASH WATER SYSTEM

All the water pumps namely BALP, FAHP, Flushing water pumps etc., shall be provided.

2.9.5 ASH WATER RECIRCULATION SYSTEM

A proposed ash water re-circulation system is designed to comply with environmental regulations. Decanted water from the ash pond will be pumped using existing 100% capacity pumps to the plant area through a dedicated pipeline from the ash dyke. This water will then be utilized in the ash handling system. Regular blow down of the ash water will be conducted to prevent scaling. Makeup water for the ash water system will primarily come from raw water reservoir, DM Plant wastewater and Aux. Cooling water blow down. However, provisions will be made to operate the system in "Once Through" mode when recirculation is not feasible, with additional makeup water sourced from the plant's raw water supply. Additionally, a fugitive dust suppression facility is proposed for the ash dyke area to control airborne dust particles.

Ash Water Recirculation System (AWRS) has been provided to recycle back the decanted water from decanted ash water tank at ash dyke to plant for reuse. Further, the decanted water is also used for Dust Suppression in Dyke area.

AWRS and Dust Suppression water pumps have been provided in the AWRS pump house with the following details:

- Ash water recirculation Pumps: Two nos. (01 in Service and 01 as Standby), Capacity-1200 M³/Hr with 35 MWC head.
- Decanted ash water tank capacity: 600 M³
- Dust Suppression water pumps: 03 nos. (02 in Service and 01 as Standby) of capacity 200 M³, 125 MWC head each.



AWRS Pump House



AWRS Pipeline

Figure 2.4 Ash Water Recirculation System

2.9.6 ASH CLASSIFICATION AND BAGGING SYSTEM

The fine ash shall be assumed as coming from the 4th field onwards and coarse ash shall be assumed as coming from first three fields (Considering all fields in service). The classified fine ash shall have a size of (-) 45 microns (95%).

The fly ash coming from ESP hoppers or buffer hoppers of all the units shall be led to a classifier silo of capacity 250 tons. From this silo the ash shall be further fed to the classifier. The fine ash and coarse ash after classification shall be stored in separate Silos. From fine ash intermediate silo, fine ash is further conveyed to the terminal silo where one silo is dedicated to separately cater the storage requirement of fine ash. A suitable number of outlets shall be provided for feeding the fine ash to bagging plant.

These silos shall have one outlet provided with a telescopic chute and rotary feeder for loading the ash into closed tankers. The silo shall be provided with Target box and bag filter assembly along with pulse jetting arrangement, fan units etc.

Suitable arrangement of aeration blowers, along with Suitable arrangement for avoiding dust nuisance shall be provided at the hoppers and silos.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



The bagging plant shall be sized for 50% of the fine ash (Classified fine ash+ direct fine ash from 4th field onwards). The bagging plant shall have provision for mechanized bagging of this fine ash. Equal quantities of fine ash shall be bagged in 50 kg bags.

The bags shall be stored in a suitable closed storage area having a provision to store both types of bags produced in one day.

2.9.7 MILL REJECT SYSTEM

To handle the Mill Rejects on a continuous basis, a mechanical type Mill Reject system shall be provided.

2.9.8 ASH DYKE

The ash dyke area for Stage-II is located adjacent to existing Stage-I ash dyke. Earlier, total proposed area for the ash pond was about 135 Ha, which is now reduced to 99 Ha for use of partial area in green belt. Accordingly, Fly ash (FA) from Stage-II is now proposed to be disposed-off in existing Stage-I HCSD lagoon through a high concentration slurry disposal (HCSD) system and bottom ash (BA) is proposed to be disposed-off in new ash pond of Stage-II through lean slurry (LCSD). In this project, about 30 lakhs cum per annum of coal-ash is expected to be produced. However, as per MOEF&CC latest notification, 100 percent fly ash utilization is to be achieved progressively within 3 years of plant commissioning. As per the MOEF&CC notification dtd. 30.12.2022, 0.1 hectares per MW for Ash Dyke is allowed for new thermal power plants or expansion of existing thermal power plants. However, due to area optimization for Stage-II, only 99 Ha of land is to be considered for new ash pond adjacent to the existing Stage-I ash dyke.

Based on experience of Stage-I ash dyke and pending topographical survey & geotechnical investigations, for estimating the storage capacity in proposed new ash dyke area, starter dyke of varying height is considered. Based on the same, two ash storage lagoons and one common Overflow lagoon will be accommodated in 99 Ha. Approx. 15% of ash pond area is occupied by dyke embankment, ash slurry pipeline corridor in dyke area, peripheral road for maintenance all along the periphery of the dyke, peripheral drain, AWRS & SWPH system facilities etc. for safe operation of dykes.

Considering the disposal requirement of Stage-II of approximately 30 lakhs cum per annum, the storage capacity of the proposed Stage-II ash pond is sufficient for stage-II operation of about 2 years (with Nil ash utilization) by constructing one starter dyke (7.5m) and one raising (effective height 3m). HDPE lining system is envisaged in overflow lagoon (OFL) and Bentonite blended lining in all ash storage lagoons.

Details of Existing Ash Dykes	
Lining	HCSD Lagoon: HCSD lining BA Lagoon-II: HCSD lining BA Lagoon-III: Clay & Bentonite OFL: Clay & Bentonite
Height of the dyke	Avg. Height – 10.0 meter
Stability	Stability study conducted through IIT-Hyderabad in December 2021 and the observations have been addressed.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

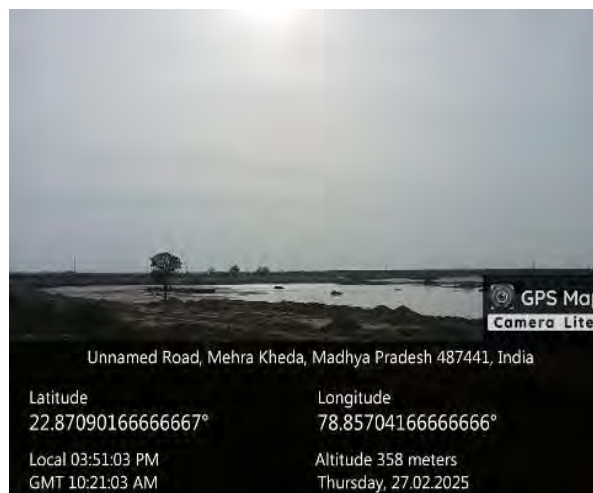


Figure 2.5 Existing Ash Pond

Life of Ash Pond

Calculations of Life of Ash Pond			
Ash Dyke Particulars	Lagoon-1	Lagoon-2	Lagoon-3
	Fly Ash Lagoon (HCSO)	Bottom Ash Lagoon	Bottom Ash Lagoon
Storage Capacity (In LCM)	31.87	21.48	25.39
Residual Capacity (In LCM) as on date	8.22	17.14	23.82
Residual Capacity in terms of Days*	147 Days	2926 Days (~ 8 Years)	

** Considering 20400 MT of coal @85% PLF and 36% ash content. (7000 MT of ash /day) Fly ash is 80% of the total ash generated.*

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Details of Proposed Ash Dykes	
Lining	HDPE lining system is envisaged in OFL and Bentonite blended lining in ash storage lagoons
Height of the dyke	7.5m (Starter dyke) + 3m (effective height of 1 Raising)
Stability	Adequate measures for safety and stability of the Ash dyke has been considered from design stage.
Ash Water Recirculation System	In case of non-utilisation in Dry Form, Bottom ash shall be disposed to Dyke for utilisation at dyke end, where in water shall be recovered through Ash Water Recirculation System (AWRS).
Life of the ash pond with calculations	Approx. 2 Years Storage Volume of Ash Pond 6.2 Million M ³ , Ash Generation estimated: 30 Lakh M ³ per annum



Figure 2.6 Proposed Ash Dyke

2.10 POLLUTION CONTROL SYSTEM

Environmental Clearance for Gadarwara Super Thermal Power Project, Stage-I (2x800 MW), was accorded by MOEF&CC on 22.03.2013 and is currently in commercial operation. The proposed expansion of the project involves installing two additional units of 800 MW each on the same premises used for Stage-I. This expansion is deemed environmentally compatible, as the site adheres to the environmental guidelines set forth by the Ministry of Environment, Forests & Climate Change (MOEF&CC) for the siting of thermal power projects. Given that much of the groundwork and infrastructure development occurred during Stage-I, the environmental impact of Stage-II construction is expected to be significantly less compared to starting from a greenfield site.

The various environmental measures, pollution control systems and mitigation measures proposed to be adopted for the proposed project are as follows:

2.10.1 AIR POLLUTION CONTROL SYSTEM

The Stage-II units (2x800 MW) will be engineered to comply with the emission standards mandated by the Ministry of Environment, Forest and Climate Change (MoEF&CC) as specified in the notifications dated 07.12.2015 and its subsequent amendments.

Electrostatic Precipitators:

The Stage-II units (2x800 MW) will incorporate high-efficiency Electrostatic Precipitators (ESP) to manage ash particle emissions. These ESPs will limit particulate emissions to 30 mg/Nm³. Additionally, a chimney of appropriate height, complying with MOEF&CC guidelines (dated 28.06.2018), will be erected to disperse emissions effectively. The chimney will include personal access for regular stack emission monitoring. To mitigate fugitive dust emissions within and around the coal handling plant, systems for coal dust extraction and suppression will be implemented. Dust suppression systems will cover critical areas such as the Coal Handling Plant (CHP), coal stack yard, and ash handling facilities including silos and ash ponds. These measures aim to ensure stringent control and reduction of environmental impact associated with plant operations.

Flue Gas Desulphurization System (FGD):

A wet limestone-based flue gas desulphurization (FGD) system will be installed downstream of the electrostatic precipitator (ESP) at the tail end of the steam generator. This system is designed to capture SO₂ gas by reacting it with limestone slurry to produce gypsum. The FGD system will include a bypass system for operational flexibility. Various auxiliary equipment and systems such as crushers, cyclones, vacuum filters, belt conveyors, pumps, storage vessels for different liquids, piping and fittings, and Zero Liquid Discharge (ZLD) capabilities will be integrated to support the FGD plant. Additionally, there will be provisions for gypsum storage to manage the byproduct efficiently.

Status of FGD installation for Gadawara Stg-I (2x800 MW)

Flue Gas Desulphurization system installation work is being done for both the units of Gadawara STPP Stage-I(2x800MW). The status of installation is as given below:

- Commissioning work is in progress. Electrical and C&I erection balance works (20% approx.) are in progress.
- Mechanical and Civil works have been completed for more than 97%.
- Chimney U#1 installation work is completed. Chimney U#2 works are expected to be completed by April 2025.
- Connection with existing FG duct for U#2 is completed. U#1 FG Duct connection is expected to be completed by May 2025.
- Limestone Handling System and Gypsum handling system's >85% work completed. Balance works are in progress.
- Estimated trial operation for U#2 is April 2025 and U#1 is June 2025
- Complete FGD system commissioning for both the units are expected by Sept25.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



ABSORBER SYSTEM



CHIMNEY UNIT-1 AND UNIT-2



**LIME HANDLING SYSTEM FOR BOTH
UNITS**



**GYPSUM SHED (GYPSUM HANDLING
SYSTEM FOR BOTH UNITS)**

NO_x Control System:

To control NO_x emissions from the steam generator, a combination of low NO_x burners (LNB) and combustion staging techniques will be implemented. Low NO_x burners are designed to minimize the formation of nitrogen oxides during the combustion process by controlling the air-fuel mixture and flame temperature. Additionally, combustion staging involves dividing the combustion process into multiple stages, which helps in reducing peak flame temperatures and hence lowering NO_x emissions. This integrated approach will effectively mitigate NO_x emissions from the steam generator, ensuring compliance with environmental regulations and promoting cleaner air quality.

Chimney:

To enhance the dispersion of emissions over a broader area, the project proposes the installation of a single chimney with twin flu with a height of 275 meters.

Chimney would be provided with personal access for regular monitoring of stack emissions. This setup aims to promote effective and efficient management of emissions by ensuring proper monitoring and dispersal of pollutants into the atmosphere.

2.10.2 WATER POLLUTION CONTROL SYSTEM

The project will incorporate Air Cooled Condensers with a makeup water demand of approximately 2000 m³/hour with AWRS. Air Cooled Condenser technology offers advantages in reducing raw water consumption compared to traditional water-cooling systems.

Effluent management will be a key focus, aiming to optimize water systems to minimize intake water needs and achieve Zero Liquid Discharge (ZLD). This involves comprehensive collection, treatment, and recycling or disposal of effluents. Various treatment facilities will be implemented to manage waste streams from the power plant:

- Filter backwash water from the PT Plant will be recycled back to the DM clarifier.
- Clarifier sludge will be directed to ash handling for reuse or processed using tube settlers, filter belt presses, and associated systems for Zero Liquid Discharge (ZLD).
- Effluents from the DM plant and Condensate Polishing Plant will be neutralized before transfer to ash handling or, if unused, discharged to a central monitoring basin for further treatment.
- ACW system blow-down will support operations in Ash handling, ClO₂ plant, and ACW treatment systems. Excess blow-down will be routed to the central monitoring basin for treatment and reuse.
- Coal settling and clarifying systems will remove coal particles from coal handling waste, with decanted water returning to the dust suppression system.
- Water treatment will involve clarifiers, reactor clarifiers, belt filter presses, and chemical storage for treatment and reuse.
- Service water effluent will undergo treatment for suspended solids before reuse or further treatment in the wastewater treatment plant.
- A comprehensive wastewater treatment plant will include pre-treatment, filtration, ultrafiltration, reverse osmosis, and associated systems for reuse in DM plant or Auxiliary CT basin.
- FGD wastewater treatment will feature primary clarification, filtration, and tank systems for ash conditioning and coal dust suppression in dry ash handling systems.

Additionally, the project's existing sewage treatment plant will be enhanced as needed to produce treated sewage meeting prescribed standards for use in plantation or horticulture purposes. This integrated effluent management strategy aims to ensure environmental compliance and resource efficiency throughout the project's operations.

2.10.3 NOISE POLLUTION

The primary sources of noise in the facility include turbines, generators, compressors, pumps, fans, and the coal handling plant. To mitigate noise levels, acoustic enclosures will be installed to keep noise below 90 dB(A). Additionally, personnel working in high-noise areas will be supplied with appropriate personal protective equipment for hearing protection.

2.10.4 SOLID WASTE MANAGEMENT

During the construction phase, solid waste management will adhere to the guidelines set forth by the Construction and Demolition Waste Management Rules, 2016 and subsequent amendments. The primary solid wastes anticipated from the project are ash and gypsum. Ash will result from coal combustion, with approximately 80% as fly ash and 20% as bottom ash. Our ash management strategy entails dry collection of fly ash and dewatering bin-based collection of bottom ash. The collected ash will be supplied to entrepreneurs for various uses, actively promoting its utilization and ensuring safe disposal of any surplus. NTPC is committed to maximizing ash utilization. Any unused fly ash and bottom ash will be disposed of in the ash dyke, where a water blanket will control dust emissions. Gypsum from the FGD system will also be handled in an environmentally responsible manner, either through utilization or suitable disposal methods.

2.10.5 AFFORESTATION AND GREEN BELT DEVELOPMENT

NTPC Gadarwara has carried out plantation on 7.740 Ha inside the main plant premises and 58.628 Ha adjacent to the main plant and periphery. Approx. 83,639 trees have been planted under Gadarwara STPP Stage-I. Further, 90.412 Ha of greenbelt is proposed adjacent to the main plant boundary and periphery. Total green belt area of 156.780 Ha has been identified within main plant premises out of which 66.368 ha. Green belt development has been completed and green belt on 90.412 Ha. is proposed under Stage-II. The greenbelt shall have 3-tier plantation as per the CPCB guidelines with re-densification & strengthening of existing greenbelt.

Afforestation efforts have been undertaken around the plant site. NTPC Gadarwara has carried out plantation on 181.17 Ha outside the plant premises in consultation with State Forest Department. Approx. 4,50,000 trees have been planted under Gadarwara STPP Stage-I. Additional afforestation initiatives will continue to be implemented across all feasible areas surrounding the project site in consultation with Madhya Pradesh Rajya Van Vikas Nigam Limited (MPRVVNL). This includes the identification and utilization of any available spaces for planting trees and promoting green cover to enhance environmental sustainability and biodiversity in the region.

Table 2.4: Year-wise Plantation Details

Financial Year	Plantation Inside Plant Premises, Nos.
2015-16	100
2016-17	20070
2017-18	-
2018-19	25156
2019-20	1300
2020-21	120
2021-22	18000
2022-23	9870
2023-24	2450
Township area (2015-2023)	6073

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Financial Year	Plantation Inside Plant Premises, Nos.
2024-25	500
Total	83,639

2.10.6 SUSTAINABLE DEVELOPMENT MECHANISM (SDM)

The Kyoto Protocol, part of the United Nations Framework Convention on Climate Change (UNFCCC), took effect in February 2005. The Clean Development Mechanism (CDM) within Article 12 of the protocol allowed industrialized countries to implement or purchase emission reductions from projects in developing nations and receive Certified Emission Reductions (CERs) as credit. However, the Kyoto Protocol's validity ended with the completion of its second commitment period on 31.12.2020.

Subsequently, the Paris Agreement, a legally binding international treaty on climate change, was adopted at COP 21 in December 2015 and came into force on November 4, 2016. This agreement united nations in combating climate change and adapting to its impacts by striving for global peaking of greenhouse gas emissions as soon as possible to achieve a climate-neutral world by mid-century. The Paris Agreement operates on a 5-year cycle of increasingly ambitious climate actions declared by countries through their nationally determined contributions (NDCs), outlining their commitments to reducing greenhouse gas emissions to align with the agreement's goals.

Article 6 of the Paris Agreement introduces mechanisms to promote efficiency gains based on countries' varying marginal costs of abatement. Article 6.4 envisages a new international carbon mechanism, like the Sustainable Development Mechanism (SDM), under the guidance of bodies such as the UNFCCC, for trading emissions reductions worldwide. This mechanism aims to replace the CDM. Meanwhile, Article 6.2 allows countries to engage in joint market cooperation, facilitating the trading of emission reductions or other climate-related achievements to meet their respective climate targets.

As of now, Article 6 of the Paris Agreement is undergoing finalization and negotiation, anticipated to be operational by 2023. The SDM under Article 6.4 or Bilateral/Multilateral crediting mechanisms under Article 6.2 offer opportunities to earn revenue through greenhouse gas emission reductions. This revenue is crucial in enhancing the Internal Rate of Return (IRR) of climate projects. Therefore, this project intends to leverage the benefits of the SDM or crediting mechanisms under Article 6.2 to improve its IRR once these mechanisms are operationalized.

NTPC is operating Gadawara STPP Stage-I (2x800MW) in Narsinghpur District of Madhya Pradesh. Various activities of the existing station are already having a significant positive impact on the surrounding area. Proposed Gadawara STPP Stage-II (2x800 MW) and allied activities shall further enhance the positive impacts on the achievement of Sustainable Development Goals. Brief on alignment of proposed project activities with Sustainable Development Goals is given as under:

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 2.5 Sustainable Development Goals

Sr. No.	Proposed Activities under Gadawara STPP, Stage-II (2x800MW)	SDG Coverage
1	Adoption of Ultra Super Critical Technology generating higher energy efficiency resulting in lesser coal & water consumption and lower GHG emissions.	7,8,9, 12, 13
2	Utilization of existing land for main plant components. Land acquisition is proposed for ash ponds only preventing the land use change.	15
3	Provision of state-of-the-art technologies for air pollution control (ESP, FGD, Low NOx Burner, Over Fire Air, Dust Extraction and Dust Suppression etc.)	9, 13
4	Provision of Closed Cycle Cooling System with higher COC of 5.0.	12, 13, 14
5	Provision of Effluent & Sewage Treatment Plant, Reuse/Recycling and compliance to Zero Liquid Discharge norms.	6,7
6	Provisions for Sustainable Waste Management Practices (Reuse/Recycling, Re-processing, Co-processing etc.)	7, 9, 12, 13,14, 15
7	Plantation inside Plant premises and Afforestation in outside Areas.	3, 13, 15, 17
8	Corporate Social Responsibility (CSR) and Community Development (CD) works for the surrounding areas.	3, 4,5, 6, 10, 17
9	Employment Generation and Economic Activities (Direct & Indirect) in the region.	5, 8,10, 17

SDG Goal no.1, 2, 11 & 16 are directly not influenced by the activities of the proposed Gadawara STPP, Stage-II (2x800MW). However, there will be a positive impact on these goals indirectly due to overall development of the area.

SUSTAINABLE DEVELOPMENT GOALS



2.10.7 POST OPERATIONAL MONITORING PROGRAMME

Ongoing monitoring of various environmental parameters, including air and water quality, is currently conducted for existing units with data submitted to the Madhya Pradesh Pollution Control Board. These units are equipped with Continuous Emission Monitoring System (CEMS) in stacks, Automatic Ambient Air Quality Monitoring Stations (AAQMS), and Effluent Quality Monitoring System (EQMS). The monitoring program will be expanded to include the new units, and any additional monitoring locations needed will be determined in collaboration with the Madhya Pradesh Pollution Control Board.

2.10.8 INSTITUTIONAL SET-UP

The Gadarwara Super Thermal Power Plant (STPP) is currently operational and has an established Environmental Management Group (EMG) in place. The post-operational monitoring program will be managed by the existing EMG at the project site. This dept. will oversee all monitoring activities using the necessary instrumentation, equipment, and skilled personnel to ensure effective environmental monitoring. Additionally, the on-site EMG will engage with the State Pollution Control Board and other regulatory bodies to address any environmental issues that may arise during the project's operation. This collaborative approach ensures comprehensive oversight and compliance with environmental regulations throughout the station's operational phase.

Operation Guidance Note (OGN) on the 'Control of Environment Pollution' has been issued with the approval of the competent authority for maintaining/corrective action on the applicable Environment/Forest norms at the station level.

In addition to the above-mentioned OGN, other applicable OGNs on Environment have been issued with the approval of Director (Operations) which acts as SOP. As mentioned in the EIA Report necessary institutional arrangement are in place to address the issues related to deviation or violation of the environmental or forest norms.

Further, a Risk Management Committee comprises of members from senior functionaries of management as per provisions of Companies Act 2013 and subsequent amendments has been constituted to establish system for reporting environment related parameters, deviations, and constraints to management. Environmental risks perceived shall be reviewed through risk management mechanism for appropriate action.

Concerned group shall oversee compliance assurance of operating stations through reviews and appraisals.

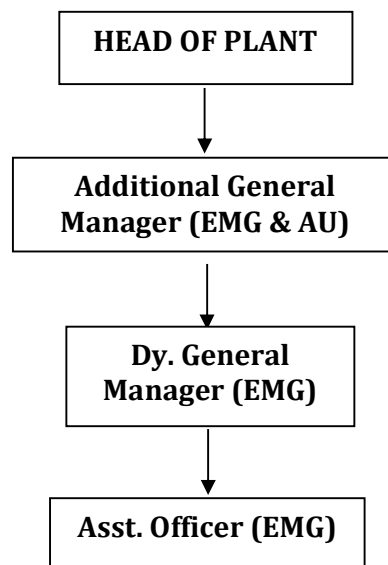


Figure 2.7: Organization Structure of Environment Management Group

2.11 SEISMIC CONSIDERATION

The Power Project area is located in Zone-III as per the demarcation of IS:1893 of Indian Code of Practice. Analysis and design of structures would be carried out accordingly taking into consideration the factors related to soil characteristics and importance of the structure together with the basic seismic co-efficient as per provision of Indian Code.

2.12 ASSESSMENT OF NEW & UNTESTED TECHNOLOGY FOR THE RISK OF TECHNOLOGICAL FAILURE

Ultra super critical technology has been adopted successfully across the country which is proposed to be used in this project. Hence no technological failures are anticipated.

3. BASELINE ENVIRONMENT

3.1 INTRODUCTION

Baseline environment data forms a part of the Environmental Impact Assessment study and helps to evaluate the predicted impacts on the various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies. Baseline data is also required in preparing an Environmental Social Management Plan (ESMP) outlining the measures for improving the environment quality and scope of future expansions for environmentally sustainable development.

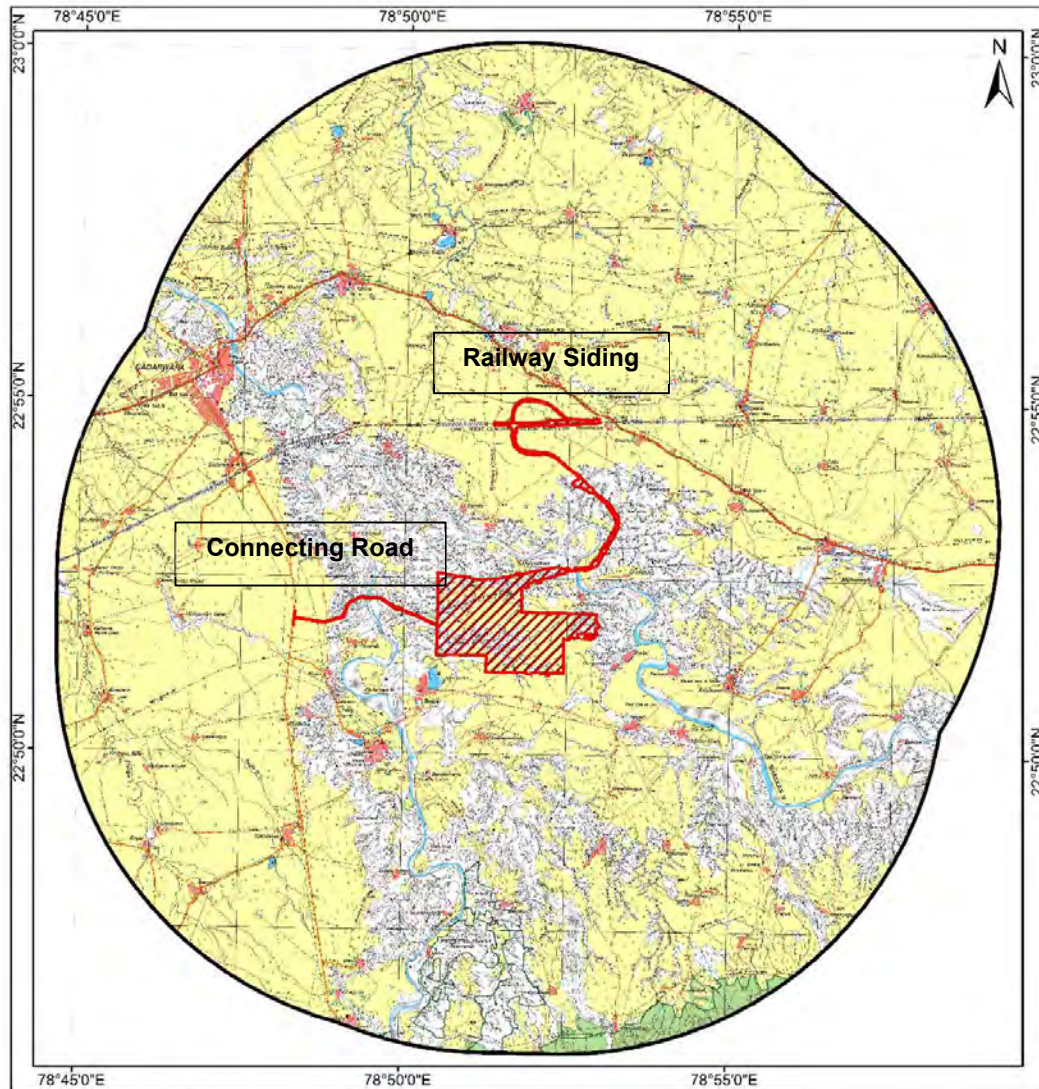
3.2 STUDY AREA AND PERIOD

An area of 10km radius (aerial distance) from the boundary of the project area is the study area for the EIA Study. The project site is located at Villages Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon etc., Tehsil Gadarwara, District Narsinghpur in Madhya Pradesh State. Features of the project site as seen on toposheet are shown in **Figure 3-1**.

The data collected are used to understand the existing environment scenario around the proposed power project against which the potential impacts of the project can be assessed. The study area is divided into two zones viz core zone and buffer zone where core zone is the Project site and buffer zone is of 10 km radius around the project boundary. The study period for baseline data collection for pre-monsoon period was **March, 2024 to May, 2024**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Legend

- Project Site
- 10km Buffer

- Settlements
- Streams
- Roads, Railways
- Forest
- Waterbody
- Vegetation
- Contours
- Locations
- Cultivated Area

Source:

1. Sol Toposheet No. 55J/9, 55J/13, 55J/14, 55M/16 & 55N/1
2. Project Layout Plan, NTPC
3. Data Provided by FAE (LU)
4. Google Satellite Imagery, 2024

Software Used:

1. ArcGIS 10.1
2. AutoCAD 2012
3. Erdas Imagine 10

RF:- 1:50,000

Graphic Scale:



Figure 0.0: Toposheet of Buffer Zone

Project:
Gadarwara Super Thermal Power Project, Stage-II (2x800MW)
Gadarwara, Narsinghpur, Madhya Pradesh

Project Proponent:
NTPC Limited

Environment Consultant:

GREENCINDIA Consulting Private Limited

(An ISO 9001 QMS, ISO 14001 EMS & OHSAS 18001 H&S MS Certified by BSI)
OCHABET Accredited Environment Consultant Certificate No. NABET/SEA/2326/RA 0297

Drafted By:	Checked By:	Approved By:
Date	26/06/2024	
Revision	00	

Path: G:\Project\NTPC Gadawara\Shp\Toposheet Map.mxd

Figure 3-1: 10km buffer zone on Toposheet

3.3 METHODOLOGY ADOPTED

The baseline study was conducted during the pre-monsoon season, 2024 i.e. March, 2024 to May, 2024. A detailed field monitoring study of the project study area was carried out for baseline environment assessment of the project area.

Baseline data was generated for various environmental parameters including air, water (surface and groundwater), land and soil, ecology and socio-economic status to determine quality of the prevailing environmental settings. Sampling of soil and water, monitoring of air quality and noise level and other field data collection were carried out by the team operating from this field station. The field team consisted of technical personnel viz. environmental officer and social experts along with the field staff. The noteworthy activities completed during the field visit are as follow:

- A meteorological station was setup at project site. Wind speed, wind direction, solar radiation, atmospheric pressure, storm, dry and wet bulb temperature, relative humidity were recorded throughout the study period in an automated data logger.
- In order to assess the Ambient Air Quality (AAQ), samples of ambient air were collected by installation of Respirable Dust Sampler and Fine Particulate Sampler with gas samplers at different locations from the study area during study period and analyzed for primary air pollutants to work out the existing status of air quality.
- Groundwater samples were collected during the study period from the existing hand-pumps, while surface water was collected from rivers. The samples were analyzed for parameters necessary to determine water quality (based on IS: 10500 criteria for groundwater and CPCB classification for surface water) and those which are relevant from the point of view of environmental impact of the proposed site.
- Soil samples were collected and analyzed for relevant physical and chemical characteristics in order to assess the impact of the proposed plant on soil.
- The noise level measurements were also made at various locations in different intervals of time with the help of sound level meter to establish the baseline noise levels in the impact zone.
- Ecological data was procured from both primary and secondary sources. A primary data was collected through survey and walkover by ecological experts.
- Socio-economic data was collected from field studies and secondary sources like Census of India 2011, BPL Lists, Revenue Department data, etc.

3.4 REGIONAL AND LOCATIONAL SETTING

3.4.1 PROJECT LOCATION

The project site is connected to State Highway No. 44 at project site (NW direction) at a distance of 8.60 km. The State Highway No. 22 meets National Highway No. 44 at Kareli at a distance of approximately 18.7 km in NE direction. The 10 km radius buffer zone falls in Narsinghpur District of Madhya Pradesh state the location of study area is presented in **Figure 3-1**. The co-ordinates of the study area are given in the **Table 3-1** and shown in **Figure 3-2**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.1: Co-ordinates of the Project Site

Point	Latitude	Longitude
A	22°52'34.18"N	78°50'30.68"E
B	22°51'24.50"N	78°50'31.31"E
C	22°51'10.92"N	78°51'16.39"E
D	22°51'10.47"N	78°52'26.94"E
E	22°51'39.23"N	78°52'26.57"E
F	22°52'0.69"N	78°52'27.08"E
G	22°52'01.01"N	78°51'47.60"E
H	22°52'24.12"N	78°51'46.77"E
I	22°52'40.47"N	78°52'53.26"E
J	22°53'17.34"N	78°53'15.79"E
K	22°54'16.82"N	78°52'12.34"E
L	22°54'46.58"N	78°52'57.37"E
M	22°54'40.57"N	78°51'20.65"E
N	22°54'16.85"N	78°51'47.74"E
O	22°53'17.97"N	78°53'14.20"E
P	22°52'44.46"N	78°52'55.55"E
Q	22°52'40.82"N	78°52'7.70"E
R	22°52'37.72"N	78°51'44.13"E
S	22°52'29.48"N	78°51'1.59"E

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

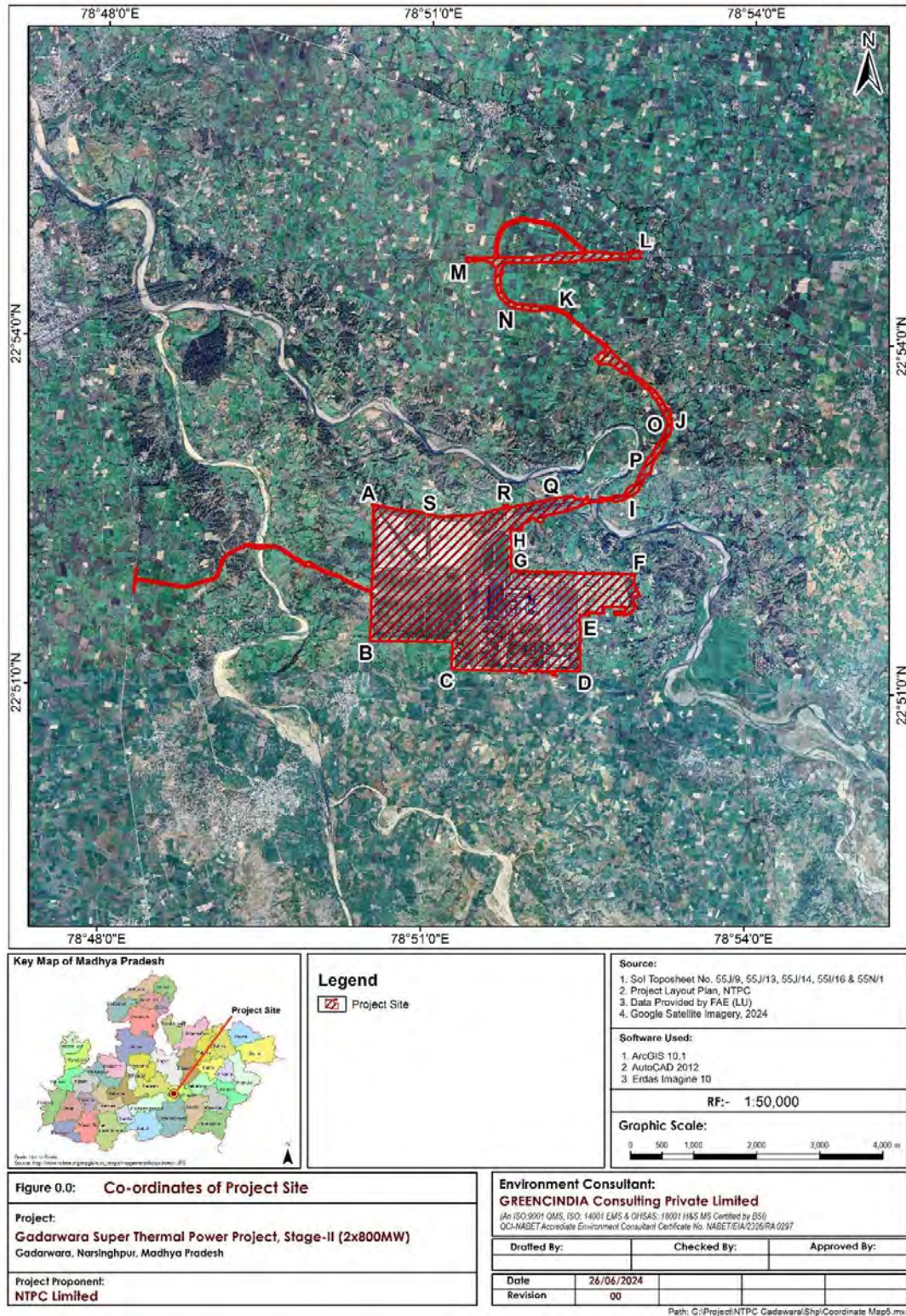


Figure 3-2: Coordinates of Project Site

3.4.2 SITE CONNECTIVITY

The nearest Railway Station is Gadarwara Railway station which is at an approx. distance of 9.0 km NW from the project site. The approximate distances from the nearest commercial airports to the site are 155 km from Jabalpur and 240 km from Bhopal. (**Figure 3-3**)

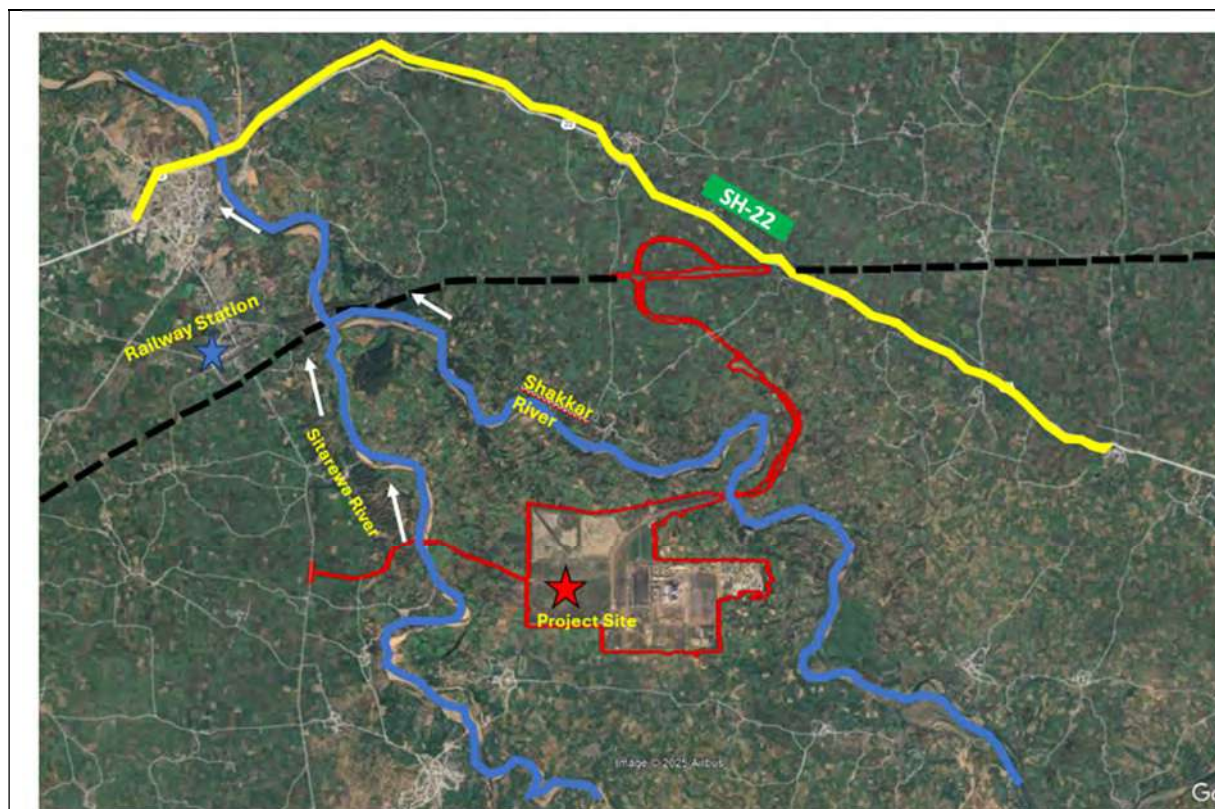


Figure 3-3: Location Connectivity of Project Site

3.4.3 ENVIRONMENT SENSITIVITY

There is no National Park, Wildlife Sanctuary or Ecologically sensitive area within 10km of the project site. Certificate regarding no National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes/ wildlife corridor and distance from protected forest is enclosed as **Annexure 3.1**. The environmental sensitivity locations are shown in **Table 3.2 & Figure 3-4** is showing the locations of environment sensitivity.

Table 3.2: Environmental Sensitivity Locations

Sno.	Name	Distance in Km	Direction
River/Nala			
1	Shakkar River	0.60	NE
2	Sitarewa River	0.90	W

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

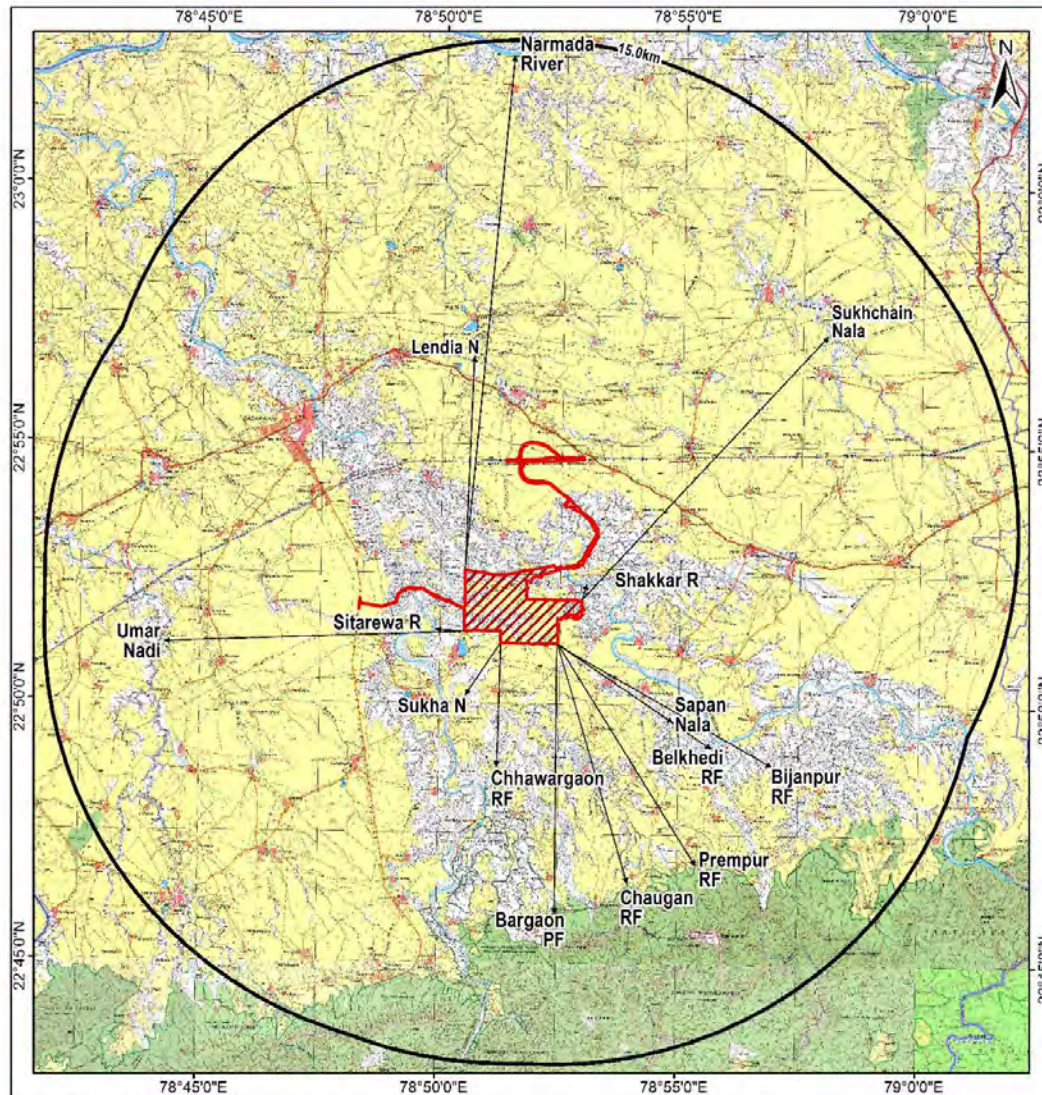
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sno.	Name	Distance in Km	Direction
3	Sukha Nadi	2.30	SW
4	Sapan Nala	5.00	SE
5	Lendia Nadi	7.60	N
6	Umar Nadi	10.7	W
7	Sukhchain Nala	13.4	NE
8	Narmada River	18.4	N
	Forest		
9	Chhawargaon Reserve Forest	4.33	S
10	Chaugan RF	8.90	SSE
11	Bargaon PF	9.80	S
12	Prempur Reserve Forest	8.94	SSE
13	Belkhedi Reserve Forest	6.72	SE
14	Bijanpur Reserve Forest	8.78	SE

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Legend

- Project Site
- 15km Buffer

- Settlements
- Streams
- Roads, Railways
- Forest
- Waterbody
- Vegetation
- Contours
- Locations
- Cultivated Area

Source:

1. Sol Toposheet No. 55J/9, 55J/13, 55J/14, 55I/16 & 55N/1
2. Project Layout Plan, NTPC
3. Data Provided by FAE (LU)
4. Google Satellite Imagery, 2023

Software Used:

1. ArcGIS 10.1
2. AutoCAD 2012
3. Erdas Imagine 10

RF:- 1:130,000

Graphic Scale:



Figure 0.0: Environment Sensitive Locations (15km)

Project:

Gadarwara Super Thermal Power Project, Stage-II (2x800MW)
Gadarwara, Narsinghpur, Madhya Pradesh

Project Proponent:

NTPC Limited

Environment Consultant:

GREENCINDIA Consulting Private Limited

(An ISO 9001 QMS, ISO 14001 EMS & OHSAS 18001 HSE MS Certified by BSI)
QCI-NABET Accredited Environment Consultant Certificate No. NABET/EIA/2266/RA 0297

Drafted By:	Checked By:	Approved By:
Date	28/03/2024	
Revision	00	

Path: G:\Project\NTPC Gadawara\Shp\Env Sen Map.mxd

Figure 3-4: Environmental-sensitivity Map of 15 km radius of project site

3.5 LAND USE AND LAND OWNERSHIP

3.5.1 LAND USE/ LAND COVER DETAILS OF THE STUDY AREA

The land-use mapping of the study area is carried out on the basis of Survey of India Toposheet, recent Google satellite imagery (2024) and site visit by FAE (LU) which is given in **Table 3-3**. The pie-diagram depicting land use pattern of the study area is shown in **Figure 3-5** while the land-use map is given in **Figure 3-6**.

Table 3.3: Land Use of Study Area

S. No.	Land Use	Area in ha	Area in %
1	Built up	972.39	1.89
2	Project Site	305.24	0.59
3	Plantation	257.17	0.50
4	Land With and Without Scrub	6716.94	13.09
5	Forest	1114.69	2.17
6	Waterbody	1297.15	2.53
7	Fallow Land	2283.38	4.45
8	Road	848.64	1.65
9	Barren Land	1911.41	3.72
10	Agriculture Land	35621.40	69.40
	Total Area	51328.40	100.00

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

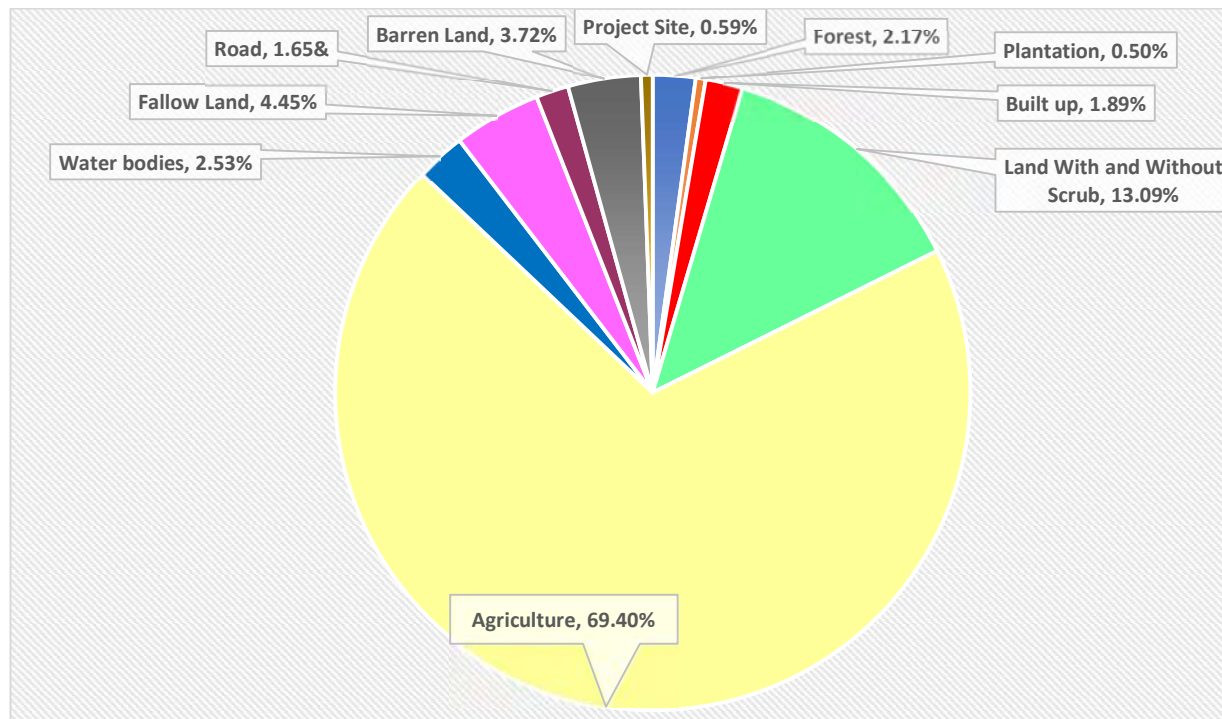


Figure 3-5: Statistical Representation of Land use of study area

Study Area: A site visit was carried out for the entire project site and the land features were compared with the satellite images and SOI Toposheet for data verification.

From **Table-3.3** Land Used of the study Area has been analyzed based on SOI Toposheet. From graphical projection and data above, it is observed that buffer zone has agricultural land use area of 35621.40 Ha. (69.40%) of the total study area. The forest land 1114.69 Ha. (2.17%), land with and without Scrub is 6716.94 (13.09%), barren land is 1911.41 (3.72%), fallow land is 2283.38 ha (4.45%), road 1.65% and plantation 257.17 Ha. (0.50%) are also crucial land use characters of the study area. About 2.53% of the study area is covered by the water body which covers primarily rivers, channels, ponds and reservoirs. Built up area (972.39 Ha) is 1.89% of the total study area.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

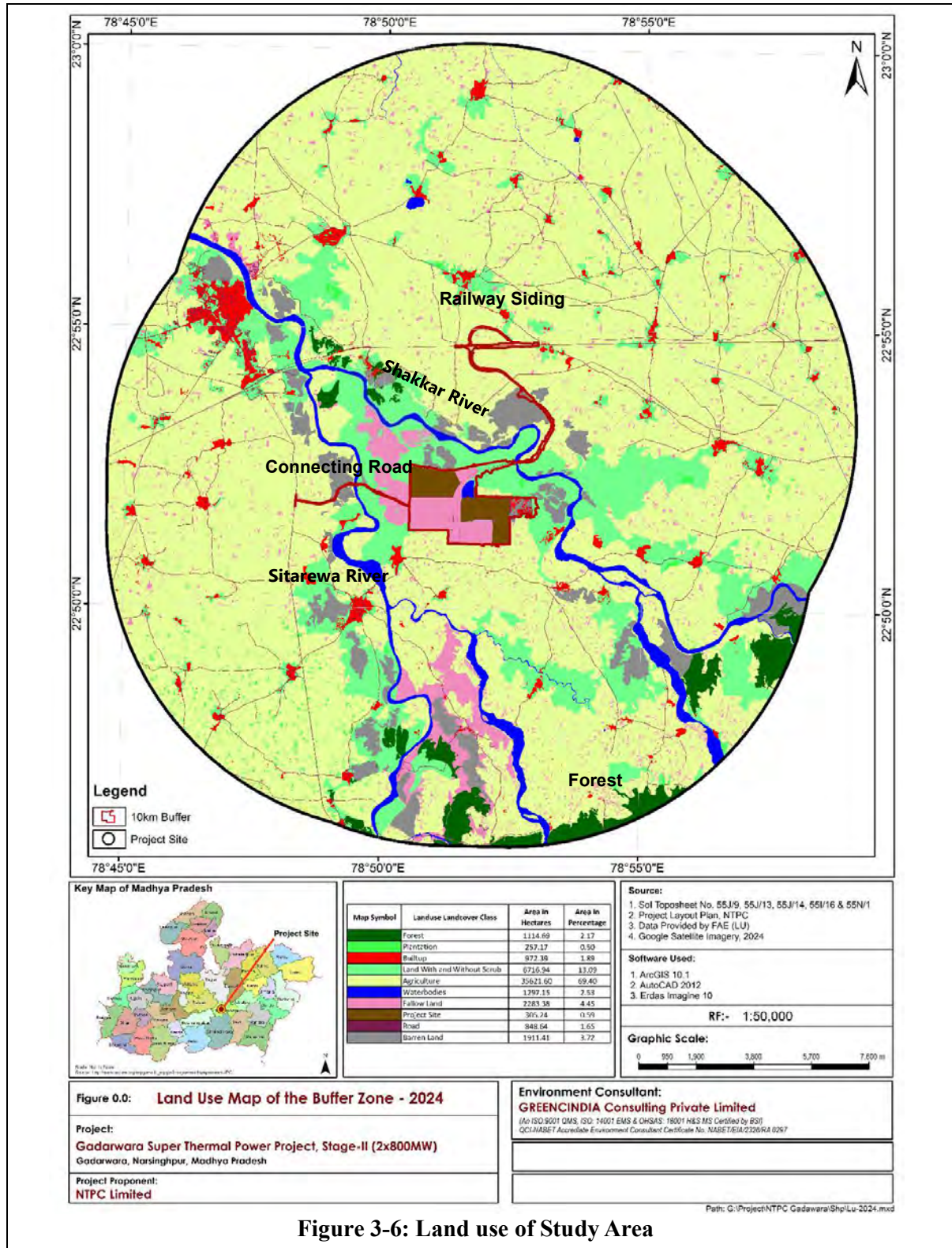


Figure 3-6: Land use of Study Area

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

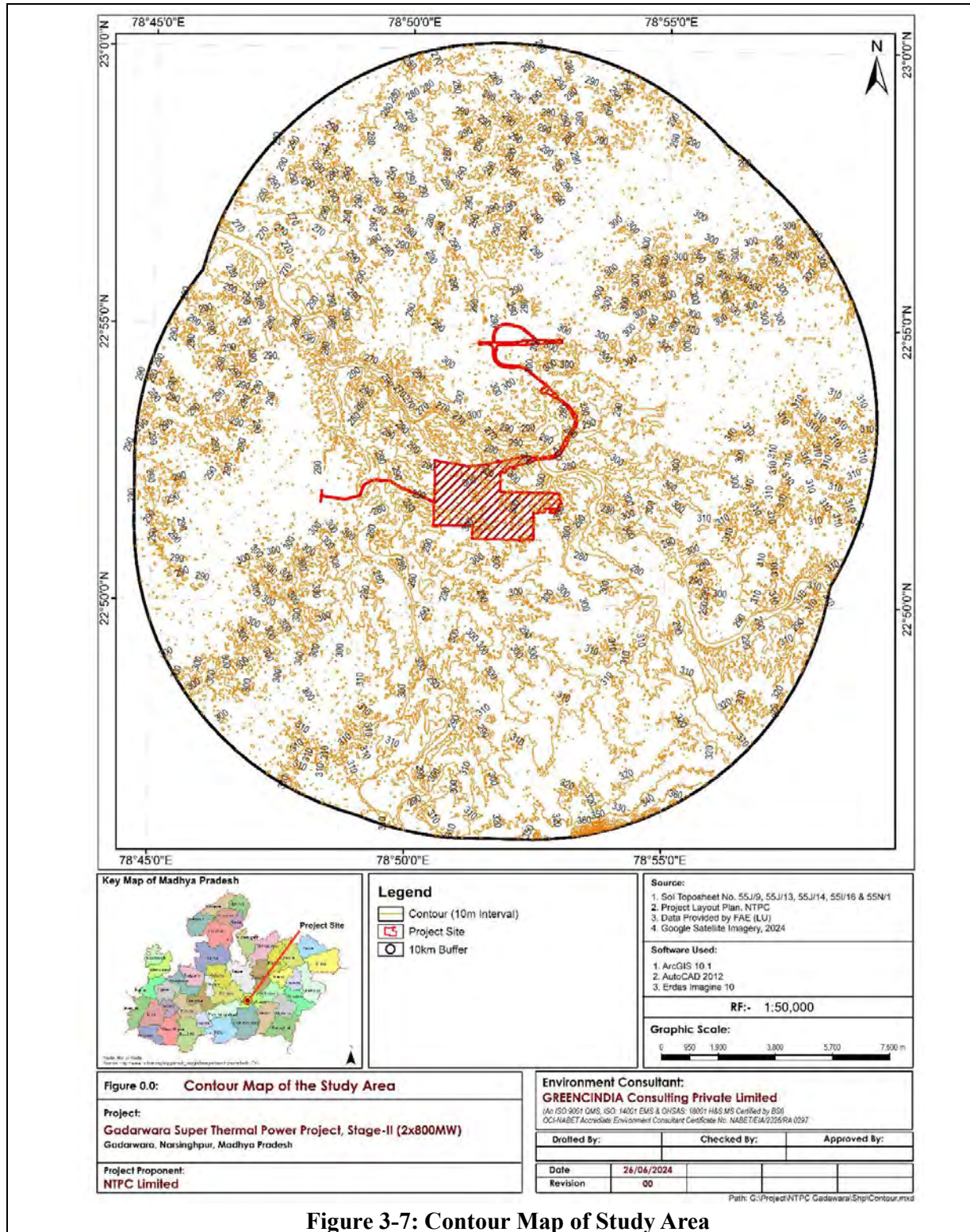


Figure 3-7: Contour Map of Study Area

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

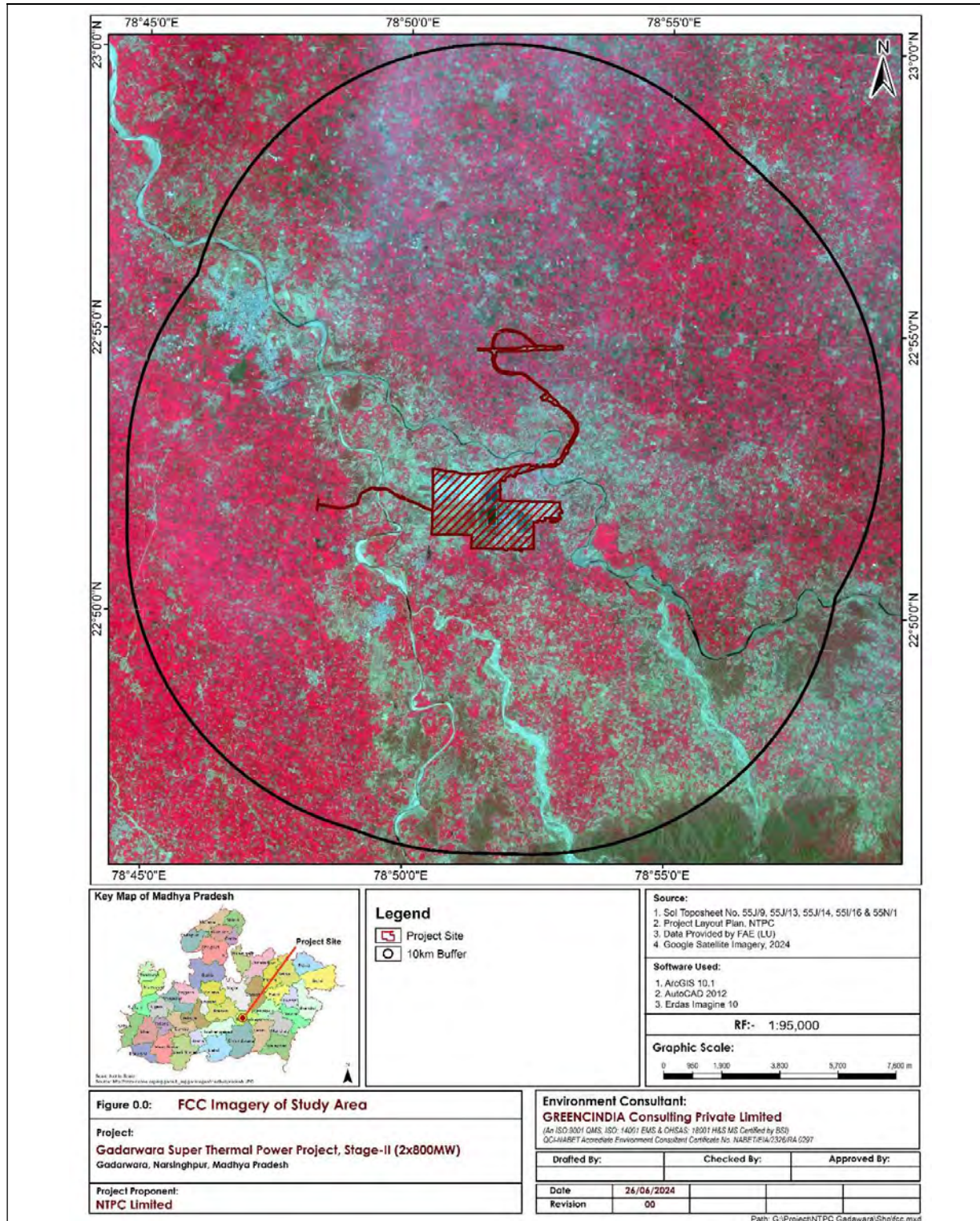


Figure 3-8: False Colour Composite map of Study Area

False Colour Composite Map: Ground truth has been carried out to validate the interpretation accuracy and reliability of remotely sensed data, by enabling verification of the interpreted details and by supplementing with the information, which cannot be obtained directly on satellite imagery. Digital image processing techniques like classification of False Color Composite (FCC) image, were applied for the mapping of the land use land cover classes of the provided area from the satellite data.

Band 2: 0.52 - 0.59 μm (green): This band corresponds to the green reflectance of healthy vegetation and is spanning the region between the blue and red chlorophyll absorption bands.

Band 3: 0.62 - 0.68 μm (red): This red chlorophyll absorption band of healthy green vegetation is one of the most important bands for vegetation discrimination. In addition, it is useful for soil-boundary and geological boundary mapping.

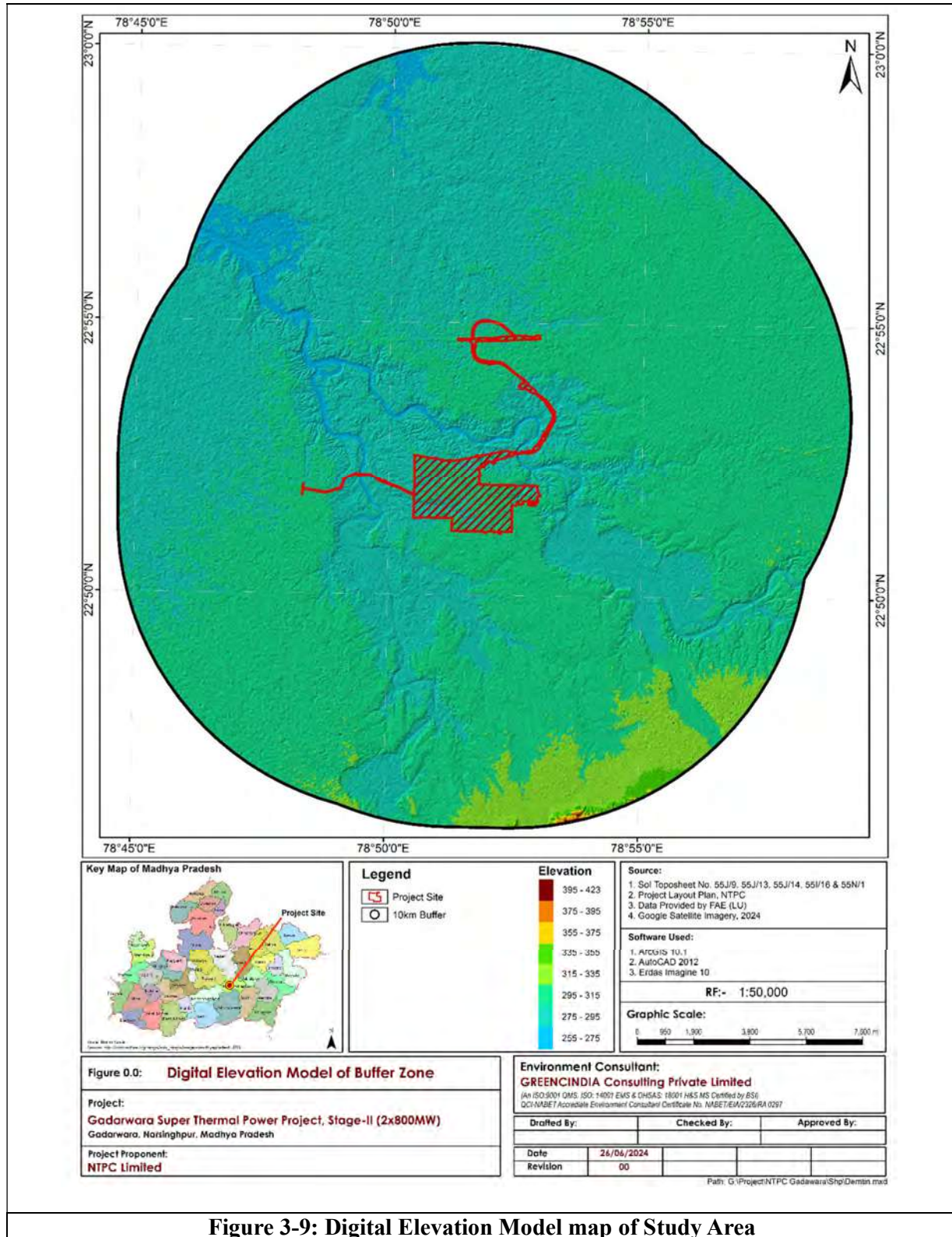
Band 4: 0.77 - 0.86 μm (near infrared): This band is especially responsive to the amount of vegetation biomass present in ascene. It is useful for identification of vegetation types, and emphasizes soil-crop and land-water contrasts.

Discussion: The FCC map highlights various land features within a 10 km buffer zone around the project site, using colour to differentiate between vegetation, water bodies, and urban areas. Vegetation typically appears in shades of red, while water bodies and other features are shown in different colours, to analyse land use and environmental conditions in the region. This map is a valuable tool for environmental assessment, offering a clear visual representation of the area.

Digital Elevation Model: The map provided is a Digital Elevation Model (DEM) representing the buffer zone surrounding the Gadawara Super Thermal Power Project, Stage-II (2x800MW), located in District Narsinghpur, State Madhya Pradesh. The DEM illustrates the varying elevations within a 10 km buffer zone around the project site, with elevation levels color-coded for easy interpretation. In the southeast direction, the highest elevation within the 10 km boundary is found at 395-423 meters. As move towards the project site, the elevation decreases, ranging from 295-315 meters to 275-295 meters.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.6 PHYSICAL ENVIRONMENT

3.6.1 TOPOGRAPHY

Narsinghpur District is situated in the central part of Madhya Pradesh. The Vindhyan range occupies in the northern and central part of the region and has ENE-WSW trend. The Vindhyan Range and Mahakoshal Range are separated from the Satpura Range by the Narmada River and vast tract of its basin area. The river valleys, other than the Narmada alluvial plain and Chambal alluvial plain, are very limited and form narrow belts along the rivers¹.

On the Northern ends Vindhyachal & on the southern ends throughout the lengths are Satpura ranges of Mountains. In the Northern part river Narmada flows from East to West, which is as sacred as holy as river Ganga.

Physio-graphically, the district area can be broadly divided into three sectors namely 1) Narmada Valley alluvial plain, 2) Satpura range in the south and 3) the Vindhyan range in the north. The vast alluvial plain of Narmada valley stretches from east to west throughout the district on both the sides of the Narmada River. The regional slope of the area is westward².

The elevation in the study area is observed to range from 255 m to 423 m above mean sea level with a general slope from southeast to North West direction. Project site falls under area having elevation between 354-380 m.

Physiological map (Figure 3.10) indicated altitude of the Narsinghpur district shows low (56 amsl) and slope map (Figure 3.12) elevation of the study area indicated 280-400m.

¹ Dynamic Ground water Resource Estimation of Madhya Pradesh

² District groundwater information booklet, MP

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

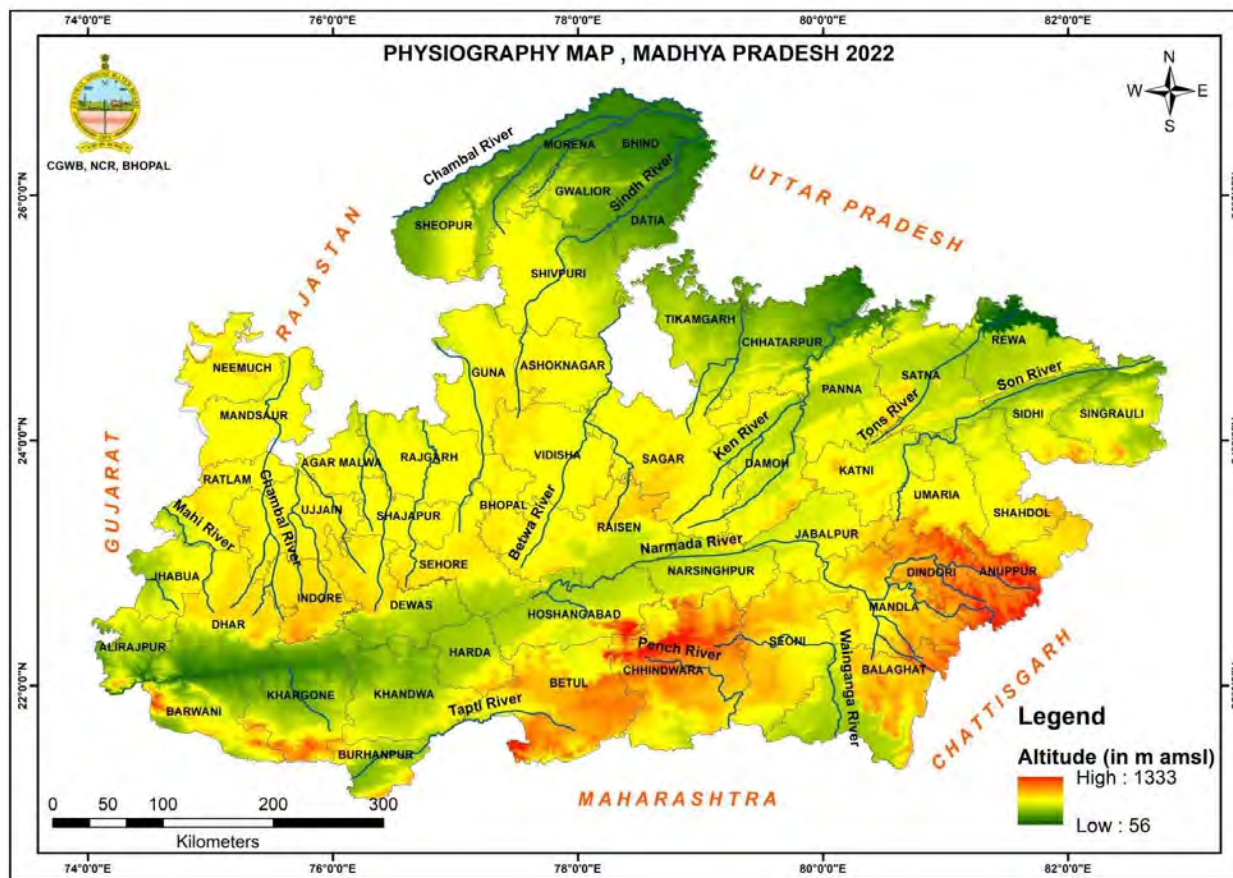


Figure 3-10: Physiography Map

3.6.2 DRAINAGE

Drainage of Study area: Two perennial rivers are flowing from study area. One river Shakkar is passing through the study area in SE to NW direction and it is located 0.81 km in northeast direction from project site, another river Sitarewa River flows S to SW direction and further it joins Shakkar river in north. Apart from this, Sukha nala flows south to north and in north it merges into Sitarewa river. In the north direction Sitarewa River merges into Shakkar River which is tributary of Narmada River. Drainage pattern of the area is in dendritic pattern. The drainage of study area has 1st to 5th order streams shown in the **Figure 3.11**.

There are few ravines towards S to W of the site, according to the drainage map, a ravine/gully, rivulet, or seasonal stream passes through the ash dyke area. This has been suitably channelized within the stormwater drainage plan prepared for the plant/ ash pond.

The storm water management plan for the plant/ash pond is attracted as **Annexure 3.8**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

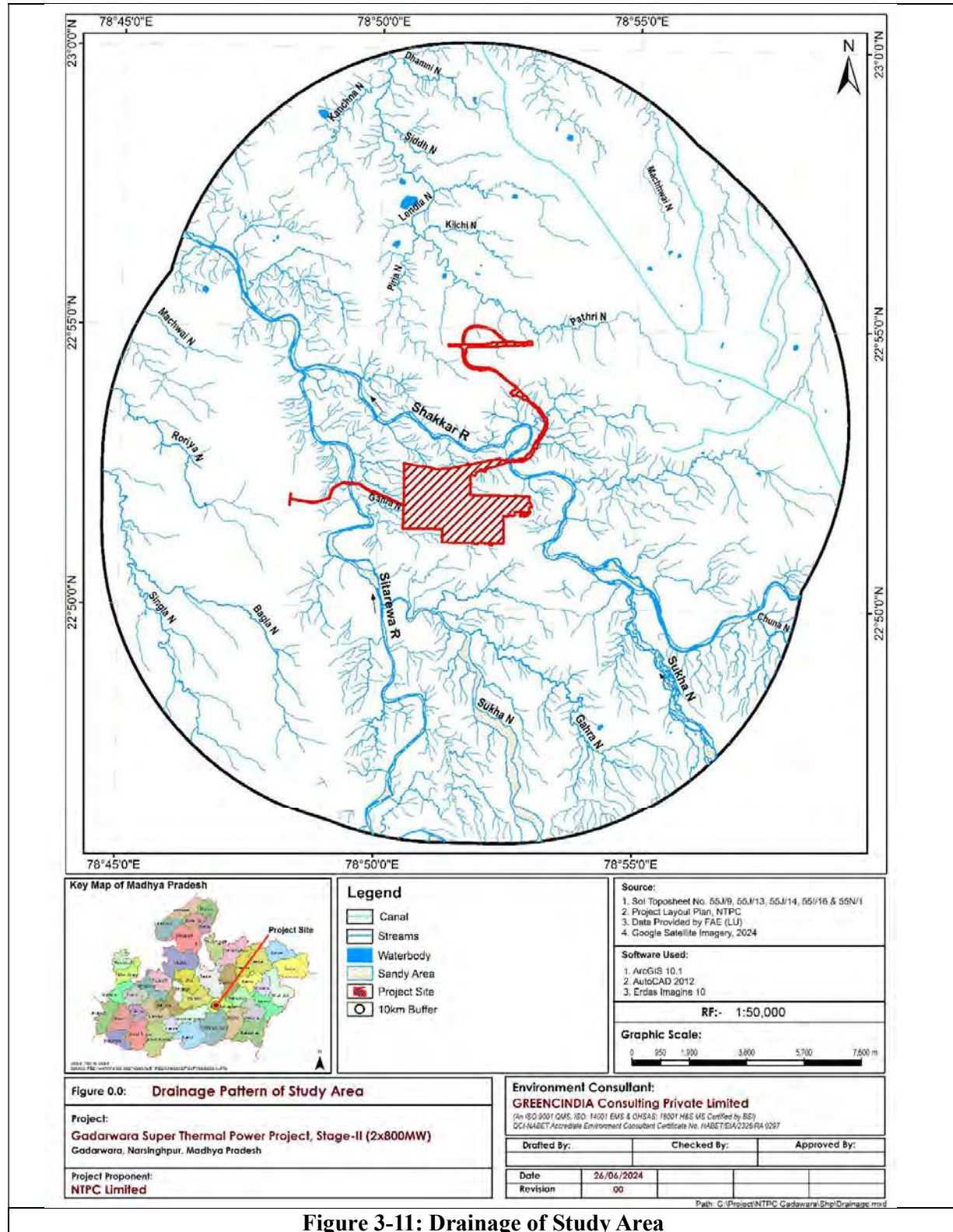


Figure 3-11: Drainage of Study Area

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

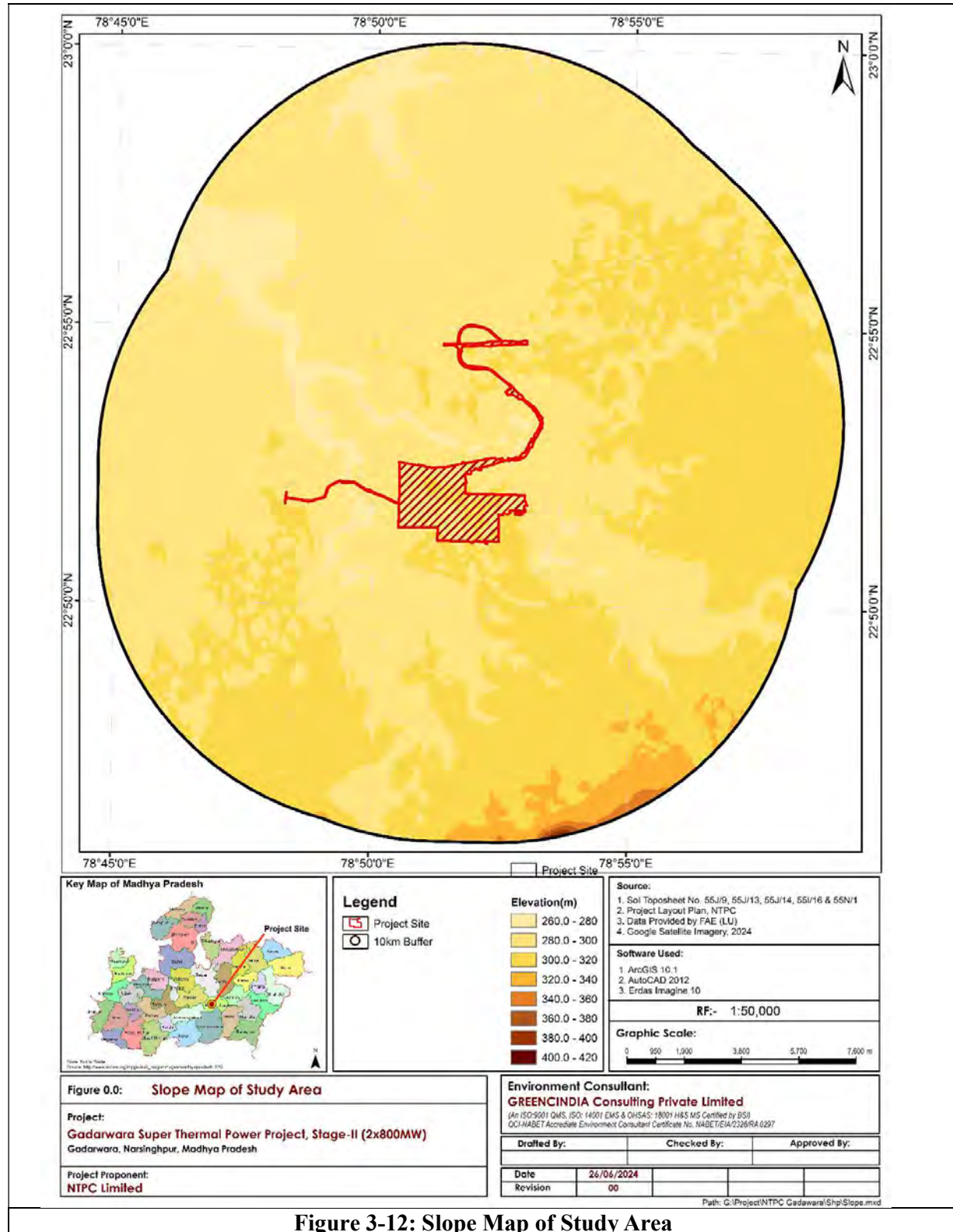


Figure 3-12: Slope Map of Study Area

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.6.3 GEOLOGY

The general geological successions in the district are given below in Table 3.4

Table 3.4: Geological successions of Narsinghpur district

Age		Stratigraphic Unit	Lithology
Recent Pleistocene		Alluvial Deposits	alluvium & soil cap comprising clays, sand, gravels etc.
Unconformity			
Cretaceous to Eocene		Deccan trap and intertrappeans	Basaltic lava flows and intertrappean bed comprising red bole.
Unconformity			
upper cretaceous		Lametas	sandstones, silt stones, limestones & Marls
Permian to upper cretaceous	Upper Gondwana	Jabalpur series, (Jabalpur stage, chaugan stage)	soft porous sandstones and light coloured shales & clays
		Mahadeva series (Bagra stage & Denwa stage)	pebble beds & conglomerateswhite & yellow sandstones and shales
Unconformity			
upper carboniferous to Permian	lower Gondwanas	Danuda series, Barakar stage	white to lava coloured sandstones & grits with occasional conglomerates and shales
		Talchir series, Talchir stage	green boulder with clays & shales
Unconformity			
Cambrian	Vindhyan	Upper Bhandar series	reddish purple to buff coloured sandstones and quartzites.
Unconformity			
upper to middle Precambrian	metamorphic	calcareous crystalline quartzite phylites & schist bijawars granitic gneiss	dolomite lime stone & calcareous shales quartz tic & cal-granulites phylites & various schist marbles and banded ferrigenous quartzites granites & granitic gneiss

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

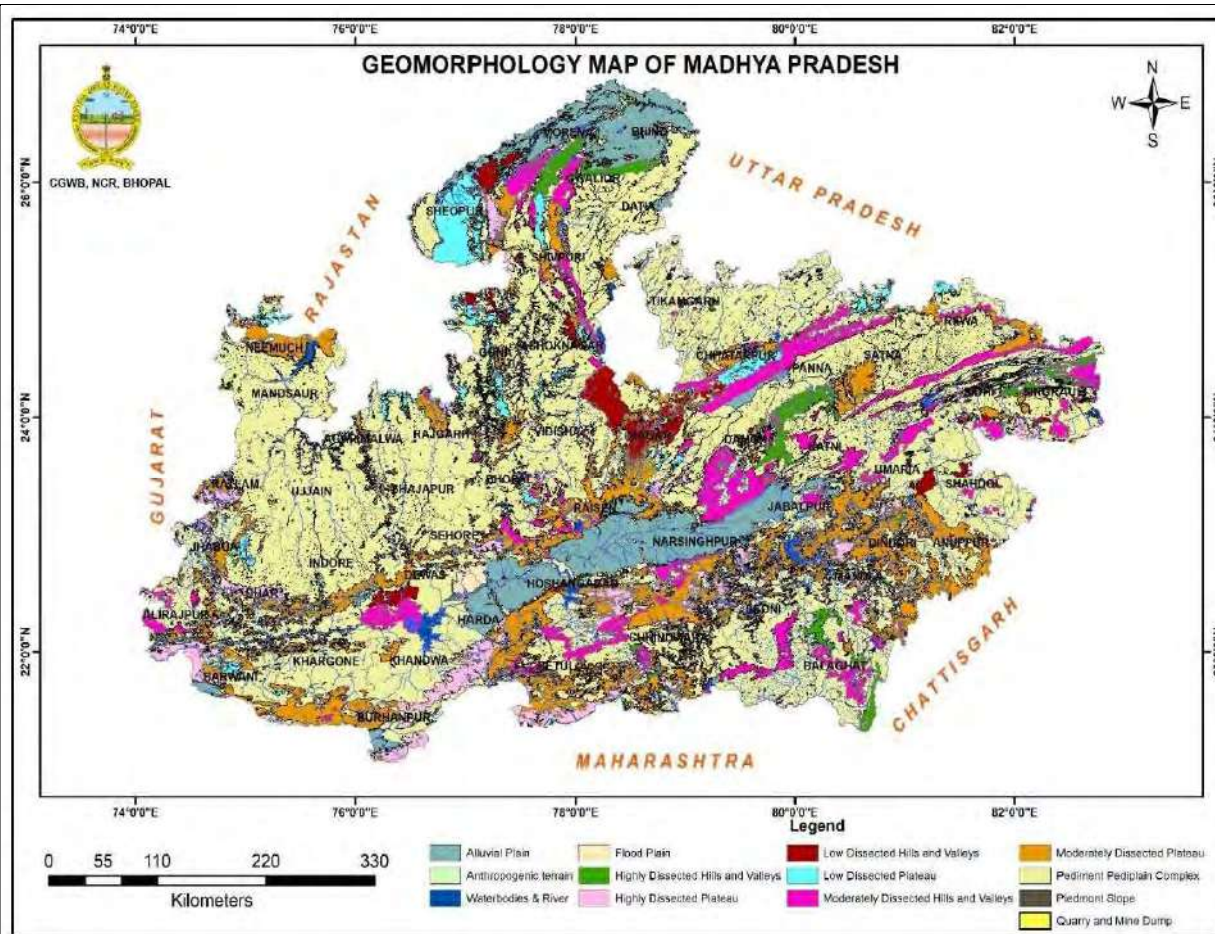


Figure 3-13: Geomorphology Map of Madhya Pradesh

Source: Dynamic Ground water Resource Estimation of Madhya Pradesh-2022

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



**मध्यप्रदेश का भूविज्ञान तथा खनिज मानचित्र
GEOLOGICAL AND MINERAL MAP OF MADHYA PRADESH**

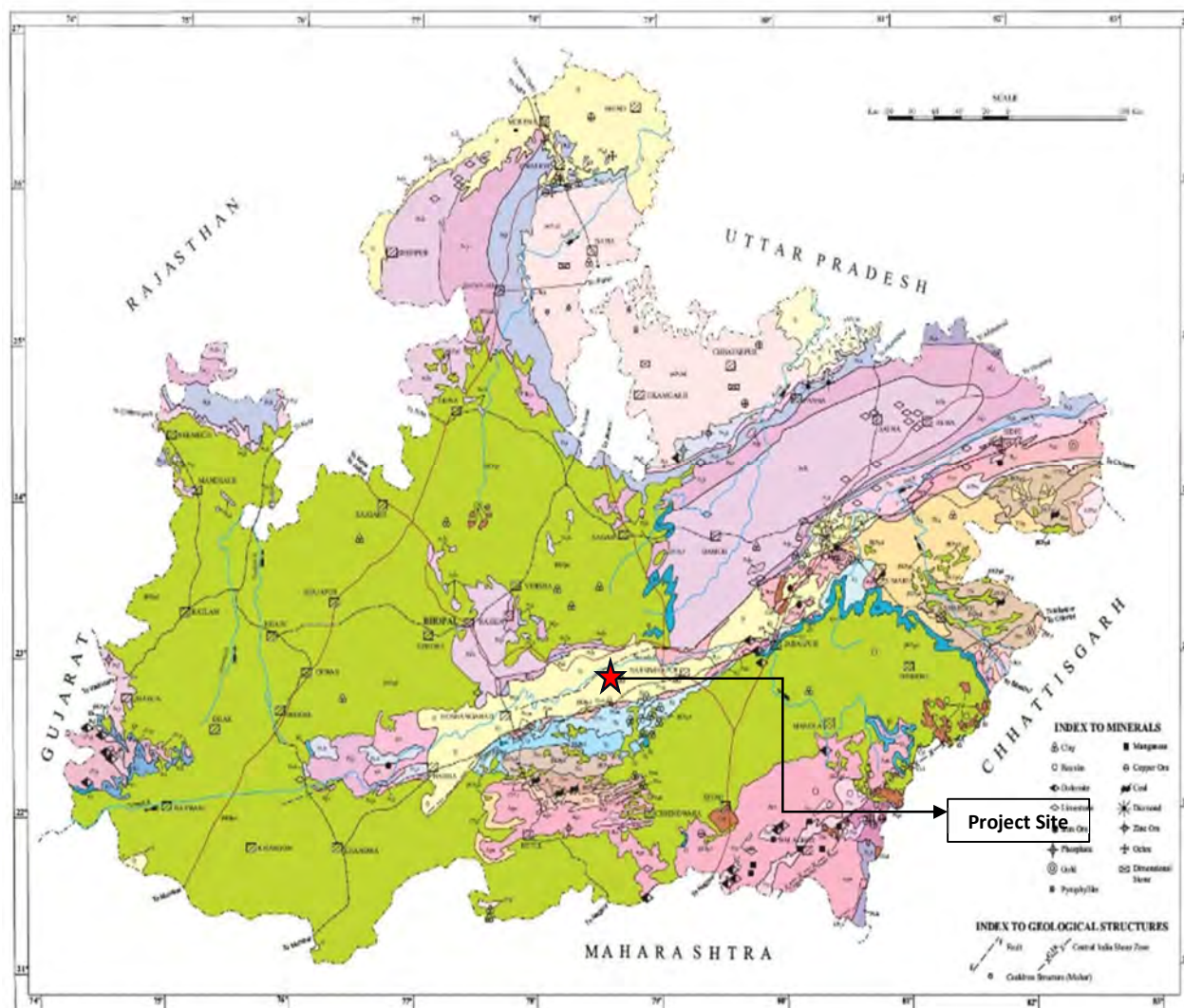


Figure 3 13A: Geological and Mineral map of Madhya Pradesh

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.6.4 HYDROGEOLOGY UNITS AND AQUIFER

Geological Age	Group	Rock Formation	Surface Exposure Area (Approx.)	Occurrence and Hydrogeological Characters
Pleistocene to Recent	Alluvial plains (older and Newer Alluvium)	Unconsolidated clays and silts, gravels and sands of different mix. Lenses of Peat and organic matter carbonate and siliceous concretions (Kankars)	38,000 Sq.Km.	Occur widespread in Bhind (Chambal basin), Hoshangabad and Narsinghpur districts (Narmada basin) and also in Sheopur, Morena, Datia, Chhatarpur, Jabalpur, Katni, Khandwa, Burhanpur, Raisen, Sidhi and Balaghat districts and along rivers in some other districts. Form very potential aquifers with a thick sequence of sandy aquifers down to great depths (>300 m.bgl). The aquifers are unconfined, semi-confined (leaky confined) or confined. The transmissivity up to 6700 m ² /day. Discharge is up to 30 lps. Specific yield is up to 12%.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

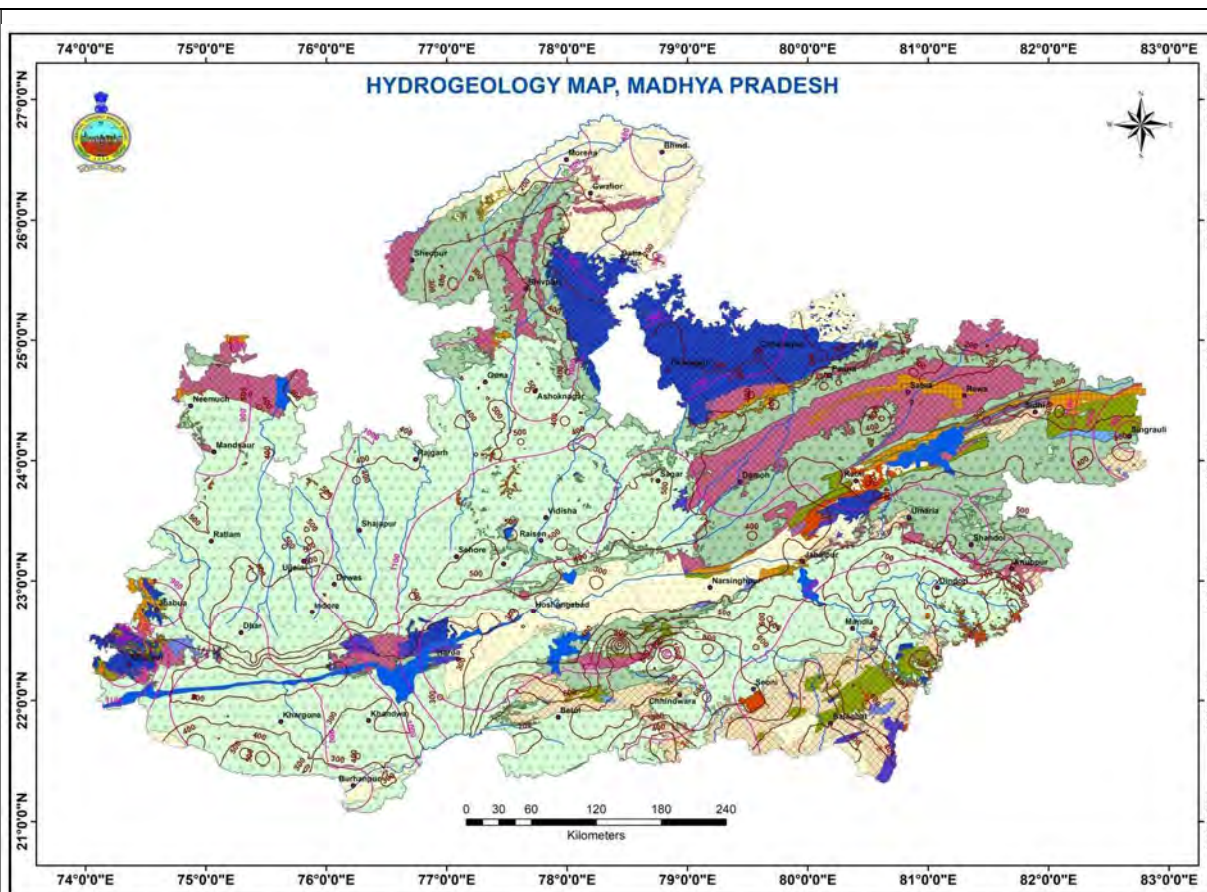
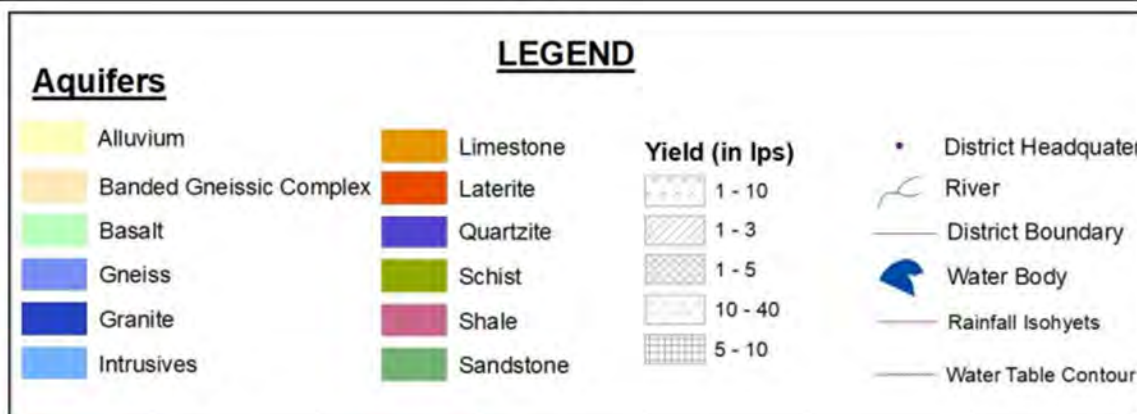


Figure 3-14: Hydrogeology Map of Madhya Pradesh



Source: Dynamic Ground water Resource Estimation of Madhya Pradesh-2022

3.6.4.1 HYDROGEOLOGY

Groundwater is the principal source of irrigation in the district and all the alluvial deposits of Narmada valley in the district forms very potential aquifers.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



The pre-monsoon depth of water level in Narsinghpur District ranges between 5-30 mbgl during the pre-monsoon. During post-monsoon period, November 2023, very shallow water levels up to 2-25 m bgl are seen in Narsinghpur district³. Figure 3.15 and 3.16 the depth of water level given respectively.

Dynamic ground water resources of the district have been estimated for base year - 2023 on block-wise basis. Out of 513300 ha of geographical area, 479100 ha (89%) is ground water recharge worthy area and 34200 ha (11%) is hilly area. Narsinghpur block, which is categorized as semi critical, all other blocks are categorized as Safe. The highest stage of ground water extraction is computed 77.09% in Narsinghpur block. The annual extractable ground water resource in the district is 112762 ham and Ground Water extraction for all uses is 72947 ham, making stage of ground water extraction 66.95% as a whole for district. After making allocation for future domestic for year 2025, balance available ground water for future use would be 37161 ham.

Assessment Unit Name	Total Extraction for irrigation, industries and domestic	Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction	Categorization
		Ham		%	
Narsinghpur	16303.84	429.39	4825.65	77.09	Semi-critical

³ Dynamic Ground Water Resource of Madhya Pradesh - 2023

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

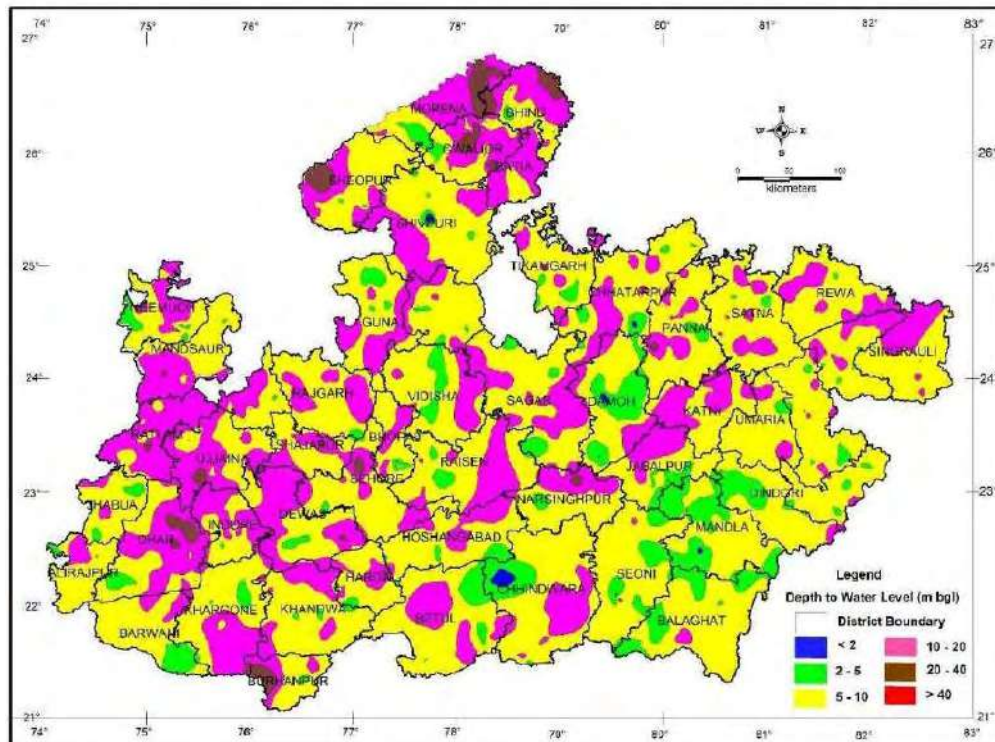


Figure 3-15: Depth of water level Pre-monsoon district Narsinghpur

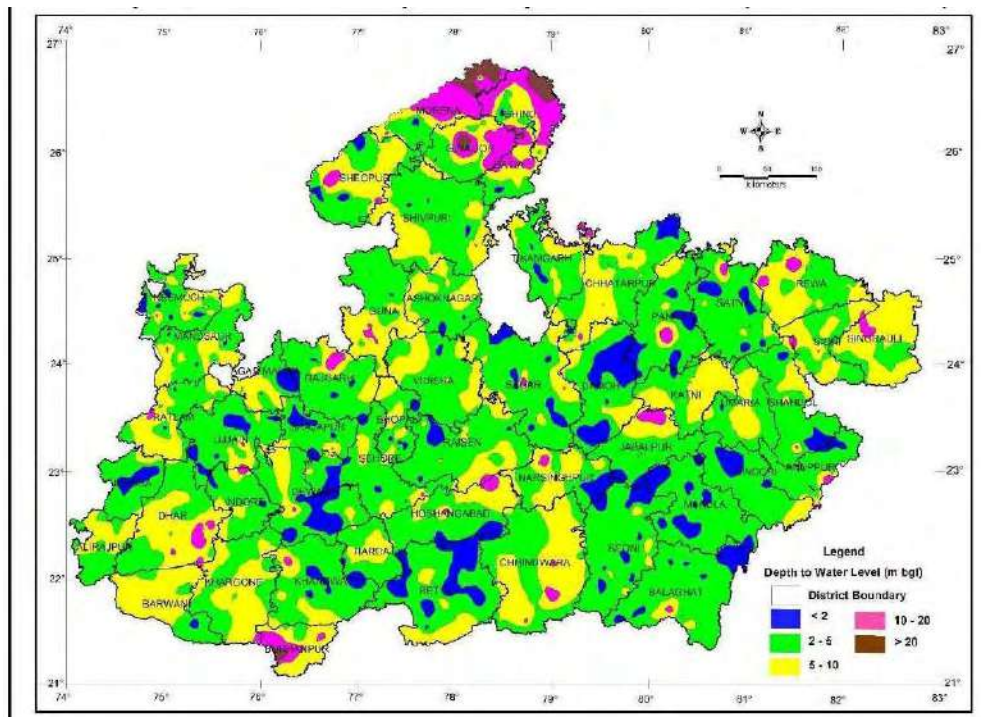


Figure 3-16: Depth of water level Post-monsoon district Narsinghpur

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

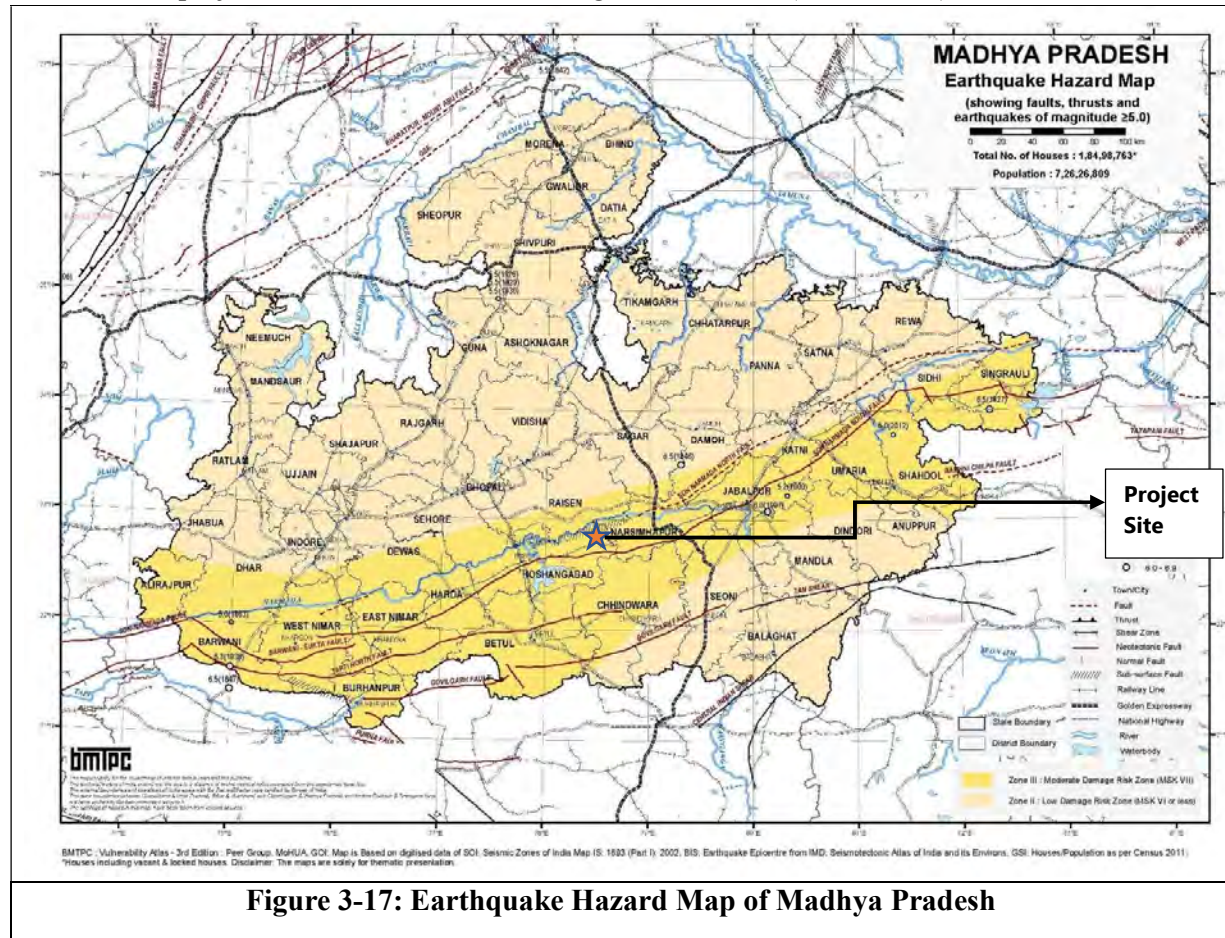
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.6.5 VULNERABILITY OF STUDY AREA

The earthquake vulnerability atlas and wind vulnerability atlas of Madhya Pradesh are provided in **Figures 3-17** and **Figure 3-18** respectively. The entire state of Madhya Pradesh falls in seismic zones according to the vulnerability atlas of India⁴ viz., Zone II: Low Damage Risk Zone (MSK VI or less) to Zone III: Moderate Damage Risk Zone (MSK VII). The district Narsinghpur falls under Zone III: Moderate Damage Risk Zone. The project site falls in moderate damage risk zone.

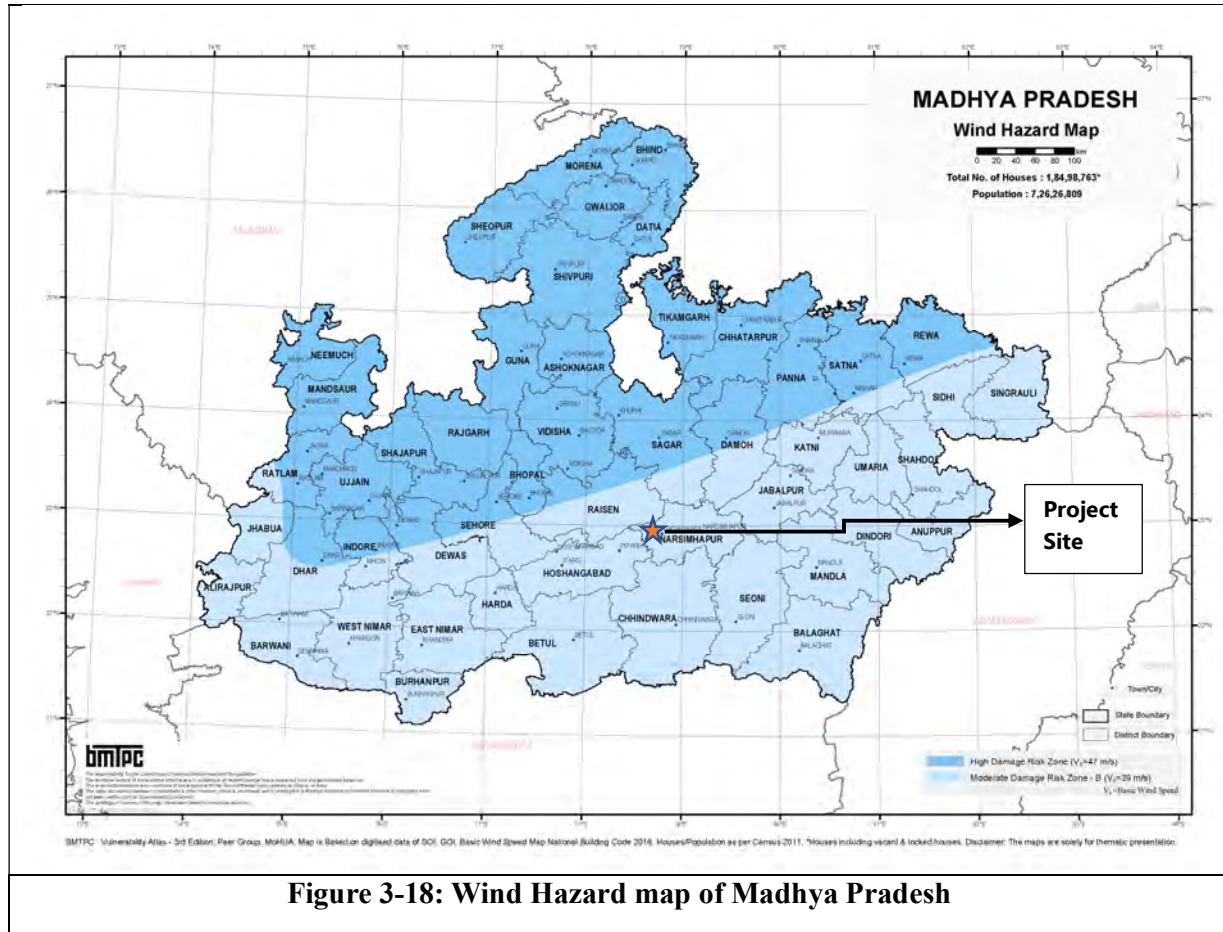
According to the wind vulnerability atlas, Madhya Pradesh falls in High Damage Risk Zone - A ($V_b=47$ m/s) to Moderate Damage Risk Zone B, where V_b is the basic wind speed. Narsinghpur district as well as the project site fall in Moderate Damage Risk Zone B ($V_b= 39$ m/s).



⁴ <https://vai.bmtpc.org/th.html>

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.6.6 SOIL QUALITY

Soil is a thin layer of earth's crust and is a living media, which is one of the important factors of crop production and serves as a natural nutrient source for the growth of plants. The components of the soils are mineral material, organic matter, water and air, the proportions of which vary and which together form a system for plant growth.

Soil quality of the study area is one of the important components for Environment Impact Assessment (EIA). The composite soil samples were collected from the study area and analyzed for different parameters. **Table 3-5** depicts the location of soil sampling in the study area. **Figure 3-20** shows the soil sampling locations.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.5: Soil Sampling Locations

Name	Latitude	Longitude	Villages	Distance in km	Direction	Category
S1	22°52'25.41"N	78°51'24.69"E	Project Site	1.75	E	Near Ash Pond
S2	22°50'48.89"N	78°50'22.36"E	Gangai	1.11	SW	Near Agriculture land
S3	22°52'10.41"N	78°52'46.07"E	Dongargaon	0.56	NE	Near Agriculture land
S4	22°52'3.70"N	78°52'14.32"E	Chorbarheta	0.09	NE	Near Agriculture land
S5	22°53'36.56"N	78°50'54.90"E	Kajrota	2.15	NNW	Near Agriculture land
S6	22°55'11.77"N	78°47'22.61"E	Gadarwara	7.14	NW	Near Agriculture land
S7	22°51'9.86"N	78°53'56.67"E	Narsara	2.54	E	Near Agriculture land
S8	22°51'44.45"N	78°46'40.33"E	Mahguwan Kalan	6.69	W	Near Agriculture land
S9	22°56'6.60"N	78°51'28.78"E	Bohani	6.82	N	Near Agriculture land
S10	22°47'54.51"N	78°51'39.85"E	Baghakudi	6.08	S	Near Agriculture land



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 3-19: Soil sampling for locations

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

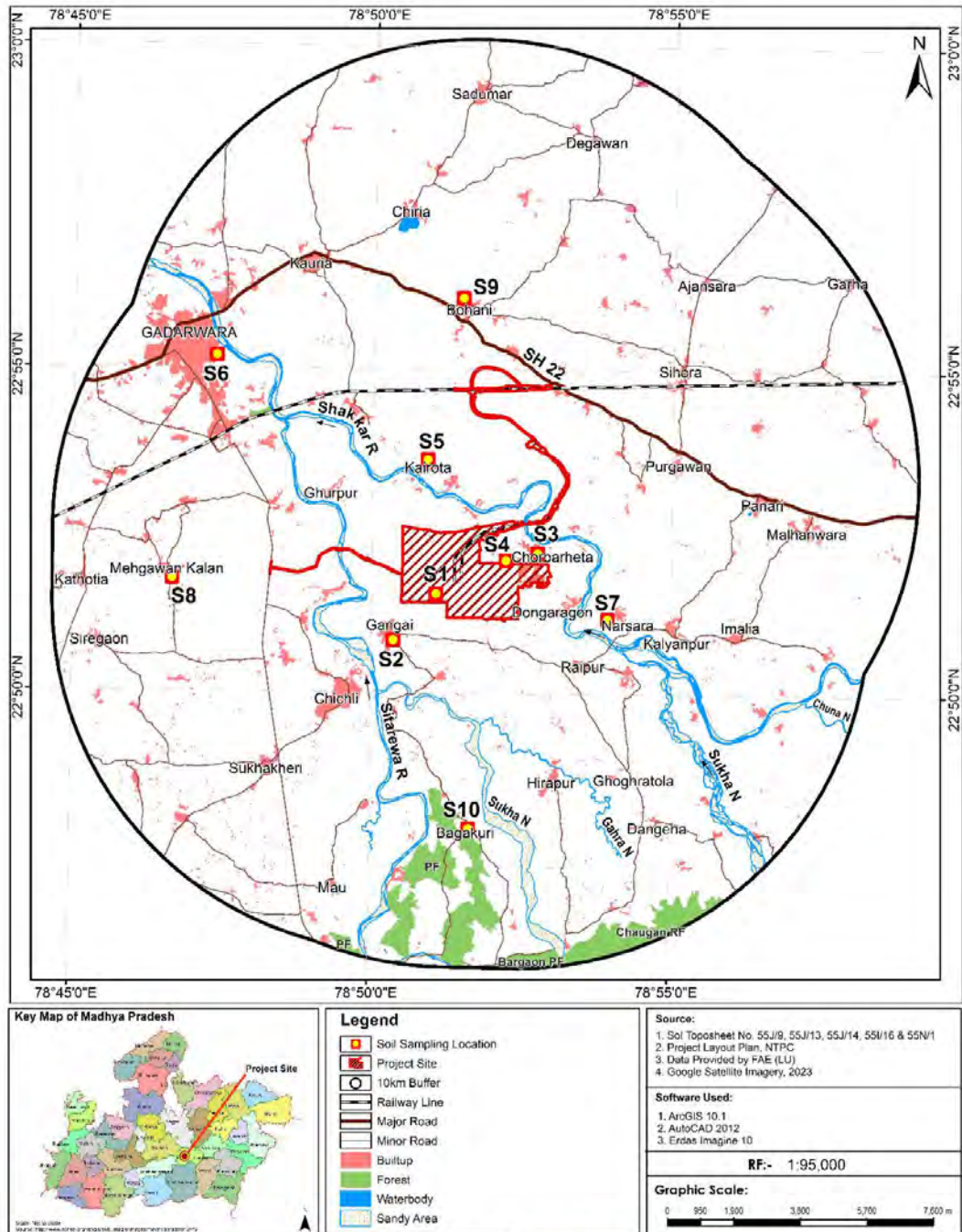


Figure 3.0: Soil Sampling Location Map

Project:
Gadarwara Super Thermal Power Project, Stage-II (2x800MW)
Gadarwara, Narsinghpur, Madhya Pradesh

Project Proponent:
NTPC Limited

Environment Consultant:
GREENCINDIA Consulting Private Limited
(An ISO 9001 QMS, ISO 14001 EMS & OHSAS 18001 HSE MS Certified by BSI)
(QCI/NABET Accredited Environment Consultant Certificate No. NABET/EIA/2325/RA/0297)

Drafted By:	Checked By:	Approved By:
Date	07/06/2024	
Revision	00	

Path: G:\Project\NTPC Gadawara\Shp\Soil_m.mxd

Figure 3-20: Soil Sampling Locations

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.6.6.1 Sampling Frequency & Analysis Method

Composite sampling method is used for collection of soil sampling in the study area. The sealed samples were sent to laboratory for analysis. The physical and chemical characteristics of the soil of the study area have been assessed by analyzing various parameters as per the methods described in “Soil Chemical Analysis” (M.L Jackson, 1967) and Department of Agriculture and Cooperation. Standard classification of Soil as per Indian Council of Agriculture Research, New Delhi.

Table 3.6: Analytical Technique for Soil Sample

Sl. No.	Parameters	Analytical Method	Reference
1	Texture	Sieve analysis & Hygro meter	-----
2	pH	pH meter	IS2720- Part 26, 1987 by pH meter
3	Conductivity (1:2)	Conductivity meter	Department of Agriculture & Cooperation, Govt of India Page No. 81-82:2011
4	Potassium	Flame Photometric	TM-S/13
5	Phosphorus	Spectrophotometric	TM-S/11
6	Nitrogen	Distillation & Titration	TM-S/17
7	Infiltration Rate		TM-S/40
8	Cation Exchange Capacity (CEC)		Department of Agriculture & Cooperation, Govt of India
9	Organic Matter	Black method	IS2720-(Part 22),1972, Reaffirmed 2001
10	Organic Carbon	Calculation	IS2720-(Part 22),1972, Reaffirmed 2001 (By Calculation)
11	Bulk Density	Sand replacement, core cutter	TM-S/34
12	Porosity		TM-S/33
13	Copper	AAS	Department of Agriculture & Cooperation, Govt of India
14	Iron	AAS	Department of Agriculture & Cooperation, Govt of India
15	Manganese	AAS	Department of Agriculture & Cooperation, Govt of India
16	Zinc	AAS	Department of Agriculture & Cooperation, Govt of India

3.6.6.2 ANALYSIS OF SOIL QUALITY

It is essential to identify the current status of soil quality and also to predict the impacts that may arise due to the project. Accordingly, a study for assessment of the baseline soil quality has been carried out in the region. The physico-chemical characteristics of soil samples collected is provided in **Table 3-7**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.7: Physico-chemical parameters of soil samples

S. No.	Parameters	S-1 Project Site	S-2 Gang ai	S-3 Dongar -gaon	S-4 Chorba rheta	S-5 Kajrota	S-6 Gadar -wara	S-7 Narsar a	S-8 Mahguwa n Kalan	S-9 Bohani	S-10 Bagha -kudi
1	pH	7.52	7.01	7.2	7.5	7.30	7.65	7.51	7.1	7.47	7.6
2	Electrical Conductivity µmhos/cm	780	750	680	880	700	720	690	550	520	660
3	Cation Exchange Capacity (CEC), meq/100g	12.5	14.8	15.6	17.8	12.6	11.7	12.5	13.2	14.7	15.1
4	Available Nitrogen, mg/Kg	105	120	156	162	270	340	330	254	260	286
	Available Nitrogen, Kg/ha	235.2	268.8	349.44	362.88	604.8	761.6	739.2	568.96	582.4	640.64
5	Available Phosphorus, mg/Kg	45	66	72	58	63	70	74	71	69	65
	Available Phosphorus, Kg/ha	100.8	147.84	161.28	129.92	141.12	156.8	165.76	159.04	154.56	145.6
6	Available Potassium, mg/Kg	188.6	229.4	180.7	204.6	192.8	177.2	194.6	184.2	191.4	186.4
	Available Potassium, Kg/ha	422.5	513.9	404.8	458.3	431.8	397	435.9	412.6	428.7	417.5
7	Organic Carbon, %	0.65	0.85	0.69	0.84	0.63	0.57	0.81	0.75	0.68	0.66
8	Organic Matter, %	1.12	1.46	1.19	1.44	1.08	0.98	1.39	1.29	1.17	1.14
9	Bulk Density	1.5	1.1	1.3	1.80	1.0	1.7	1.2	1.6	1.4	1.6
10	Available Moisture, %	7.64	6.44	8.4	7.05	6.62	6.85	5.34	7.43	5.67	4.85

**ENVIRONMENT CONSULTANT
GRENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 3
BASELINE ENVIRONMENT**

**Page
3-33**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Parameters	S-1 Project Site	S-2 Gang ai	S-3 Dongar -gaon	S-4 Chorba rheta	S-5 Kajrota	S-6 Gadar -wara	S-7 Narsar a	S-8 Mahguwa n Kalan	S-9 Bohani	S-10 Bagha -kudi
11	Water Holding Capacity, %	41.6	35.7	39.4	32.6	36.2	40.4	44.6	41.6	37.5	38.1
12	Calcium, meq/100g	10.52	10.8	5.6	9.8	24.6	7.85	8.65	9.74	6.55	9.68
13	Magnesium, meq/100g	1.68	1.73	0.90	1.57	3.94	1.26	1.38	1.54	1.05	1.55
Macronutrients											
14	Copper, mg/kg	0.25	0.21	0.25	0.26	0.28	0.24	0.18	0.29	0.17	0.11
15	Iron, mg/kg	1.85	3.65	4.51	1.29	2.64	1.87	3.65	3.47	3.33	2.85
16	Zinc, mg/kg	0.41	0.45	0.55	0.47	0.54	0.5	0.62	0.68	0.71	0.66
17	Lead, mg/kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Texture		Sandy Loam	Loamy sand	Sandy Loam							
18	Sand, % by mass	58	55	59	60	57	65	64	67	66	58
19	Silt, % by mass	23	25	20	26	22	23	20	21	22	25
20	Clay, % by mass	19	15	21	14	21	12	16	12	12	17

Test reports is enclosed as Annexure 3.3

3.6.6.3 OBSERVATION:

pH: The pH value recorded in the study area varies from “Neutral to Slightly Alkaline” as per ICAR report. pH has been found to be lowest in S2: Gangai (Agriculture land) which is neutral in nature. Alkaline soils have a high saturation of base cations (K^+ , Ca^{2+} , Mg^{2+} and Na^+) (**Figure 3.21A**). This is due to an accumulation of soluble salts which are classified as either saline soil or alkaline soil. In the study area S1, S4, S6, S7, S9 & S10 show slightly alkaline pH in soil. Other samples remain in neutral pH range. Graphical representation given in **Figure 3.21A** and soil pH result in **Table 3.7** and classification has been represented in **Table 3.8** and. In other classification availability of soil nutrients mainly NPK with pH has been represented in **Figure 3.22**.

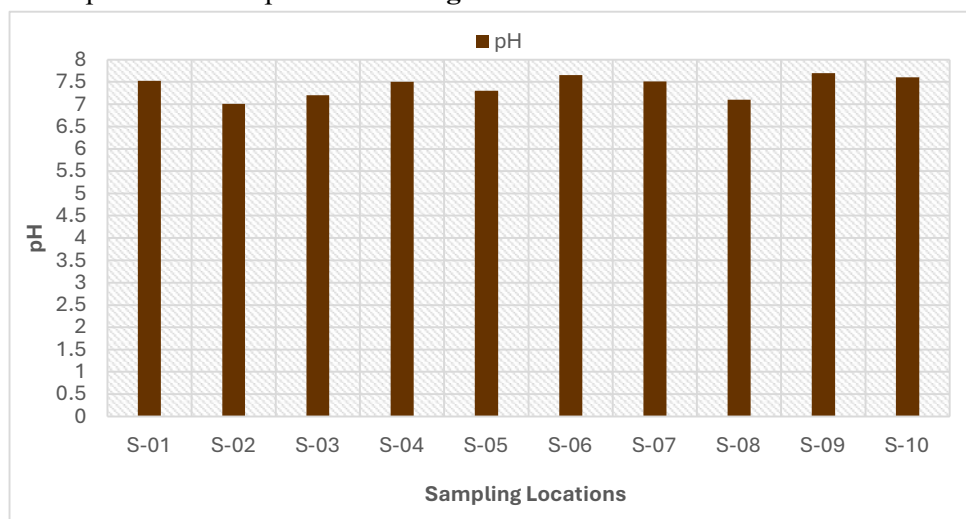


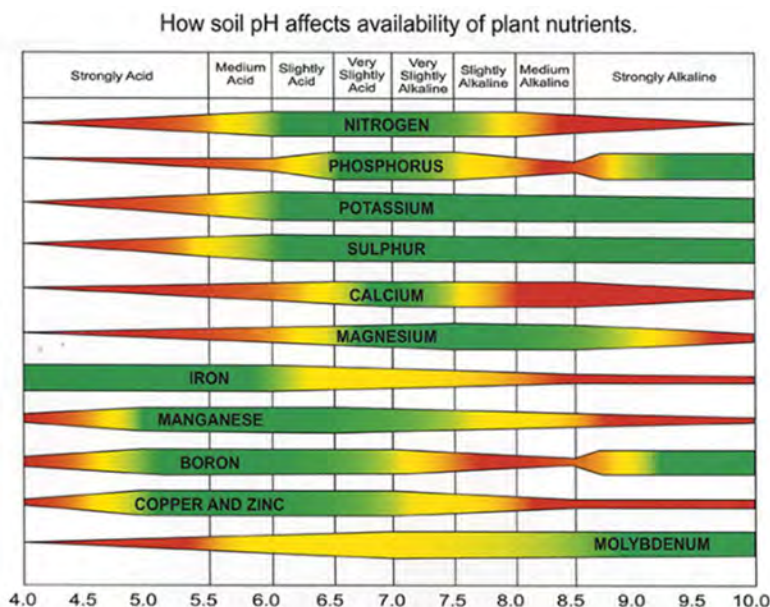
Figure 3-21A: pH of the Soil sample

Table 3.8: Soil classification for pH

Standard Classification of Soil pH as per ICAR, New Delhi	
<4.5	Extremely acidic
4.51- 5.50	Very strongly acidic
5.51-6.0	Moderately acidic
6.01-6.50	Slightly acidic
6.51-7.30	Neutral
7.31-7.80	Slightly alkaline
7.81-8.50	Moderately alkaline
8.51-9.0	Strongly alkaline
9.01	Very strongly alkaline

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Green: available; yellow: low availability; red: not availability

Figure 3-22: Availability of Soil Nutrients (NPK) with pH class

Electrical Conductivity (EC): The electrical conductivity of soil is actually a measure of salinity. Excessively high salinity can affect plants in the following ways: Specific toxicity of a particular ion (such as Sodium), higher osmotic pressure around the roots prevents an efficient water absorption by the plant. Some plants are more susceptible to electrical conductivity than others and each species has an electrical conductivity threshold, beyond which yield decreases. In the study area soil conductivity varies between 520 $\mu\text{mhos/cm}$ at S9 to 880 $\mu\text{mhos/cm}$ at S4. ICAR classification has been represented in **Table 3.9** and the graphical representation of soil EC has been shown in **Figure 3.23** respectively.

Table 3.9: Conductivity of the Soil Sample collected from the project site and study area

Parameter	Classification
Salinity Electrical Conductivity (ppm) (1 ppm = 640 $\mu\text{mhos/cm}$)	- Up to 1.00 Average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops (sensitive to salts)

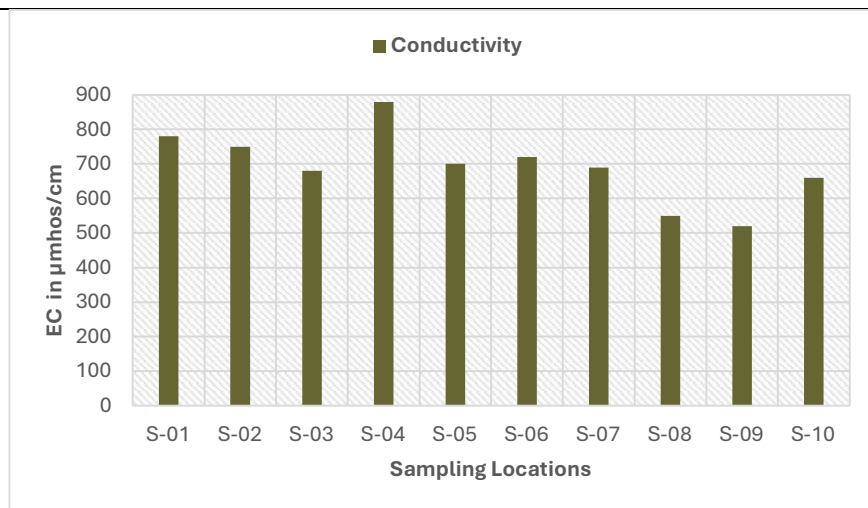


Figure 3-23: Conductivity of the Soil sample

Soil Texture: According to the study of soil texture, the soil of the study area varies from 20% clay, 70% sandy loam and 10% silt. The soil texture of the study area varies between sandy loam (S1, S3, S4, S5, S6, S7, S8, S9 & S10) to loamy sand (S2). Loam soil is ideal for growing crops because it retains nutrients well and retains water while still allowing the water to flow freely. These soils allow for better water penetration than clays, better water holding capacity and better nutrient retention than sands and silts, and more of the soil moisture and nutrients available to the plants than in clays.

In **Figure- 3.24** the textural triangle showing the 12 classes and points of different samples in it has been shown which represents the textural classification of the sample in the study area.

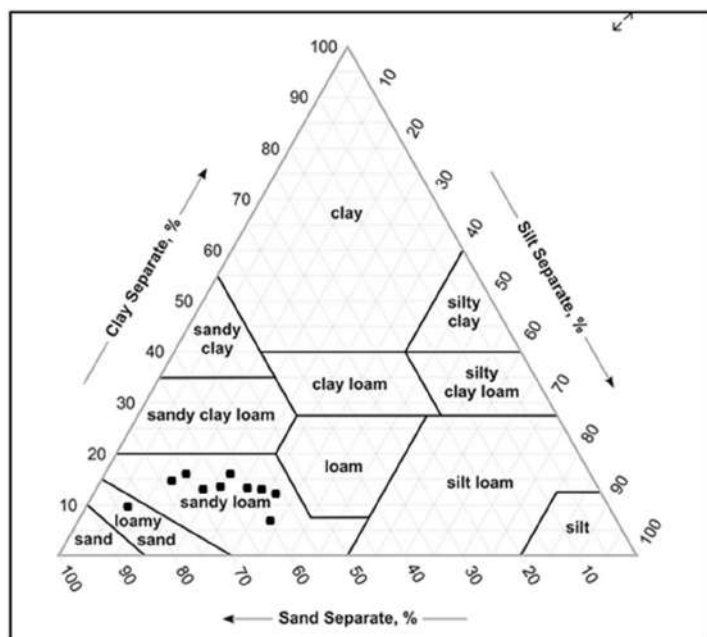


Figure 3-24: Textural triangle showing 12 classes with black dots pointing to the classified soil sample. (Reprinted from USDA-NRCS, 1999)

Bulk Density: Bulk density of a soil is a dynamic property that varies with the soil structural conditions. In general, it increases with profile depth, due to changes in organic matter content, porosity and compaction. It is required for gaseous exchange, such as high bulk density would pose restriction to the growth of deeper rooted plants and may be one of the reasons of cessation of plant growth (Ghose *et al.*, 2004).

Bulk density of the study area ranges between 1.0 gm/cm³ at S5 to 1.8 gm/cm³ at S4. A normal range of bulk densities for clay is 1.0 to 1.6 mg/m³ and a normal range for sand is 1.2 to 1.8 mg/m³ with potential root restriction occurring at ≥ 1.4 mg/m³ for clay and ≥ 1.6 mg/m³ for sand. Bulk density of a soil is a dynamic property that varies with the soil structural conditions. In general, it increases with profile depth, due to changes in organic matter content, porosity and compaction.

Moisture: Soil moisture is important for hydrological, biological and biogeochemical processes. The field moisture of all the samples range between 4.85% at S10 to 8.41% at S3. The moisture content of the study area, however, remains lower than the wilting point which is shown in **Table 3.10**.

Table 3.10: Average available water content for various soil textural classes

Textural class	Wilting point	Field capacity	Available water
	(% moisture)		
Sand	5	12	7
Sandy loam	9	21	12
Loam	16	36	20
Silt loam	18	39	21
Clay loam	24	39	15
Silty clay	24	39	13
Clay	27	39	12

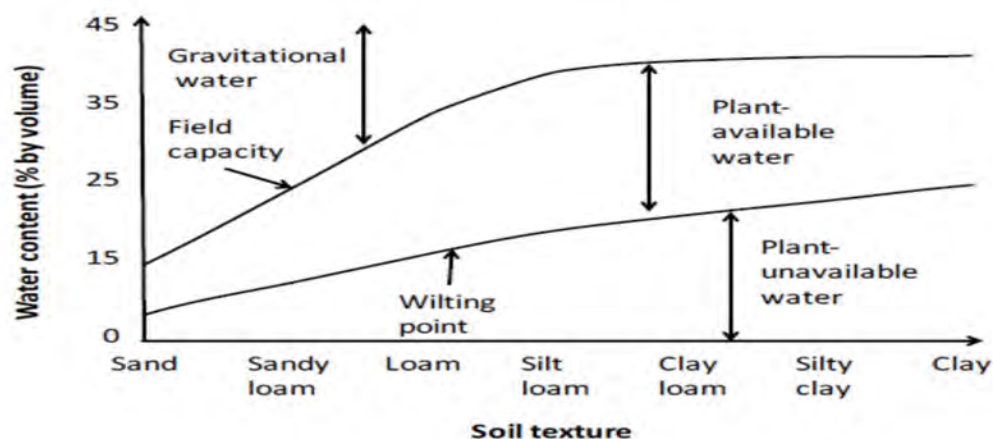


Figure 3-25: Gravitational, plant-available and plant-unavailable water content for various soil texture

- **Wilting Point:** Moisture level at which plants will begin to suffer
- **Field Capacity:** Highest moisture level at which do not exceed to avoid runoff

The water available to support plant growth is called plant available water and is the difference between field capacity and the wilting point. Field capacity is the amount of water remaining in the soil profile after 48-72 hours of free drainage following saturated conditions. Water moving downward in the soil

following a saturating event can be effectively used by growing plant. The relation between moisture content and infiltration rate has been represented in **Figure 3.25**.

Soil nutrients refer to the inherent capacity of the soil to supply nutrients in adequate amounts and in suitable proportions for crop growth and crop yield. The trend in increasing the yield by adopting high yielding varieties has resulted in deficiency of nutrients in soils and has reflected as deficiency symptoms in plants. Hence, it is required to know the fertility (NPK) status of the soils of the State for applying the required dosage of fertilisers and planning the regional distribution of fertilisers.

- a) **Phosphorus:** Phosphorus is the key content which plays an important role in the photosynthesis, respiration, energy storage and transfer, cell division, cell enlargement and several other properties in the living plant. Available Phosphorus ranges between 100.8 kg/ha at S1 site to 165.76 kg/ha at S7. As per ICAR classification the phosphorus in the study area present is classified “more than sufficient”.
- b) **Potassium:** Potassium is an essential plant nutrient and is required in large amounts for proper growth and reproduction of plants. Potassium is considered second important after nitrogen, when it comes to nutrients needed by plants, and is commonly considered as the “quality nutrient. It affects the plant shape, size, color, taste and other measurements attributed to healthy produce. Potassium content in the study area ranges between 397 kg/ha at S6 to 513.9 kg/ha at S2. As per ICAR classification the potassium in the study area present is classified as “more than sufficient”.
- c) **Nitrogen:** Nitrogen is important because it is a major component of chlorophyll, the compound by which plants use sunlight energy to produce sugars from water and carbon dioxide during photosynthesis. It is also a major component of amino acids. Soil nitrogen exists in three general forms: organic nitrogen compounds, ammonium (NH_4^+) ions and nitrate (NO_3^-) ions. The majority of plant-available nitrogen is in the inorganic forms NH_4^+ and NO_3^- (called mineral nitrogen). Nitrogen content in the surface soil of the study area varies between 235.2 kg/ha at S1 to 761.6 kg/ha at S6. As per ICAR classification the nitrogen in the study area present as “better” to “sufficient” in the study area. The Classification of NPK as per ICAR in soil are given in **Table 3.11**.

Table 3.11: Classification of NPK as per ICAR

Sl. No.	Parameter	Classification
1	Phosphorus (kg/ha.)	• Up to 15 very less • 16-30 less • 31-50 medium, • 51-65 on an average sufficient • 66-80 sufficient • >80 more than sufficient
2	Potassium (kg/ha.)	• 0 -120 very less • 120-180 less • 181-240 medium • 241-300 average • 301-360 better

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Parameter	Classification
		• >360 more than sufficient
3	Nitrogen (kg/ha.)	• Up to 50 very less • 51-100 less • 101-150 good • 151-300 Better • >300 sufficient

Organic Matter: The organic matter of the soil has its origin in the decay of dead plants and animals. Research on soil and plants have received considerable impetus in connection with the role of organic matter in regulating the growth of plants. But it must be remembered that all organic matters are not beneficial to higher plants. In the coastal region soil organic matter also rises by soil salt. The soil organic matter plays an important role as the store house of plants nutrients. In the study area organic matter varies between 0.98% to 1.46%. As per ICAR classification as given in **Table 3.12**, the organic matter found in the study area is “more than sufficient”. The quality of soil is rather dynamic and can affect the sustainability and productivity of land use.

Table 3.12: Classification of Organic Matter as per ICAR

Parameter	Classification
Organic Matter (%)	• Up to 0.2: very less • 0.21-0.4: less • 0.41-0.5 medium, • 0.51-0.8: on an average sufficient • 0.81-1.00: sufficient • >1.0 more than sufficient

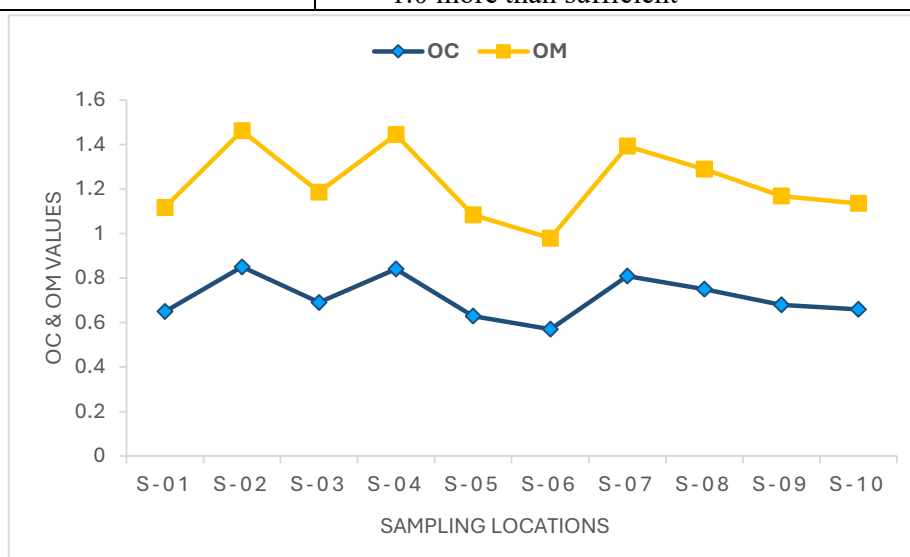


Figure 3-26: Organic Carbon & Organic Matter status of soil samples

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Micronutrients

Copper: Copper has an essential function for plant growth. Its essential status for plant nutrition. Cu content in study area varied between 0.11 mg/kg (S10) to 0.29 mg/kg (S8)

Zinc: It is an essential micronutrient that has significant role in basic plant metabolic processes and enhances the growth, yield and quality by stimulating chlorophyll production, photosynthetic activity, nutrient uptake and protein biosynthesis. Zn varied from 0.41 mg/kg (S1) to 0.71 mg/kg (S9).

Iron: Iron (Fe) plays a significant role in physiological and biochemical pathways in plants. It involved in the synthesis of chlorophyll and is essential for the maintenance of chloroplast structure and function. Fe varied from 1.29 mg/kg (S4) to 4.51 mg/kg (S3).

Inferences: The NPK content was found to be satisfactory for growth of plants. Therefore, it can be concluded that the soil quality in terms of fertility is good for growth of vegetation in study area.

3.7 CLIMATOLOGY AND METEOROLOGY

3.7.1 IMD METEOROLOGICAL DATA

Meteorology is the key to understand the air quality. The essential relationship between meteorological condition and atmospheric dispersion involves the wind in the broadest sense. Other factors such as variation in temperature, humidity etc. also play a direct role in dispersion and dilution of pollutants. Wind fluctuations over a very wide range of time, accomplish dispersion and strongly influence other processes associated with them. This section makes a comparative analysis of the meteorological data of the study area collected by project team in 2024. The data used for the purpose are the 30 years average IMD data from 1991 to 2020 taken from Meteorological Station, Narsinghpur. The area has irregular and erratic rainfall. The winter starts in December when day and night temperatures fall rapidly. December is the coldest month. The highest rainfall occurs in the month of September. The summary of the 30 years meteorological data of Narsinghpur IMD Station from 1991-2020 is shown in **Table 3-13**.

Table 3.13: Meteorological Data of Narsinghpur IMD from 1991-2020

Sl. No.	Parameters	Season	Months	Monthly Total
1	Rainfall in mm	Winter (Dec to Feb)	December	62.0
			January	40.5
			February	71.0
			Total	173.5
		Summer (Mar to May)	March	47.0
			April	25.2
			May	37.6
			Total	109.8
		Monsoon (Jun to Sep)	June	217.6
			July	184.0
			August	230.4
			September	271.3

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Parameters	Season	Months	Monthly Total			
			Total	903.3			
		Post-Monsoon (Oct to Dec)	October	166.8			
			November	76.8			
			December	62.0			
			Total	305.6			
2	Temperature		Month	Max	Min	Average	
		Winter (Dec to Feb)	December	27.8	9.0	18.4	
			January	26.3	9.4	17.8	
			February	29.8	11.8	20.8	
			Average	27.97	10.07	19.02	
		Summer (Mar to May)	March	35.2	16.1	25.65	
			April	39.7	21.0	30.35	
			May	42.6	26.0	34.3	
			Average	39.17	21.03	30.1	
		Monsoon (Jun to Sep)	June	38.4	25.6	32	
			July	32.1	23.8	27.95	
			August	29.7	22.9	26.3	
			September	31.6	22.6	27.1	
			Average	32.95	23.73	28.34	
		Post-Monsoon (Oct to Dec)	October	33.1	19.4	26.25	
			November	30.3	14.1	22.2	
			December	27.8	9.0	18.4	
			Average	30.1	14.17	22.28	
3	Relative Humidity in (RH) %		Month	08:30 Hrs		17:30 Hrs	
		Winter (Dec to Feb)	December	71		46	
			January	75		47	
			February	68		39	
			Average	71.33		44.0	
		Summer (Mar to May)	March	53		32	
			April	41		25	
			May	44		27	
			Average	46		28	
		Monsoon (Jun to Sep)	June	60		47	
			July	79		71	
			August	84		79	
			September	82		71	
			Average	76.25		67	
			October	74		54	
			November	72		49	

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Parameters	Season	Months	Monthly Total	
		Post-Monsoon (Oct to Dec)	December	71	46
			Average	72.33	49.67
4	Wind pattern		Months	Wind Speed (Kmph)	
		Winter (Dec to Feb)	December	2.0	
			January	2.4	
			February	3.0	
			Average	2.47	
		Summer (Mar to May)	March	3.8	
			April	4.4	
			May	5.9	
			Average	4.7	
		Monsoon (Jun to Sep)	June	8.0	
			July	6.8	
			August	6.0	
			September	3.8	
			Average	6.15	
		Post-Monsoon (Oct to Dec)	October	2.2	
			November	2.2	
			December	2.0	
			Average	2.13	

Temperature: Temperature of the study area is generally high during April to June. As per the IMD Climatological table (1991–2020) the maximum temperature was recorded in the month of May & the minimum temperature is recorded in the month of December. (Refer **Figure 3-27**)

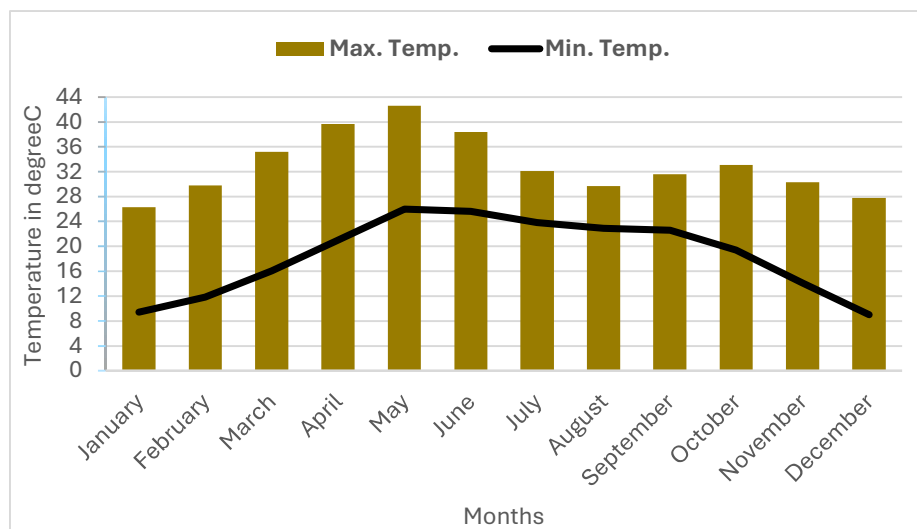


Figure 3-27: Temperature as per IMD

Rainfall: The average annual rainfall is 1192.1 mm. Maximum Rainfall was recorded in the months of August and September. The intensity varies from 109.8 mm to 903.3 mm. The maximum annual rainfall is received during the months from June to September. The 30-years average monthly rainfall data is furnished in **Figure 3-28**.

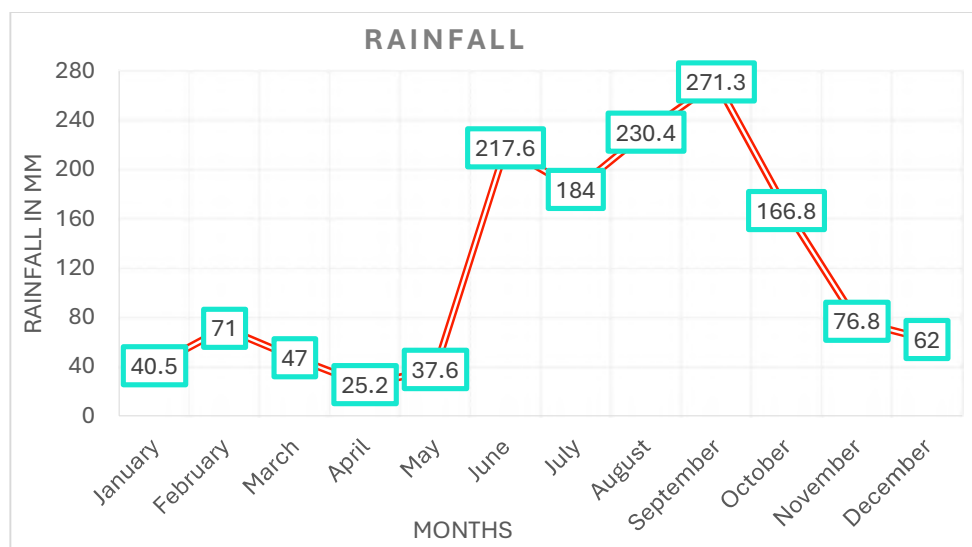


Figure 3-28: Rainfall as per IMD

Relative Humidity: The humidity is highest in July to October with average relative humidity of 76.25%. The annual mean relative humidity of 30 years is furnished in **Figure 3-29**.

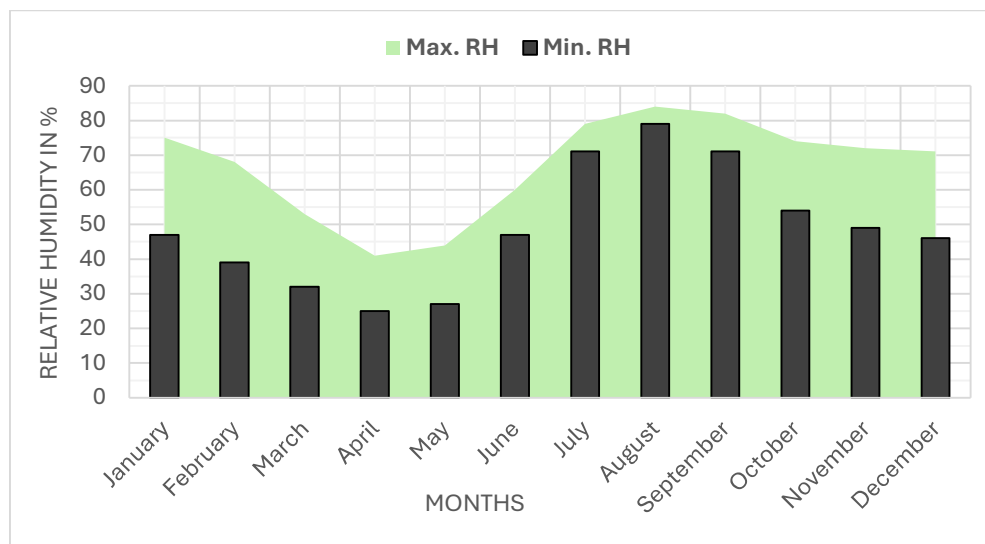


Figure 3-29: Relative Humidity as per IMD

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



As per IMD station at Narsinghpur, the dominant wind direction throughout the year is from NW and during the pre-monsoon the pre-dominant wind direction is from WNW. The wind-speed was found to be highest during the monsoon month of Mar-May with the average wind speed of 6.15 kmph (1.70 m/s). The IMD wind rose diagrams are shown in **Figure 3-30**.

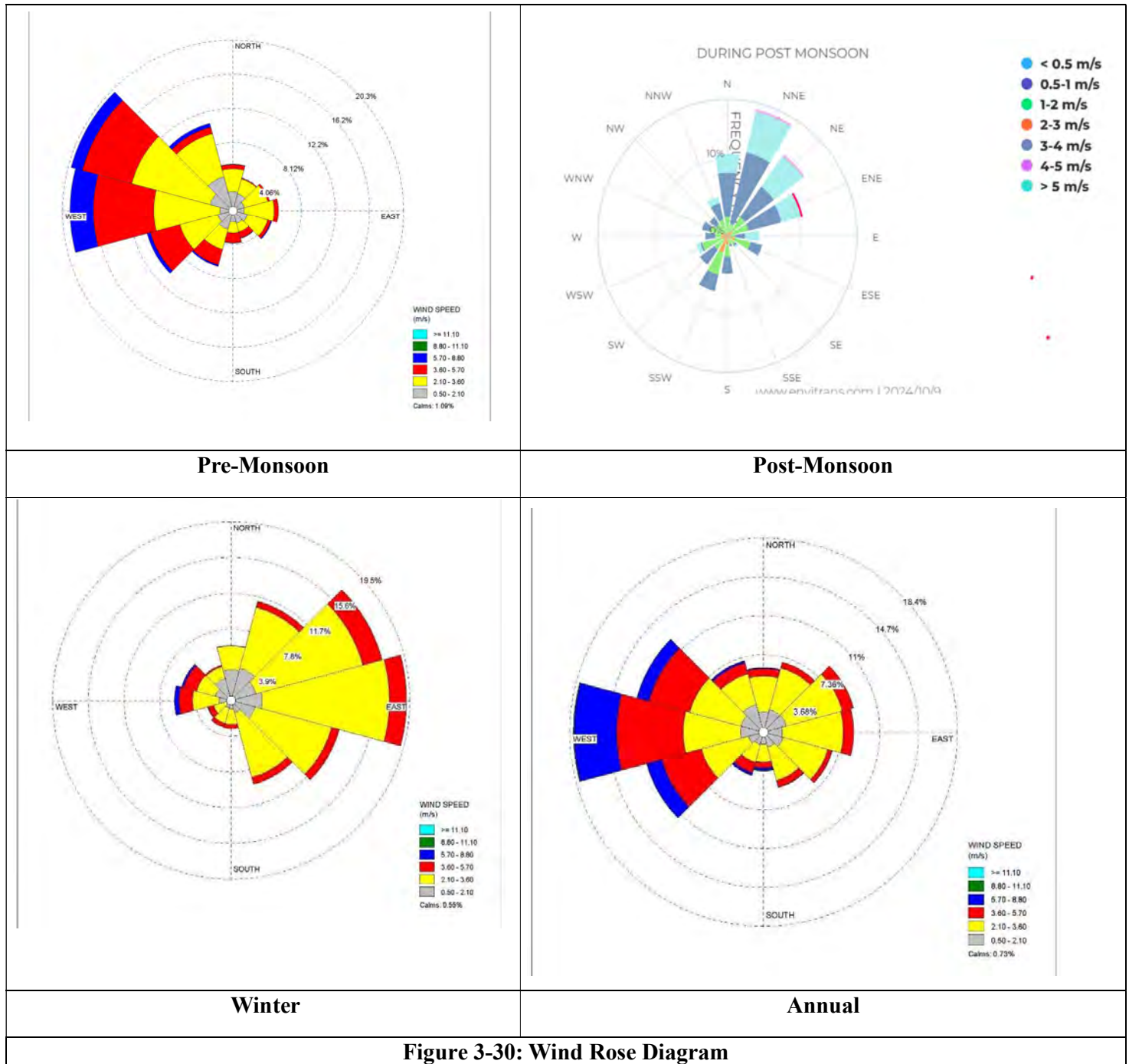


Figure 3-30: Wind Rose Diagram

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.7.2 Methodology of Data Generation

During the study a continuous automatic weather monitoring station was established at site to record Wind speed, Wind Direction, Solar radiation, Relative Humidity and Temperature at 2 m and 10 m above ground. Atmospheric pressure was recorded twice a day at 08:30 and 17:30 hrs. Cumulative Rainfall was monitored by rain gauge on daily basis. This station is in operation since March, 2024 and the present report incorporates the data from March, 2024 to May, 2024. The methodology adopted for monitoring meteorological observations is as per the standard norms laid down by Bureau of Indian Standards (BIS) and the India Meteorological Department (IMD). Hourly maximum, minimum and average values of wind speed, direction and temperature are recorded continuously at site.

Meteorological Observation at Site

A fully instrumented continuous recording meteorological observatory is established and operating at Gadarwara from March, 2024 and this report presents the data from March, 2024 to May, 2024. The following parameters are being measured: -

- Temperature at 2 m and 10 m level
- Relative humidity
- Wind speed and direction
- Rainfall

The brief details of instruments, parameter and frequency are presented in **Table-3.14**

Table 3.14: Instruments, Parameters and Frequency of Meteorological Monitoring at Site

S. No.	Parameters	Instruments	Frequency
1.	Wind Speed	Automatic Weather station (Envirotech AWS10B)	Continuous (averaging time of 1 hour)
2.	Wind Direction		
3.	Ambient Temperature at Two Heights 2m & 10m		
4.	Max. & Min Temperature	Wet & Dry Bulb Thermometer	Daily at 08:30 & 17:30 IST
5.	Humidity	RH sensor	Daily at 08:30 & 17:30 IST
6.	Atmospheric Pressure	Barometer sensor	Daily at 08:30 & 17:30 IST
7.	Storm	Visual observation	Daily
8.	Rainfall	Rain Gauge	Daily
9.	Solar radiation	Solar radiation sensor	Continuous (averaging time of 1 hour)

The meteorological data for three months i.e. from March, 2024 to May, 2024, recorded at site is given in **Table- 3.15**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.15: Onsite Meteorology Data

Month	Temperature, °C			Relative Humidity, %		Rainfall (mm)		Monthly Mean Station level Pressure, hPA		Wind Speed, km/hr
	Min	Max	Monthly average	At 08:30	At 17:30	Rainy Days	Monthly Total	At 08:30	At 17:30	Mean
March	22.5	39.0	26.5	55.1	43.8	0.00	0.00	955.8	950.3	2.50
April	22.0	41.0	31.5	55.6	47.4	2.00	2.00	959.1	954.4	2.16
May	21.0	43.0	32.0	48.0	42.3	1.00	1.00	971.2	956.8	3.13

Month	Temperature		Solar Radiation	Storm
	Dry bulb 8:30	Wet bulb 17:30	W/m ²	
March	22.7	20.9	773.3	0
April	28.7	22.6	791.2	2
May	32.8	24.9	761.8	1

The analysis of the field observation is given below:

3.7.2.1 Ambient Temperature

The observed seasonal minimum and maximum temperatures were 43.0°C and 39.0°C where the minimum temperature was observed 21.0°C to 22.5°C. Whereas the average temperature ranges between 26.5°C to 32.0°C respectively.

3.7.2.2 Relative Humidity

The seasonal average relative humidity varies from 48.0% to 55.6% at 08:30 hrs and 42.3% to 47.4% at 17:30 hrs. Relative humidity ranges between 33.7 % to 75.4 %.

3.7.2.3 Barometric Pressure

The minimum atmospheric pressure was found to be 955.8hPa in the month of March to maximum 971.2hPa in the month of May at 8:30 hrs whereas minimum atmospheric pressure was found to be 950.3hPa to maximum atmospheric pressure was found to be 956.8hPa at 17:30 hrs in the month of May.

3.7.2.4 Rainfall & Storm

During April two days and in May, one day rainfall with storm was observed.

3.7.2.5 Wind Speed

Analysis of hourly wind speed shows that the winds are generally light to moderate in this area. The monthly mean wind speed varies from 2.16 to 3.13 km/hr. WS varies between 0.1 km/hr to 18.7 km/hr

3.7.2.6 Wind Pattern

The wind-rose diagram for pre monsoon season has been drawn on the basis of hourly wind speed and direction data. The wind rose shows that the dominant directions of the wind flow are west northwest for the months of March to May. The seasonal wind rose diagram at site is presented in **Figure 3.31**.

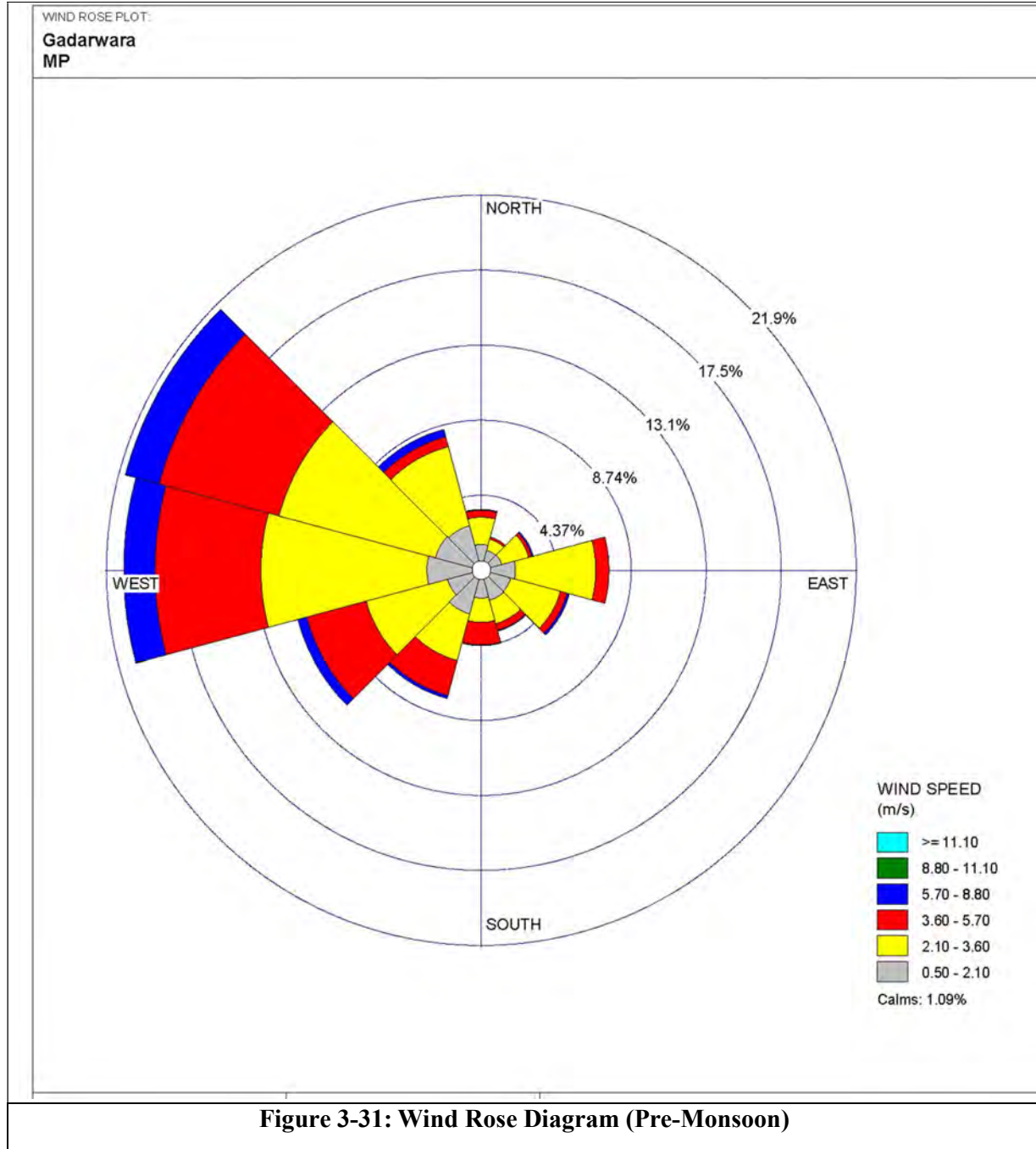
3.7.2.7 Solar Radiation

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



The minimum solar radiation was found to be 761.8 W/m² in the month of May and maximum solar radiation was found to be 791.2 W/m² in the month of April.



3.8 AIR ENVIRONMENT

3.8.1 FREQUENCY AND PARAMETERS OF MONITORING

The area is relatively clean with no predominant industrial activities. Transport and domestic activities are main sources of air pollution. Ambient air quality monitoring has been carried out with a frequency of two samples per week at Ten locations for three months (March, 2024 – May, 2024). The monitoring of ambient air quality has been carried out for the following parameters as mentioned below:

- Particulate Matter₁₀ (PM₁₀)
- Fine Particulate Matter_{2.5} (PM_{2.5})
- Sulphur dioxide (SO₂)
- Nitrogen Oxide (NO_x)
- Carbon monoxide (CO)
- Ozone (O₃)
- Mercury (Hg)
- Ammonia (NH₃)
- Lead (Pb)
- Nickel (Ni)
- Arsenic (As)
- Benzene (C₆H₆)
- Benzo Pyrene (BaP)

3.8.2 INSTRUMENT USED FOR SAMPLING

In order to assess the Ambient Air Quality (AAQ), samples of ambient air were collected by installation of Respirable Dust Sampler and Fine Particulate Sampler at different locations within the study area and analyzed to find out the existing status of air quality.

3.8.3 SAMPLING AND ANALYTICAL TECHNIQUE

With a view to collecting the samples, Envirotech/SSCE made Fine Particulate Sampler and Respirable Dust Samplers along with Gaseous attachment have been used. Filter papers were used for the collection of PM₁₀ & PM_{2.5}. SO₂ was collected by drawing air at a flow-rate of 0.5 litres per minute (lpm) through an absorbing solution (TCM). The NO_x and Ozone were collected by drawing air at a flow rate of 0.5 liters per minute (lpm) through the mixture of absorbing solutions. Carbon monoxide was collected 8 hourly and analyzed by Non-Dispersive Infra-Red Spectroscopy (NDIR). The particulate matter for analysis of Mercury was collected on EPM2000 filter paper.

3.8.4 SELECTION OF SAMPLING LOCATIONS

Ten monitoring locations have been selected on the basis of predominant wind direction. All probable directions, which may be affected due to expansion of the project, have been considered. Also, the effort was made to collect the representative baseline conditions of all the project affecting villages.

The monitoring stations have been setup in order by selecting locations as close as feasible to the anticipated maximum pollutant concentration areas. Logistic considerations such as accessibility, security, and availability of reliable power supply etc. were also examined while finalizing the stations.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



A Coverage Factor concept was used for determining the location of AAQ monitoring stations (R E Munn). A large number of stations were identified as potential monitoring stations all around the project. A Coverage Factor (C) (R E Munn) was calculated by the following equation:

$$C_{ij} = F_j / (1 + D_i)$$

Where, C_{ij} = Coverage Factor of i^{th} station in j^{th} direction

F_j = Frequency of wind in j^{th} direction

D_i = Distance of i^{th} station

The stations having high values of C_{ij} were selected as final monitoring stations. The monitoring locations are depicted in **Table 3-16** and **Figure 3-32**.

Table 3.16: Air Monitoring Locations

Name	Latitude	Longitude	Village	Distance	Directions	Category
AAQ1	22°52'13.32"N	78°51'43.74"E	Near project site	Inside the Project Boundary	0.0	Industrial
AAQ2	22°53'2.76"N	78°49'14.76"E	Ghoorpur	2.39	WNW	1st upwind
AAQ3	22°51'14.84"N	78°53'14.06"E	Kudari, Narsara	1.41	ESE	1st downwind
AAQ4	22°51'52.03"N	78°46'35.74"E	Mahguwan Khurd	6.74	W	2nd upwind
AAQ5	22°51'12.56"N	78°55'5.11"E	Kalyanpur	4.48	E	2 nd downwind
AAQ6	22°55'8.88"N	78°47'13.47"E	Gadarwara	7.49	NW	Populated
AAQ7	22°55'55.45"N	78°51'32.12"E	Bohani	6.51	N	Crosswind
AAQ8	22°52'10.54"N	78°52'40.15"E	Dongargaon	0.52	NE	Crosswind & downwind
AAQ9	22°50'50.06"N	78°50'17.57"E	Gangai	1.81	SW	Crosswind
AAQ10	22°47'51.38"N	78°51'44.41"E	Badgaon PF near village Baghakudi	6.15	S	Sensitive

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

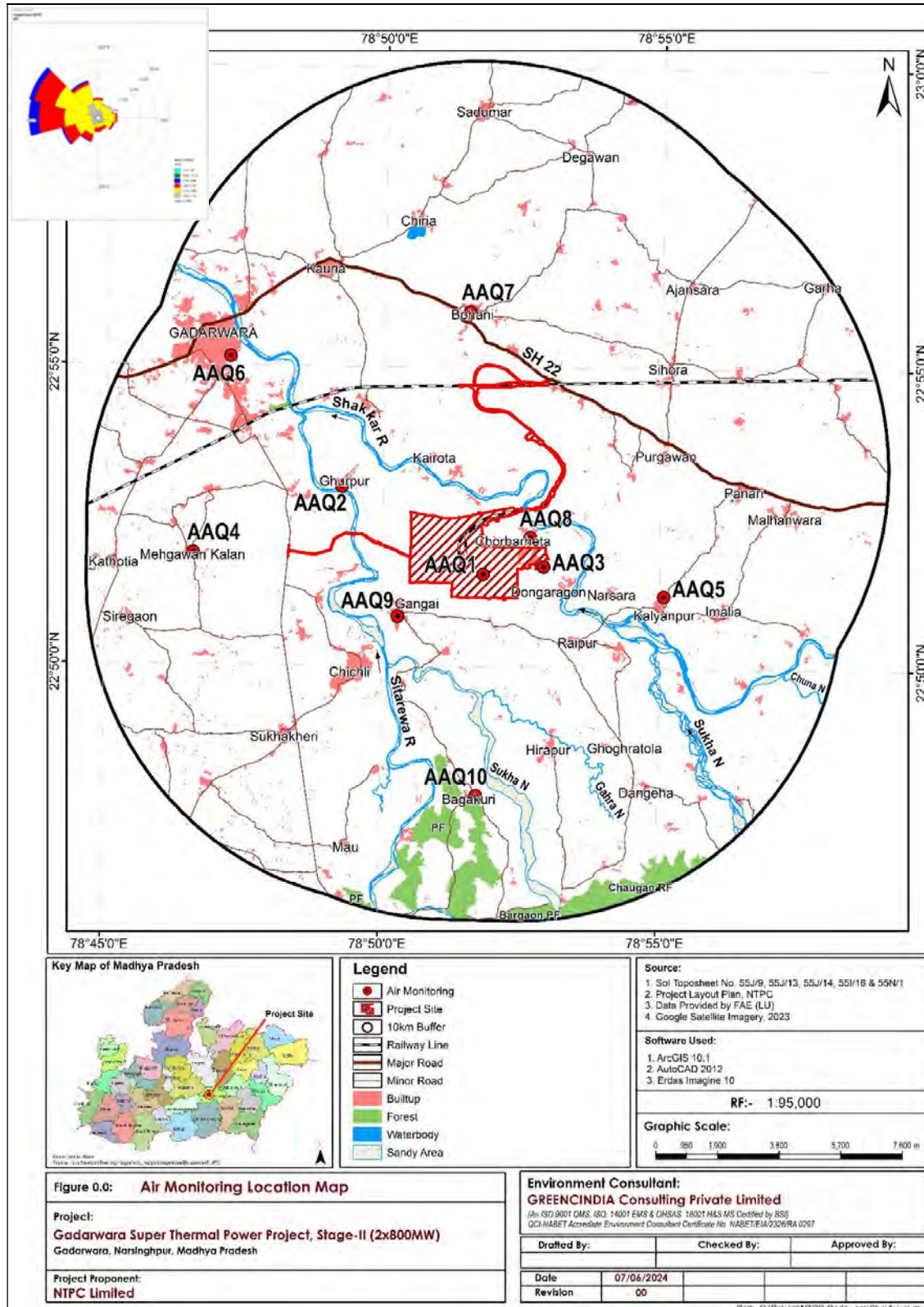


Figure 3-32: Air Sampling Locations

3.8.5 Instruments Used for Sampling and Analytical Techniques

With a view to collecting the samples, Envirotech/SSEC Make Calibrated Respirable Dust Samplers (RDS-APM 460 BL) along with Gaseous attachment and Fine Particulate Matter (FPS-APM 550) have been used. The RDS is capable of drawing air at a flow rate of 0.95 to 1.3 m³/min with very little pressure drop for RDS and FPS is designed to operate at an air flow rate of 1m³/hr. Filter papers (EPM 2000, Whatman & Whatman 46.2 mm dia.) were used for the collection of samples to analyze them for particulate matters and heavy metals. Samples for analyzing SO₂ & NO₂ were collected by drawing air at a flow-rate of 0.5 liters per minute (lpm) through an absorbing solution for the duration of 24 hrs. Sampling of Ozone (O₃) has been performed using 10 ml of absorbing solution in a standard impinger and sample for eight hour at the flow rate of 1 l/min. After sampling measure the volume of sample and transfer to a sample storage bottle without exposing the absorbing reagent to direct sunlight. Sampling and analysis methodology adopted is given in **Table 3-17**.

Table 3.17: Sampling & Analysis Methodology

Sl. No.	Parameter	Methodology	Protocol
1	Particulate Matter (PM ₁₀) (µg/m ³)	Gravimetric method	IS-5182; Part-4
2	Particulate Matter (PM _{2.5}) (µg/m ³)	Gravimetric	IS-5182; Part-24
3	Sulphur Dioxide as SO ₂ (µg/m ³)	West and Gaeke Method	IS-5182; Part-2
4	Nitrogen Dioxide as NO ₂ (µg/m ³)	Jacob & Hochheiser modified	IS-5182; Part-6
5	Carbon Monoxide (mg/m ³)	NDIR	IS-5182; Part-10
6	Ozone (µg/m ³)	Chemical Method	As per CPCB
7	Mercury	AAS method	As per CPCB
8	Ammonia (µg/m ³)	Indophenol method	--
9	Arsenic (ng/m ³)	AAS method	--
10	Benzene (µg/m ³)	GC analysis	--
11	Benzo Pyrene (BaP) (ng/m ³)	GC analysis	--
12	Nickel (ng/m ³)	AAS method	--
13	Lead (µg/m ³)	AAS method	--

3.8.6 AMBIENT AIR QUALITY RESULT

The analysis was carried out as per the method described in the applicable IS codes. Various statistical parameters like 98th percentile, average, standard deviation, maximum and minimum values have been computed from the observed raw data for all the AAQ monitoring locations. The results are shown in **Table 3-18**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.18: Results of Ambient Air Quality Data

Parameters	AAQ 1 Project Site	AAQ 2 Ghoorpur	AAQ 3 Kudari	AAQ 4 Mahguwan Khurd	AAQ 5 Kalyanpur	AAQ 6 Gadarwara	AAQ 7 Bohani	AAQ8 Dongargaon	AAQ9 Gangai	AAQ10 Badgaon PF n/v Baghakudi
PM₁₀ (NAAQ Limit 100 µg/m³)										
Min.	51.70	40.98	40.14	36.10	39.67	48.04	42.54	44.48	43.59	41.19
Max.	91.30	60.89	65.20	53.65	58.95	71.39	63.22	66.10	64.78	61.21
98percentile	89.92	60.55	63.77	53.34	58.62	70.99	62.87	65.73	64.42	60.86
PM_{2.5} (NAAQ Limit 60 µg/m³)										
Min.	18.26	16.53	15.04	14.56	16.00	19.38	17.16	17.95	17.59	16.62
Max.	30.46	27.58	25.10	24.29	26.70	32.33	28.63	29.94	29.34	27.72
98 percentile	30.07	27.23	24.78	23.99	26.36	31.92	28.27	29.56	28.97	27.37
SO₂ (NAAQ Limit 80 µg/m³)										
Min.	7.26	6.57	5.98	5.79	6.36	7.71	6.82	7.14	6.99	6.61
Max.	12.42	11.24	10.23	9.91	10.89	13.18	11.67	12.21	11.96	11.30
98 percentile	12.01	10.87	9.89	9.58	10.52	12.74	11.29	11.80	11.56	10.93
NO₂ (NAAQ Limit 80 µg/m³)										
Min.	13.43	12.16	11.06	10.71	11.77	14.25	12.62	13.20	12.94	12.22
Max.	17.62	15.95	14.52	14.05	15.44	18.70	16.56	17.32	16.97	16.03
98 percentile	17.31	15.67	14.26	13.80	15.17	18.37	16.27	17.01	16.67	15.75
CO (NAAQ Limit 2.0mg/m³)										
Min.	0.23	0.41	0.3	0.42	0.63	0.42	0.22	0.52	0.55	0.2
Max.	1.1	0.84	0.78	0.93	0.77	0.68	0.81	0.76	0.73	0.5
O₃ (NAAQ Limit 100 µg/m³)										

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Parameters	AAQ 1	AAQ 2	AAQ 3	AAQ 4	AAQ 5	AAQ 6	AAQ 7	AAQ8	AAQ9	AAQ10
	Project Site	Ghoorpur	Kudari	Mahguwan Khurd	Kalyanpur	Gadarwara	Bohani	Dongargaon	Gangai	Badgaon PF n/v Baghakudi
Min.	29.41	26.29	18.68	16.50	26.51	17.73	12.14	19.50	15.26	13.48
Max.	31.20	32.74	24.3	27.62	30.51	28.47	25.44	26.63	22.4	21.8
Ammonia (NAAQ Limit 400 µg/m³)										
Min.	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)
Max.	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)	BDL (<20.0)
Lead (NAAQ Limit 0.50 µg/m³)										
Min.	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)
Max.	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)
Nickel, (NAAQ 20ng/m³)										
Min.	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)
Max.	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)
Mercury, µg/m³										
Min.	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
Max.	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
Arsenic (NAAQ Limit 6 ng/m³)										
Min.	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
 NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 3
BASELINE ENVIRONMENT

Page
3-54

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Parameters	AAQ 1	AAQ 2	AAQ 3	AAQ 4	AAQ 5	AAQ 6	AAQ 7	AAQ8	AAQ9	AAQ10
	Project Site	Ghoorpur	Kudari	Mahguwan Khurd	Kalyanpur	Gadarwara	Bohani	Dongargaon	Gangai	Badgaon PF n/v Baghakudi
Max.	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)
Benzene, (NAAQ Limit 5 µg/m³)										
Min.	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
Max.	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
BaP, (NAAQ Limit 1 ng/m³)										
Min.	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
Max.	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
Monitoring/sampling/testing done by GCPL and EEPL, Kolkata and test reports attached as Annexure 3.4										
* For CO, O ₃ & Hg, 8 hourly standard is being considered.										

Air quality monitoring data of 104 observations in a year for relevant parameters (PM₁₀, PM_{2.5}, SO₂, NO₂ and Hg at identified air quality monitoring stations has been included as **Annexure-3.7**. The parameters are observed to be within the NAAQMS 2009 Norms.

3.8.7 Observation

The 98th percentile value of PM₁₀ varies between 53.34 $\mu\text{g}/\text{m}^3$ at AAQ4 to 89.92 $\mu\text{g}/\text{m}^3$ at AAQ1 and the 98th percentile value of PM_{2.5} varies between 23.99 $\mu\text{g}/\text{m}^3$ at AAQ4 to 31.92 $\mu\text{g}/\text{m}^3$ at AAQ6. The higher concentration of PM₁₀ at project site, may be due to local activities of the project like coal handling, ash handling, construction and erection works of FGD and vehicular movements etc.

Anthropogenic sources

include fuel combustion, burning of bagasse and domestic cooking in some area and fuel combustion for vehicles in the study area. Concentration of PM_{2.5} were observed in all sites remain within the limits.

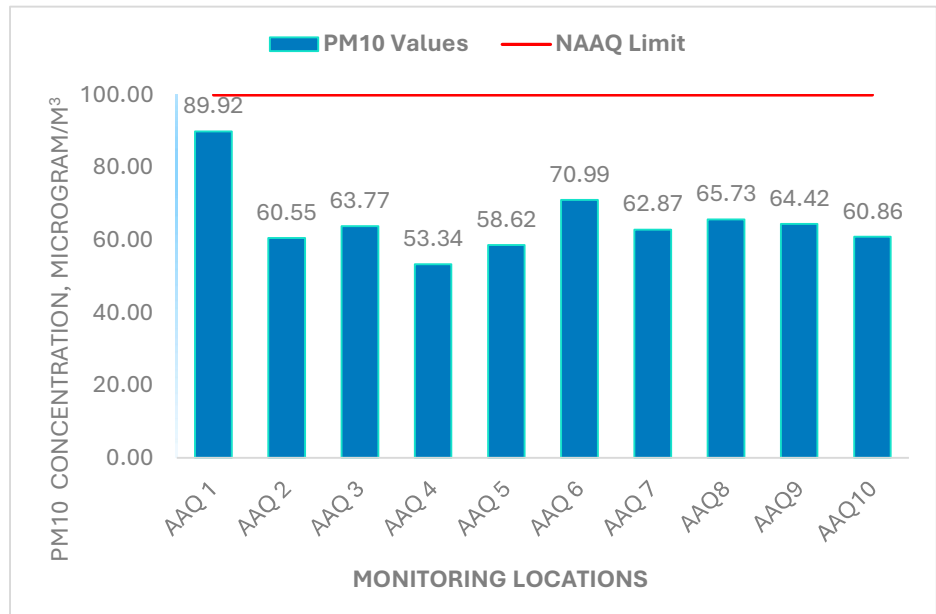


Figure 3-33: 98 percentile of PM₁₀ in $\mu\text{g}/\text{m}^3$

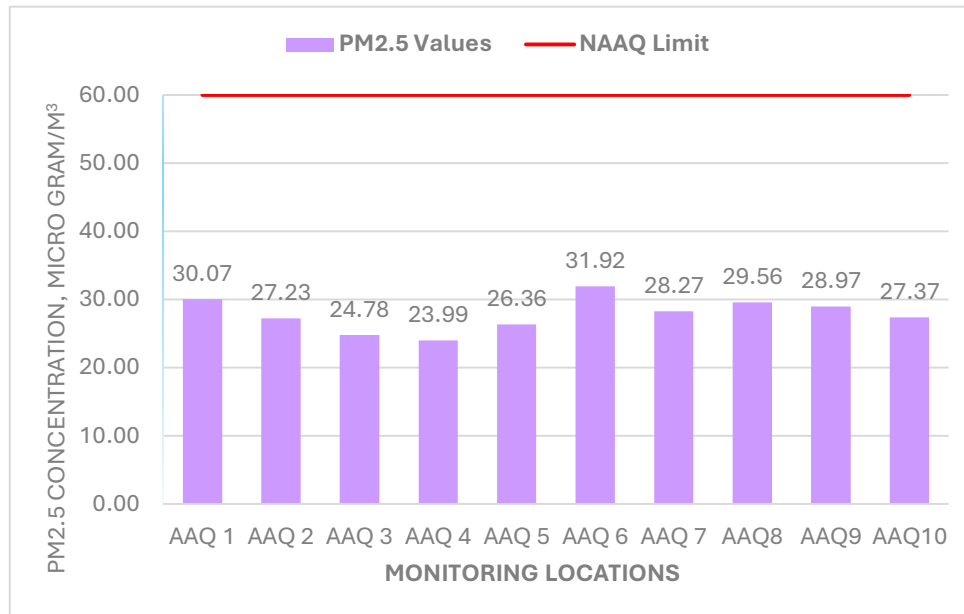


Figure 3-34: 98 percentile of PM_{2.5} in $\mu\text{g}/\text{m}^3$

The source of SO₂ in the study area is mainly from burning fuels containing sulphur or emissions from coal combustion depending on the Sulphur content in the coal. Sulphur dioxide reacts with other substances in the atmosphere to form sulphate aerosols (USEPA, 1982)⁵. Since most sulphate aerosols are part of PM_{2.5}, they may have an important role in the health impacts associated with fine particulates (WHO, 1979)⁶. However, the values of oxides of sulphur pollutants in this case were found well below the NAAQ standard. The 98th percentile value of SO₂ in the study area ranges from 9.58 µg/m³ at AAQ4 to 12.74 µg/m³ at AAQ6.

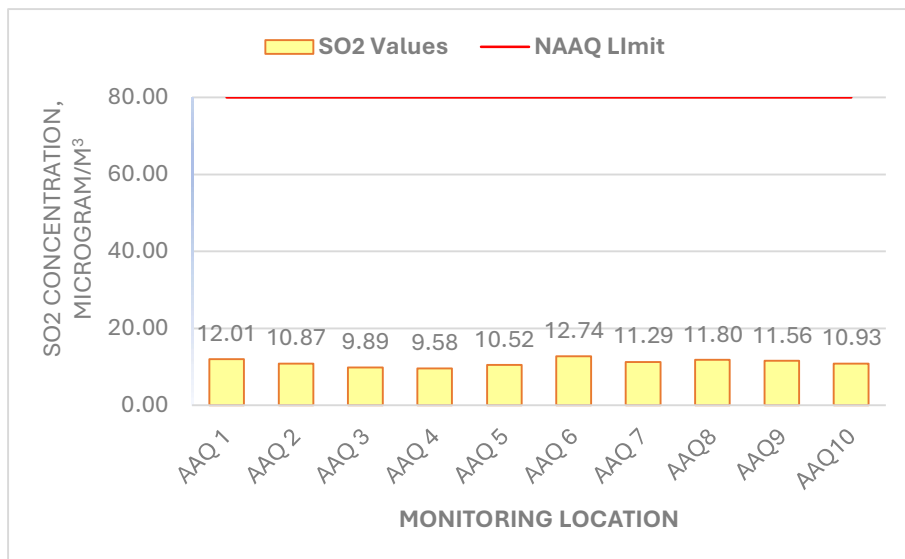


Figure 3-35: 98th percentile of Sulphur Dioxide (SO₂) in µg/m³

In the study area, the 98th percentile of NO₂ varies between 13.80 µg/m³ at AAQ4 to 18.37 µg/m³ at AAQ6. The values of Oxides of Nitrogen were found well below the NAAQ standard. The primary sources of NO₂ are motor vehicles, electric utilities and residential sources that burn fuels. NO₂ is one of the main ingredients involved in the formation of ground level ozone, which can trigger serious respiratory problems. It reacts to form nitrate particles, acid aerosols, as well as NO₂, which also cause respiratory problems (NAPAP 1991)⁷.

⁵USEPA (United States Environmental Protection Agency). 1982. *Air Quality Criteria for Particulate Matter and Sulfur Oxides*. EPA-600/8-82-029, December, Research Triangle Park, N.C.

⁶WHO (World Health Organization) 1979, "Sulfur Oxides and Suspended Particulate Matter," *Environmental Health Criteria* 8 Geneva

⁷NAPAP (National Acid Precipitation Assessment Program). Various years, 1987–91, Washington, D.C.: Government Printing Office.

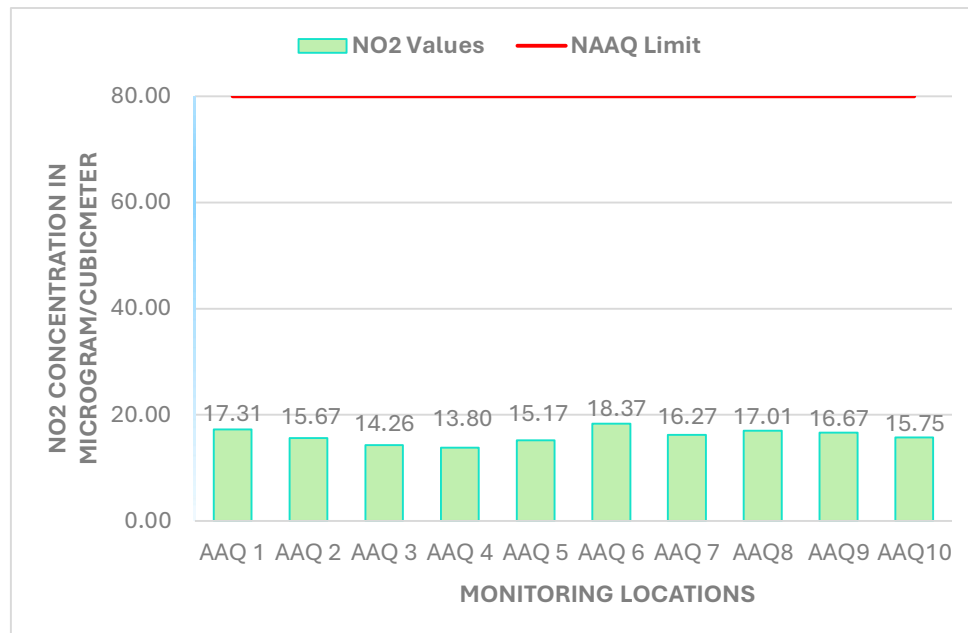


Figure 3-36: 98th percentile of Nitrogen Dioxide (NO₂) in µg/m³

The CO in the study area varies from 0.20 mg/m³ at AAQ10 to 1.10 mg/m³ at AAQ1. The values recorded were below the prescribed standard of NAAQ.

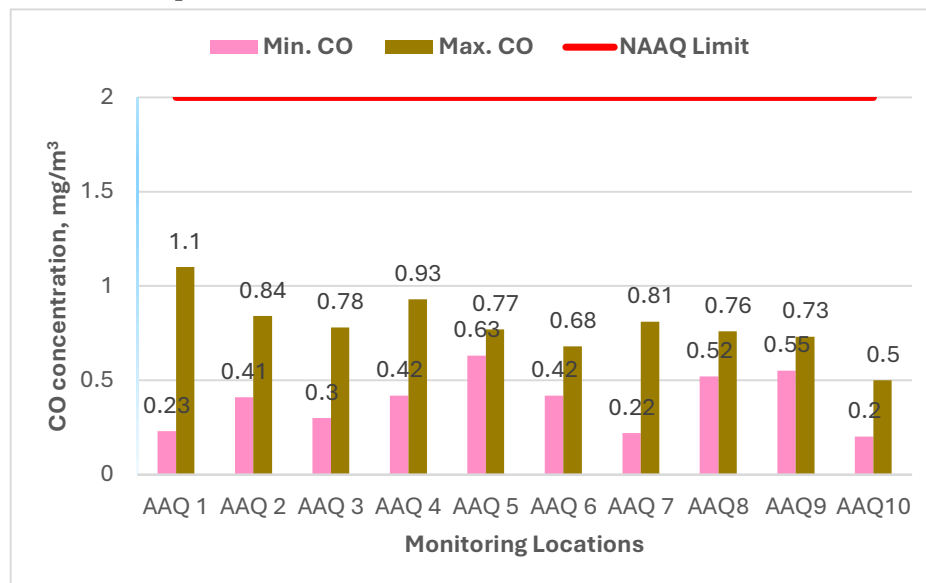


Figure 3-37: 98th percentile of Carbon Monoxide (CO) in mg/m³

Ammonia, Lead, Nickel, Benzene, BaP and Mercury was below detection limit at all locations.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 3-38: Ambient Air Quality Monitoring

3.9 NOISE ENVIRONMENT

3.9.1 FREQUENCY AND PARAMETERS OF SAMPLING

Noise levels were recorded at an interval of 5 minutes during the day and night times to compute the day equivalent, night equivalent and day-night equivalent level. The noise level was recorded continuous for 24 hours at an interval of 5 minutes. The noise level was monitored once during the study period at each monitoring location. The noise level is recorded in dB(A).

3.9.2 INSTRUMENT USED FOR SAMPLING

Sound level meter (SL 4033) was used for measuring the noise levels. This instrument measures sound pressure level (SPL), maximum sound pressure level (max) and equivalent continuous noise level (Leq).

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



The SL4033 “Type 1” Sound Level Meter is used which is designed to meet the requirements of IS 9989:1981 RA 2023. The instrument has a frequency weighting of “A” type and allows the user to select Slow or Fast mode of measurement. A built-in Data Logger/SD card can record all the important Sound Level parameters in Non-Volatile Flash memory for 24 hours making detailed field data collection very simple. Record consists of the Leq, Sound Pressure Level and Sound Exposure Level (SEL) observed during the recording interval. A built-in Real Time Clock maintains a date and time stamp in the recorded data. **Table 3-19** shows the ambient noise quality standards as per CPCB.

Table 3.19: Ambient Noise Quality Standards as per CPCB

Type of Area	Limits in dB(A) Leq*	
	Day Time	Nighttime
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

**dB (A) Leq denotes the time weighted average of the level sound in decibels on scale A which is relatable to human hearing*

Source: The Noise Pollution (Regulation and Control) Rules, 2000

Day and Night time shall mean from 6:00 a.m. to 10:00 p.m. and 10:00 p.m. to 6:00 a.m. respectively.

3.9.3 SELECTION OF MONITORING LOCATIONS

Assessment of ambient noise levels is an important parameter in preparation of impact assessment report. Noise levels are more annoying in the night time particularly in the residential area. The environmental impact of noise can have several effects varying from annoyance to hearing loss depending on loudness of noise levels. The monitoring for noise levels was carried out at 10 locations considering the population and traffic in the area. **Table 3.20** and **Figure 3-40** is showing the noise monitoring locations. **Table 3-21** shows the values recorded at these locations.

Table 3.20: Description of noise sampling locations

Name	Latitude	Longitude	Location	Distance& Directions	Category
N1	22°52'13.32"N	78°51'43.74"E	Project Site	0.00	Industrial Area
N2	22°53'2.76"N	78°49'14.76"E	Ghoorpur	2.39 km, WNW	Residential Area
N3	22°51'14.84"N	78°53'14.06"E	Kudari, Narsara	1.41 km, ESE	Residential Area
N4	22°51'52.03"N	78°46'35.74"E	Mahguwan Khurd	6.74 km, W	Residential Area
N5	22°51'12.56"N	78°55'5.11"E	Kalyanpur	4.48 km, E	Residential Area
N6	22°55'8.88"N	78°47'13.47"E	Gadarwara	7.49 km, NW	Populated Area
N7	22°55'55.45"N	78°51'32.12"E	Bohani	6.51 km, N	Residential Area
N8	22°52'10.54"N	78°52'40.15"E	Dongargaon	0.52 km, NE	Residential Area

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Name	Latitude	Longitude	Location	Distance & Directions	Category
N9	22°50'50.06"N	78°50'17.57"E	Gangai	1.81 km, SW	Residential Area
N10	22°47'51.38"N	78°51'44.41"E	Badgaon PF n/v Baghakudi	6.15 km, S	Sensitive Area



Figure 3-39: Noise Monitoring Locations

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

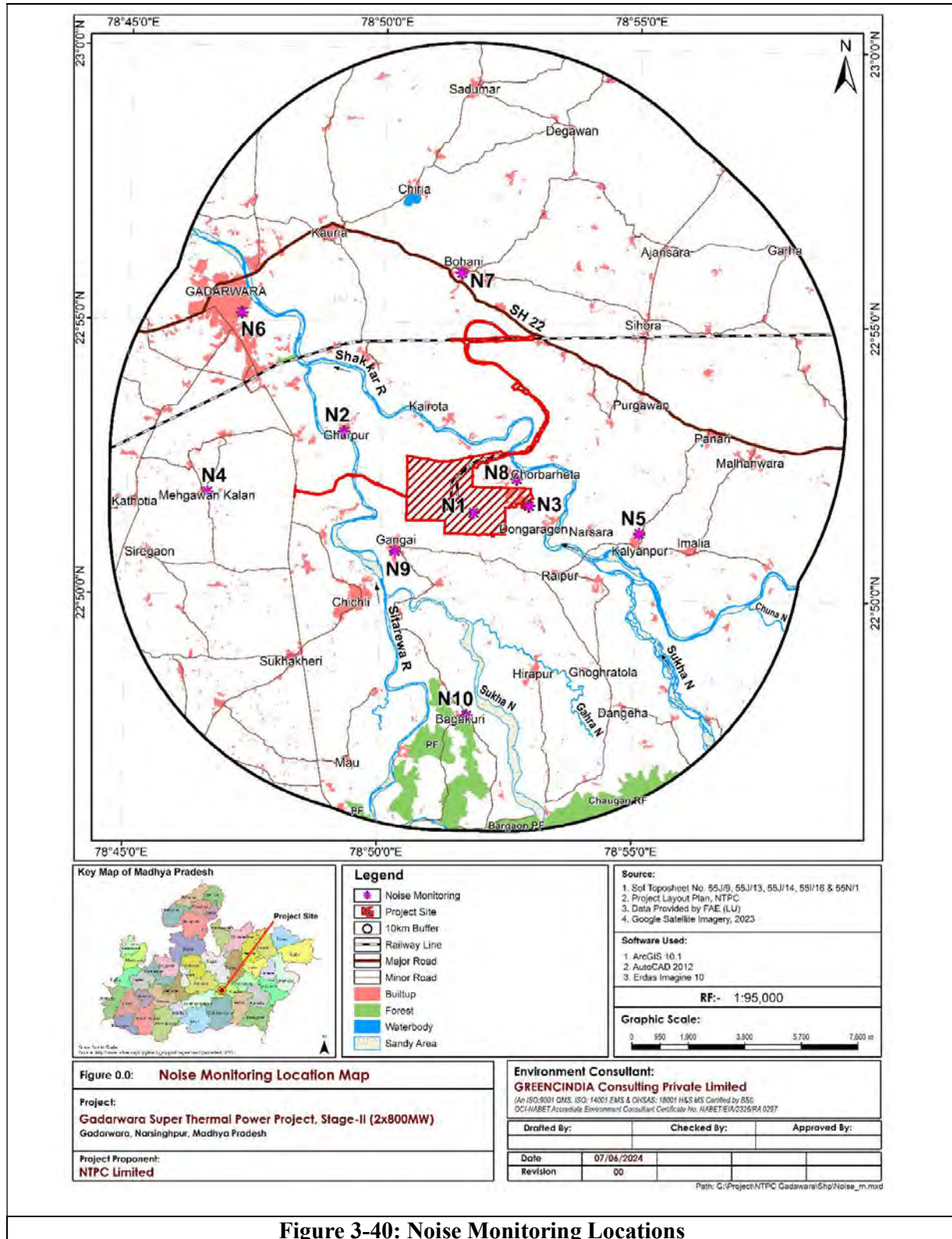


Figure 3-40: Noise Monitoring Locations

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.21: Noise parameters recorded at different locations

Name	Location/Village	Day Time Noise Level Leq-dB(A)		Night Time Noise Level Leq- dB(A)	
		Limits	Actual	Limit	Actual
N1	Project Site	75	72.1	70	61.3
N2	Ghoorpur	55	53.7	45	43.7
N3	Kudari, Narsara	55	52.6	45	42.8
N4	Mahguwan Khurd	55	53.8	45	43.4
N5	Kalyanpur	55	54.5	45	44.6
N6	Gadarwara	55	54.4	45	44.7
N7	Bohani	55	54.0	45	42.5
N8	Dongargaon	55	54.6	45	44.8
N9	Gangai	55	53.3	45	44.2
N10	Badgaon PF n/v Baghakudi	55	50.0	45	41.7
<i>Report is enclosed as Annexure 3.5</i>					

DISCUSSION & CONCLUSION

Day Time: During day time noise level recorded in project site is 72.1 dB(A), whereas, in buffer zone noise observed during day time showed minimum 50.0 dB(A) at Badgaon PF n/v Baghakudi to maximum 54.6 dB(A) at Dongargaon village. In the study area during day time at all locations noise level observed is under prescribed limit of 55 dB (A) for rural/residential areas and 75 dB (A) for industrial zones.

Night Time: In night time noise level recorded in project site is 61.3 dB(A), whereas, in buffer zone during night time noise levels showed minimum 41.7 dB(A) at Badgaon PF n/v Baghakudi to maximum 44.8 dB(A) Dongargaon village. In study area during night time at all locations noise level observed values in under prescribed limits for residential zones. As per CPCB, the prescribed limit during night time is 45 dB (A) for rural/residential areas and 70 dB (A) for industrial zones.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

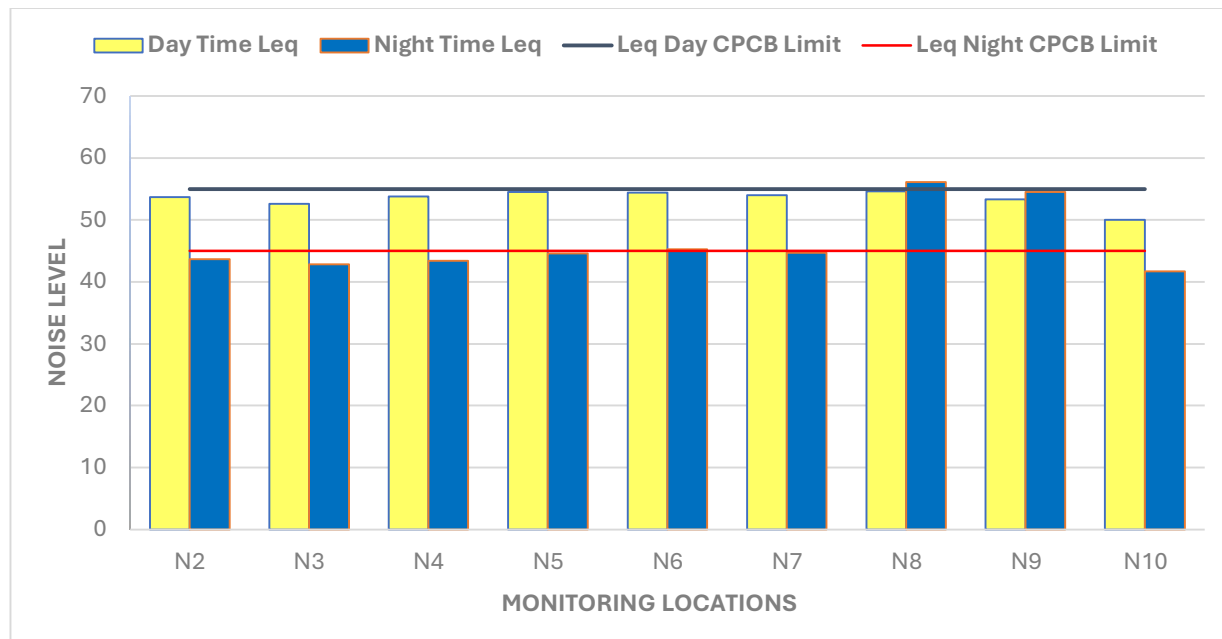


Figure 3-41: Noise level in dB(A) recorded at the monitoring stations



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.10 WATER ENVIRONMENT

3.10.1 FREQUENCY AND PARAMETERS

Water samples were collected once in a month during the study period and analyzed for following selected physico-chemical and biological parameters.

- **Physical Parameters-** Temperature, Turbidity, Colour, Electrical Conductivity, TSS & TDS
- **Chemical parameters-** pH, DO, Alkalinity, Hardness, BOD, COD, NO₃, PO₄, Cl, F, SO₄, Na, K, Ca, Mg, Silica, Oil & Grease, Phenolic compounds
- **Heavy metals-** As, Hg, Pb, Cd, Cr⁶, Total Cr, Cu, Zn, Se, Fe
- **Bacteriological-** MPN and Total coliform

3.10.2 SAMPLE COLLECTION TECHNIQUE

The samples were collected as per IS standard procedures. The parameters such as Temperature, Turbidity, Colour, Electrical Conductivity, Dissolved Oxygen & TDS were analyzed at the site at the time of collection of samples (with the help of handy sampler and onsite Laboratory) while for other parameters, samples were collected, preserved and analyzed in laboratory. Samples were collected, preserved and analyzed as per methods given in Standard Methods for the Examination of Water and Wastewater (APHA& IS standard).

3.10.3 SAMPLING LOCATIONS

Six samples each of surface and ground water have been collected to assess the water quality. The details of water quality sampling locations are given in **Table 3-22** and shown in **Figure 3-43**.

Table 3.22: Description of sampling locations for surface water and ground water

Name	Latitude	Longitude	Location	Distance& Directions	Source
GW1	22°51'58.00"N	78°51'10.00"E	Project Site		Bore well
GW2	22°50'48.54"N	78°50'18.52"E	Gangai	1.19 km, SW	Hand pump
GW3	22°52'11.25"N	78°52'42.96"E	Dongargaon	0.66 km, NE	Hand pump
GW4	22°53'28.39"N	78°50'54.06"E	Kajrota	2.10 km, NNW	Hand pump
GW5	22°48'43.00"N	78°54'24.60"E	Khala	5.64 km, SE	Hand pump
GW6	22°55'14.62"N	78°47'14.67"E	Gadarwara	7.70 km, NW	Hand pump
SW1	22°50'54.08"N	78°54'32.92"E	Shakkar River Upstream	3.63 km, SE	River
SW2	22°53'25.35"N	78°49'55.77"E	Shakkar River downstream	1.93 km, NW	River
SW3	22°50'2.76"N	78°50'7.21"E	Sitarewa River Upstream	2.50 km, SW	River

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Name	Latitude	Longitude	Location	Distance & Directions	Source
SW4	22°53'19.61"N	78°48'40.64"E	Sitarewa River downstream	3.45 km, WNW	River
SW5	22°51'47.76"N	78°46'40.22"E	Mahguan kalan pond	6.58 km, W	Pond
SW6	22°52'50.14"N	78°56'17.80"E	Panari Village Pond	6.81 km, NE	Pond



Figure 3-42: Ground water sample collection for one season

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

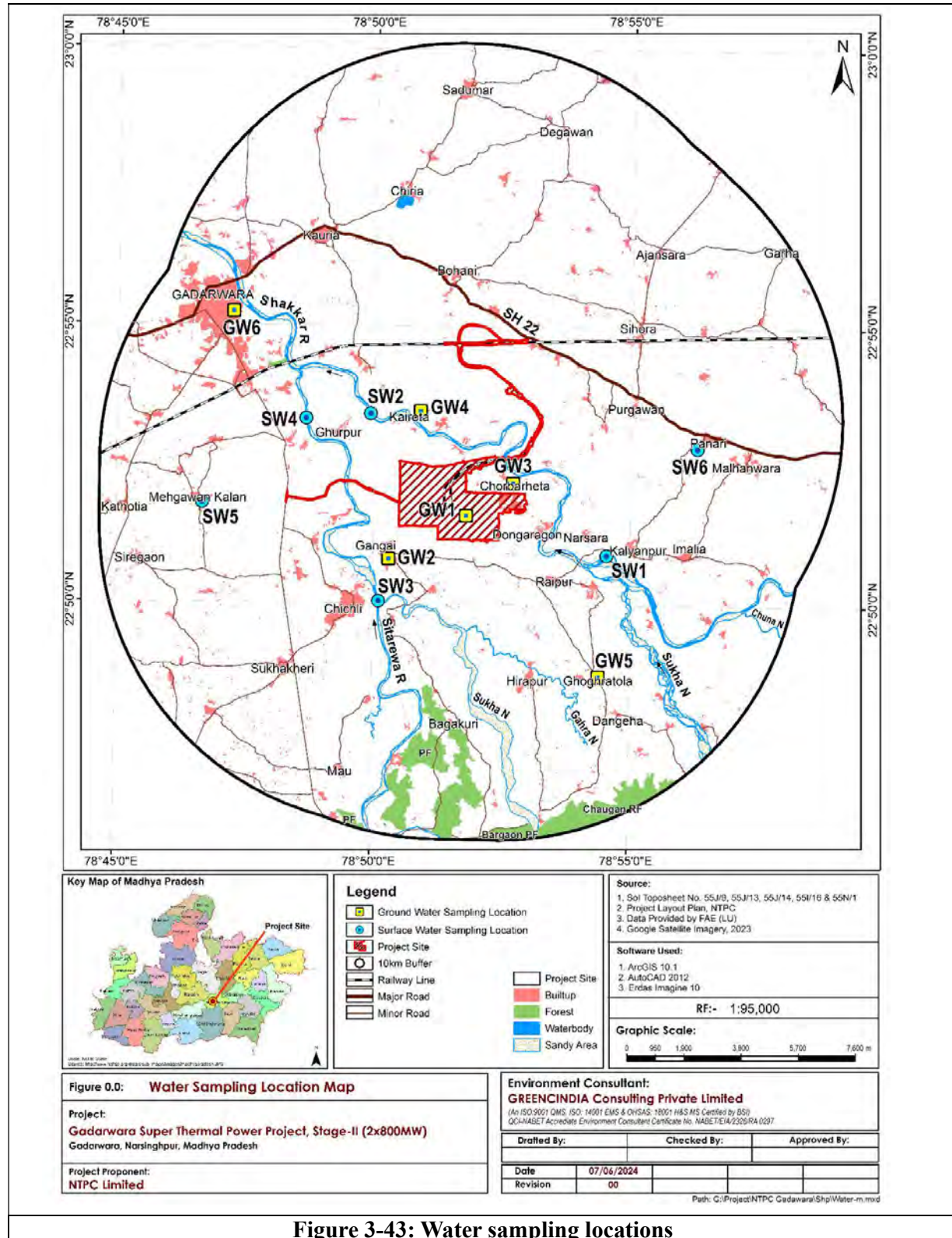


Figure 3-43: Water sampling locations

3.10.4 ANALYSIS OF WATER QUALITY

Water quality parameters of surface and ground water resources within the study area has been studied for assessing the water environment and evaluate anticipated impact of the project. Understanding the water quality is essential in preparation of environmental impact assessment and to identify critical issues with a view to suggest appropriate mitigation measures for implementation.

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters;
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Predict impact on water quality by this project and related activities

The information required has been collected through primary surveys in March, 2024 to May, 2024 and secondary sources. Ten ground water and ten surface water samples were collected and analyzed for physico-chemical, heavy metals and bacteriological parameters in order to assess the effect of industrial and agriculture activities. The location of ground water and surface water sampling is shown in **Figure 3-43**.

The samples were analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Wastewater' published by American Public Health Association (APHA) and IS 10500:2012. Samples for physico-chemical analysis were collected in polyethylene and glass bottle and preserved as per standard procedure (APHA 22nd Ed.). Samples collected for heavy metals content were acidified with 1ml HNO₃. The samples collection, storage and preservation have been mentioned in **Table 3-23**. The analytical procedures are described in **Table 3-24**.

Table 3.23: Parameter wise Water Sampling Procedure, Sample Size and Storage/Preservation

Sl. No	Parameter	Sample collection	Sample Size	Storage/ preservation
1	pH	Grab sampling, Plastic /glass container	100 ml	On site analysis
2	Conductivity	Grab sampling, Plastic /glass container	100 ml	On site parameter
3	TDS	Grab sampling, Plastic /glass container	100 ml	Refrigeration, can be stored for 7 days
4	Oil & Grease	Wide mouth glass container	500 ml	Add HCl to pH>2, refrigeration, 28 days
5	Hardness	Grab sampling, Plastic /glass container	100 ml	Add HNO ₃ to pH<2, refrigeration; 6 months
6	Chlorides	Grab sampling, Plastic/ glass container	100 ml	Not required; 28 days
7	Sulphates	Grab sampling, Plastic /glass container	100 ml	Refrigeration; 28 days
8	Na ⁺ and K ⁺	Plastic container	100 ml	Not required; 6 months

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No	Parameter	Sample collection	Sample Size	Storage/ preservation
9	Nitrates	Plastic containers	100 ml	Refrigeration; 48 hrs
10	Alkalinity	Plastic/ glass containers	100 ml	Refrigeration; 14 days
11	Heavy Metals	Plastic/ Glass rinsed with 1+1 HNO ₃	500 ml	HNO ₃ to pH>2; Grab sample; 6 months
12	Silica	Plastic/ Glass rinsed with 1+1 HNO ₃	500ml	HNO ₃ to pH>2; Grab sample; 6 months
13	COD	Plastic/ Glass	100	Cooling between 2 to 5°C and store in dark
14	BOD	Plastic/ Glass	1000	Cooling between 2 to 5°C and store in dark
15	DO	Plastic/ Glass	300	As soon as possible

Source: Standard Methods for the Examination of Water and Wastewater, Published By APHA, 22nd Edition, 2012 and 3025-Part 1.

Table 3.24: Standard National and International Analytical Procedure and Methods for Different Water Quality Parameters

Sl. No.	Parameters	Analytical Method	Reference
1	pH	pH Electrode	IS: 3025 (Part-11)
2	Turbidity	Nephelometric	IS: 3025 (Part-10)
3	Conductivity (at 25 °C)	Conductivity Electrode	APHA 22 nd edition, 2510 B:2012
4	Total Dissolve Solids	Gravimetric	IS: 3025 (Part-16)
5	Alkalinity as CaCO ₃	Titrimetric analysis	IS: 3025 (Part-23)
6	Total Hardness as CaCO ₃	Titrimetric analysis	IS: 3025 (Part-21)
7	Calcium as Ca	Titrimetric analysis	IS: 3025 (Part-40)
8	Magnesium as Mg	Calculation	APHA 22 nd edition, 3500 Mg B:2012
9	Sodium	Flame Photometric	APHA 22 nd edition, 3500 Na B:2012
10	Potassium	Flame Photometric	APHA 22 nd edition, 3500 K- B:2012
11	Chloride as Cl	Argenometric	IS: 3025 (Part-32)
12	Sulphate as SO ₄	Turbidimetric	IS: 3025 (Part-24)
13	Nitrate as NO ₃	Spectrophotometric	IS: 3025 (Part-34)
14	Phosphate	Spectrophotometric	IS: 3025 (Part-31)
15	Fluoride as F	SPANDS	APHA 22 nd edition, 4500 F- D:2012
16	Phenolic compound	Spectrophotometric	IS: 3025 (Part-43)
17	Cyanide	AAS	IS: 3025 (Part-27)
18	Dissolve Oxygen	Membrane Electrode Method	IS:3025 (Part-38), Reaffirmed 2009

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Parameters	Analytical Method	Reference
19	Oil & Grease	Gravimetric	IS:3025 (Part 39), Reaffirmed 2003
20	Arsenic	AAS	IS: 3025 (Part-37)
21	Cadmium	AAS	IS: 3025 (Part-41)
22	Total Chromium	AAS	IS: 3025 (Part-52)
23	Iron	AAS	IS:3025 (Part-53), Reaffirmed 2009
24	Copper	AAS	IS: 3025 (Part-42)
25	Lead	AAS	IS: 3025 (Part-47)
26	Manganese	AAS	IS: 3025 (Part-59)
27	Mercury	AAS	IS: 3025 (Part-48)
28	Zinc	AAS	IS: 3025 (Part-49)
29	Silica	Molibdosilicate Method	APHA 22 nd edition, 4500-SiO ₂ :2012
30	Selenium	Colorimetric Method	APHA 22 nd edition, 3500-Se:2012
31	Total Coliform	MPN Method	IS: 1622: 1981

3.10.4.1 SURFACE WATER QUALITY

Water pollution is the contamination of water bodies such as rivers, lakes and other water bodies when pollutants are directly or indirectly discharged into these water bodies without adequate treatment to remove harmful compounds. There are many factors which lead to water pollution. It is essential that firstly understand the sources which contribute to the problem. There are point sources of water pollution that may enter waterway from a single source and non-point sources of water pollution are diffused contaminants which do not originate from a single discrete source.

Table 3.25: Physico-chemical characterisation of surface water, March.2024

S.No	Parameters	SW-1 Shakkar River Upstream	SW-2 Shakkar River downstream	SW-3 Sitarewa River Upstream	SW-4 Sitarewa River downstream	SW-5 Mahgua n kalan pond	SW-6 Panari Village Pond
1	Temperature, °C	25.2	26.5	26.1	27.8	27.4	27.3
2	Colour, Hazen	4	4	5	4	5	5
3	Turbidity, NTU	2	3	3	3	3	3
4	pH	7.42	7.51	7.26	7.28	7.66	7.14
5	Conductivity, µS/cm	548	422	456	386	544	392
6	Total Dissolve Solids, mg/l	339.76	261.64	282.72	239.32	337.28	243.04
7	Alkalinity as CaCO ₃ , mg/l	144.56	124.6	125.62	164.2	210.5	184.26
8	Total Hardness as CaCO ₃ , mg/l	126.86	109.56	110.48	126.85	178.22	162.62

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S.No	Parameters	SW-1 Shakkar River Upstream	SW-2 Shakkar River downstream	SW-3 Sitarewa River Upstream	SW-4 Sitarewa River downstream	SW-5 Mahgua n kalan pond	SW-6 Panari Village Pond
9	Calcium as Ca, mg/l	41.6	40.56	29.66	42.56	52.12	54.84
10	Magnesium as Mg, mg/l	5.59	2.01	8.85	5.00	11.68	6.24
11	Sodium as Na, mg/l	30.66	28.6	25.52	45.6	32.65	42.52
12	Potassium as K, mg/l	0.74	0.66	0.82	1.12	0.58	1.12
13	Total Suspended Solids, mg/l	1.5	1	2.2	1	1.6	2.5
14	Chloride as Cl, mg/l	14.62	18.6	15.8	21.6	24.6	22.4
15	Sulphate as SO ₄ , mg/l	22.75	26.4	24.6	32.6	24.6	28.5
16	Nitrate as NO ₃ , mg/l	8.62	4.6	5.62	6.26	8.6	8.3
17	Fluoride as F, mg/l	0.24	0.33	0.26	0.34	0.32	0.26
18	Phenolic compound as C ₆ H ₅ OH	BDL	BDL	BDL	BDL	BDL	BDL
19	Phosphate, mg/l	0.03	0.02	0.035	0.04	0.032	0.028
20	Silica as Si, mg/l	5.6	8.26	6.11	5.62	6.11	7.12
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
23	Chromium as Cr ⁺⁶	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron as Fe, mg/l	0.18	0.18	0.19	0.2	0.15	0.12
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
29	Zinc as Zn, mg/l	0.75	0.25	0.62	0.51	0.48	0.65
30	Dissolved Oxygen, mg/l	5.4	5.2	5.4	5.2	5.5	5.6
31	COD, mg/l	26	24	32	20	20	20
32	BOD, 27°C 3 days, mg/l	8	7	8	6	6	6
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
35	Total Coliforms, MPN/100ml	35	30	31	38	35	29

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.26: Physico-chemical characterisation of surface water, April.2024

S.No	Parameters	SW-1 Shakkar River Upstream	SW-2 Shakkar River downstream	SW-3 Sitarewa River Upstream	SW-4 Sitarewa River downstream	SW-5 Mahguan kalan pond	SW-6 Panari Village Pond
1	Temperature, °C	25.2	26.4	26.1	26.8	27.1	27.1
2	Colour, Hazen	<5	<5	<5	<5	<5	<5
3	Turbidity, NTU	2	4	3	2	2	3
4	pH	7.31	7.41	7.38	7.44	7.52	7.28
5	Conductivity, µS/cm	534	456	438	395	524	424
6	Total Dissolve Solids, mg/l	331.08	282.72	271.56	244.9	324.88	262.88
7	Alkalinity as CaCO ₃ , mg/l	140.24	154.26	154.2	192.42	234.26	186.24
8	Total Hardness as CaCO ₃ , mg/l	110.56	124.57	116.84	126.85	178.22	152.44
9	Calcium as Ca, mg/l	44.5	45.6	31.2	43.8	50.4	56.4
10	Magnesium as Mg, mg/l	1.13	2.60	9.46	4.25	12.73	2.82
11	Sodium as Na, mg/l	24.66	30.44	28.62	51.42	34.56	37.66
12	Potassium as K, mg/l	0.66	0.61	0.75	0.94	0.55	0.89
13	Total Suspended Solids, mg/l	1.5	1	2.2	1	1.6	2.5
14	Chloride as Cl, mg/l	15.26	20.45	17.56	25.15	22.46	26.42
15	Sulphate as SO ₄ , mg/l	20.45	25.44	20.48	30.56	22.84	26.45
16	Nitrate as NO ₃ , mg/l	7.72	4.86	5.22	6.78	8.14	7.86
17	Fluoride as F, mg/l	0.22	0.28	0.26	0.31	0.3	0.25
18	Phenolic compound as C ₆ H ₅ OH	BDL	BDL	BDL	BDL	BDL	BDL
19	Phosphate, mg/l	0.03	0.044	0.035	0.04	0.058	0.051
20	Silica as Si, mg/l	5.264	7.7644	5.7434	5.2828	5.7434	6.6928
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
23	Chromium as Cr ⁺⁶	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron as Fe, mg/l	0.14	0.12	0.17	0.21	0.18	0.22
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
29	Zinc as Zn, mg/l	0.66	0.28	0.48	0.36	0.44	0.62
30	Dissolved Oxygen, mg/l	5.5	5.5	5.5	5.8	5.8	5.8
31	COD, mg/l	24	22	30	22	24	22

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S.No	Parameters	SW-1 Shakkar River Upstream	SW-2 Shakkar River downstream	SW-3 Sitarewa River Upstream	SW-4 Sitarewa River downstream	SW-5 Mahguan kalan pond	SW-6 Panari Village Pond
32	BOD, 27°C 3 days, mg/l	6	6	7	5	7	6
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
35	Total Coliforms, MPN/100ml	45	46	38	63	29	55

Table 3.27: Physico-chemical characterisation of surface water, May.2024

S. No	Parameters	SW-1 Shakkar River Upstream	SW-2 Shakkar River downstream	SW-3 Sitarewa River Upstream	SW-4 Sitarewa River downstream	SW-5 Mahguan kalan pond	SW-6 Panari Village Pond
1	Temperature, °C	27.6	26.5	27.3	25.3	26.3	24.7
2	Colour, Hazen	<5	<5	<5	<5	<5	<5
3	Turbidity, NTU	2	4	3	2	5	6
4	pH	7.27	7.35	7.11	7.13	7.50	6.99
5	Conductivity, µS/cm	537.04	413.56	446.88	378.28	533.12	384.16
6	Total Dissolve Solids, mg/l	332.96	256.40	277.06	234.53	330.53	238.17
7	Alkalinity as CaCO ₃ , mg/l	155.24	135.85	155.24	160.91	220.14	180.57
8	Total Hardness as CaCO ₃ , mg/l	124.32	107.36	108.27	124.31	174.65	159.36
9	Calcium as Ca, mg/l	40.76	39.74	29.06	41.70	51.07	53.74
10	Magnesium as Mg, mg/l	5.47	1.97	8.67	4.90	11.44	6.11
11	Sodium as Na, mg/l	31.88	29.74	26.54	42.22	33.95	38.62
12	Potassium as K, mg/l	0.76	0.68	0.85	1.16	0.60	1.16
13	Total Suspended Solids, mg/l	1.56	1.04	2.288	1.04	1.664	2.6
14	Chloride as Cl, mg/l	15.2	19.34	16.43	22.46	25.58	23.29
15	Sulphate as SO ₄ , mg/l	23.66	27.456	25.58	33.90	25.58	29.64
16	Nitrate as NO ₃ , mg/l	8.96	4.78	5.84	6.51	8.94	8.63
17	Fluoride as F, mg/l	0.24	0.34	0.27	0.35	0.33	0.27
18	Phenolic compound as C ₆ H ₅ OH	BDL	BDL	BDL	BDL	BDL	BDL
19	Phosphate, mg/l	0.03	0.04	0.04	0.04	0.06	0.05
20	Silica as Si, mg/l	5.82	8.59	6.35	5.84	6.35	7.40
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No	Parameters	SW-1 Shakkar River Upstream	SW-2 Shakkar River downstream	SW-3 Sitarewa a River Upstream	SW-4 Sitarewa River downstream	SW-5 Mahguan kalan pond	SW-6 Panari Village Pond
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
23	Chromium as Cr ⁺⁶	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron as Fe, mg/l	0.19	0.16	0.19	0.22	0.15	0.17
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
29	Zinc as Zn, mg/l	0.66	0.42	0.6	0.58	0.66	0.58
30	Dissolved Oxygen, mg/l	5.4	5.5	5.8	5.7	5.7	5.5
31	COD, mg/l	22	22	26	18	15	19
32	BOD, 27°C 3 days, mg/l	6	5	7	5	5	6
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
35	Total Coliforms, MPN/100ml	24	25	29	29	55	55

BDL Below detection limit

Report is enclosed as Annexure 3.6

Table 3.28: Water Quality Criteria as per CPCB

Designated Best Use	Class of Water	Criteria
Drinking water source without conventional treatment but after disinfection	A	- Total Coliform Organism MPN/100ml shall be 50 or less - pH between 6.5 and 8.5 - Dissolved Oxygen 6mg/l or more - Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organized)	B	- Total Coliform Organism MPN/100ml shall be 500 or less - pH between 6.5 and 8.5 - Dissolved Oxygen 5mg/l or more - Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	- Total Coliform Organism MPN/100ml shall be 5000 or less - pH between 6 to 9 - Dissolved Oxygen 4mg/l or more - Biochemical Oxygen Demand 5 days 20°C 3mg/l or less

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



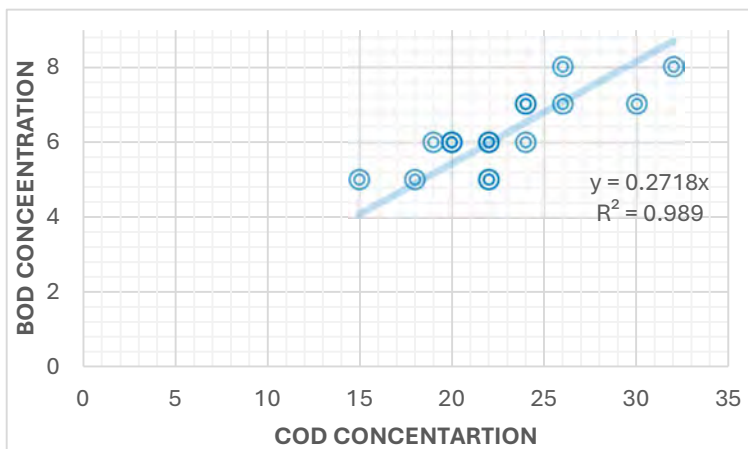
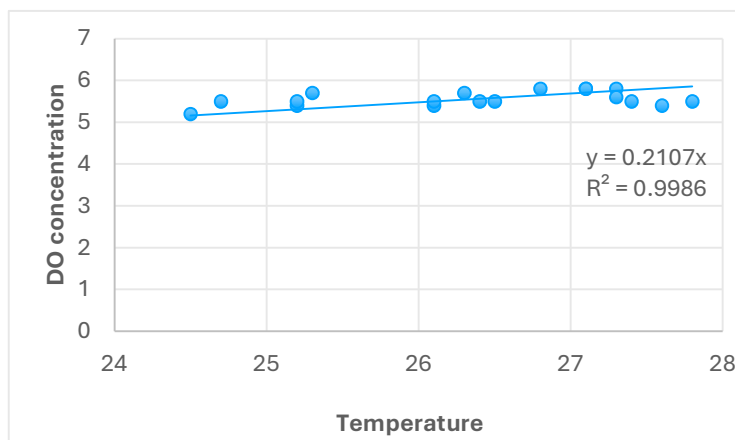
Designated Best Use	Class of Water	Criteria
Propagation of Wild life and Fisheries	D	- pH between 6.5 to 8.5 - Dissolved Oxygen 4mg/l or more - Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	- pH between 6.0 to 8.5 - Electrical Conductivity at 25°C micro mhos/cm Max.2250 - Sodium absorption Ratio Max. 26 - Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

DISCUSSION

pH is an important chemical parameter that determines the suitability of water for various purposes. pH of water is very important for the biotic communities because an average pH is adopted by most of the aquatic organism. pH of the study area varied from 7.0 (SW6) in month of May to 7.66 (SW5) in the month of March which is slightly alkaline in nature. TDS was observed in the range of 234.53 mg/l at SW4 in the month of May to max. 339.76 mg/l at SW1 in the month of March which is under desirable limit (500 mg/l) as per IS10500:2012. Analysis of total suspended solids was observed 1.0 mg/l to 2.6 mg/l which is very low. Conductivity of water samples are much below the limit as per **Table 3.28** (non-saline in nature) i.e varied between 378 μ S/cm at SW4 in May to 548 μ S/cm at SW1 in March. Nitrate and fluoride were under desirable limit.

Dissolved oxygen is one of the key factors of natural it is influenced by the physico-chemical parameter and biological activity in the water body

such as rivers and lakes. DO is a general indicator shows the health and ability of the water body. It is source of Oxygen for respiration of aquatic organisms. A minimum concentration of 4 mg/l (**Table 3.28**)



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



was considered necessary to maintain the fauna of the waterbody. Dissolved oxygen was recorded sufficient in the study area i.e minimum 5.20 mg/l (SW2) in March month to max. 5.80 mg/l (SW3, SW4, SW5 and SW6) in May for SW3 and rest in April month. DO is directly or indirectly dependent on water temperature, a partial pressure of air etc.

BOD in surface water found marginally above which is varied between 5.0 mg/l in SW2, SW4 and SW5 to 8.0 mg/l in SW1 & SW3 during March month. Marginally above BOD in surface water is due to decaying plants, animal waste, and other organic compounds added to water. Whereas COD also found high in surface water sample and it was observed min. 18 mg/l at SW4 during May month to max. recorded 32 mg/l in SW3 during March month. Reason behind presence of COD may be due to accumulation of solid waste, soluble organic compounds, residual food waste, emulsified oils and the dying bacterial cells.

Comparing the values of pH, DO, BOD and total coliform with 'Use based classification of surface waters' published by Central Pollution Control Board given in **Table 3.28**, surface water samples results are meeting the water quality criteria applicable to D and E criteria.

Hard water makes it difficult for domestic water users. Hardness is defined as the concentration of calcium and magnesium in water expressed as the equivalent of calcium carbonate (CaCO_3). The minimum total hardness of surface water samples in study area was found to be 108.27 mg/l in sample at SW3 in March month and the maximum was observed as 178.22 mg/l in the sample at SW5 during month of April. All samples are well within desirable limit i.e 200 mg/l. The range of Ca^{2+} varied between 29.07-56.40 mg/l and Mg^{2+} ranges 1.97-10.49 mg/l respectively are within the desirable limits.

Alkalinity: The alkalinity of water is caused mainly due to OH^- , CO_3^{2-} , HCO_3^- ions. Alkalinity is an estimate of the ability of water to resist change in pH upon addition of acid. The alkalinity of water bodies samples was found to range between 132.4 mg/l to 234.26 mg/l in the study area.

Chloride: The minimum chloride concentration (14.62 mg/l) was found at SW1 during March month and the maximum (26.42 mg/l) was recorded at SW6 during March and April.

Fluoride: The level of fluoride ranged between 0.22 mg/l at SW1 in April to 0.35 mg/l at SW4 in April and were found to be within the desirable limit of surface water.

Nitrate: The nitrate in surface water ranged between 4.8 mg/l at SW4 in March to 12.31 mg/l at SW5 in May and were found to be within the desirable limit of surface water.

INFERENCES

BOD and COD of the samples have been observed to be above limit as per class C of CPCB water quality criteria. The higher values of BOD is due to decaying plants, human or animal waste and other organic compounds added to water and the COD values recorded due to accumulation of solid waste, soluble organic compounds, residual food waste, emulsified oils and the dying bacterial cells. Since, the existing units and proposed units are equipped with Zero Liquid Discharge, there shall be no negative impact on water quality due to plant operations.



Figure 3-44: Surface water sample collection for Pre-monsoon season

3.10.4.2 GROUND WATER QUALITY

Selection of groundwater sampling location: Several types of wells can be available for groundwater monitoring:

- Monitoring wells (wells with single or multiple piezometers);
- Water supply wells (tube wells or dug wells used for domestic, municipal, agricultural or industrial water supply)

Reconnaissance survey was undertaken, and monitoring locations were finalized based on:

- Drainage pattern and surface water bodies;
- Location of residential areas representing different activities/likely impact areas; and
- Likely areas, which can represent baseline conditions

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.29: Physico-chemical characterisation of ground water samples, March.2024

S. No	Parameters	GW-1 Project Site	GW-2 Gangai	GW-3 Dongargaon	GW-4 Kajrota	GW-5 Khala	GW-6 Gadarwar a	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
1	Temperature, °C	23.5	24.1	23.8	23.4	23.6	24.1	--	--
2	Colour, Hazen	<5	<5	<5	<5	<5	<5	5	15
3	Turbidity, NTU	<1	<1	<1	<1	<1	<1	1	5
4	pH	7.64	7.52	7.71	7.84	7.26	7.34	6.5-8.5	No Relaxation
5	Conductivity, µS/cm	507	595	572	710	610.6	653.2	--	--
6	Total Dissolve Solids, mg/l	385.32	398.65	383.24	475.71	378.57	404.98	500	2000
7	Alkalinity as CaCO ₃ , mg/l	284.54	280.5	243.67	318.78	244.6	268.2	200	600
8	Total Hardness as CaCO ₃ , mg/l	189.8	230.9	188.6	230.6	210.5	236.8	200	600
9	Calcium as Ca, mg/l	45.6	54.86	40.48	62.8	70.6	68.5	75	200
10	Magnesium as Mg, mg/l	18.5	22.8	21.3	17.9	8.31	15.97	30	100
11	Sodium as Na, mg/l	50.26	38.66	40.25	50.44	26.56	42.26	--	--
12	Potassium as K, mg/l	1.26	0.95	0.54	0.66	0.72	0.74	--	--
13	Total Suspended Solids, mg/l	2	1.6	1.8	1.6	1.1	1	--	--
14	Chloride as Cl, mg/l	10.4	14.6	17.5	14.8	15.9	16.2	250	1000
15	Sulphate as SO ₄ , mg/l	32.24	24.8	32.6	30.4	31.6	36.8	200	400
16	Nitrate as NO ₃ , mg/l	7.4	8.1	9.5	10.6	15.2	9.5	45	No Relaxation
17	Fluoride as F, mg/l	0.22	0.28	0.3	0.34	0.26	0.28	1.0	1.5
18	Phenolic compound as C ₆ H ₅ OH	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.002
19	Phosphate, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
20	Silica as Si, mg/l	5.26	6.56	7.26	8.94	14.62	10.25	--	--
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.05
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.003	No Relaxation
23	Chromium as Cr ⁺⁶	BDL	BDL	BDL	BDL	BDL	BDL	--	--

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 3
BASELINE ENVIRONMENT**

**Page
3-79**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No	Parameters	GW-1 Project Site	GW-2 Gangai	GW-3 Dongargaon	GW-4 Kajrota	GW-5 Khala	GW-6 Gadarwar a	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
24	Iron as Fe, mg/l	0.26	0.24	0.23	0.22	0.19	0.2	0.3	No Relaxation
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	1.5
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.001	No Relaxation
29	Zinc as Zn, mg/l	0.48	0.52	0.66	0.85	0.61	0.84	5	15
30	Dissolved Oxygen, mg/l	8.1	7.8	7.9	7.8	7.9	8.2	--	--
31	COD, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
32	BOD, 27°C 3 days, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.5	No Relaxation
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	No Relaxation
35	Total Coliforms, MPN/100ml	Absent	Absent	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml sample	

BDL Below detection limit

Table 3.30: Physico-chemical characterisation of ground water samples, April 2024

S. No	Parameters	GW-1 Project Site	GW-2 Gangai	GW-3 Dongargaon	GW-4 Kajrota	GW-5 Khala	GW-6 Gadarw ara	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
1	Temperature, °C	28.4	28.4	28.5	27.9	28.3	28.3	--	--
2	Colour, Hazen	<5	<5	<5	<5	<5	<5	5	15
3	Turbidity, NTU	1	<1	<1	<1	1	3	1	5
4	pH	7.54	7.44	7.62	7.71	7.18	7.22	6.5-8.5	No Relaxation
5	Conductivity, µS/cm	485	568	528	685	589.1	630.2	--	--
6	Total Dissolve Solids, mg/l	385.32	398.65	383.24	475.7	365.24	390.72	500	2000

**ENVIRONMENT CONSULTANT
GRENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 3
BASELINE ENVIRONMENT**

**Page
3-80**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No	Parameters	GW-1 Project Site	GW-2 Gangai	GW-3 Dongargaon	GW-4 Kajrota	GW-5 Khala	GW-6 Gadarw ara	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
7	Alkalinity as CaCO ₃ , mg/l	277.55	248.45	274.15	351.25	224.08	251.25	200	600
8	Total Hardness as CaCO ₃ , mg/l	210.7	214.8	234.2	276.2	187.64	214.56	200	600
9	Calcium as Ca, mg/l	48.1	55.4	57.2	70.44	64.24	65.74	75	200
10	Magnesium as Mg, mg/l	22.0	18.6	22.2	24.4	6.61	12.24	30	100
11	Sodium as Na, mg/l	51.26	34.52	38.77	44.62	22.51	39.62	--	--
12	Potassium as K, mg/l	0.92	0.88	0.51	0.61	0.75	0.68	--	--
13	Total Suspended Solids, mg/l	2	1.6	1.5	1.6	1.1	1	--	--
14	Chloride as Cl, mg/l	16.22	18.62	19.54	16.22	16.85	17.25	250	1000
15	Sulphate as SO ₄ , mg/l	25.62	21.46	31.66	29.45	30.6	30.8	200	400
16	Nitrate as NO ₃ , mg/l	10.24	9.25	9.14	11.24	16.21	10.22	45	No Relaxation
17	Fluoride as F, mg/l	0.28	0.26	0.33	0.38	0.24	0.29	1.0	1.5
18	Phenolic compound as C ₆ H ₅ OH, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.002
19	Phosphate, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
20	Silica as Si, mg/l	4.94	6.17	6.82	8.40	13.74	9.64	--	--
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.05
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.003	No Relaxation
23	Chromium as Cr ⁺⁶	BDL	BDL	BDL	BDL	BDL	BDL	--	--
24	Iron as Fe, mg/l	0.24	0.18	0.16	0.14	0.158	0.17	0.3	No Relaxation
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	1.5
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.001	No Relaxation
29	Zinc as Zn, mg/l	0.44	0.48	0.64	0.82	0.45	0.77	5	15
30	Dissolved Oxygen, mg/l	7.8	7.5	7.9	8.1	7.8	8	--	--

ENVIRONMENT CONSULTANT
GRENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 3
BASELINE ENVIRONMENT

Page
3-81

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No	Parameters	GW-1 Project Site	GW-2 Gangai	GW-3 Dongargaon	GW-4 Kajrota	GW-5 Khala	GW-6 Gadarw ara	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
31	COD, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
32	BOD, 27°C 3 days, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.5	No Relaxation
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	No Relaxation
35	Total Coliforms, MPN/100ml	Absent	Absent	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml sample	

BDL Below detection limit

Table 3.31: Physico-chemical characterisation of ground water samples, May.2024

S. No	Parameters	GW-1 Project Site	GW-2 Gangai	GW-3 Dongargaon	GW-4 Kajrota	GW-5 Khala	GW-6 Gadarw ara	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
1	Temperature, °C	30.5	30.6	29.8	29.6	29.8	30.2	--	--
2	Colour, Hazen	<5	<5	<5	<5	<5	<5	5	15
3	Turbidity, NTU	<1	<1	<1	<1	<1	<1	1	5
4	pH	7.5	7.4	7.6	7.7	7.1	7.2	6.5-8.5	No Relaxation
5	Conductivity, µS/cm	496.86	583.10	560.56	695.80	598.39	640.14	--	--
6	Total Dissolve Solids, mg/l	377.61	390.68	375.58	466.19	371.00	396.88	500	2000
7	Alkalinity as CaCO ₃ , mg/l	258.56	280.55	238.80	312.40	239.71	244.24	200	600
8	Total Hardness as CaCO ₃ , mg/l	186.0	226.3	184.9	226.0	206.29	232.06	200	600
9	Calcium as Ca, mg/l	44.68	53.76	39.67	61.54	69.18	67.13	75	200
10	Magnesium as Mg, mg/l	18.1	22.4	20.9	17.6	8.15	15.66	30	100
11	Sodium as Na, mg/l	54.62	44.25	45.25	55.24	27.62	43.95	--	--
12	Potassium as K, mg/l	1.31	0.99	0.56	0.69	0.75	0.77	--	--
13	Total Suspended Solids, mg/l	2.08	1.3	1.4	1	1.1	1.2	--	--
14	Chloride as Cl, mg/l	24.15	15.18	18.20	15.39	16.54	16.85	250	1000

**ENVIRONMENT CONSULTANT
GRENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 3
BASELINE ENVIRONMENT**

**Page
3-82**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No	Parameters	GW-1 Project Site	GW-2 Gangai	GW-3 Dongargaon	GW-4 Kajrota	GW-5 Khala	GW-6 Gadarw ara	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
15	Sulphate as SO ₄ , mg/l	31.56	25.79	33.90	31.62	32.86	28.66	200	400
16	Nitrate as NO ₃ , mg/l	14.22	8.42	9.88	11.02	15.81	9.88	45	No Relaxation
17	Fluoride as F, mg/l	0.23	0.29	0.31	0.35	0.27	0.29	1.0	1.5
18	Phenolic compound as C ₆ H ₅ OH, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.002
19	Phosphate, mg/l	0.06	0.07	0.04	0.05	0.06	0.06	--	--
20	Silica as Si, mg/l	5.47	6.82	7.55	9.30	15.20	10.66	--	--
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.05
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.003	No Relaxation
23	Chromium as Cr ⁺⁶	BDL	BDL	BDL	BDL	BDL	BDL	--	--
24	Iron as Fe, mg/l	0.27	0.25	0.24	0.23	0.20	0.21	0.3	No Relaxation
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	1.5
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.001	No Relaxation
29	Zinc as Zn, mg/l	0.54	0.56	0.74	0.88	0.68	0.74	5	15
30	Dissolved Oxygen, mg/l	8.2	7.6	8.2	8.6	8.4	8.1	--	--
31	COD, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
32	BOD, 27°C 3 days, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.5	No Relaxation
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	No Relaxation
35	Total Coliforms, MPN/100ml	Absent	Absent	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml sample	

BDL Below detection limit

Report is enclosed as Annexure 3.6

ENVIRONMENT CONSULTANT
GRENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 3
BASELINE ENVIRONMENT

Page
3-83

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Discussion:

pH: The data revealed that the pH value of ground water samples varied from 7.1 to 7.84. The water samples are slightly alkaline. The reasons for such conditions may be due to different types of buffers that may be present in the ground water and presence of weak basic salt in the soil. But as per IS 10500:2012 pH is within acceptable limit.

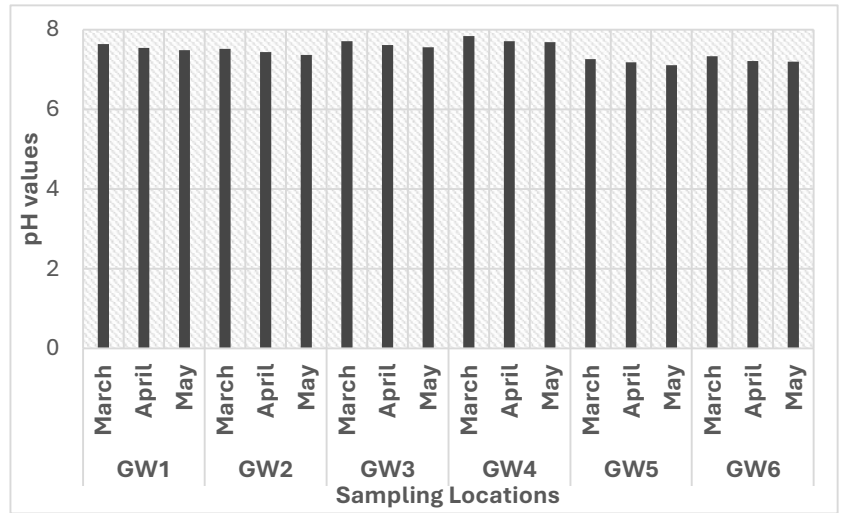


Figure 3-45: pH of the GW sample of study area

Electrical Conductivity (EC):

Electrical conductivity of ground water ranged between 485 $\mu\text{S}/\text{cm}$ during April to 710 $\mu\text{S}/\text{cm}$ during March. The maximum value of EC was observed in at GW4 and the minimum value found in the sample at GW1. All samples showed non saline ground water.

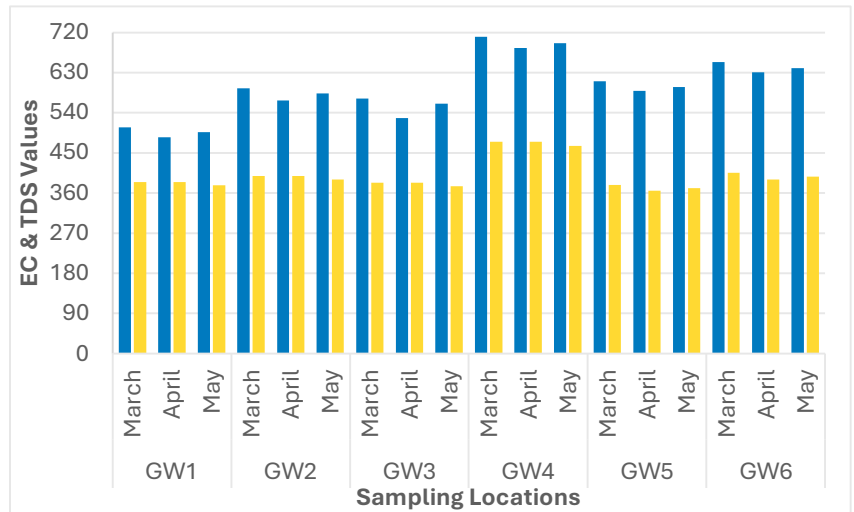


Figure 3-46: EC & TDS of the GW sample of study area

Total Dissolved Solid (TDS):

The total dissolved solids are composed of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium, manganese, organic matter, salt and other particles (Mahananda *et al*, 2010). The study of ground water sample shows a positive correlation between TDS and EC (**Figure-3.47**). All samples are within the permissible limits of the IS10500:2012.

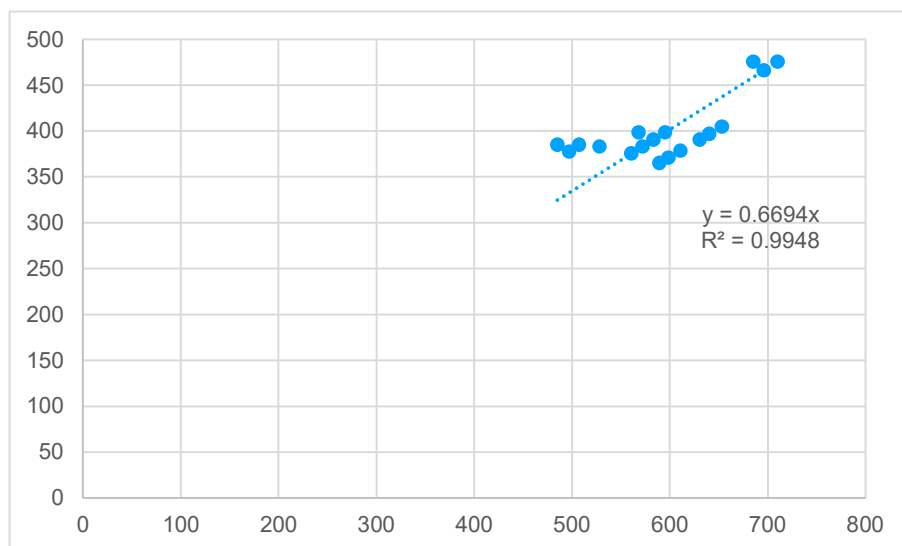


Figure 3-47: Correlation between EC & TDS

Total

Hardness (TH), Calcium (Ca²⁺) and Magnesium (Mg²⁺): Hard water makes it difficult for domestic water users. Hardness is defined as the concentration of calcium and magnesium in water expressed as the equivalent of calcium carbonate (CaCO₃). The minimum total hardness of ground water was found to be 184.9 mg/l in sample GW3 in May month and the maximum 276.2 mg/l in sample at GW4 in April month. 100% of the samples were within the permissible limit recommended by BIS (600 mg/l). The range of Ca²⁺ ranges 39.67-70.6 mg/l and Mg²⁺ between 8.15 mg/l (GW5) during May to 24.4 mg/l (GW2) during April respectively (**Figure- 3.48**) are within the acceptable limits.

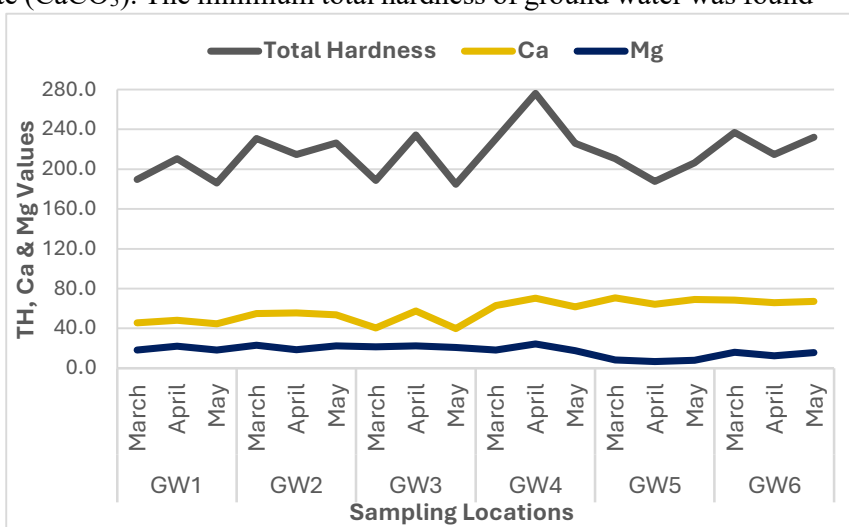


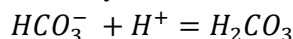
Figure 3-48: TH, Ca²⁺ & Mg²⁺ of the GW sample

Calcium or Magnesium salts or both causes almost all hardness of water (Nirmala *et. al.*, 2012). High value of hardness during summer can be attributed to decrease in water volume and increase of rate of evaporation of water (Sahoo *et al.*, 2016).

Alkalinity: The alkalinity of water is the capacity of that water to accept protons, it is the quantitative capacity of an aqueous medium to react with hydrogen ions to pH 8.3(phenolphthalein) and then to pH 3.7 (Methyl Orange) the equation is :



From pH 8.3 To 3.7, the following reaction may occur



The alkalinity of hand pump water was found minimum 224.08 mg/l at GW5 in April to maximum 351.25 mg/l at GW4 in April.

In the present study, all the samples analyzed are within the permissible limit prescribed range as per drinking water quality standard (IS: 10500). The correlation between pH-Alkalinity shows R² value 0.4764 (**Figure-3.49**).

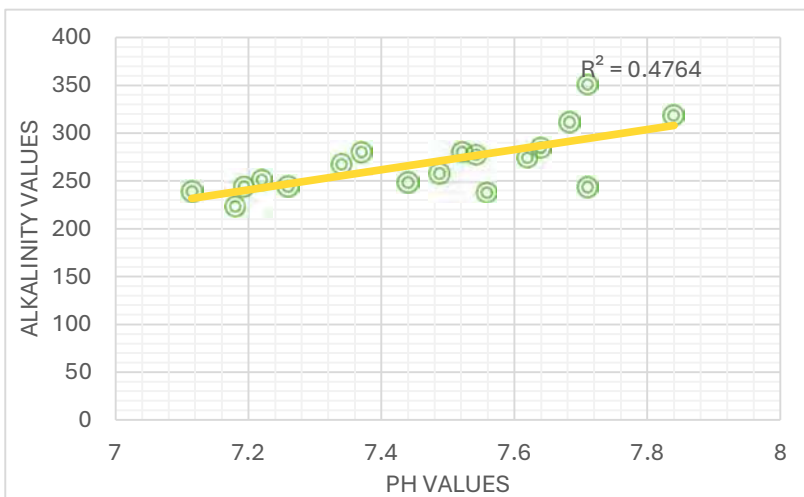


Figure 3-49: Correlation between pH & Alkalinity

Chloride: The minimum concentration of Cl 10.4 mg/l was recorded at GW1 in March to maximum 24.15 mg/l was found at GW1 in May. The samples were compared with the BIS standard and all the samples were within the acceptable limit of 250 mg/l.

Fluoride: Fluoride in groundwater has drawn worldwide attention due to its considerable impact on human physiology. Though fluoride is considered as an essential element at very lower concentration for human beings, higher concentration leads to health defects. The minimum level of fluoride (0.22 mg/l) was found in GW1 in March and the maximum value (0.38 mg/l) was found at GW4 in April. All

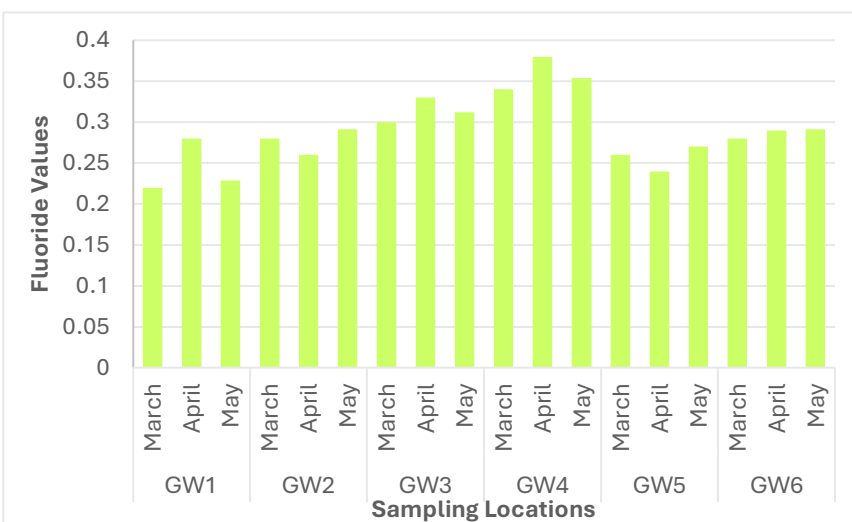


Figure 3-50: Fluoride concentration of the GW samples

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



samples were within acceptable limits of 1.0 mg/l.

Nitrate: The concentration of nitrate in ground water samples ranged from 7.40 mg/l at GW1 during March to 16.21 mg/l at GW5 in April. All the samples were compared with the BIS standard and found within the acceptable limit of 45 mg/l.

Heavy Metals: Some of the metals are essential to sustain life - calcium, magnesium, potassium and sodium must be present for normal body functions. However, excess exposure to heavy metals can result in toxicity.

Zinc concentration in the ground water samples were within the acceptable limit of 5 mg/l prescribed by BIS. Other heavy metals like arsenic, cadmium, chromium, copper, lead and selenium were recorded below detection limit.

Dissolved oxygen in groundwater varied between 7.5 mg/l in GW2 during April to 8.6 mg/l in GW4 during May. Nevertheless, measurement of DO is critical to the scientific understanding of the potential for chemical and biochemical processes in groundwater. Organic matter or oxidisable minerals present in different zone in soil profile rapidly deplete the dissolved oxygen. Besides, in deeper aquifers the dissolved organic matter concentration is very less except the shallow aquifers. Therefore, in aquifers where organic materials are less plentiful, groundwater contains not measurable concentrations of DO for deeper aquifers.

Groundwater is an important source of drinking water throughout the world (Chilton and Seiler, 2006) and it is often consumed with little or no treatment (Pedley *et al.*, 2006). Total coliform presence in groundwater sources can be used to indicate that the groundwater source may be vulnerable to contamination. But study indicated absent of total coliforms in all groundwater samples in study area.



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Water quality at Hotspot within 2 Km study Area:

Twelve samples were collected within 2km radius of the site, where hand pumps have been provided. Details of location in given in **Table 3.32, Figure no. 3.51**

Table 3.32: Description of ground water sampling locations at Hotspot areas

Name	Latitude	Longitude	Location	Distance& Directions	Source
GW1	22°52'44.19"N	78°51'42.66"E	Mehra Kheda (School)	0.35 km, N	Hand pump
GW2	22°53'28.20"N	78°50'53.88"E	Kajrota (School)	1.86 km NNW	Hand pump
GW3	22°50'46.78"N	78°50'28.26"E	Gangai (High secondary School)	0.90 km SW	Hand pump
GW4	22°50'18.47"N	78°51'10.95"E	Chhena kachhar (School)	1.66 km S	Hand pump
GW5	22°51'57.41"N	78°52'45.92"E	Dongargaon (School)	0.66 km NE	Hand pump
GW6	22°52'19.08"N	78°52'30.48"E	Chorbarheta (School)	0.41 km NE	Hand pump
GW7	22°53'16.51"N	78°51'19.88"E	Ghatpipariy (School)	1.48 Km N	Hand pump
GW8	22°51'36.07"N	78°49'29.97"E	Khairi (School)	1.78 km WSW	Hand pump
GW9	22°55'14.90"N	78°52'19.92"E	Branjh (School)	1.95 km N	Hand pump
GW10	22°54'39.30"N	78°53'2.11"E	Manakwara (School)	1.85 km NNE	Hand pump
GW11	22°50'59.46"N	78°52'16.41"E	Kudari (School)	0.34 km SE	Hand pump
GW12	22°52'33.80"N	78°53'20.53"E	Tekapar (School)	1.84 km NE	Hand pump

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

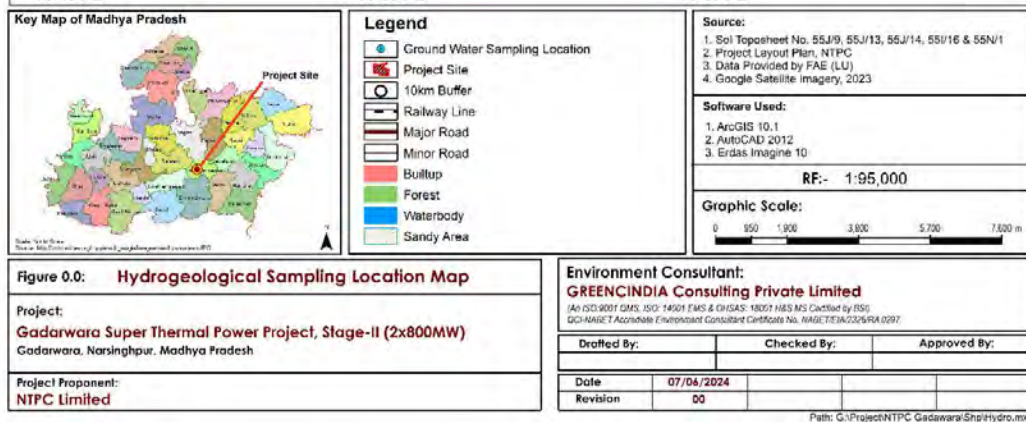
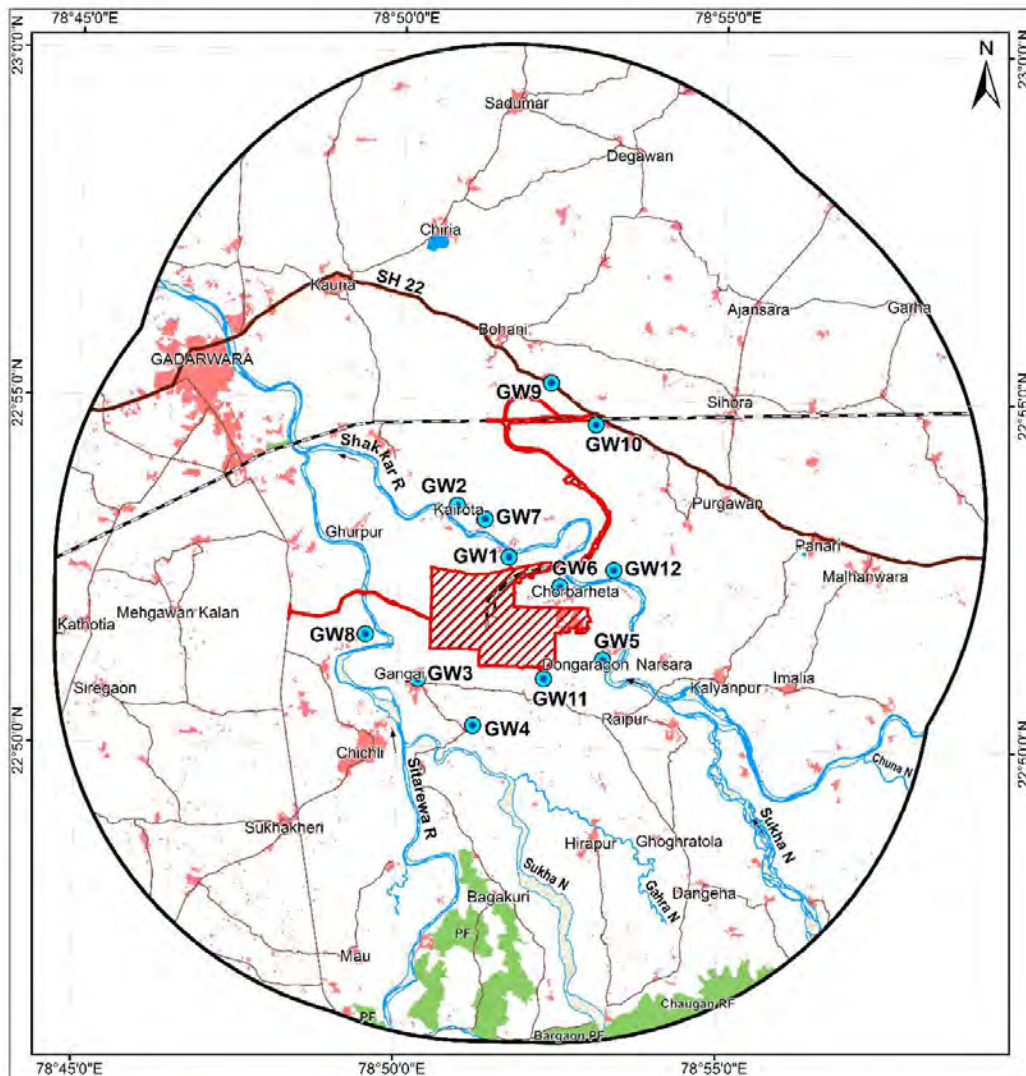


Figure 3-51 Groundwater Sampling Locations at Hotspot (Hand Pump)

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.33: Physico-chemical characterisation of Ground water at Hotspots within 2 kms

S.No	Parameters	GW-1 Mehra Kheda	GW-2 Kajrot a	GW-3 Gangai	GW-4 Chhen a kachhar	GW-5 Dongarga on	GW-6 Chorbarhe ta	GW-7 Ghatpipari	GW-8 Khairi	GW-9 Branjh	GW-10 Manakwara	GW-11 Kudari	GW-12 Tekapur	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
1	Temperature, °C	28.5	29.2	29.4	28.2	29.8	29.6	29.5	29.2	29.4	30.3	30.1	29.4	--	--
2	Colour, Hazen	<5	<5	<5	<5	<5	<5	<5	6	<5	<5	<5	<5	5	15
3	Turbidity, NTU	1.1	<1	<1	1	<1	5.8	2.3	12.1	<1	<1	<1	<1	1	5
4	pH	7.35	7.19	7.2	7.09	7.64	7.19	7.29	7.21	7.14	7.03	7.60	6.97	6.5-8.5	No Relaxation
5	Conductivity, µS/cm	896.2	1610	1312	1870	1683	1131	1073	892.9	754	812	857	850	--	--
6	TDS, mg/l	600.5	1078.7	879.0	1252.9	1127.6	757.8	718.9	598.2	505.1	544.0	574.2	569.5	500	2000
7	Alkalinity as CaCO ₃ , mg/l	410.6	534.3	452.2	423.9	654.6	425.6	386.4	330.4	246.4	278.5	373.9	350.4	200	600
8	TH as CaCO ₃ , mg/l	344.0	492.9	418.3	467.2	564.8	349.1	405.6	350.9	270.4	254.7	345.3	308.0	200	600
9	Calcium as Ca, mg/l	82.2	128.2	123.4	113.5	136.2	85.8	82.2	112.6	74.3	74.2	89.3	88.4	75	200
10	Magnesium as Mg, mg/l	33.7	42.0	26.8	44.6	54.6	32.8	48.7	17.0	20.7	16.9	29.7	21.2	30	100

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S.No	Parameters	GW-1 Mehra Kheda	GW-2 Kajrota	GW-3 Gangai	GW-4 Chhen kachhar	GW-5 Dongarga on	GW-6 Chorbarhe ta	GW-7 Ghatpipari	GW-8 Khairi	GW-9 Branjh	GW-10 Manakwara	GW-11 Kudari	GW-12 Tekapur	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
11	Sodium as Na, mg/l	62.3	144.5	86.4	186.4	124.6	102.4	42.18	32.8	46.2	28.9	35.1	48.62	--	--
12	Potassium as K, mg/l	8.2	12.26	8.4	21.6	12.44	8.46	5.8	1.1	4.6	5.5	2.4	4.48	--	--
13	Total Suspended Solids, mg/l	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	--	--
14	Chloride as Cl, mg/l	41.6	181.3	98.0	318.4	154.3	73.5	66.1	53.9	51.4	34.6	44.1	44.5	250	1000
15	Sulphate as SO ₄ , mg/l	78.3	110.4	71.3	80.4	70.5	74.5	51.2	34.8	30.1	41.3	34.3	41.3	200	400
16	Nitrate as NO ₃ , mg/l	14.3	15.3	21.2	12.5	24.7	20.4	15.6	12.7	10.4	17.6	10.5	11.1	45	No Relaxation
17	Fluoride as F, mg/l	0.5	0.8	0.8	0.6	0.9	0.4	0.6	0.7	0.5	0.6	0.5	0.5	1.0	1.5
18	Phenolic compound as C ₆ H ₅ OH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.002
19	Phosphate, mg/l	0.04	0.06	0.05	0.05	0.02	0.06	0.07	0.06	0.05	0.05	0.05	0.03	--	--
20	Silica as Si, mg/l	10.3	18.4	21.7	20.4	21.6	7.9	9.6	8.4	7.6	17.2	12.3	14.8	--	--
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.05

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 3
BASELINE ENVIRONMENT**

**Page
3-91**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S.No	Parameters	GW-1 Mehra Kheda	GW-2 Kajrota	GW-3 Gangai	GW-4 Chhenakachhar	GW-5 Dongargaon	GW-6 Chorbarhta	GW-7 Ghatpipariy	GW-8 Khairi	GW-9 Branjh	GW-10 Manakwara	GW-11 Kudari	GW-12 Tekapur	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.003	No Relaxation
23	Chromium as Cr ⁺⁶	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--
24	Iron as Fe, mg/l	0.14	0.25	0.18	0.25	0.23	0.15	0.18	0.16	0.14	0.15	0.13	0.22	0.3	No Relaxation
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.05	1.5
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001	No Relaxation
29	Zinc as Zn, mg/l	0.77	0.26	0.48	0.34	0.68	0.21	0.22	0.28	0.26	0.27	0.22	0.53	5	15
30	DO, mg/l	6.8	6.6	6.2	6.6	6.7	6.8	6.7	6.6	6.8	6.8	6.7	6.4	--	--
31	COD, mg/l	10	11	12	10	9	9	9	10	10	9	12	13	--	--
32	BOD, 27°C 3 days, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 3
BASELINE ENVIRONMENT**

**Page
3-92**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S.No	Parameters	GW-1 Mehra Kheda	GW-2 Kajrota	GW-3 Gangai	GW-4 Chhenakachhar	GW-5 Dongargaon	GW-6 Chorbarhta	GW-7 Ghatpipariy	GW-8 Khairi	GW-9 Branjh	GW-10 Manakwara	GW-11 Kudari	GW-12 Tekapara	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.5	No Relaxation
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.05	No Relaxation
35	Total Coliforms, MPN/100ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml sample	

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.10.4.3 Discussion

In order to assess the chemical quality of groundwater of phreatic aquifers of Gadarwara STPP, Narsinghpur, MP groundwater samples of within 2km buffer zone have been collected and analyzed. The Salient features of chemical parameters of groundwater of phreatic aquifer are given in **Table 3.33**. A perusal of the analysis indicates that the groundwater is near neutral to slightly alkaline in nature with pH ranged between 6.87 and 7.64. Electrical conductivity (EC) is an important criterion for assessing suitability of water for various uses. The EC values indicate that the groundwater is non saline with observed value ranges between 754 $\mu\text{S/cm}$ to 1870 $\mu\text{S/cm}$ at 25°C. TDS of groundwater ranges from 505.1 mg/l to 1252.9 mg/l which is above acceptable limit but under permissible limit. Analysis indicates that Ca, Mg and Na are three dominating cations while bicarbonate and chloride are dominating anions. The water is mainly calcium-magnesium bicarbonate type. A perusal of the chemical analysis of groundwater tapping phreatic aquifer indicates that the groundwater is by and large potable in nature and also suitable for irrigation purposes.

3.10.4.4 Groundwater quality samples were collected within a 2 km radius of hotspots such as schools and hospitals from the TPP boundary. The location and analysis details are provided in **tables 3.33**. It was concluded that all water samples collected within 2 km radius are well within the permissible limits as per IS 10500:2012.

3.10.5 Comparative Study

A comparative study for baseline data has been conducted to assess the environmental quality (Air, Water, Noise and Soil) from the start of the project up to year 2024. This study focuses on a 5 km radius, analysing data from common stations that were monitored both in 2011 and 2024 within the study area. Previous baseline study was conducted during winter season (Dec.2010 to February, 2011).

S. No.	Parameters	Study Year	
		2011	2024
1.	PM ₁₀	60.0 $\mu\text{g/m}^3$ to 84.0 $\mu\text{g/m}^3$	36.10 $\mu\text{g/m}^3$ to 91.30 $\mu\text{g/m}^3$
2.	PM _{2.5}	34.0 $\mu\text{g/m}^3$ to 47 $\mu\text{g/m}^3$	14.56 $\mu\text{g/m}^3$ to 32.33 $\mu\text{g/m}^3$
3.	SO ₂	9.0 $\mu\text{g/m}^3$ to 13 $\mu\text{g/m}^3$	5.79 $\mu\text{g/m}^3$ to 13.18 $\mu\text{g/m}^3$
4.	NO ₂	12.0 $\mu\text{g/m}^3$ to 19 $\mu\text{g/m}^3$	10.71 $\mu\text{g/m}^3$ to 18.70 $\mu\text{g/m}^3$

Air Quality: During the previous baseline study (2011), minimum and maximum values of PM₁₀ were 60 $\mu\text{g/m}^3$ (Ghurpur Village) and 84.0 $\mu\text{g/m}^3$ (Manakwara Village), respectively. The minimum & maximum values of PM_{2.5} varies between 34 $\mu\text{g/m}^3$ (Ghurpur Village) to 47 $\mu\text{g/m}^3$ (Chichli Village). The minimum and maximum values of SO₂ varies between 9 $\mu\text{g/m}^3$ (Ghurpur Village) to 13 $\mu\text{g/m}^3$ (Manakwara Village). Minimum and maximum and values of NO₂ varies between 12.0 $\mu\text{g/m}^3$ (Ghurpur village) to 19 $\mu\text{g/m}^3$ (Chichli Village).

During the current baseline study (2024), the minimum and maximum values of PM₁₀ ranges between 36.10 $\mu\text{g/m}^3$ (Mahguwan Khurd) to 91.30 $\mu\text{g/m}^3$ (Project site) and the minimum and maximum values

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



of PM_{2.5} varies between 14.56 µg/m³ (Mahguwan Khurd) to 32.33 µg/m³ (Gadarwara). The SO₂ minimum and maximum values of varies between 5.79 µg/m³ (Mahguwan Khurd) and 13.18 µg/m³ (Gadarwara). Minimum and maximum values of NO₂ varies between 10.71 µg/m³ (Mahguwan Khurd) to 18.70 µg/m³ (Gadarwara).

Common monitoring station found in both the baseline studies is Ghoorpur village where the maximum value for PM₁₀ is observed as 60.89 µg/m³ (2024) as compared to 84 µg/m³ (2011), maximum value of PM_{2.5} is observed as 27.58 µg/m³ (2024) as compared to 44 µg/m³ (2011), maximum value of SO₂ is observed as 11.24 µg/m³ (2024) as compared to 10 µg/m³ (2011) and maximum value of NO₂ is observed as 15.95 µg/m³ (2024) as compared to 12 µg/m³ (2011).

So, it is concluded that in Ghoorpur village the baseline ambient air quality w.r.t PM₁₀, PM_{2.5} and NO₂ has slightly reduced while SO₂ has slightly increased which may be due to different monitoring seasons during both the baseline studies and other variables like anthropogenic sources including fuel combustion, vehicular emission, agricultural activities, domestic fuel burning etc., in the study area. Overall, it can be concluded that during 2011 and 2024 study ambient air quality indicated PM₁₀, PM_{2.5}, SO₂ and NO₂ are within standard limit of NAAQ, 2009.

Soil: In 2011 study, pH in soil observed neutral to slightly alkaline to neutral in in nature. EC observed average, texture of soil is sandy loam whereas nutrient level in soil showed nitrogen good to sufficient, phosphorous less to medium and potassium very less to better. So, it was concluded that nutrient level is sufficient for the irrigation within study area.

Whereas during 2024 study, pH in soil neutral to slightly alkaline in nature indicated that other nutrient like K, S and Mg available in soil. Texture of soil is sandy loam whereas nutrient level in soil showed nitrogen good to sufficient, phosphorus medium to average sufficient and potassium very less to medium. So, it was concluded that nutrient level (NPK) content was found to be satisfactory for growth of plants. Therefore, it can be concluded that the soil quality in terms of fertility is good for growth of vegetation in study area. As the pH is slightly alkaline in nature macronutrient such as Fe, Mn, Cu & Zn availability is less in soil.

S. No.	Parameters	Study Year	
		2011	2024
1.	pH	6.35-7.08	7.01 to 7.65
2.	EC	110 µmhos/cm to 364 µmhos/cm	520 µmhos/cm to 880 µmhos/cm
3.	Texture	Loamy sand and Sandy loam	Sandy Loam and Loamy Sand
4.	Nitrogen	40 mg/gm to 48 mg/gm	235.2 kg/ha to 761.6 kg/ha
5.	Phosphorus	204 mg/gm to 425 mg/gm	100.8 kg/ha to 165.76 kg/ha
6.	Potassium	2.1 mg/gm to 4.0 mg/gm	397 kg/ha to 513.9 kg/ha

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Whereas in common soil location i.e Gagai village, Dongargaon and Chorbarheta village NPK observed less to better N, P found less and K observed sufficient. Whereas in current study period N found good to better, P on an average sufficient to sufficient and potassium observed less to average.

Therefore, it is concluded that the NPK content is satisfactory for the growth of seasonal crops. During both the baseline studies, it can be concluded that study area shows that NPK content has improved in 2024.

Ambient Noise: During 2011 noise study observed during day time varies between 47.4 dB(A) (Mahrakhera) to 60.4 dB(A) (Chorbarheta), whereas during night time it varied between 38.2 dB(A) in Chorbarheta to 43.2 dB(A) in Dongargaon.

However, in 2024 study during day time in study area noise level minimum 50.0 dB(A) at Badgaon PF n/v Baghakudi to maximum 54.6 dB(A) at Dongargaon village, whereas during night time minimum 41.7 dB(A) at Badgaon PF n/v Baghakudi to maximum 44.8 dB(A) Dongargaon village. It is observed that during both day and night time noise levels under prescribed limit is 55 dB (A) and 45 dB(A) for rural/residential areas and 75 dB (A) for industrial zones.

S. No.	Parameters	Study Year	
		2011	2024
1.	Day Time	47.4 dB(A) to 60.4 dB(A)	50.0 dB(A) to 54.6 dB(A)
2.	Night Time	38.2 dB(A) to 43.2 dB(A)	41.7 dB(A) to 44.8 dB(A)

In common monitoring station i.e Ghoorpur, Dongargaon and Gagai village noise level is under limit during day and night time as per CPCB norms for residential area.

So, it can be concluded that noise study conducted during 2011 and 2024 the noise level are well within prescribed limit in 10km study area as per CPCB Norms.

Surface water: In 2011 study, annual surface analysis data shows pH alkaline in SW1 and SW2 samples. TDS of SW indicated under tolerance limit and conductivity indicated non saline nature of water. Nitrate of samples observed under tolerance limit. BOD and COD of surface water samples indicated less than <2 mg/l and COD observed <4 mg/l. Total coliform observed under limit as per CPCB norms Class B and C.

However, during pre-monsoon, 2024 study, pH in SW indicated slightly alkaline. Nitrate and fluoride were under limit in pre-monsoon season i.e March to May, 2024. High BOD in surface water may be attributed to decaying plants, animal waste, and other organic compounds, agriculture runoffs etc. added to water. Whereas COD also found high in surface water sample and it was observed min. 18 mg/l in SW4 during May month to max. recorded 32 mg/l in SW3 during March month. Reason behind high COD may be due to accumulation of solid waste, soluble organic compounds, residual food waste, emulsified oils and the dying bacterial cells. During summer, the value of dissolved Oxygen was found to be low because DO is directly or indirectly dependent on water temperature, a partial pressure of air etc.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Parameters	Study Year	
		2011	2024
1.	pH	8.1-8.59	7.0 to 7.66
2.	EC	317 µmho/cm	378.2 µS/cm to 548 µS/cm
3.	TDS	203 mg/l	234.53 mg/l to 339.76 mg/l
4.	Nitrate	0.05	4.6 mg/l to 8.96 mg/l
5.	BOD	<2	5.0 mg/l to 8.0 mg/l
6.	COD	<4	15 mg/l to 32 mg/l
7.	Total Coliform	128 MPN/100 ml	24 MPN/100 to 63 MPN/100ml

Comparing the values of pH, DO, BOD and total coliform with 'Use based classification of surface waters' published by Central Pollution Control Board given in Table 3.28 and majority of the surface water samples meet the criteria C, D and E.

Therefore, it is concluded that the BOD in Shakkar river and Sitarewa River showed high BOD is due to decaying plants, human or animal waste and other organic compounds added to water and high COD may be due to accumulation of solid waste, soluble organic compounds, residual food waste and the natural organic substances.

Ground water: In 2011 study, annual surface analysis data shows pH slightly alkaline. TDS of GW indicated under permissible limit and conductivity indicated non saline nature of water. Nitrate samples observed under permissible limit as per IS10500:2012. BOD a of ground water samples indicated less than 2 mg/l and COD observed <4 mg/l. Total coliform absent in groundwater.

Whereas, during pre-monsoon, 2024 study, pH in GW indicated slightly alkaline. EC and TDS show strong positive correlation. All samples were within permissible limits of 1.5 mg/l. Nitrate were under limit acceptable limit as per IS1050:2012. BOD & COD in groundwater observed below detection limit. Total coliform is absent in groundwater.

S. No.	Parameters	Study Year	
		2011	2024
1.	pH	7.10 to 7.7	7.1 to 7.84
2.	EC	885 µmho/cm to 895 µmho/cm	485 µS/cm to 710 µS/cm
3.	TDS	575 mg/l to 582 mg/l	365.24 mg/l to 475.71 mg/l
4.	Nitrate	0.015 mg/l to 0.16 mg/l	7.40 mg/l to 16.21 mg/l
5.	Fluoride	-	0.22 mg/l to 0.38 mg/l
6.	Chloride	36 mg/l to 40 mg/l	10.4 mg/l to 24.15 mg/l
7.	Total coliform	Absent	Absent

S. No.	Parameters	Study Year	
		2011	2024
8.	BOD	<2	BDL
9.	COD	<4	BDL

Therefore, it is concluded that the ground water has not contaminated since 2011 to 2024 as compare with IS 10500:2012.

3.11 TRAFFIC SCENARIO

The traffic survey monitoring was carried out for one month (April.2024) to assess the existing traffic scenario and to forecast future traffic growth and the burden on the road and environment as a result of the plant's expansion. Measurements of traffic density was conducted at T1: Road Junction near 220KV substation, Chichli, T2: SH 22, Panari and T3: SH 22, Gadarwara. Which is the route used for transportation. This is done by visual observation and counting of vehicles in 4 categories, namely, cycle/ motorcycles/ scooters (two-wheelers), passenger cars/vans/ auto-rickshaws (three- wheelers), heavy motor vehicle & light motor vehicle. Two people were stationed on either side of the road to tally the number of automobiles. The total number of vehicles per hour in each of the four categories was calculated. Traffic Volume count was done at the survey locations and presented in **Table 3.34**.

Table 3.34: Existing Traffic Scenario

Carrier Type	T1: Road Junction near 220KV substation, Chichli	T2: SH 22, Panari	T3: SH 22, Gadarwara	Equivalency factor	No. of PCU/day		
					(A*D)	(B*D)	(C*D)
	No. of Vehicle/day	A	B	C	D	T1	T2
2 Wheelers	1576	1089	3866	0.5	788	544.5	1933
3-4 Wheeler	612	726	1589	1	612	726	1589
LMV	123	157	384	1.5	184.5	235.5	576
HMV	285	380	320	3.0	855	1140	1560
Total	2596	2352	6359	-	2439.5	2646	5658

Source: (i) Traffic Survey by GCPL (ii) IRC: 106-1990 (iii) IRC: 64-1990

Table 3.35: Existing Level of Service

Location	Distance (km)	Direction	V: Volume in 24 hours (PCU)	C: Design capacity in PCU/day	V/C	LoS as per IRC
T1: Road Junction near 220KV substation, Chichi	3.87	W	2439.5	15000	0.16	A
T2: SH 22, Panari	5.47	ENE	2646	15000	0.17	A

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



T3:	SH	22,	8.43	NE	5658	15000	0.37	B
Gadarwara								
Relation between V/C ratio & LoS								
V/C Ratio	LoS	Performance						
0.0-0.2	A	Represents a condition of free flow						
0.2-0.4	B	Represents a zone of stable flow						
0.4-0.6	C	The general level of comfort and convenience declines noticeably at this level						
0.6-0.8	D	Represents the limit of stable flow						
0.8-1.0	E	Represents operating condition when traffic volumes are at or close to the capacity level						

The results of the survey, the existing passenger car unit (PCU) of each location were compared with the capacity of each type of road as suggested by Indian Road Congress thus determining the existing Level of Service (LoS) for each location. The existing conditions shows **A Level of service** at T1 & T2 and **LoS B** at T3, which implies a zone of stable flow (**Table 3.35**).

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

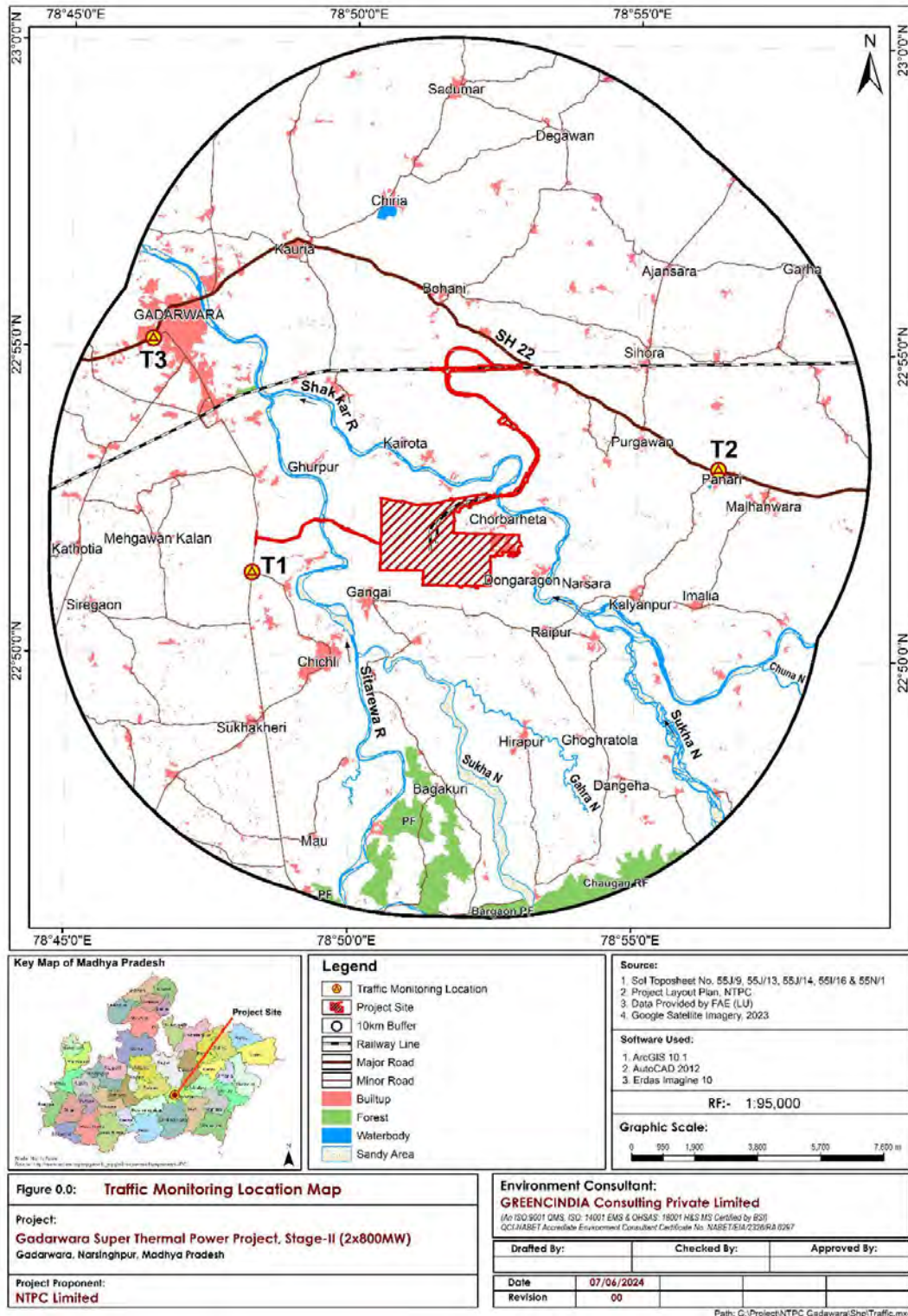


Figure 3-52 Traffic Density Map

3.12 TERRESTRIAL ECOLOGICAL SURVEY AND BIODIVERSITY STUDY

Plants and animals are particularly vulnerable to environmental stress. Changes in the composition of biological communities are evident through shifts in the distribution pattern, frequency, density, and abundance of natural flora and fauna species within the ecosystem. These changes can be measured over time and linked to current environmental conditions. Baseline ecological information is gathered through literature reviews and quadrat surveys in forest areas of the study region. The baseline terrestrial ecology study included all ecological zones likely to be affected.

The ecological survey depends on primary survey and secondary literature review and assessment of habitat types, vegetation patterns, and inventory of flora and fauna within a 10km radius from the project site's boundary. The biological assessment aimed to identify any rare, endangered, or threatened species of flora or fauna in both the core and buffer zones, as well as any ecologically sensitive areas within the buffer zone that might be impacted.

To achieve these objectives, a detailed study was conducted using the following methods:

- Field surveys to collect primary data
- Interviewing local residents to gather information about local plants, animals, and their uses
- Collecting ethno-biological data

This study covers review of published secondary data and presents the findings from the general ecological survey conducted in the area. The terrestrial ecological status of the area is detailed below.

3.12.1 FOREST TYPE

Located in Central India, Madhya Pradesh is the second largest State covering an area of 3,08,252 sq km which is 9.38% of the geographical area of the country and is bordered on the west by Gujarat, on the northwest by Rajasthan, on the northeast by Uttar Pradesh, on the east by Chhattisgarh, and on the south by Maharashtra. The State lies between 21°17' N to 26°52' N latitude and 74°08' E to 82°49' E longitudes. Physiographically, the State can be divided into four regions, viz the low lying areas in north and north-west of Gwalior, Malwa Plateau, Satpuda and Vindhyan Ranges. Madhya Pradesh has a subtropical climate. The annual rainfall ranges 800 mm to 1,800 mm and the annual temperature varies from 22°C to 25°C. The State is drained by a number of rivers, which include Narmada, Tapti, Son, Betwa, Shipra and Chambal. The State has 50 districts, of which 21 are tribal districts. The State does not have any hill district. As per the 2011 census, Madhya Pradesh has a population of 72.63 million accounting to 6 percent of India's population. The rural and urban population stands at 72.37% and 27.63% respectively. Tribal population of the State is 21.09%. The population density of the State is 236 per sq km, which is much lower than the national average. The 19th Livestock census 2012 has reported a total livestock population of 36.33 million.

As per ISFR 2019, Madhya Pradesh is a forest rich State and is ranked first among the States in terms of the RFA. The State has a sizeable tribal and rural population which is dependent on the forests for their livelihood and basic needs. As per the Champion & Seth Classification of Forest Types (1968), the forests in Madhya Pradesh belong to five Forest Type Groups, which are further divided into 21

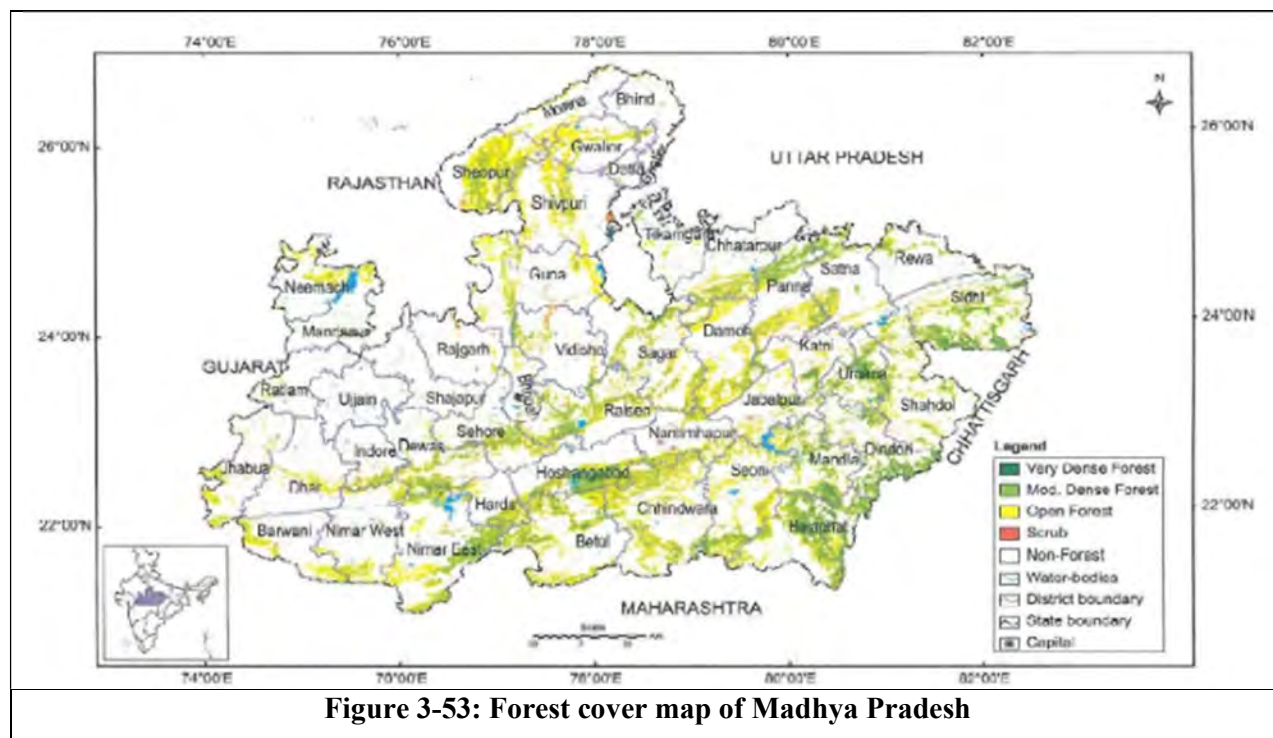
**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Forest Types. Madhya Pradesh is a pioneering State in the implementation of the Joint Forest Management (JFM) movement in the country. The State has a strong JFM network through 15,228 JFMC/VSS/EDCs covering an area of 66,874 sq km. In order to provide benefits to forest dwellers in collection and trade of forest produce, the Madhya Pradesh State Minor Forest Produce (Trading & Development) Co-operative Federation was formed in 1984. The Federation co-ordinates collection, processing and marketing of Tendu leaves, Sal Seed, Kullu Gum and other Non-Timber Forest Products (NTFPs) through Primary Forest Produce Co-operative Societies. The Madhya Pradesh Rajya Van Vikas Nigam Ltd. Undertakes the scientific harvest of forests and its regeneration. Recorded Forest Area (RFA) in the State is 94,689 sq km of which 61,886 sq km is Reserved Forests, 31,098 sq km is Protected Forests and 1,705 sq km is Unclassed Forests. In Madhya Pradesh, during the period 1st January 2015 to 5th February 2019, a total of 12,785.98 hectares of forest land was diverted for nonforestry purposes under the Forest Conservation Act, 1980 (MoEF & CC, 2019). Ten National Parks and 25 Wildlife Sanctuaries constitute the Protected Area network of the State covering 3.51% of its geographical area. There are 6 Tiger Reserves in the State covering an area of 6117.26 sq km. Eco-sensitive zones have been declared for 19 protected areas. The State with a population of 526 Tigers, is recognized as Tiger State of India.

The thermal power plant falls in the Narsinghpur district of the state of Madhya Pradesh and the 10 km radius around it is called the study area for this report. A major river Shalkar River (0.6 km, NE) and Sitarewa River (0.9 km, W) flows near the project site.



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.12.2 FLORAL STUDY

Study of biological environment is one of the important aspects in Environmental Impact Assessment in view of the need for protection of Environmental quality. Ecological study was carried out by ecology team of GCPL. Reconnaissance study of the area was done to obtain flora & Fauna structure of the area. Stakeholder consultation with villagers, government officials, gram panchayat, teachers, workers, etc were carried out. Forest officials were also consulted and data based on their records were also collected.

In the study region, dry tropical vegetation is seen. Within the study area, trees such as *Tectona grandis*, *Butea monosperma*, *Acacia catechu*, *Dalbergia latifolia*, *Bauhinia purpurea*, *Azadiracta indica*, *Mangifera indica*, *Albizia lbbeck* and others are found. In the research region, shrubs were found like *Targestes erecta*, *Lantana camara*, *Nerium oleander*, *Calotropis gigantea*, *Hibiscus rosa-sinensis* to name a few. The common species of the grassland observed during field survey are congress grass, kans, munher, sevai grass etc. **Table 3.36** provides the inventory of trees, climbers, herbs, shrubs, grasses, etc. recorded during the survey from the entire study area and from information obtained from all the secondary sources.

The crops sown in the area are jowar (*Sorghum sp.*), wheat (*Triticum sp.*), tuhar (pulses- *Cajanas cajan*), Soyabean (*Glycine max*), paddy (*Oryza sativa*), grams etc. Oilseeds like peanut and sesame seeds are also commonly grown in this area.

Table 3.36: Inventory of Trees, Shrubs, Herbs and Climbers recorded from the study area

Sl. No.	Common Name	Scientific Name	Family	Source		
				Survey	Villagers	Forest Officials
Tree Species						
1	Babool	Acacia arabica	Fabaceae	✓		
2	Bel	Aegle marmelos	Rutaceae	✓		
3	Mahaneem	Ailanthus excelsa	Simaroubaceae	✓		
4	Babool	Acacia nilotica	Fabaceae	✓		
5	Palash,	Butea monosperma	Fabaceae	✓		
6	Amaltas	Cassia fistula	Leguminosae	✓		
7	Kathmohle e	Bauhinia racemosa	Leguminosae	✓		
8	Kachnar	Bauhinia vahlii	Leguminosae	✓		
9	Aam	Mangifera indica	Anarcardiaceae	✓		
10	Aonla	Emblica officinalis	Euphorbiaceae			
11	Bakain	Melia azedarach	Meliaceae		✓	
12	Datranga	Ehretia laevis	Boraginaceae		✓	
13	Katai	Flacourtia indica	Bixaceae		✓	

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Common Name	Scientific Name	Family	Source		
				Survey	Villagers	Forest Officials
14	Kevati	<i>Ventilago maderaspatana</i>	Rhamnaceae		✓	
15	Koirala	<i>Bauhinia variegata</i>	Leguminosae	✓		
16	Karanj	<i>Pongamia pinnata</i>	Leguminosae	✓		
17	Kala siris	<i>Albizia lebbbeck</i>	Leguminosae	✓		
18	Kainsa	<i>Sterculia urens</i>	Sterculiaceae			✓
19	Tendu	<i>Diospyros melanoxylon</i>	Ebanaceae	✓		
20	Amla	<i>Emblica officinalis</i>	Euphorbiaceae	✓		
21	Peepal	<i>Ficus religiosa</i>	Moraceae			✓
22	Arjun	<i>Terminalia arjuna</i>	Combretaceae			✓
23	Neem	<i>Azadirachta indica</i>	Meliaceae	✓		
24	Gular	<i>Ficus glomerata</i>	Moraceae	✓		
25	Gulmohar	<i>Delonix regia</i>	Fabaceae			✓
26	Jamun	<i>Syzygium cumini</i>	Myrtaceae	✓		
27	Dhoka	<i>Lannea coromandelica</i>	Anacardiaceae		✓	
28	Dhawda	<i>Anogeissus latifolia</i>	Combretaceae	✓		
29	Dudhi	<i>Wrightia tinctoria</i>	Apocynaceae	✓		
30	Shisham	<i>Dalbergia sissoo</i>	Leguminosae	✓		
31	Bar	<i>Ficus tomentosa</i>	Moraceae	✓		
32	Neelgiri	<i>Eucalyptus</i>	Myrtaceae	✓		
33	Jungle Jalebi	<i>Pithecellobium dulce</i>	Fabaceae	✓		
34	Semal	<i>Bombax ceiba</i>	Bombacaceae	✓		
35	Lasora	<i>Cordia dichotoma</i>	Ehretiaceae			✓
36	Bargad	<i>Ficus benghalensis</i>	Moraceae			✓
37	Bael	<i>Aegle marmelos</i>	Rutaceae	✓		
38	Baer	<i>Zizyphus mauritiana</i>	Rhamnaceae	✓		
39	Mahua	<i>Madhuca indica</i>	Sapotaceae	✓		
40	Sagwan	<i>Tectona grandis</i>	Verbenaceae	✓		
41	Saja	<i>Terminalia tomentosa</i>	Combretaceae	✓		
42	Saal	<i>Shorea robusta</i>	Depterocarpaceae		✓	
43	Salai	<i>Boswellia serrata</i>	Burseraceae		✓	
44	Sitaphal	<i>Anona squamosa</i>	Anonaceae		✓	
45	Siddha	<i>Lagerstroemia parviflora</i>	Lythraceae		✓	
46	Karanj	<i>Pongamia pinnata</i>	Fabaceae	✓		

Climbers

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 3
BASELINE
ENVIRONMENT**

**Page
3-104**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Common Name	Scientific Name	Family	Source		
				Survey	Villagers	Forest Officials
1	Chodhari bela	<i>Vallisneria spiralis</i>	Alismaceae	✓		
2	Dam bel	<i>Tylophora indica</i>	Asclepiadaceae		✓	
3	Kadvi lauki	<i>Lagenaria siceraria</i>	Cucurbitaceae	✓		
4	Karela	<i>Momordica charantia</i>	Cucurbitaceae	✓		
5	Kiwach	<i>Mucuna pruriens</i>	Fabaceae	✓		
6	Safed musli	<i>Chlorophytum arundinaceum</i>	Liliaceae		✓	
7	Satavar	<i>Asparagus racemosus</i>	Liliaceae		✓	
8	Giloy	<i>Tinospora cordifolia</i>	Menispermaceae	✓		
9	Anthi	<i>Helicteres isora</i>	Sterculiaceae	✓		
Shrubs						
1	Khakholi	<i>Maytenus senegalensis</i>	Celastraceae	✓		
2	Chandarjot	<i>Jatropha curcas</i>	Euphorbiaceae		✓	
3	Kaner	<i>Nerium oleander</i>	Apocynaceae	✓		
4	Chameli	<i>Jasminum officinale</i>	Oleaceae	✓		
5	Dhataki	<i>Woodfordia fruticosa</i>	Lythraceae		✓	
6	Kandola	<i>Carissa opaca</i>	Apocynaceae		✓	
7	Putoosh	<i>Lantana camara</i>	Verbenaceae	✓		
8	Gudhal	<i>Hibiscus rosa-sinensis</i>	Malvaceae		✓	
9	Khareti	<i>Sida cordifolia</i>	Malvaceae	✓		
10	Chilla	<i>Casuarina tomentosa</i>	Salicaceae	✓		
11	Baer	<i>Zizyphus jujuba</i>	Rhamnaceae	✓		
12	Indrajav	<i>Holarrhena pubescens</i>	Apocynaceae		✓	
13	Genda	<i>Taraxacum officinale</i>	Asteraceae			
HERBS						
1	Dudhi	<i>Euphorbia hirta</i>	Euphorbiaceae	✓		
2	Bankulthi	<i>Cajanus scarabaeoides</i>	Fabaceae			
3	Janglimethi	<i>Sida acuta</i>	Malvaceae	✓		
4	Salparni	<i>Desmodium gangeticum</i>	Leguminosae	✓		
5	Ratnamala	<i>Indigofera linifolia</i>	Fabaceae	✓		
6	Chakora	<i>Cassia tora</i>	Fabaceae	✓		
7	Gokhru	<i>Echinops echinatus</i>	Asteraceae	✓		
8	Amarbel	<i>Cuscuta reflexa</i>	Convolvulaceae	✓		
9	Bantulsi	<i>Hyptis suaveolens</i>	Lamiaceae	✓		
10	Chirchir	<i>Achyranthes aspera</i>	Amaranthaceae	✓		

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Common Name	Scientific Name	Family	Source		
				Survey	Villagers	Forest Officials
11	Chia	<i>Lindenbergia philippensis</i>	Orobanchaceae	✓		
12	Sadabahar	<i>Catharanthus roseus</i>	Apocynaceae	✓		
13	Satyanashi	<i>Argemone mexicana</i>	<i>Papaveraceae</i>	✓		
Grasses						
1	Needle grass	<i>Aristida adscensionis</i>	Gramineae	✓		
2	Bamboo	<i>Dendrocalamus strictus</i>	Gramineae	✓		
3	Kel	<i>Dicanthium annulatum</i>	Gramineae	✓		
4	Bhurbhusi	<i>Eragrostis tenella</i>	Gramineae	✓		
5	Ghaas	<i>Heteropogon contortus</i>	Gramineae	✓		

3.12.3 PHYTO-SOCIOLOGICAL STUDY

To understand the floristic composition, a Phyto-sociological study of vegetation in reference to trees, shrub & herb layer was conducted in three forest patches in the study area of the proposed project. The direction and distance of these locations from the project site is provided in **Table 3.37**. At each selected site, random vegetation sampling was done with the help of quadrat (Size 10m X 10 m for tree & shrub layer and 1m² quadrat for herb layer). In each quadrat number and name of all the tree, shrub and herb species was counted. Quantitative analysis of vegetation for frequency, density and abundance was calculated following Curtis and Mc. Intosh (1950) method. Their relative values were calculated and summed to get important value index (IVI). The IVI is a composite index based on measures of relative frequency (RF), relative density (RD) and relative abundance (RAB) (Muller – Dombois and Ellenberg, 1974). Species diversity index was calculated using Shannon-Weiner index (1963). Shanon Weiner diversity index was calculated by following formula:

$$H = - \sum P_i \log P_i$$

Where: H = Shanon Weiner diversity index

$P_i = n_i/N$ where n_i is number or biomass or IVI of individual species and N is the total number or biomass or IVI of all individuals. In the present study IVI (Importance Value Index) has been taken into consideration for evaluation of diversity index. Since IVI includes many of the attributes at a time, therefore consideration of IVI was preferred on number over this Shanon-Weiner diversity index. The diversity index gives an indication about the status of community, higher the value of index indicates more stability of the community. The location of the monitoring stations is mentioned in **Figure 3.54 and Table 3.37**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

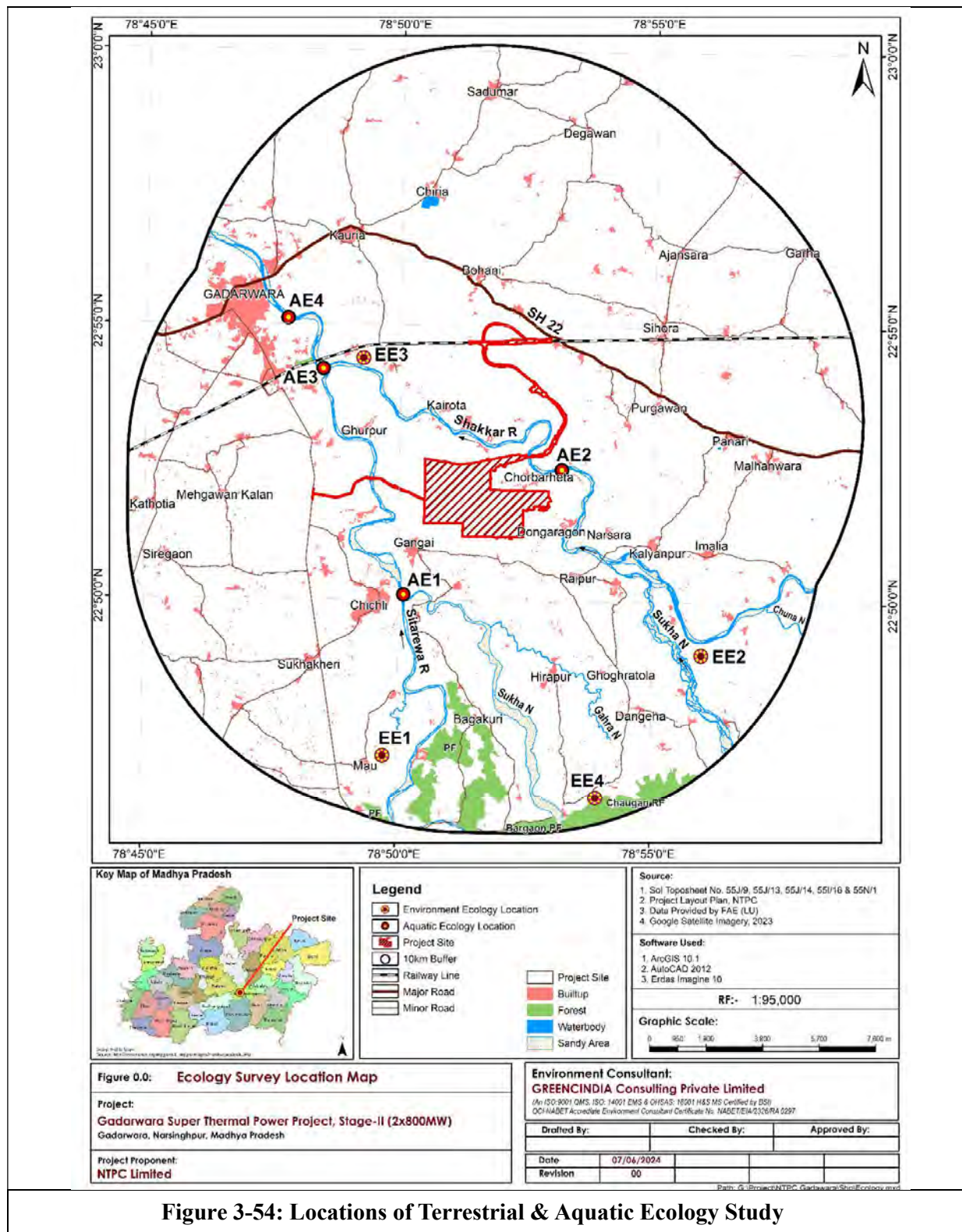


Figure 3-54: Locations of Terrestrial & Aquatic Ecology Study

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.37: Co-ordinates of Terrestrial and Aquatic Ecology Study

Terrestrial Ecology Study Locations					
Sr. No.	Description	Latitude	Longitude	Distance (in km)	Direction
EE1	(PSS 1) Phyto-sociology sample 1 Bargaon PF	22°47'9.69"N	78°49'44.75"E	6.08	S
EE2	(PSS 2) Phyto-sociology sample 2 Barkheri	22°49'2.70"N	78°55'58.83"E	6.88	SE
EE3	(PSS 3) Phyto-sociology sample 3 Barheta	22°54'23.76"N	78°49'16.48"E	4.02	NW
EE4	(PSS 4) Phyto-sociology sample 4 Sesadebar	22°46'25.8"N	78°53'56.15"E	9.15	SSE
Aquatic Ecology Study Locations					
AE1	Aquatic sample 1 Sitarewa river	22°53'44.0"N	78° 48'36"E	2.50	SW
AE2	Aquatic sample 2 Shakkar river	22°54'26.0"N	78°48'15.0"E	1.93	NW
AE3	Aquatic sample 3 Confluence point of Sitarewa and Shakkar rivers	22°54'25.66"N	78°48'15.25"E	5.19	NW
AE4	Aquatic sample 4 Shakkar river	22°52'23.71"N	78°53'12.10"E	1.39	NNE

The phyto-sociological parameters for different types of vegetation- trees, shrubs and herbs for the four different locations in core zone and three locations in buffer zone is provided in the **Tables 3.38 to Table 3.49**.

Table 3.38: Phyto-sociological analysis of trees in PSS 1 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	<i>Tectona grandis</i>	20.0	150.0	30.00	52.09
2	<i>Mangifera indica</i>	20.0	100.0	20.00	31.73
3	<i>Emblica officinalis</i>	20.0	200.0	40.00	46.64
4	<i>Melia azedarach</i>	20.0	150.0	30.00	42.54
5	<i>Delonix regia</i>	20.0	150.0	30.00	49.32
6	<i>Azadirachta indica</i>	20.0	100.0	20.00	32.55
7	<i>Zizyphus jujuba</i>	10.0	200.0	20.00	27.49
8	<i>Holoptelea integrifolia</i>	10.0	100.0	10.00	17.63

Table 3.39: Phyto-sociological analysis of shrubs in PSS 1 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	<i>Jatropha curcas</i>	20	250.00	50.00	88.25
2	<i>Nerium oleander</i>	10	200.00	20.00	45.30
3	<i>Jasminum officinale</i>	20	150.00	30.00	75.80
4	<i>Woodfordia fruticosa</i>	20	150.00	30.00	61.75
5	<i>Carissa opaca</i>	10	100.00	10.00	28.90

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.40: Phyto-sociological analysis of herbs in PSS 1 location

S. No.	Botanical Name	Frequency	Abundance	Density
1	<i>Indigofera linifolia</i>	30	3.33	100
2	<i>Cassia tora</i>	20	5.00	100
3	<i>Echinops echinatus</i>	30	4.33	130

Table 3.41: Phyto-sociological analysis of trees in PSS 2 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	<i>Pongamia pinnata</i>	20.0	100.0	20.00	35.20
2	<i>Albizia lebeck</i>	20.0	100.0	20.00	28.48
3	<i>Sterculia urens</i>	20.0	100.0	20.00	27.38
4	<i>Diospyros melanoxylon</i>	20.0	150.0	30.00	37.86
5	<i>Emblica officinalis</i>	20.0	150.0	30.00	43.74
6	<i>Ficus religiosa</i>	20.0	250.0	50.00	52.98
7	<i>Terminalia arjuna</i>	10.0	100.0	10.00	15.50
8	<i>Azadirachta indica</i>	20.0	250.0	50.00	58.86

Table 3.42: Phyto-sociological analysis of shrubs in PSS 2 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	<i>Carissa opaca</i>	20	250.00	50.00	63.87
2	<i>Lantana camara</i>	20	250.00	50.00	77.06
3	<i>Hibiscus rosa-sinensis</i>	20	150.00	30.00	54.64
4	<i>Sida cordifolia</i>	30	133.33	40.00	62.70
5	<i>Casearia tomentosa</i>	20	100.00	20.00	41.73

Table 3.43: Phyto-sociological analysis of herbs in PSS 2 location

S. No.	Botanical Name	Frequency	Abundance	Density
1	<i>Hyptis suaveolens</i>	30	1.00	30
2	<i>Achyranthes aspera</i>	20	1.50	30

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 3.44: Phyto-sociological analysis of trees in PSS 3 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	<i>Adina cordifolia</i>	30.0	200.0	60.00	64.67
2	<i>Terminalia arjuna</i>	20.0	100.0	20.00	22.24
3	<i>Buchnanania lanzan</i>	20.0	150.0	30.00	26.61
4	<i>Albizia lebbbeck</i>	20.0	150.0	30.00	29.12
5	<i>Acacia nilotica</i>	20.0	100.0	20.00	25.96
6	<i>Cassia fistula</i>	30.0	266.7	80.00	63.25
7	<i>Bauhinia racemosa</i>	20.0	200.0	40.00	37.01
8	<i>Pongamia pinnata</i>	20.0	150.0	30.00	31.14

Table 3.45: Phyto-sociological analysis of shrubs in PSS 3 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	<i>Casearia tomentosa</i>	30	166.67	50.00	82.36
2	<i>Zizyphus jujuba</i>	20	150.00	30.00	60.78
3	<i>Holarrhena pubescens</i>	20	200.00	40.00	76.17
4	<i>Targestes erecta</i>	30	166.67	50.00	80.69

Table 3.46: Phyto-sociological analysis of herbs in PSS 3 location

S. No.	Botanical Name	Frequency	Abundance	Density
1	<i>Euphorbia hirta</i>	80	1.25	100
2	<i>Cajanas scarabaeoides</i>	70	1.43	100
3	<i>Sida acuta</i>	60	2.17	130

Table 3.47: Phyto-sociological analysis of trees in PSS 4 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	<i>Wrightia tinctoria</i>	20.0	150.0	30.00	49.32
2	<i>Dalbergia sissoo</i>	20.0	100.0	20.00	22.24
3	<i>Ficus tomentosa</i>	20.0	100.0	20.00	28.48
4	<i>Eucalyptus</i>	20.0	150.0	30.00	29.12
5	<i>Sterculia urens</i>	20.0	200.0	40.00	46.64
6	<i>Bombax ceiba</i>	10.0	100.0	10.00	15.50
7	<i>Cordia dichotoma</i>	20.0	250.0	50.00	58.86
8	<i>Tectona grandis</i>	20.0	150.0	30.00	31.14

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

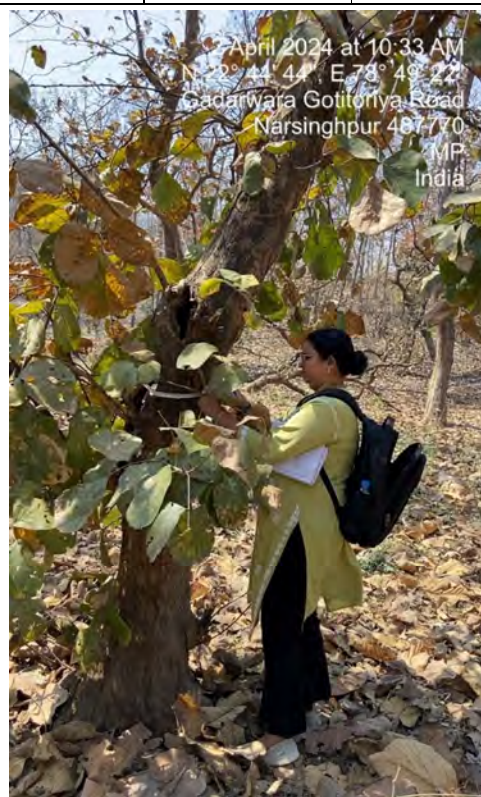


Table 3.48: Phyto-sociological analysis of shrubs in PSS 4 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	<i>Woodfordia fruticosa</i>	30	166.67	50.00	82.36
2	<i>Carissa opaca</i>	30	133.33	40.00	62.70
3	<i>Lantana camara</i>	20	150.00	30.00	61.75
4	<i>Hibiscus rosa-sinensis</i>	10	100.00	10.00	28.90

Table 3.49: Phyto-sociological analysis of herbs in PSS 4 location

S. No.	Botanical Name	Frequency	Abundance	Density
1	<i>Hyptis suaveolens</i>	20	5.00	100
2	<i>Achyranthes aspera</i>	70	1.43	100
3	<i>Lindenbergia philippensis</i>	20	1.50	30



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 3-55: Terrestrial Ecology Study

3.12.4 FAUNAL STUDY

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, habitats available, approach for various locations of buffer zone of TPP 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 analysed the impacts of the proposed project on ecological baseline.

3.12.4.1 MAMMALS

Mammals are the most challenging groups to do research on due to their relatively low abundance at which they are found, and the vast range of environmental niches they may inhabit. Tracks and scats can possibly be used with practically all mammals. It might not be able to identify an animal if one cannot actually catch it or see it. Animal presence clues like footprints or scats can be interpreted in a useful way. In addition to this, the species can be positively identified using bones, teeth, and skulls.

3.12.4.2 BIRDS

The methods used to sample birds are often among the simplest, although the enormous diversity in any given area and the range of cries and colour changes within species themselves can make sampling birds more difficult. For this, the following data collection techniques were used. In populated areas, the periods in between were employed, although early morning and late evening were more frequently used in desolate areas. Additionally, efforts were made to locate any nearby avian roosting, breeding, or nesting locations.

(i) Visual and call census: It involved identifying species visually (either by naked eye or by binocular). Bird calls are extremely useful in surveying birds.

(ii) Additional signs: The identification of old eggs, nests and feathers or other signs (like owl pellets) give a valuable information on the presence of a species in the surveyed area.

3.12.4.3 REPTILES & AMPHIBIANS

For the purpose of cataloguing and counting the amphibians and reptiles, a thorough search strategy was used along the water hedges of all aquatic environments. Active searches are conducted actively

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



and purposefully at a set time and place when the habitat is physically disturbed in an effort to find animals that may be hiding. Conversely, a passive search may involve simply observing animals for a fixed time.

3.12.5 FAUNAL STATUS

Inside the project site some common bird species, squirrel, chameleon etc were recorded. From the buffer zone, 11 Species of mammals, 19 species of birds, 6 species of reptiles and amphibians were recorded. 2 reptilian Schedule 1 species (*Naja naja* and *Python molurus*); 3 avian Schedule 1 species (*Bubo bubo*, *Tachy spizabadia* & *Pavo cristatus*) and 3 Schedule 1 mammalian species (*Antelope cervicarpa*, *Canis aureus* and *Herpestes edwardsii*) were recorded from the study area. List of fauna in the study area given in **Table 3.50**.

Table 3.50: List of Animals in the study area

Mammals									
S. No.	Scientific Name	Core Zone	Buffer Zone	Common Name	Status		Source		
					WPA Amendm ent 2022	IUC N	Survey	Village rs	Other Stake holder s
1	<i>Antelope cervicarpa</i>	-	+	Black Buck	Schedule I	LC		✓	✓
2	<i>Canis aureus</i>	-	+	Jackal	Schedule I	LC	✓	✓	
3	<i>Herpestes edwardsii</i>	-	+	Indian Grey Mongoose	Schedule I	LC	✓		✓
4	<i>Lepus nigricollis</i>	-	+	Indian Hare	Schedule II	LC	✓		✓
5	<i>Sus scrofa</i>	-	+	Wild pig	Schedule II	LC	✓		✓
6	<i>Axis axis</i>	-	+	Chital	Schedule II	LC		✓	✓
7	<i>Boselaphu strago camelus</i>	-	+	Neel Gai	Schedule II	LC	✓		✓
8	<i>Semnopith ecus entellus</i>	-	+	Gray Langoor	Schedule II	LC	✓		

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



9	<i>Macaca mullata</i>	-	+	Monkey	Schedule II	LC	✓		
10	<i>Bandicota benghalensis</i>	-	+	Bandicoot Rat	Schedule IV	LC	✓		
11	<i>Suncus murinus</i>	-	+	Asian House Shrew	Schedule IV	LC	✓		
Reptiles & Amphibians									
1	<i>Cyrtodactylus nebulosus</i>	-	+	Clouded Gecko	Schedule II	LC	✓		
2	<i>Python molurus</i>	-	+	Indian Python	Schedule I	NT		✓	
3	<i>Naja naja</i>	-	+	Indian Cobra	Schedule I	LC	✓	✓	
4	<i>Vipera russelli</i>	-	+	Viper	Schedule II	-		✓	
5	<i>Calotes versicolor</i>	-	+	Garden Lizard	-	LC	✓		
6	<i>Duttaphrynus mela</i>	-	+	Common Indian Toad	-	LC	✓		
Birds									
1	<i>Bubo bubo</i>	Eurasian Eagle Owl			Schedule I	✓	✓		
2	<i>Pavo cristatus</i>	Peafowl			Schedule I	✓	✓		
3	<i>Tachy spizabadia</i>	Shikra			Schedule I	✓	✓		
4	<i>Columba livia</i>	Blue Rock Pigeon			LC	✓	✓	✓	
5	<i>Sitta castanea</i>	Indian Nuthatch				✓	✓	✓	
6	<i>Alcedo atthis</i>	Common kingfisher			LC	✓	✓	✓	
7	<i>Corvus splendens</i>	House crow			LC	✓	✓	✓	
8	<i>Eudynamis scolopaceus</i>	Asian koel			LC	✓	✓	✓	

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 3
BASELINE
ENVIRONMENT**

**Page
3-115**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



9	<i>Passer domesticus</i>	House Sparrow	LC	✓	✓	✓
10	<i>Vanellus indicus</i>	Red-wattled Lapwing	LC	✓		
11	<i>Psittacula cyanocephala</i>	Parrot	LC	✓	✓	
12	<i>Coracias benghalensis</i>	Indian roller/ Blue Jay	LC	✓	✓	
	<i>Egretta qurzetta</i>	Little egret	LC	✓		
13	<i>Merops orientalis</i>	Green Bee Eater	LC	✓	✓	
14	<i>Streptopelia senegalensis</i>	Little Brown Dove	LC	✓	✓	
15	<i>Melophus lathami</i>	Bulbul	LC	✓	✓	✓
16	<i>Coturnix coromandelica</i>	Rain Quail	LC	✓		✓
17	<i>Psittacula krameri</i>	Rose ringed parakeet	LC	✓		✓
18	<i>Upupa epops</i>	Common Hoopeo	LC	✓		✓

Schedule I Species in study area

S. No.	Scientific Name	Core Zone	Buffer Zone	Common Name	Status	
					WPA Amendment 2022	IUCN
Mammals						
1	<i>Antelope cervicarpa</i>	-	+	Black Buck	Schedule I	LC
2	<i>Canis aureus</i>	-	+	Jackal	Schedule I	LC
3	<i>Herpestes edwardsii</i>	-	+	Indian Grey Mongoose	Schedule I	LC
Reptiles & Amphibians						
4	<i>Python molurus</i>	-	+	Indian Python	Schedule I	NT
5	<i>Naja naja</i>	-	+	Indian Cobra	Schedule I	LC
Birds						
6	<i>Bubo bubo</i>	-	+	Eurasian Eagle Owl	Schedule I	LC
7	<i>Pavo cristatus</i>	-	+	Peafowl	Schedule I	LC
8	<i>Tachy spizabadia</i>	-	+	Shikra	Schedule I	LC

3.12.6 AQUATIC ECOLOGY

The aquatic ecology of Gadarwara, Narsinghpur, is characterized by its river systems, especially the Shakkar River and Sitarewa River. Studies indicate that the water quality is affected by both natural and anthropogenic factors, including contamination from industrial and agricultural activities. Additionally, the area is rich in aquatic biodiversity, supporting various fish species and aquatic plants.

3.12.6.1 Study of Phytoplanktons

Methodology

1. Sample Collection

- **Location Selection:** Different sampling sites representing different aquatic environments have been provided in **Figure 3.52**
- **Collection Tools:** A plankton net with a mesh size 55 μ was used for capturing phytoplankton.
- **Sample Volume:** 1-2 litres of water were collected from locations.

2. Preservation

- **Fixatives:** Used Lugol's iodine solution or formaldehyde for immediate preservation.
- **Storage:** Stored samples in dark, cool conditions to prevent degradation.

3. Laboratory Analysis & Identification

- **Sedimentation:** Allow samples to settle for 24-48 hours to concentrate phytoplankton at the bottom.
- **Taxonomic Keys:** Standard taxonomic keys and guides were employed.
- **Morphological Features:** Focus on cell shape, size, color, and colony formation was given to identify the phytoplanktons and also reference from text books and online available material was done.

Inventory of phytoplanktons recorded from the study area is provided in **Table 3.51**. These groups represent common genera that are often found in freshwater systems, reflecting a variety of ecological niches and environmental conditions.

Table 3.51: Inventory of Phytoplanktons from study area

Sl No.	Phyto-plankton
Cyanophyceae (Blue-green Algae)	
1	Microcystis
2	Anabaena
3	Oscillatoria
4	Nostoc
5	Spirulina
6	Synechocystis
Submerged, Emergent and Floating plants/weeds	
1	Hydrilla
2	Ranunculus aquatilis
3	Vallisneria
4	Potamogeton
5	Pistia
6	Azolla
7	Eichhorina
8	Salvinia

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl No.	Phyto-plankton
9	<i>Limnophilia heterophyll</i>
Chlorophyceae (Green Algae)	
1	Chlorella
2	Scenedesmus
3	Pediastrum
4	Spirogyra
5	Volvox
6	Closterium
Bacillariophyceae (Diatoms)	
1	Navicula
2	Nitzschia
3	Fragilaria
4	Coconeis
5	Synedra
Euglenophyceae (Euglenoids)	
1	Euglena
2	Phacus
3	Trachelomonas
Dinophyceae (Dinoflagellates)	
1	Ceratium
2	Peridinium

3.12.6.2 Study of Zooplanktons

1. Sample Collection

- **Location Selection:** Sampling sites representing different aquatic habitats as shown in **figure 3.52** were used to study zooplankton diversity.
- **Collection Tools:** A plankton net with a mesh size of 50-200 µm, depending on the target zooplankton size was used.
- **Collection Technique:**
 - **Vertical Haul:** Lower the net to a known depth and then haul vertically.
 - **Horizontal Tow:** Drag the net horizontally for a set distance or duration.
 - **Integrated Sample:** Combine multiple vertical and horizontal samples.

2. Preservation

- **Fixatives:** Immediately preserved samples in 4% formalin or Lugol's iodine solution.
- **Storage:** Samples were kept in dark, cool conditions to avoid degradation.

3. Laboratory Analysis & Identification

- **Sedimentation:** Allow samples to settle for 24-48 hours to concentrate phytoplankton at the bottom.
- **Taxonomic Keys:** Standard taxonomic keys and guides were employed.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



- **Morphological Features:** Focus on cell shape, size, color, and colony formation was given to identify the zooplanktons and also reference from text books and online available material was done.

Inventory of zooplanktons recorded from the study area is provided in **Table 3.52**. These groups represent common genera that are often found in freshwater systems, reflecting a variety of ecological niches and environmental conditions.

Table 3.52: Inventory of zooplanktons recorded from the study area

Sl. No.	Zooplanktons
Rotifera	
1	<i>Brachionus</i>
2	<i>Keratella</i>
3	<i>Asplanchna</i>
4	<i>Polyarthra</i>
5	<i>Notholca</i>
6	<i>Philodin</i>
Cladocera	
1	<i>Daphnia</i>
2	<i>Ceriodophynia</i>
3	<i>Moina</i>
Copepoda	
1	<i>Cyclops</i>
2	<i>Diaptomus</i>
3	<i>Eucyclops</i>
Protozoa	
1	<i>Paramecium</i>
2	<i>Vorticella</i>
3	<i>Diffugia</i>
4	<i>Arcella</i>

3.12.6.3 Benthic Macro-invertebrates

Methodology

1. Sample Collection

- **Kick Sampling:** A D-frame net to disturb the substrate and collect dislodged macroinvertebrates is used.
- **Surber Sampler:** Employed a Surber sampler for quantitative sampling in specific areas.
- **Core Sampling:** Extracted sediment cores for benthic macroinvertebrate sampling.

2. Preservation

- **Immediate Preservation:** Preserved collected samples in 70% ethanol or formalin on-site.
- **Labeling:** Properly labelled each sample with site, date, and other relevant information.

3. Laboratory Analysis

- **Sorting:** Rinsed samples and sorted macro invertebrates from debris by hand.
- **Identification:** Identified macro invertebrates to the lowest practical taxonomic level using keys and guides.

The commonly found benthic biota is given below:

Table 3.53: Inventory of macro invertebrates recorded from study area

Sl. No.	Macro invertebrates
1	<i>Tiara scabra</i>
2	<i>Parregsiavideus</i>
3	<i>Plentalia spp.</i>
4	<i>Lymnaea acuminata</i>
5	<i>Polichaeteyvorm</i>
6	<i>Pilaglobosa</i>
7	<i>Hirudinariagranulosa</i>
8	<i>T. tuberculata</i>
9	<i>Argalaspp</i>
10	<i>Ostracodes spp.</i>

3.12.6.4 Study of Fishes

Secondary sources and stakeholder consultations and visit to the fish markets were made to create an inventory of the fishes found in and around the study area. The following species were reported to be present.

➤ **Cypriniformes:**

- *Labeo rohita* (Rohu)
- *Labeo fimbriatus*
- *Catla catla* (Catla)
- *Tor tor* (Mahasheer)
- *Cirrhinus mrigala* (Mrigal)
- *Puntius sophore*
- *Ctenopharyngodon idella* (Grass carp)
- *Puntius puntius*
- *Hypophthalmichthys molitrix* (Silver carp)
- *Cyprinus carpio* (Common carp)

➤ **Siluriformes:**

- *Clarias batrachus* (Magur)
- *Heteropneustes fossilis* (Singhi)
- *Mystus vittatus*
- *Wallago attu* (Parhan)

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



- **Perciformes:**
- *Channa punctata* (Spotted snakehead)
- *Channa marulius*
- *Anabas testudineus* (Koi)
- **Osteoglossiformes:**
- *Notopterus chitala*
- *Notopterus notpoterus*

3.13 SOCIAL ENVIRONMENT

The project site is located at Villages Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon etc., Tehsil Gadarwara, District Narsinghpur in Madhya Pradesh. In this section the profile of the socio-economic conditions of the people in the 10 km radius of project site has been described. The demographic and socio-economic parameters i.e. population growth, gender ratio, health facilities, education facilities, work force participation, occupational structure, literacy etc. play an important role in determining the impact of the proposed thermal power activity directly or indirectly on the human population of the study area.

3.13.1 DEMOGRAPHIC CHARACTERISTICS OF THE STUDY AREA

There are 125 villages in the study area. These villages have total population of 1,09,427 (in 2001) & 1,43,280 (in 2011). The average household size in the study area was found to have reduced from 5.4 in 2001 to 4.52 in 2011. According to the survey, gender ratio of study area was 897 in 2001 and 910 in 2011. The details are given in **Table 3.54, Figure 3.56 & Table 3.55**.

Table 3.54: Demographic Profile of the Study Area

Parameters	Number of Villages	Total Population		Male		Female		Gender Ratio	
		2001	2011	2001	2011	2001	2011	2001	2011
within 2 km	15	11728	13617	6232	7100	5496	6517	882	918
2km to 5km	26	26739	50008	14094	26303	12645	23705	897	901
5km to 7km	26	25136	28381	13308	14858	11828	13523	889	910
7km to 10 km	58	45824	51274	24048	26756	21776	24518	906	916
Total	125	109427	143280	57682	75017	51745	68263	897	910

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

Table 3.55: Demographic Features of the Study Area

Parameters	Number of Villages	Total Population		Number of House Hold		House Hold Size	
		2001	2011	2001	2011	2001	2011
within 2 km	15	11728	13617	2174	3112	5.39	4.38
2km to 5km	26	26739	50008	5110	10912	5.23	4.58

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Parameters	Number of Villages	Total Population		Number of House Hold		House Hold Size	
		2001	2011	2001	2011	2001	2011
5km to 7km	26	25136	28381	4555	6122	5.52	4.64
7km to 10 km	58	45824	51274	8419	11541	5.44	4.44
Total	125	109427	143280	20258	31687	5.40	4.52

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

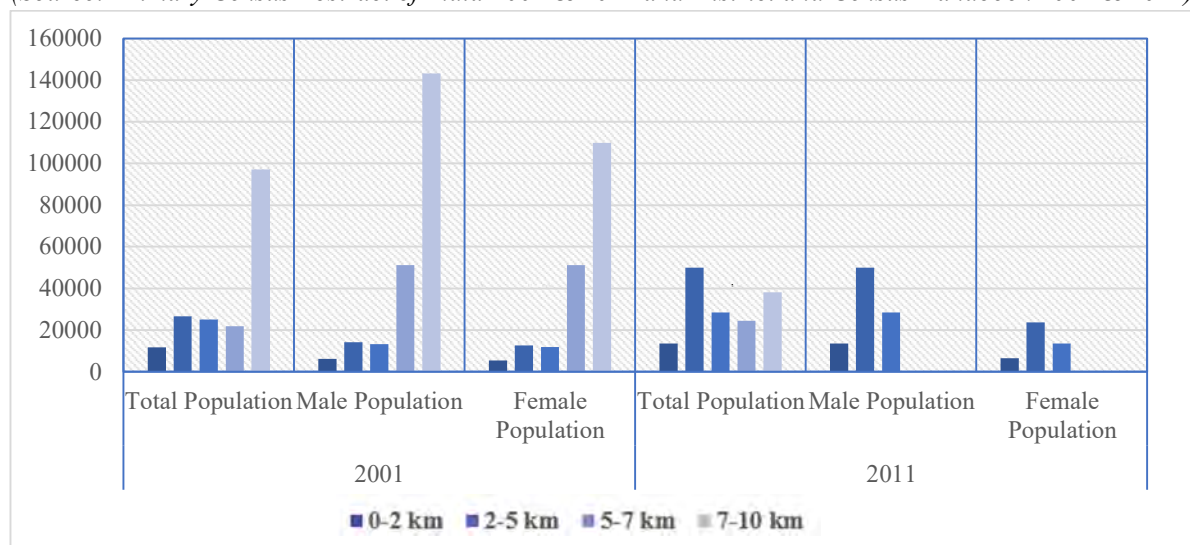


Figure 3-56: Demographic Profile of Study Area

3.13.2 VULNERABLE GROUP

As of the 2011 census, the study area encompasses a scheduled caste population of approximately 17.8% and a scheduled tribe population of 10.4%. The data is further broken down based on different distance ranges, providing insights into the distribution of scheduled caste and scheduled tribe populations within specific areas. The percentages represent the proportion of these populations in relation to the total population of each distance range within the study area. (Refer **Table 3.56, Figure 3.57**).

Table 3.56: Vulnerable Group

Parameters	Number of Villages	Total Population		SC				ST			
		2001	2011	2001	2011	2001 (%)	2011 (%)	2001	2011	2001 (%)	2011 (%)
within 2 km	15	11728	13617	1713	2061	14.6 %	15.1 %	969	981	8.3%	7.2%
2km to 5km	26	26739	50008	4365	8312	16.3 %	16.6 %	2157	4604	8.1%	9.2%

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Parameters	Number of Villages	Total Population		SC				ST			
		2001	2011	2001	2011	2001 (%)	2011 (%)	2001	2011	2001 (%)	2011 (%)
5km to 7km	26	25136	28381	4713	5514	18.8 %	19.4 %	2284	2667	9.1%	9.4%
7km to 10km	58	45824	51274	7792	9560	17.0 %	18.6 %	6163	6584	13.4 %	12.8 %
Total	125	109427	143280	18583	25447	17.0 %	17.8 %	11573	14836	10.6 %	10.4 %

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

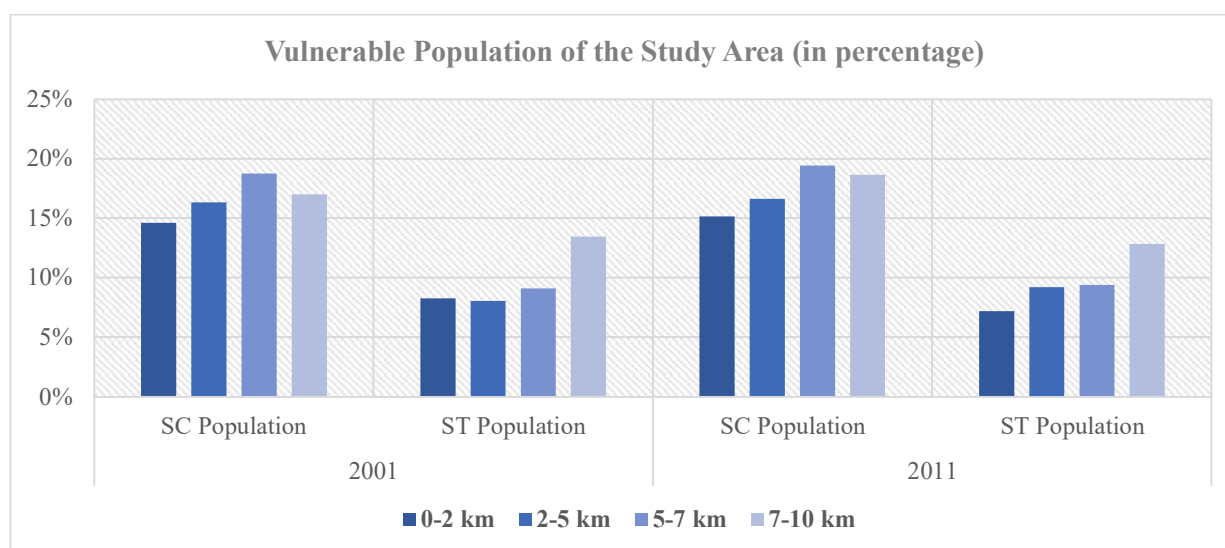


Figure 3-57: Vulnerable Population in the Study Area

3.13.3 LITERACY RATE

Literacy is one of the most significant indicators of human and social development. This not only reflects on the educational attainment of the population but also reflects on the status of women, caste equation and economic condition of a particular area. It also shows the skill level of the people and their capability to get trained and work. **Table 3.57 and Figure 3.58** indicates the gender-wise literacy rate of the people in the study area. The female literacy rate of the study area has decreased with time (58% in 2001 & 56% in 2011), whereas the male literacy rate which was 76% in 2001 have increased to 78% in 2011.

Table 3.57: Literacy Rate

Parameters	Number of Villages	Male Literate				Female Literate			
		2001	2011	2001 (%)	2011 (%)	2001	2011	2001 (%)	2011 (%)
within 2 km	15	3471	4794	56%	74%	2528	3379	46%	52%

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Parameters	Number of Villages	Male Literate				Female Literate			
		2001	2011	2001 (%)	2011 (%)	2001	2011	2001 (%)	2011 (%)
2km to 5km	26	9154	18953	65%	80%	6560	13874	52%	59%
5km to 7km	26	9137	10262	69%	76%	5883	7095	50%	52%
7km to 10 km	58	22223	18922	92%	77%	15116	13658	69%	56%
Total	125	43985	52931	76%	78%	30087	38006	58%	56%

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

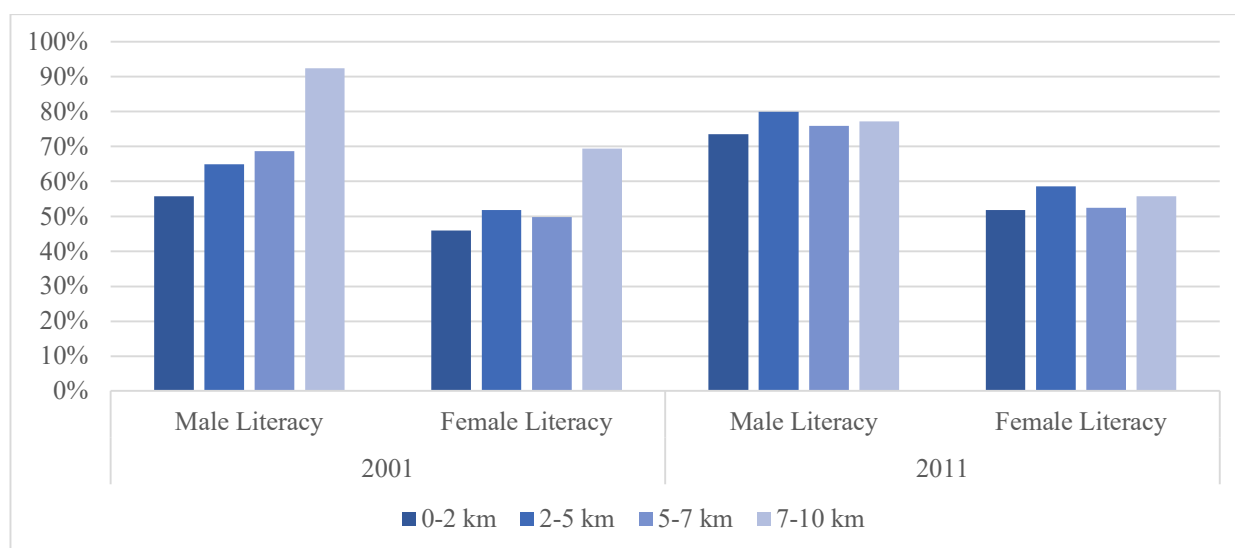


Figure 3-58: Literacy Rate in the Study Area

3.13.4 WORK PARTICIPATION

3.13.4.1 OCCUPATIONAL STRUCTURE

As per the District Census Handbook, Narsinghpur, the villages around the study area, people mainly earn from agriculture and animal rearing. From **Table 3.58** and **Figure 3.59**, it can be said that the percentage of non-workers is high (>50%) in the study area as compared to the total workers. It can also be seen that the percentage of workers have decreased marginally from 2001 to 2011.

Table 3.58: Occupational Structure of the Study Area

Parameters	Number of Villages	Total Population		Total Workers		Main Workers		Marginal Workers		Non - Workers	
		2001	2011	2001 (%)	2011 (%)	2001 (%)	2011 (%)	2001 (%)	2011 (%)	2001 (%)	2011 (%)
within 2 km	15	11728	13617	33	49	24	25	9	14	42	51

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Parameters	Number of Villages	Total Population		Total Workers		Main Workers		Marginal Workers		Non - Workers	
		2001	2011	2001 (%)	2011 (%)	2001 (%)	2011 (%)	2001 (%)	2011 (%)	2001 (%)	2011 (%)
2 km to 5 km	26	26739	50008	36	42	28	24	8	10	53	58
5 km to 7 km	26	25136	28381	42	40	32	25	10	8	59	60
7 km to 10 km	58	45824	51274	58	46	44	25	14	12	79	54
Total	125	109427	143280	46	44	35	25	11	11	64	56

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

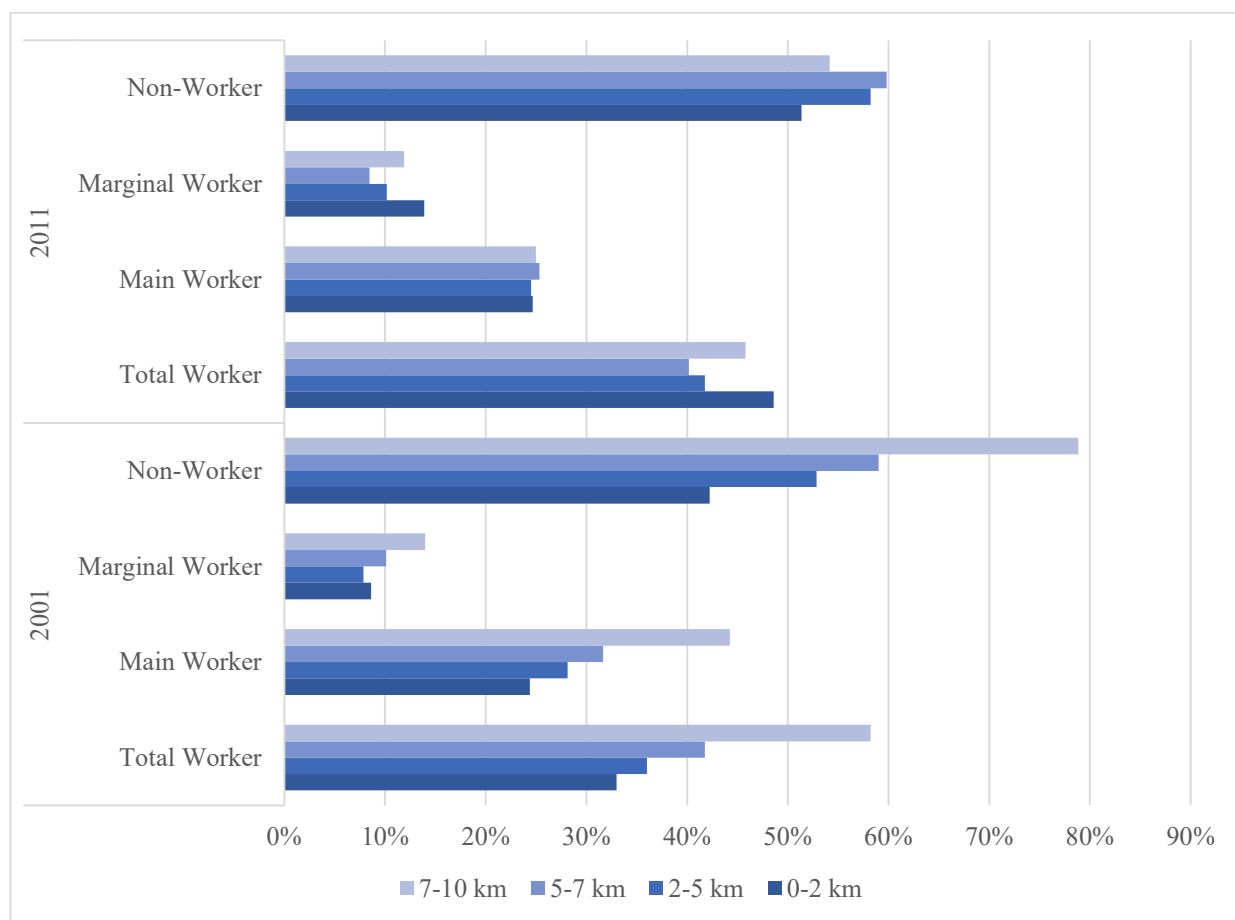


Figure 3-59: Category of workers in the Study Area

3.13.5 INFRASTRUCTURE

3.13.5.1 EDUCATIONAL FACILITIES:

There is a total of 122 Primary Schools, 56 Middle Schools, 23 Secondary School and 9 Senior Secondary Schools in the study area as per Census 2011. It can be seen that there has been a substantial increase in the number of middle and secondary schools over the 10 years in the study area. This is a very healthy sign which is reflected in the increase of literacy rate of the area.

Table 3.59: Educational Facilities in the Study Area

Parameters	Number of Villages	Primary School		Middle School		Secondary School		Senior Secondary School	
		2001	2011	2001	2011	2001	2011	2001	2011
within 2 km	15	23	17	3	7	0	1	0	0
2km to 5km	26	26	24	7	13	3	6	1	2
5km to 7km	26	24	24	6	11	3	7	3	2
7km to 10 km	58	54	57	13	25	4	9	3	5
Total	125	127	122	29	56	10	23	7	9

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

3.13.5.2 HEALTH FACILITIES:

The healthcare facilities present in the study area did not have any significant improvement except for the increase in number of primary health sub-centers and TB Clinics. Though a balanced distribution of different types of health facilities can be seen in the study area. (Refer **Table 3.60**).

Table 3.60: Health Facilities in the Study Area

Parameters	Number of Villages	Mother & Child Welfare Centre		Primary Health Centre		Primary Health Sub-Centres		Family Welfare Centre		TB Clinic	
		2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
within 2 km	15	0	0	0	0	0	1	0	0	0	0
2km to 5km	26	0	1	1	1	2	5	0	2	0	1
5km to 7km	26	1	0	0	0	3	6	0	1	0	0
7km to 10 km	58	2	1	1	1	6	8	0	0	9	0
Total	125	3	2	2	2	11	20	0	3	9	1

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.13.5.3 BANKING AND POST OFFICE FACILITIES:

Number of banking infrastructures like commercial and cooperative banks have increased whereas infrastructure like Post offices have decreased from 25 in 2001 to 16 in 2011 and Agricultural credit society from 13 in 2001 to 6 in 2011. The census data for the infrastructures are given in the **Table 3.61**.

Table 3.61: Banking & Post Office Facilities in the Study Area

Parameters	Number of Villages	Post Office		Commercial Bank		Coop Bank		Agricultural Society	
		2001	2011	2001	2011	2001	2011	2001	2011
within 2 km	15	1	1	0	0	0	0	1	0
2 km to 5km	26	9	3	2	2	2	3	3	3
5 km to 7 km	26	5	2	2	2	2	4	6	2
7 km to 10 km	58	10	10	1	3	1	1	3	1
Total	125	25	16	5	7	5	8	13	6

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

3.13.5.4 DRINKING WATER FACILITIES:

One of the most important factors responsible for the emergence of a settlement is availability of water. Many water sources such as wells, hand pumps, tanks, etc. are available in rural areas. In the villages under study, the main source of water is tap water, well, followed by hand pump and service reservoirs. The list of water sources is given in **Table 3.62**.

Table 3.62: Drinking Water Facilities in the Study Area

Parameters	Number of Villages	Tap		Well		Tank		Tube well		Handpump	
		2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
within 2 km	15	6	9	6	10	1	5	0	11	14	15
2km to 5km	26	15	12	14	15	4	11	8	14	26	26
5km to 7km	26	14	11	10	13	1	7	3	11	24	26
7km to 10 km	58	28	29	28	26	4	21	19	40	54	57
Total	125	63	61	58	64	10	44	30	76	118	124

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



3.13.6 CONCLUSION OF STACKHOLDER CONSULTATION

As per public consultation, focus group discussion, individual villages and household survey and analysis of census data below mentioned gaps were identified in core zone/project influence areas/ villages. Basic amenities available in study area is presented in **Table 3.63**.

Table 3.63: Stakeholder consultation in the Study Area

Village Name	Remark
Focus group discussion Discussion with gram Panchayat and Anganwadi	Tree plantation in villages, skill development of villagers, school development and electricity requirement in the 2 km radius.
Discussion with village women	Women empowerment, employment, and skill development training to the village women. Self help groups , Sewing classes
Discussion with school principal and teachers Government Integrated Secondary School, Chorbarheta Primary School at village Chhena Kachhar, chichli, Branjh, Kajrota, Manakwara, Tekanpur, Dongergaon, Mehrakheda and Khairi Secondary school, Chhena Kachhar, chichli, Ghat pipariya, Kudai Government High School, Gangai	Provision of books, chair table, english spoken coaching classes, smart classes and playground for children. Scholarship to meritorious children. There are 9 govt primary school, 4 Secondary school and 1 high school available in the 2km study area.
Group discussion with villagers	As per discussion villagers the points comes under discussion is employment, agriculture, education, development of schools, renovation of school building and medical checkup etc.
In village Gangai, Mehrakheda, Dongargaon, Ghat pipariya and chichli	Drinking water requirement, Advance farming training. Repair of roads and drainage
In village Gangai, Mehrakheda, Dongargaon, Ghat pipariya, chichli, Chhena Kachhar, Branjh, Kajrota, Manakwara, Tekanpur	Medical facilities should be provided to the villagers Mobile medical unit with free medicines

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 3-60: Public Consultation in Study Area

4. IMPACT ASSESSMENT & MITIGATION MEASURES

4.1 INTRODUCTION

Environmental impact is the change to the surrounding environment caused by anthropogenic activities, either directly or indirectly. Impact Identification is a method of "mapping" the environmental effects of the project's major components and alternatives. After that, impact predictions are made. A variety of quantitative and qualitative tools and procedures are used to predict the impacts of project operations on physical, ecological and social components of the environment. This chapter identifies and estimates the likely impacts on various environmental parameters as a result of the proposed activities' construction and operation. An environment mitigation measure details pollution mitigation and control measures based on prediction results in order to minimize negative environmental impacts.

Any developmental project may cause impacts on the surrounding environment unless proper environmental mitigation measures are adopted. For plants undergoing expansion within the existing plant area can minimize the major possible impacts by adopting mitigation measures.

In this chapter, an attempt has been made to quantify the possible environmental impacts on various features such as air quality, noise level, water use and quality, land-use, ecological status, soil quality and socio-economic factors.

The construction and operational phase of the proposed project comprises various activities each of which may have an impact on some or other environmental parameters. The above-mentioned aspects have been studied to identify the impacts of the proposed expansion. The magnitude and significance of the environmental pollution caused by the project depends on extent of project activity. On the basis of the impact analysis, the mitigating action and future monitoring requirement are focused in Environmental Management Plan (EMP) (Chapter 10) for minimizing adverse impacts. The impact identification has been done using a Matrix given in **Table 4-1 & 4-2**.

Table 4.1: Environment Impact Identification Matrix for Construction Phase

Environmental Parameters	Activities during Construction Phase					
	Site Preparation	Transportation and Storage of Construction Material/ Equipment	Civil Construction Activities	Mech. & Elec. Erection Activities	Influx of Labour & Construction of Temporary Houses	Transportation and Disposal of Construction Debris
Ambient Air	●	●	●	●		●

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Environmental Parameters	Activities during Construction Phase					
	Site Preparation	Transportation and Storage of Construction Material/ Equipment	Civil Construction Activities	Mech. & Elec. Erection Activities	Influx of Labour & Construction of Temporary Houses	Transportation and Disposal of Construction Debris
Water Resource	●				●	●
Water Quality		●	●	●	●	●
Ambient Noise	●	●	●	●		●
Flora and Fauna	●					●
Soil Quality		●				●
Public Utilities		●				
Socio-economic			○	○	●	

● Adverse Impacts

○ Beneficial Impacts

Table 4.2: Environment Impact Identification Matrix for Operation Phase

Environmental Factors	Activities during Operation Phase					
	Plant Operation	Unloading and Storage of Coal	Coal Combustion	Water withdrawal & Treatment	Ash Handling	Disposal and Storage of Gypsum
Ambient Air	●	●	●		●	
Water Resource				●	●	●
Water Quality	●	●		●	●	●
Ambient Noise	●	●				
Flora and Fauna			●	●	●	
Soil Quality			●		●	●
Public Utilities				●	●	●
Socio-economic	○					

● Adverse Impacts

○ Beneficial Impacts

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



4.2 IDENTIFICATION OF ACTIVITIES AND ITS IMPACT

A brief description of impacts by the proposed project is given in **Table 4.3 and 4.4.**

Table 4.3 :Description of identifiable impacts during Construction Phase

Sl. No.	Activities	Parameters	Description of Impacts
1	Site Preparation	Ambient Air	Fugitive Dust Emissions Air Emissions from construction equipment & machinery
		Water Resource	Extraction of water and disposal of sewage
		Ambient Noise	Noise Emissions from use of construction equipment & machinery
		Flora and Fauna	Deposition of air pollutants on flora and disturbance to fauna from noise generation.
2	Transportation and Storage of Construction Material/ Equipment	Ambient Air	Noise and air emissions from vehicles Fugitive dust emissions due to traffic movement Spillage and fugitive emissions of construction materials
		Water Quality	Spillage of construction material and flow into streams Run-off from storage areas of construction material
		Ambient Noise	Noise Emissions from movement of construction equipment & machinery
		Soil Quality	Deposition of spilled construction material on soil
		Public Utilities	Increased flow of traffic Congestion on roads
3	Civil Construction Activities	Ambient Air	Air Emissions from Construction Machinery Fugitive Dust Emissions due to Movement of Traffic
		Water Quality	Run-off from Construction Areas containing construction material
		Ambient Noise	Noise Emissions from Construction Machinery
		Socio Economic	Employment and secondary activities
4	Mechanical & Electrical Erection Activities	Ambient Air	Noise & air emissions from machines/ activities
		Water Quality	Run-off from erection areas containing oils, paints
		Ambient Noise	Noise generation from erection activities.
		Socio Economic	Employment and secondary activities
5	Influx of Labour & Construction	Water Resource	Extraction of water and disposal of sewage
		Water Quality	Domestic wastewater from labour colonies
		Socio Economic	Stress on infrastructure

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Activities	Parameters	Description of Impacts
	of Temporary Houses		Stress on social relations
6	Transportation & Disposal of Construction Debris	Ambient Air	Gaseous emissions from construction and transport vehicles. Fugitive dust emissions due to movement of heavy construction vehicles Fugitive emissions of debris materials
		Water Quality	Spillage/ spread of debris material and flow into streams Run-off from disposal areas
		Ambient Noise	Noise generation from construction and transport vehicles
		Soil Quality	Spillage/ spread/ deposition of debris

Table 4.4: Description of identifiable impacts during Operation Phase

Sl. No.	Activities	Parameters	Description of Impacts
1	Plant Operation	Ambient Air	Air emission due to operation and transportation of coal. Fugitive dust emission due to material handling, movement of trucks and oil tankers
		Water Quality	Spillage of coal/ oil and flow into streams
		Flora and Fauna	Dust emission due to operation and transportation of coal. Fugitive dust emission due to material handling, movement of trucks and oil tankers
		Public Utilities	Increased flow of traffic Congestion of roads
		Socio-Economic	Primary and secondary employment
2	Unloading and Storage of Coal	Ambient Air	Fugitive dust emissions and noise from coal handling areas
		Water Quality	Effluents from CHP/ oil storage areas Effluents from dust extraction/suppression systems Run-off from coal stock yard
		Ambient Noise	Noise emission due to operation and transportation of coal. Noise emission due to material handling, movement of trucks and oil tankers

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Activities	Parameters	Description of Impacts
3	Coal combustion	Ambient Air	Stack emissions
		Soil Quality	Deposition of dust on soil
		Flora and Fauna	Deposition of dust and gaseous pollutants on leaves
4	Water withdrawal & Treatment	Water Resource	Reduced availability to downstream users Reduced flow in downstream direction/change in regime
		Water Quality	Generation of Effluents and Sludge from Treatment Plant Clarifier Sludge Filter Backwash DM Plant Regeneration Waste Tube Settler Sludge
		Flora and Fauna	Entrapment/ impingement of organisms
5	Ash Handling	Ambient Air	Air pollution due to fugitive nature of coal ash
		Water Resource	Water needs for ash disposal
		Water Quality	Leachate from ash dyke may affect ground water quality
		Soil Quality	Spill out of ash may accumulate in soil leading to change in soil structure.
6	Disposal and Storage of Gypsum	Water Resource	Water needs for FGD and gypsum disposal
		Water Quality	Generation of effluents and sludge
		Soil Quality	Generation of effluents and sludge

4.3 OVERALL IMPACTS & MITIGATION MEASURES

Some of the impacts identified in various construction & operation phases are insignificant and do not warrant much attention whereas some others are important especially with respect to the existing site context. Therefore, such impacts which are significant and require a detailed analysis for decision-making or formulating adequate management measures have been identified. This section deals with an assessment of impact of various activities during construction & operation phase on environmental conditions. The methodology of assessment is based upon identification and description of the project activities as well as environmental components followed by predicting the impact of the proposed expansion project and associated activities on the environment. The environmental components that are likely to be influenced during construction phase are: (i) Air environment, (ii) Noise level, (iii) Water resources, (iv) Soil quality; (v) Water quality; (vi) Biological environment and (vii) Socio-economic status of the area. The identification of impacts and mitigation/ minimizing measures of the

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



proposed activity during construction phase and operation phase are detailed in **Table 4.5 & Table 4.6** respectively.

A. Impacts due to Construction of the project:

Table 4.5: Identification of Impacts & Mitigation Measures-Construction Phase

Sl. No.	Aspects	Impact identified	Mitigation Measures
A	Land Environment		
A.1	Soil Quality	Soil compaction may occur due to movement of trucks bringing construction material and transporting construction debris which may affect the soil characteristics like soil fertility, infiltration rate, porosity etc. This ultimately restricts the growth of deep-rooted plants which finally leads to stagnation of succession. Contamination of the soils of surrounding area due to spillage of construction materials such as cement, sand etc.	● Truck movement shall be carried out through existing roads. Any unpaved roads shall be avoided to prevent accidents. ● Trucks shall be covered with tarpaulin and overloading shall be avoided.
	Soil Quality	Excavation, leveling, and the removal of existing vegetation are examples of construction operations that inevitably disrupt the topsoil. The primary causes of soil effects during the building phase will be topsoil loss in the construction areas and soil pollution in the surrounding regions from construction materials such cement, sand, oils, etc. Strong rains throughout monsoon seasons would cause the impacts to be more noticeable.	● Appropriate soil conservation measures associated with improved construction techniques would minimize such local impacts. ● Preserve & conserve the topsoil for refilling and plantation
A.2	Public utilities	Transportation of construction materials shall be by road which will	● Transportation of construction materials shall be through connecting road to NH -22 which

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
		increase the traffic load and may lead to congestion.	will be able to accommodate the vehicles that will be required for transportation of necessary materials to and from the site. ● Traffic study, LOS for existing and proposed traffic remains in the range of A to C in all three points.
B	Air Environment		
B.1	Air Quality	Dust will be the main pollutant affecting the ambient air quality of the area during the construction phase. Activities such as site preparation, operation of heavy machineries and vehicle movement shall generate fugitive dust. Vehicle movement shall also emit gaseous pollutants.	● Necessary dust suppression measures like water sprinkling using road tankers and barricading the construction site wherever possible will be deployed to mitigate the dust emissions. ● Suitable surface treatment to the roads and regular sprinkling of water shall be provided which will reduce the dust generation. ● Proper tuning of vehicles will be done and pollution certificate to keep the gas emissions under check will be made compulsory. ● Necessary pollution control measures as per the requirement under local laws and regulations, and otherwise also, will be provided.
	Air Quality	The movement of equipment at site, dust emitted during the leveling, grading, earthworks, foundation works, vehicle movement on unpaved roads and other construction related activities, exhaust emissions from diesel generators, vehicles and other	● Transport vehicles and construction equipment/ machineries will be properly maintained to reduce air emissions

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
		heavy construction equipment deployed at site will be the main sources of air pollution during the construction period. Due to the short duration of the planned action, any impacts on ambient air quality during construction activities are expected to be short term.	● Equipment will be periodically checked and maintained time to time. ● Exhaust vent of DG set will be kept at proper height to ensure quick dispersion of gaseous emissions ● Sprinkling of water on roads and construction site, growing sufficient vegetation are some of the measures that would greatly reduce the impacts during the construction phase. ● Implementing proper upkeep and maintenance of vehicles, and using Pollution under Control (PUC) certified vehicles for transport machinery.
B.2	Noise Level	The operation of construction equipment will generate noise. The noise produced during the construction will have significant impact on the existing ambient noise levels. There will be noise generation from construction equipment and material handling equipment. Vehicles carrying construction materials will also generate noise.	● Any machinery or equipment generating excessive noise levels will be taken out for maintenance. ● Use of proper personal protective equipment will be encouraged which will mitigate any significant impact of the noise generated by such equipment. ● Well-tuned vehicles will be used.
	Noise Level	The activities such as foundation & infrastructure construction, plant erection will produce periodic noise during construction phase. However, possible noise control measures will be adopted and hence the impact of generated noise on the equipment is	● D.G set to be used during construction phase shall be provided with acoustic enclosures. ● Noise protection PPEs shall be provided to the workers and their use by workers shall be enforced

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
		likely to be temporary and insignificant.	by contractors as well as site management.
C	Water Environment		
C.1	Water quality	During the construction phase, site preparation (leveling, excavations etc.) and erection of structures may have temporary effect on the water quality of receiving water body. Flow of loose materials (soil and construction material) into the drains, especially during monsoons may result in higher turbidity and suspended solids content. Stagnation of water may create unhygienic condition.	Construction management will ensure the following: • The wash off will be directed to a sedimentation basin before discharge. As the site and drainage network is already developed, the impacts shall be controlled effectively. • Fuel oil, lubricants and grease etc. shall be stored in closed containers in dykes in storage areas with impermeable floors. • Adequate arrangements would be made to ensure proper drainage and disposal of the wastewater; so that water does not stagnate promoting the breeding of mosquitoes and creating unhygienic conditions.
D	Ecology	As the land is already under possession of Gadarwara STPP and is under industrial use, the direct impact on terrestrial ecology (loss of flora and fauna) during construction phase is likely to be insignificant. Construction activities may result in fugitive dust emission. The dust deposition on pubescent leaves of the surrounding vegetation may lead to temporary reduction of photosynthesis. The runoff from construction area may lead to a short-term increase in	• As the site infrastructure facilities are already developed, construction activities will be confined to the proposed expansion project and the impact will be marginal for a short time period. • Fugitive dust emission shall be minimized through regular water sprinkling in dust-generating areas and green belt development. • All the stormwater runoff shall be channelized through

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
		suspended solids and decrease in dissolved oxygen near the discharge point in receiving water body. This may lead to a temporary decrease in the photosynthetic activity of phytoplanktons, rise in anaerobic conditions and food chain modification.	sedimentation basins to control suspended solids.
E	Demography & Socio-economics	The social impact during the construction stage will be beneficial in nature. During construction phase, people from neighborhood will be engaged by contractors on daily wage basis as most of the construction work is labour intensive. Local people would be preferred for secondary employment with contracting agencies, depending upon their skill and experience. During construction, due to influx of labour, economic activities in surrounding areas will be increased. The construction material like stone chips and sand may be procured locally. Thus, there is possibility of generation of local trading opportunities for a limited period of time.	Positive impacts ● Generation of employment both direct and indirect to the local people. ● Improvements in local infrastructure, such as roads, transportation, and utilities. ● Increased employment and small business opportunities near construction site that can increase economic growth, leading to improved living standards.
F	Local Infrastructure	The influx of labour will result in increased load on drinking water facilities, health facilities and sewerage system.	● Basic facilities for labours hired from outside such as shelters, and adequate drinking and sanitation facilities shall be provided.
G	Site Development & Construction	The site development and construction activity will generate dust, which generally settles down on the adjacent areas within a short	● Dust nuisance from the construction site will be suppressed through periodical

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
	of Main Plant & Ash Pond	period due to its larger particulate size. This temporary dust generation and deposition on vegetation from the construction activity have adverse impact on visual and aesthetic quality in and around the proposed activity. The proposed main plant expansion is located within the existing power plant site. The potential impact on visual and aesthetics due to fugitive emission without mitigation major is considered to be moderate significance.	water spraying at disturbance area; ● Construction material will be transported through covered truck/trailers.

Hence, negative impact is considered to be insignificant due to the construction of the proposed expansion project as proper mitigation measures are taken in account. However, there will be positive impacts on social conditions.

B. Impacts due to Operation of the project:

Table 4.6: Identification of Impacts & Mitigation Measures-Operation Phase

Sl. No.	Aspects	Impact identified	Mitigation Measures
A	Land Environment		
A.1	Soil Quality	During the operation stage, the project will generate fugitive dust and gas emissions. The transportation of ash and coal will also have some spillage which will have limited impact on localized soils. The soils within the deposition zone of pollutants may undergo physico-chemical changes due to deposition of PM (ash particles) and washout of gases (SO₂ and NO_x) during the rains.	Transportation vehicles will have tarpaulin cover to avoid dust emission. The impacts on soil due to operation of the power plant and gaseous emission are likely to be under control as the incremental concentration of particulate matter PM₁₀, PM_{2.5}, SO₂ & NO₂ levels are observed well within NAAQS in the surrounding areas. PM from boilers will be controlled by the installation of ESP. Dust suppression and bag filters for the

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
		The soil microbial environment undergoes changes as a result of accumulation of pollutants. Fugitive dust (including ash particles) induced alterations in soil properties ultimately affects plant growth. Spillage of fly ash while transportation may lead to change in soil characteristics. Impact on soil quality due to ash disposal.	coal and ash handling systems will control PM emissions. FGD and NOx control systems such as Low NOx burner and Over Fire Air shall be provided to effectively control SO₂ and NOx emission levels. Ash silos will be provided for collection of fly ash in dry form for further transportation to utilities. Vehicle washing for avoiding fugitive ash shall be provided. For proposed new ash dyke, HDPE lining system is envisaged in OFL and Bentonite blended lining in ash storage lagoons following the imperviousness requirements as per “CEA and CPCB Guidelines for Design, Construction, O&M and Annual certification of Coal Ash Ponds-June 2023”. Also, the ash dyke stability design will be done by NTPC in line with “CEA and CPCB Guidelines for Design, Construction, O&M and Annual certification of Coal Ash Ponds-June 2023”.
A.2	Solid and Hazardous Wastes	Solid Waste: During the operation stage, the project will generate fly ash and bottom ash. Approximately 80% of it will be fly ash and balance 20% will be in the form of bottom ash.	Solid Waste: Ash utilization shall be made as per MoEF&CC notification. Dry ash will be handled by pneumatic conveying systems and will be supplied to Cement, ash brick/ash product manufacturers, other end users etc. Wet ash will be handled using HCSD systems. Bottom Ash shall be stored in Ash Dyke.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
		Hazardous Waste: During the operation stage, the project will generate Hazardous Wastes which will be managed according to the applicable regulation.	Hazardous Waste: The used oil will be collected in drums and sent to authorized re-processor. All other waste will be co processed/reuse/recycled through authorized agencies as per the authorization from SPCB.
		The hazardous materials used during the construction may include diesel and paints. Construction sites handle small quantities of lube oils and diesel for running the construction equipment's. In case of spill of these materials, the soil quality can get deteriorated.	● In order to avoid soil contamination due to accidental spills, it has been recommended to provide spill absorbing material at the construction site and the contaminated soil should be excavated and these materials shall be stored and disposed of to hazardous waste disposal sites according to the guidelines. ● Hazardous waste such as used oil generated during construction activities shall be stored at designated paved area in leak proof containers at site and shall be sent for disposal to an authorized recycler. ● Other solid waste generated during operation phase such as packaging waste i.e. paper, plastic etc., shall be collected in dedicated area and shall be disposed off to an approved scrap dealer. ● Care will be taken to avoid spillage of painting waste containing heavy metals during painting job. It is recommended to cover ground with protecting sheets to avoid damage to soil.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
B	Air Environment		
B.1	Air Quality	The proposed expansion of coal based thermal power station along with the existing unit will have pollutant emission in form of SO₂, NO_x and PM from flue gas of the stacks. The air borne fugitive dust from the plant is likely to be generated from coal handling plants, which will be deposited on the topsoil and leaves of flora in the immediate vicinity of the plant boundary. Fugitive dust nuisances are the aspects of concern for people residing nearby, trees in vicinity whose leaves will accumulate these depositions and local fauna which will inhale the Respirable component of those dust particles. Predictions have been carried out for stack emissions & emissions from crusher houses considering worst coal characteristics.	To control PM emissions from TPP Stacks, high efficiency Electrostatic Precipitator (ESP) is proposed. For control of SO₂ emissions, Flue Gas Desulphurization (FGD) with lime scrubbing is proposed. To control NO_x emission provision of low NO_x burner and Over Fire Air has been envisaged. Necessary dust suppression arrangement will be used in railway siding and coal handling plant. The top surface of coal wagons will be adequately sprinkled to reduce fugitive emissions during unloading. Belt conveyors will be covered to minimize the fugitive dust emissions. Auxiliary fuel (LDO) transportation will be occasional; hence its impact will be for limited time period. The ash handling system will be provided with sprinkler and bag filter to control emission. Regular housekeeping will be done at plant roads, platforms and storage area.
	Transportation of Coal	● Noise and Air Emissions from Vehicles ● Fugitive Dust Emissions due to Traffic Movement ● Fugitive emissions of coal	● A regular water spraying during unloading. ● Plantation of fast growing, evergreen, broad leaved, dust-resistant indigenous plant species (also proposed under Greenbelt Development Program).

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
			• Proper maintenance of tracks and wagons by railway authority.
B.2	Noise Level	During operation, the maximum expected noise level will be from turbine generator and other sources like cooling tower, boiler, mills, transformer, compressors, etc. Exposure to prolonged or excessive noise has been shown to cause a range of health problems ranging from stress, poor concentration, productivity losses in the workplace, and communication difficulties and fatigue from lack of sleep to other more serious issues.	Noise pressure level from equipment will be kept low by proper design and enclosures, wherever possible. Dense green belt all around will attenuate noise to acceptable limits at boundary and beyond. In addition, protective measures (earmuff & ear plug etc.) will be provided to the operators and workers working near high noise generating machineries. As per Occupational Safety and Health Administration (OSHA) Standards, the maximum allowable noise level for the workers is 90 dB (A) for 8 hours exposure a day which will be taken care. In case of higher noise level at work places, rotation of employees will be done as per OSHA Limits.
C	Water Environment		
C.1	Water resource	A thermal power plant requires huge quantity of water for its continuous operation. Water requirement for the existing unit is 1,12,200 KLD while additional water requirement for the proposed unit is 48,000 KLD with AWRS system. The entire water shall be sourced from Narmada River allocated by Water Resources Department, Bhopal, MP.	Ultra Super Critical Technology, ACC, ETP, STP, ZLD, rainwater harvesting etc., provisions have been made to conserve fresh water. Further wastewater will be treated, recycled & re-used to reduce freshwater consumption and make it more sustainable & efficient.
C.2	Surface water quality	Sources of wastewater include:	Regeneration waste from DM (De-mineralized Water) Plant and CPU

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
		- Regeneration waste from DM plant - Boiler blow down - Boiler & ESP area wash water - CHP-DS system effluent & CHP run off - Effluent from floor washing run-off and oil handling areas. - Domestic sewage These effluents, if discharged outside, may degrade the quality of the water body. The effluent system may also pose a risk to surface water bodies if allowed to mix up with the storm water drainage system.	(Condensate Polishing Unit) will be collected in Neutralizing pit. After neutralizing the water will be pumped to CMB (Central Monitoring Basin). Boiler blow down collected in separate sump will be pumped to CMB. Boiler & ESP area wash water will be collected in pre settling pit. Water collected in CMB will be monitored and after pH correction water will be treated in UF & RO to make it suitable for reuse in DM Plant makeup / Aux. CT (Cooling Water) make-up. The sewage from plant shall be treated in a sewage treatment plant. The treated sewage conforming to prescribed standards shall be utilized for plantation & horticulture to the extent possible. The proposed plant will be designed for Zero Liquid Discharge (ZLD).
C.3	Groundwater resource and quality	Groundwater issues typically arise from leachate from ash disposal area.	No groundwater extraction is proposed. The existing ash dyke is lined with impermeable layer to prevent any seepage of ash water to the ground. Stormwater will be collected in RWH system to the extent possible and reused.
		Ground water pollution can take place due to leachate from ash pond.	Ash pond will be lined by an impervious layer. Though possibility of leaching of metals from ash water is very low, the impervious lining will eliminate

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
		Ground water pollution can take place due to leachate from storage of toxic waste.	possibility of ground water pollution. ● There is also no storage of toxic waste and thus there is also no scope of polluting ground water sources by seepage or leaching.
D	Ecology	Quantitative and qualitative changes in solar radiation impinging on the leaf surface and alterations in the energy exchange process of leaf due to dust deposition. Particulate emission and Sulphur dioxide emissions from the proposed TPP are the major pollutant that may affect the ecology of the area. Dust particles deposited on stigmatic surfaces of flowers reduce effective pollinations and hence fruit yields. Noise generated from various activities of the plant may disrupt breeding behaviors, resulting in shifts in population dynamics. As the water required shall be drawn from Narmada River, fish may tend to get entrapped and impinged in the intake system; and smaller organism as phytoplanktons & zooplanktons may get entrained in the intake system. The entrained organism may be subjected to a combination of physico-chemical and	To control PM emissions from TPP Stacks, high efficiency Electrostatic Precipitator (ESP) is proposed. For control of SO₂ emissions, Flue Gas Desulphurization (FGD) with lime scrubbing is proposed. To control NO_x emission low NO_x burner and Over Fire Air system is envisaged. CPCB adopted the injury symptoms and pollution dose thresholds of tolerance by sensitive species of plants developed by W.H. Smith (1981) which stipulates that SO₂ at 0.70 ppm (1820 µg/m³) after 1 hour exposure or 0.18 ppm (468 µg/m³) after 8 hours' exposure gives rise to visible injury symptoms in vegetation. Similarly, NO_x at 20 ppm (38x10³ µg/m³) after 1 hour exposure or 1.6-2.6 ppm (3000-5000 µg/m³) after 48 hours' exposure or 1 ppm (1900 µg/m³) after 100 hours' exposure is likely to bring about injury symptoms in vegetation. However, such high ambient air concentration of SO₂ and NO_x is not likely to occur in the area. As per the modeling studies considering the worst-case scenario, the maximum resultant concentration of SO₂ will

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
		mechanical stresses, leading to their destruction.	be $6.66 \mu\text{g}/\text{m}^3$ and NO_x will be $5.87 \mu\text{g}/\text{m}^3$ (@$100 \mu\text{g}/\text{m}^3$) and $17.6 \mu\text{g}/\text{m}^3$ (@$300 \mu\text{g}/\text{m}^3$) in the ambient air even after the power plant comes into operation. The details of the incremental concentration of the pollutants at study area as given in Table 4.8, which show that the values are well within the ambient air quality limit. Hence there will be no significant impact on vegetation. Suitable screens are provided at the intake point of water to prevent entrapment of organisms.
E	Demography & Socio-economics	The proposed project will improve the basic infrastructure & the people of nearby villages will be able to use these amenities. During operational phase, manpower of 186 (direct) & 1500 (indirect) are anticipated for operation, maintenance and general requirements of the power station. The skilled manpower will be in general sourced from the present pool, while the semi-skilled and unskilled workers will be sourced locally as per qualification and skill.	No additional land acquisition is envisaged for the proposed expansion project. The project will have positive impact on the socio-economics of the region.
	Impact on nearby sensitive areas like; schools, villages and habitations	Adverse health impacts due to emissions of pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM), and fugitive dust emission. High concentration above the permissible limits may lead to respiratory ailments, cardiovascular	To control PM emissions from TPP Stacks, high efficiency Electrostatic Precipitator (ESP) is proposed. For control of SO_2 emissions, Flue Gas Desulphurization (FGD) with lime scrubbing is proposed. To control

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
	(Bal Bharti school (BBPS) in NTPC township, Chorbarheta govt. school and Kodari govt. school and Dongargaon govt. school)	diseases, and other health problems. However ambient air quality parameters within the norms NAAQs, 2009 may not pose any serious health issues.	NOx emission low NOx burner and Over Fire Air system is envisaged. Air Quality Monitoring will be carried out in and around the sensitive locations to monitored pollutant levels. Creation of plantation barriers of pollution absorbing plants like Neem, Pipal and fruit bearing plants like Mango and shrubs around schools to act as natural barrier reducing the exposure to the pollutants. Health screenings: Regular health check-ups in villages and schools to detect and address pollution-related health issues early. Awareness Programs to educate students and staff about the health risks associated with air pollution and promote practices to minimize exposure.
F	Physical Presence of Plant, Ash Pond and Associate Facility	The physical presence of main plant, especially the elevated structures like Boiler & turbine house, stack, coal silos, elevated coal conveyor, etc. will lead to adverse visual impact for residents of the area.	Greenbelt development proposed in the plan need to be implemented along with the construction phase depending upon the availability of the area for sapling plantation. It is proposed to develop a greenbelt around the main plant, and ash pond on available area. Periodic monitoring of greenbelt survival as well as plantation of new plants shall be carried out. Plantation shall be carried out in 2 to 3 tier.
G	Coal Handling Plant	Unloading of coal from coal rakes, transport of coal-to-coal crushing	Dust suppression measures in coal unloading site, crushing plant,

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Aspects	Impact identified	Mitigation Measures
		plant, crushing of coal and stacking of coal will generate coal dust, which lead to dust nuisance in the immediate vicinity of coal handling plant. The deposition of coal dust on vegetation and property would have some adverse impact. However, dust suppression measures in coal unloading site, crushing plant, storage of coal in silos, greenbelt along the main plant will minimize dust emission. This limited dust generation in coal handling plant will settle down on the adjacent areas within a short period due to its larger particulate size.	storage of coal in silos, greenbelt along the main plant will minimize dust emission. Provision of Dust Extraction Dust Suppression, Dry Fog Dust Suppression and Sprinklers has been envisaged for control of dust emissions. Greenbelt plantation around the CHP has been envisaged.
H	Coal Combustion and Stack Emission	The major visual impact from the power plant will be deposition of fly ash from the stack emission on the adjacent land and property. The Project will be having advanced air pollution control systems like ESP, FGD, NO_x control etc., that will be in place in order to comply with the air quality standards, which include taller stacks for better dispersion of pollutants. Stack emissions will also be monitored by Continuous Emission Monitoring System.	● Installation and operation of high efficiency pollution control equipment to ensure maximum removal of flue gas air pollutants. Continuous emissions monitoring of flue gas.

4.4 IMPACT ON AIR QUALITY

4.4.1 AIR POLLUTION MODELLING

4.4.1.1 FUGITIVE EMISSION

The air borne fugitive dust from the plant is likely to be generated from coal handling plants, stock piles and traffic movement which will be deposited on the topsoil in the immediate vicinity of the plant

boundary. However, the fugitive emission is likely to be controlled to a great extent through control measure like dust suppression system at coal transfer point, dedusting system at Crusher House, greenbelt etc. The impact of fugitive emissions from all sources is likely to be restricted within the plant premises.

4.4.1.2 PROCESS STACK EMISSION

Other than the fugitive emission, the flue gas emission from the chimney of the existing and proposed units of the power plant as a result of coal burning is anticipated to be the major contributor to increase in pollution level in the ambient air quality of the project vicinity. For the proposed units, PM will be limited below 30 mg/Nm³ and 100 mg/Nm³ for SO₂ & NO₂ as per standards vide S.O.3305E dated 7th December, 2015 and its amendments. The emissions from the existing unit are well within the applicable norms.

In order to quantify the maximum likely impact within a 10 km buffer area around the project site, the contribution of the existing as well as proposed units of the power plant on the ambient concentration level is assessed using suitable approved dispersion model.

4.4.1.3 AIR MODELLING AIR POLLUTION IMPACT PREDICTION THROUGH MODELLING FOR OPERATING PHASE

The impact on air quality is assessed based on combined emissions of the proposed power plant along with the present baseline data. Suspended Particulate Matter (SPM), Sulphur dioxide (SO₂) and Oxides of Nitrogen (NO_x) will be the important pollutants emitting from the power plant. Prediction of impacts on air environment has been carried out employing mathematical model based on a steady state Gaussian plume dispersion model designed for multiple point sources for short term. In the present case, AERMOD dispersion model based on steady state Gaussian plume dispersion, designed for multiple point sources for short term and developed by United States Environmental Protection Agency [USEPA] has been used for simulations from point sources.

Air Dispersion Modelling Studies

Prediction of impacts on air environment has been carried out by air dispersion modelling employing mathematical model based on a steady state Gaussian plume dispersion model designed for multiple point sources.

The assessment methodology for the air dispersion modelling is done based on document “Assessment of Impact to Air Environment: Guidelines for Conducting Air Modelling” by Central Pollution Control Board.

The detailed model recommended is AMS/EPA Regulatory Model (AERMOD). The model of selection was the commercially available AERMOD Ver 9.9.1 View dispersion model, developed by Lakes Environmental. This model is used extensively to assess pollution concentration and deposition from a wide variety of sources. AERMOD View is a true, native Microsoft Windows application and runs in Windows applications. The AMS/EPA Regulatory Model (AERMOD) was specially designed to support the EPA’s regulatory modelling programs.

AERMOD is a regulatory steady-state plume modelling system with three separate components:

- AERMOD (AERMIC Dispersion Model)
- AERMAP (AERMOD Terrain Preprocessor), and
- AERMET (AERMOD Meteorological Preprocessor).

The AERMOD model includes a wide range of options for modelling air quality impacts of pollution sources, making it a popular choice among the modelling community for a variety of applications.

Modelling capabilities of AERMOD include the following:

- The model can be used to analyse primary pollutants and continuous releases of toxic and hazardous waste pollutants.
- Source emission rates can be treated as constant or may be varied by month, season, hour-of-day, or other optional periods of variation. These variable emission rate factors may be specified for a single source, line source, area source (transportation of coal, coal handling), or for a group of sources. For this project all emission rates were treated as constant.
- The model can account for the effects of aerodynamic downwash due to buildings that are nearby point source emissions.
- Receptor locations can be specified as gridded and/or discrete receptors in a Cartesian or polar coordinate system.
- For applications involving elevated terrain, the U.S. EPA AERMAP terrain preprocessing program can be incorporated into the model to generate hill height scales as well as terrain elevations for all receptor locations.
- The model contains algorithms for modelling the effects of settling and removal (through dry and wet deposition) of large particulates and for modelling the effects of precipitation scavenging for gases or particulates.

AERMOD requires two types of meteorological data files, a file containing surface scalar parameters and a file containing vertical profiles. These two files are provided by the U.S. EPA AERMET meteorological preprocessor program.

➤ **For existing and Proposed Units:**

- Chimney height of 275m for dispersion of emissions.
- Electrostatic Precipitators to limit the particulate emission (PM) within 30 mg/Nm³
- Wet FGD system will be provided to bring down SO₂ emission within 100 mg/Nm³.
- Low NO_x burners (LNB)/Low NO_x System, which reduces the air available to the fuel stream during the devolatilization process, and thus reduces NO_x production to bring down NO₂ emission within stipulated norms.

4.4.1.4 STACK DETAILS

The emission data in the model has been calculated using the Sulphur content and emission factors of various components. MoEF&CC emission standards for thermal power plant have been considered in

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



calculation of emission rates. Modelling has been done with 3 stack scenarios (2 for existing units and 1) for proposed units as given as below.

Scenario 1: Emissions from existing units of NTPC Gadawara with 150-m stack height & with FGD and proposed units 275-m stack height & with FGD within 10 km radius.

The stack details are given in table below:

Table 4.7: Details of Stack Emissions of Existing and Proposed Project

Description	Existing 2x800 MW		Proposed 2x800 MW	
Scenario	With FGD		Configuration with FGD	
Units	(Unit – 1)	(Unit – 2)	(Unit – 1)	(Unit – 2)
No. of Stack(s)	01 (Single Flue)	01 (Single Flue)	01 (one with twin flue)	
Stack height (m)	150	150	275	275
Internal diameter at Stack Top (m)	9.576	9.576	9.02	9.02
Exit velocity of flue gas (m/s)	17	17	18.3 (Max.)	18.3 (Max.)
Temp. of flue gas degree °C	54.4	54.4	60	60
Flue gas flow rate (Nm ³ /Hr)	3053921 (1027.72 m ³ /s)	3053921 (1027.72 m ³ /s)	3203135 (1096.37 m ³ /s)	3203135 (1096.37 m ³ /s)
Rate of coal consumption, TPH	538	538	479	479
GCV of Coal(kcal/kg)	3200	3200	3600	3600
Ash Content (max.), %	42	42	37	37
Sulphur in coal(max.), %	0.3	0.3	0.4	0.4
SO ₂ emission rate (g/s) (*100mg/Nm ³)	84.83 (@100 mg/Nm ³)	84.83 (@100 mg/Nm ³)	88.98 (@100 mg/Nm ³)	88.98 (@100 mg/Nm ³)
NO _x emission rate (g/s) (*100mg/Nm ³)	77.44 (@100 mg/Nm ³ approx.)	77.44 (@100 mg/Nm ³ approx.)	78.513 (@100 mg/Nm ³)	78.513 (@100 mg/Nm ³)
NO _x emission rate (g/s) (*300 mg/Nm ³)	271.05 (@350 mg/Nm ³ approx)	271.05 (@350 mg/Nm ³ approx)	235.54 (@300 mg/Nm ³)	235.54 (@300 mg/Nm ³)
PM emission rate (g/s) (*30 mg/Nm ³)	23.233 (@30 mg/Nm ³ approx)	23.233 (@30 mg/Nm ³ approx)	23.554 (@30 mg/Nm ³)	23.554 (@30 mg/Nm ³)

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 4.7A: Details of Stack Emissions for Existing and Proposed Project without Control measures

Description	Existing 2x800 MW		Proposed Stage-II (2x800 MW)	
Scenario	With FGD		Configuration without FGD	
Units	Unit – 1	Unit – 2	Unit-1	Unit-2
No. of Stack(s)	01 (Single Flue)	01 (Single Flue)	01 (One) with twin flue	
Stack height (m)	150	150	275	275
⁶ Internal diameter at Stack Top (m)	9.576	9.576	8.58	8.58
³ Exit velocity of flue gas (m/s) (approx.)	17	17	25 (Max.)	25 (Max.)
³ Temp. of flue gas degree °C	54.4	54.4	131	131
³ Flue gas flow rate (Nm ³ /hr)	3053921 (1027.72 m ³ /s)	3053921 (1027.72 m ³ /s)	2844252 (1151.63 m ³ /s)	2844252 (1151.63 m ³ /s)
³ Rate of coal consumption, TPH	538	538	547	547
³ GCV of Coal (kcal/kg)	3200	3200	3200	3200
³ Ash Content, %	42	42	43	43
³ Sulphur in coal, %	0.3	0.3	0.55	0.55
⁴ PM emission rate (g/s) (maximum)	84.83 (@100 mg/Nm ³)	84.83 (@100 mg/Nm ³)	23.702 (@30 mg/Nm ³)	23.702 (@30 mg/Nm ³)
SO ₂ emission rate (g/s) (maximum)	77.44 (@100 mg/Nm ³ approx.)	77.44 (@100 mg/Nm ³ approx.)	1743.33 (@2207 mg/Nm ³)	1743.33 (@2207 mg/Nm ³)
NO _x emission rate (g/s) (maximum)	271.05 (@350 mg/Nm ³ approx)	271.05 (@350 mg/Nm ³ approx)	79.007 (@100 mg/Nm ³)	79.007 (@100 mg/Nm ³)
NO _x emission rate (g/s) (maximum)	23.233 (@30 mg/Nm ³ approx)	23.233 (@30 mg/Nm ³ approx)	237.021 (@300 mg/Nm ³)	237.021 (@300 mg/Nm ³)

4.4.1.5 PREDICTED GROUND LEVEL CONCENTRATION

Short-term simulations, for 24-hourly average as applicable has been carried out to predict the concentrations at the various receptors to quantify the likely impact on the ambient concentration level over an area covering 10-km radius from the point of emission source. The maximum incremental ground level concentrations (GLCs) are predicted taking the worst-case scenario of emission from the proposed project. The maximum incremental GLCs due to the proposed expansion project for PM₁₀, PM_{2.5}, SO₂ and NO_x are superimposed on the ambient baseline concentration of PM₁₀, PM_{2.5}, SO₂ and NO_x recorded at all the monitoring locations during the field monitoring period of pre monsoon season i.e., March, 2024 to May, 2024.

The ground level concentrations (baseline + incremental) after implementation of worst-case scenario are tabulated in **Table 4-8-4.8A**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT MANAGEMENT
PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 4.8: Resultant Ambient Air Quality GLC during Operation of proposed project in $\mu\text{g}/\text{m}^3$ (Existing & Proposed with FGD)

Sl. No.	Station Name	Direction	Distance (km) project boundary	Baseline AAQ (98 percentile) Values				Incremental GLC with proposed expansion					Resultant with proposed expansion				
				PM ₁₀	PM _{2.5}	SO ₂	NO ₂	PM ₁₀	PM _{2.5}	SO ₂	NO ₂ (@100 mg/Nm ^{3*})	NO ₂ (@300 mg/Nm ^{3**})	PM ₁₀	PM _{2.5}	SO ₂	NO ₂ (@100 mg/Nm ³)	NO ₂ (@300 mg/Nm ³)
1	Project Site	-	-	89.92	30.07	12.01	17.31	1.61	0.42	4.2	4.1	10.5	91.53	30.49	16.21	21.41	27.81
2	Ghoorpur	WNW	2.39	60.55	27.23	10.87	15.67	0.5	0.11	1.1	1.2	5.3	61.05	27.34	11.97	16.87	20.97
3	Kudari, Narsara	ESE	1.41	63.77	24.78	9.89	14.26	1.3	0.40	5.2	4.5	10.6	65.07	25.18	15.09	18.76	24.86
4	Mahguwan Khurd	W	6.75	53.34	23.99	9.58	13.80	0.4	0.12	1.2	1.3	4.2	53.74	24.11	10.78	15.1	18
5	Kalyanpur	E	4.48	58.62	26.36	10.52	15.17	1.4	0.31	4.1	4.2	10.5	60.02	26.67	14.62	19.37	25.67
6	Gadarwara	NW	7.49	70.99	31.92	12.74	18.37	0.3	0.15	1.1	1.2	3.3	71.29	32.07	13.84	19.57	21.67
7	Bohani	N	6.51	62.87	28.27	11.29	16.27	0.45	0.10	1.2	1.5	4.3	63.32	28.37	12.49	17.77	20.57
8	Dongargaon	NE	0.52	65.73	29.56	11.80	17.01	1.52	0.54	6.3	5.5	10.8	67.25	30.1	18.1	22.51	27.81
9	Gangai	SW	1.81	64.42	28.97	11.56	16.67	0.5	0.22	2.1	1.3	5.2	64.92	29.19	13.66	17.97	21.87
10	Badgaon PF n/v Baghakudi	S	6.15	60.86	27.37	10.93	15.75	0.32	0.10	1.3	0.95	3.6	61.18	27.47	12.23	16.7	19.35
24 hourly Average limits as per NAAQS, 2009													100	60	80	80	80
*NO ₂ @100mg/Nm ³ emission from stack ** NO ₂ @300mg/Nm ³ emission from stack																	

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 4
IMPACT ASSESSMENT & MITIGATION
MEASURES

Page
4-25

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT MANAGEMENT
PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 4.8A: Resultant Ambient Air Quality GLC during Operation of proposed project in $\mu\text{g}/\text{m}^3$ (Existing with FGD & Proposed without FGD)

Sl. No.	Station Name	Direction	Distance (km) project boundary	Baseline AAQ (98 percentile) Values				Incremental GLC with proposed expansion					Resultant with proposed expansion				
				PM ₁₀	PM _{2.5}	SO ₂	NO ₂	PM ₁₀	PM _{2.5}	SO ₂	NO ₂ (@100 mg/Nm ^{3*})	NO ₂ (@300 mg/Nm ^{3**})	PM ₁₀	PM _{2.5}	SO ₂	NO ₂ (@100 mg/Nm ³)	NO ₂ (@300 mg/Nm ³)
1	Project Site	-	-	89.92	30.07	12.01	17.31	0.30	0.16	26.8	1.85	3.85	90.22	30.23	38.81	19.16	4.15
2	Ghoorpur	WNW	2.39	60.55	27.23	10.87	15.67	0.42	0.10	33.4	1.43	4.32	60.97	27.33	44.27	17.1	4.74
3	Kudari, Narsara	ESE	1.41	63.77	24.78	9.89	14.26	0.85	0.25	61.6	2.65	8.5	64.62	25.03	71.49	16.91	9.35
4	Mahguwan Khurd	W	6.75	53.34	23.99	9.58	13.80	0.25	0.093	11.6	1.0	2.3	53.59	24.083	21.18	14.8	2.55
5	Kalyanpur	E	4.48	58.62	26.36	10.52	15.17	0.74	0.23	52.2	2.20	7.5	59.36	26.59	62.72	17.37	8.24
6	Gadarwara	NW	7.49	70.99	31.92	12.74	18.37	0.22	0.095	22.1	0.96	2.6	71.21	32.02	34.84	19.33	2.82
7	Bohani	N	6.51	62.87	28.27	11.29	16.27	0.31	0.11	32.4	1.10	3.1	63.18	28.38	43.69	17.37	3.41
8	Dongargaon	NE	0.52	65.73	29.56	11.80	17.01	0.87	0.26	60.2	2.41	8.0	66.6	29.82	72	19.42	8.87
9	Gangai	SW	1.81	64.42	28.97	11.56	16.67	0.52	0.13	33.7	1.11	5.5	64.94	29.1	45.26	17.78	6.02
10	Badgaon PF n/v Baghakudi	S	6.15	60.86	27.37	10.93	15.75	0.33	0.10	32.5	0.90	3.2	61.19	27.47	43.43	16.65	3.53
24 hourly Average limits as per NAAQS, 2009													100	60	80	80	80
*NO ₂ @100mg/Nm ³ emission from stack ** NO ₂ @300mg/Nm ³ emission from stack																	

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 4
IMPACT ASSESSMENT & MITIGATION
MEASURES

Page
4-26

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT
AND ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Observation:

It can be observed that the resultant GLCs of PM₁₀, PM_{2.5}, SO₂ and NO_x are well within the limits of NAAQS 2009.

Table 4.8B: Additional Air Quality Control Measures

Impact on air quality	Mitigation Measures	Action plan
The air quality monitoring data of 104 observations a year for relevant parameters PM ₁₀ , PM _{2.5} , SO ₂ and NO ₂ . The data recorded for PM ₁₀ annual average is 57.71 µg/m ³ at project site. 104 monitored data is enclosed as Annexure 3.7	Various air quality control measures like High efficiency ESP, Low NO_x burners & separated Over Fire Air system for NO_x control, Dust Extraction System, Dry Fog Dust Suppression System, Sprinklers and online monitoring systems for stack emissions/ambient air quality/effluent quality and plantation in and around the plant and township areas have already implemented in the existing units of Gadarwara STPP Stage-I (2x800MW). Besides the above, Installation of additional Air Quality control measures have been undertaken under Stage-I: • Flue Gas Desulphurization (under implementation) • Sprinklers in Coal Handling, Ash dyke area, Internal & External Roads • Thick Plantation • Water tankers for ash transportation routes • Regular maintenance and overhauling of the systems	Capital cost 356.67 Cr budget for ESP have been given in EMP. FGD and low NO_x burners capital cost 566.25 Cr and recurring will be 11.32 Cr have been given for proposed project. FGD will be installed along with project commissioning during operation of Stage-II. Other activities like, dust extraction & suppression System, Chimney, Ash Dyke and Green Belt, Afforestation & Landscaping, budget for the same have been given in EMP.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)**

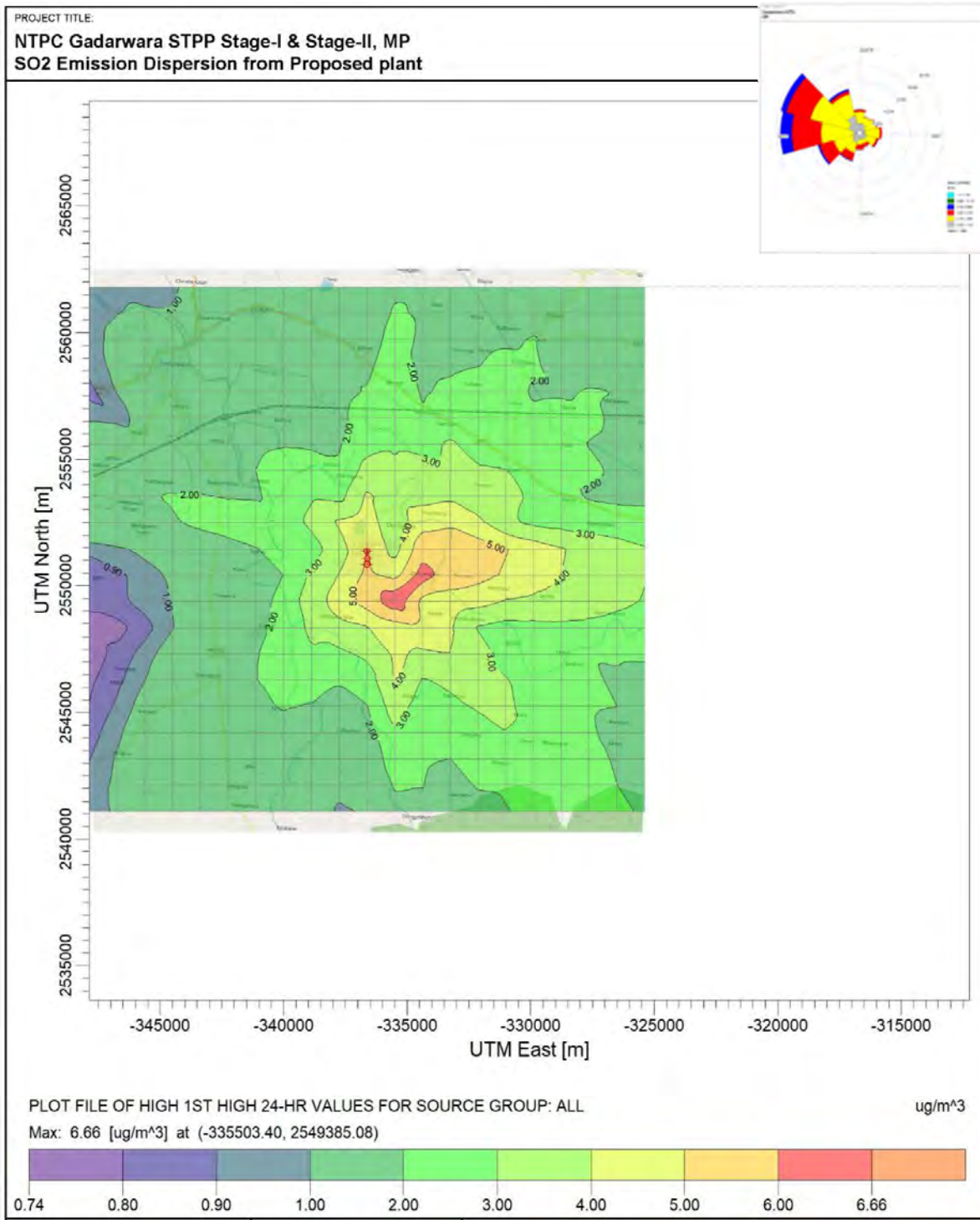


Figure 4-1: SO₂ Incremental Ground Level Concentration (Max. GLC 6.66 µg/m³ at 1.10 km in SSE direction)

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)**

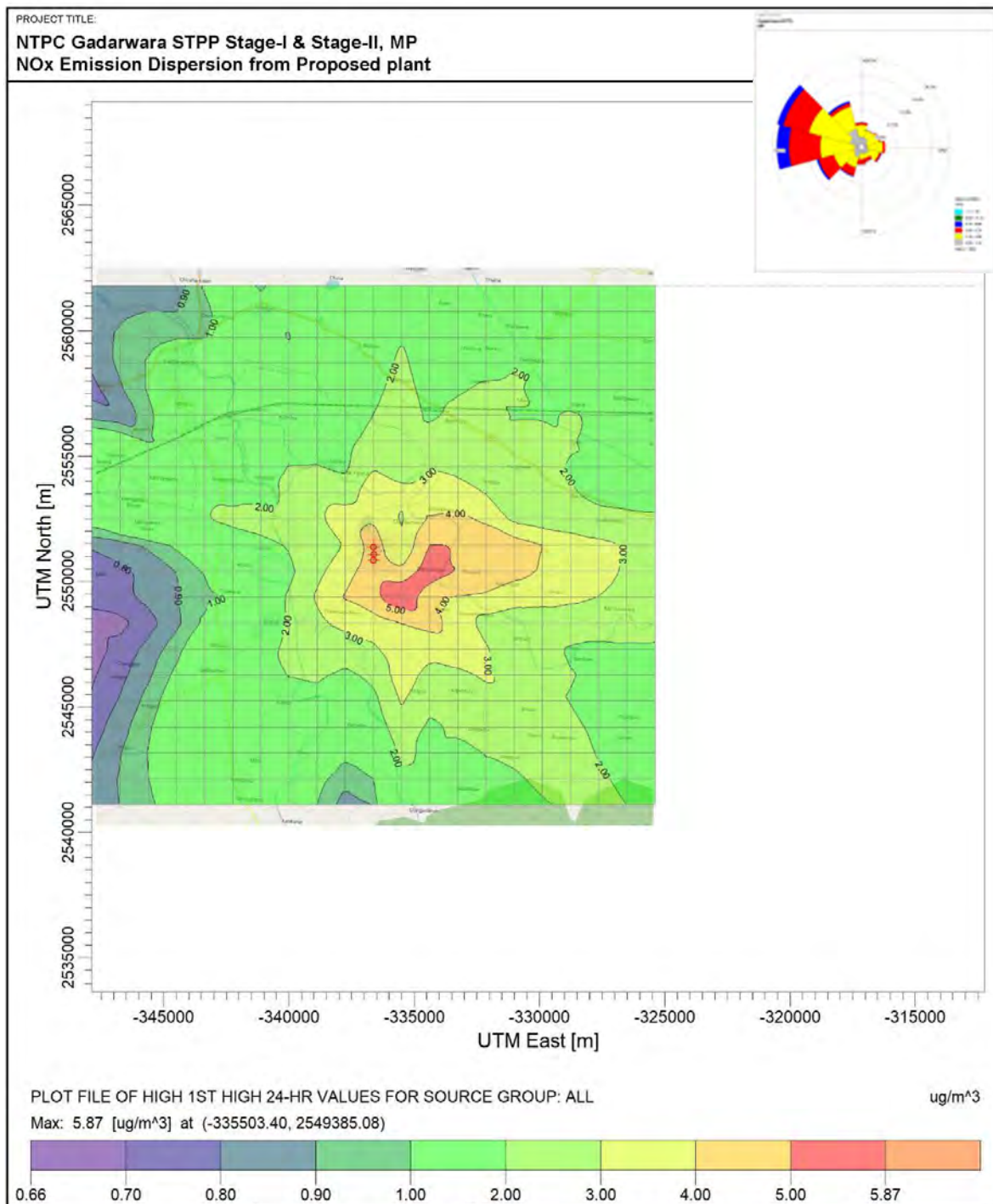


**Figure 4-2: NO₂ Incremental Ground Level Concentration @100 mg/Nm³
(Max. GLC 5.87 $\mu\text{g}/\text{m}^3$ at 1.10 km in SSE direction)**

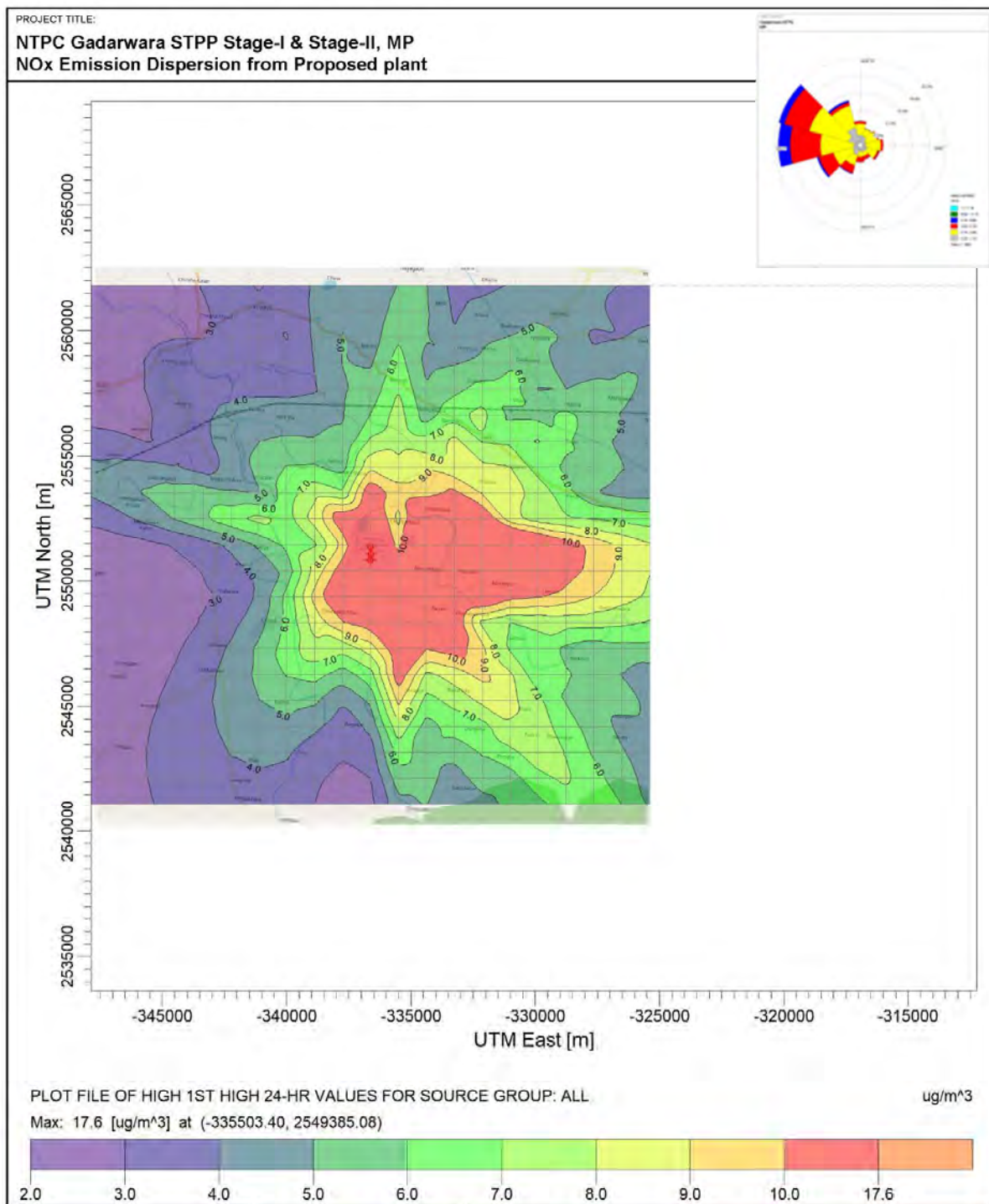


Figure 4-3: NO_x Incremental Ground Level Concentration @300 µg/m³ (Max. GLC 17.6 µg/m³ at 1.10 km in SSE direction)

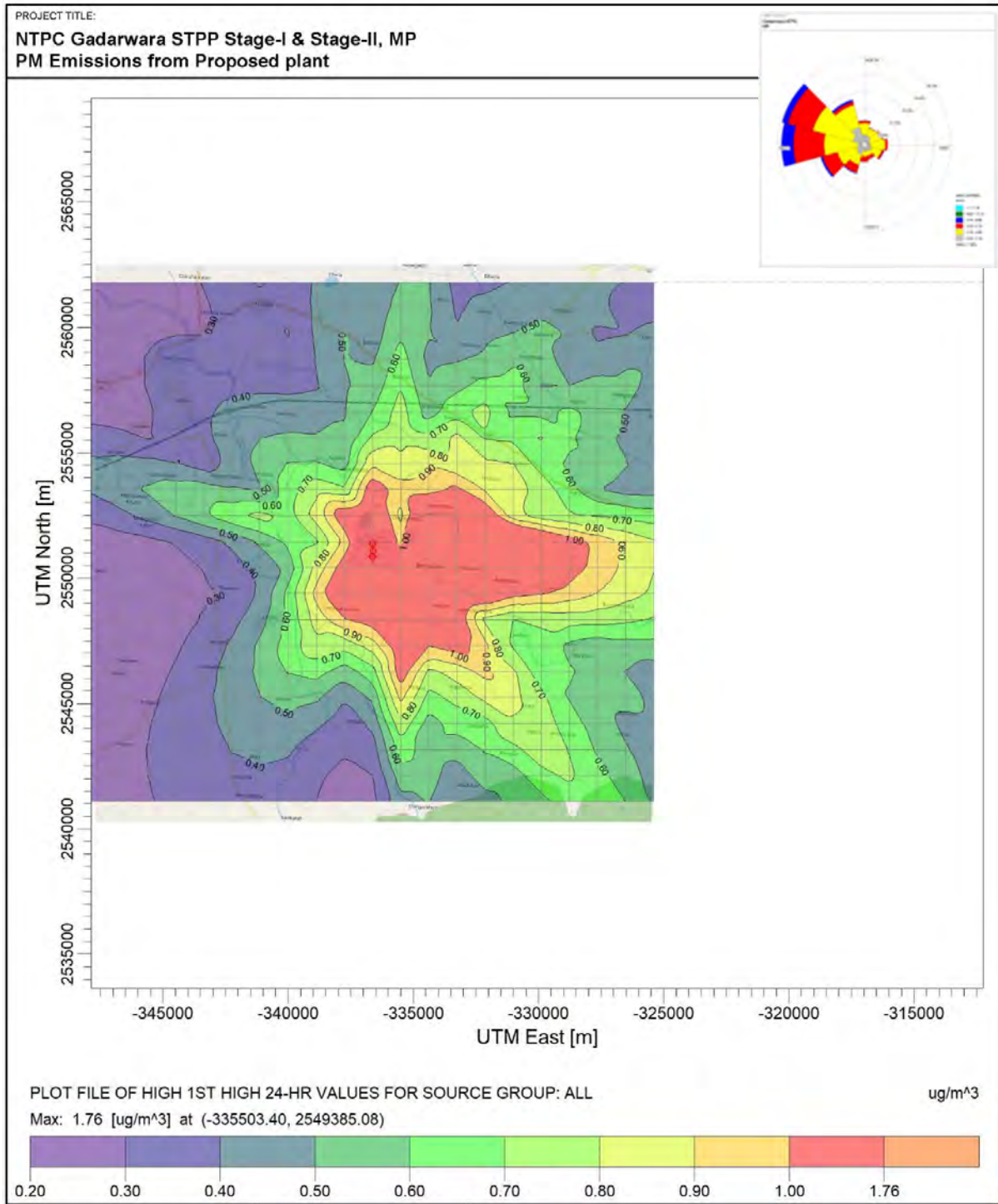


Figure 4-4: PM₁₀ Incremental Ground Level Concentration (Max. GLC 1.76 µg/m³ at 1.10 km in SSE direction)

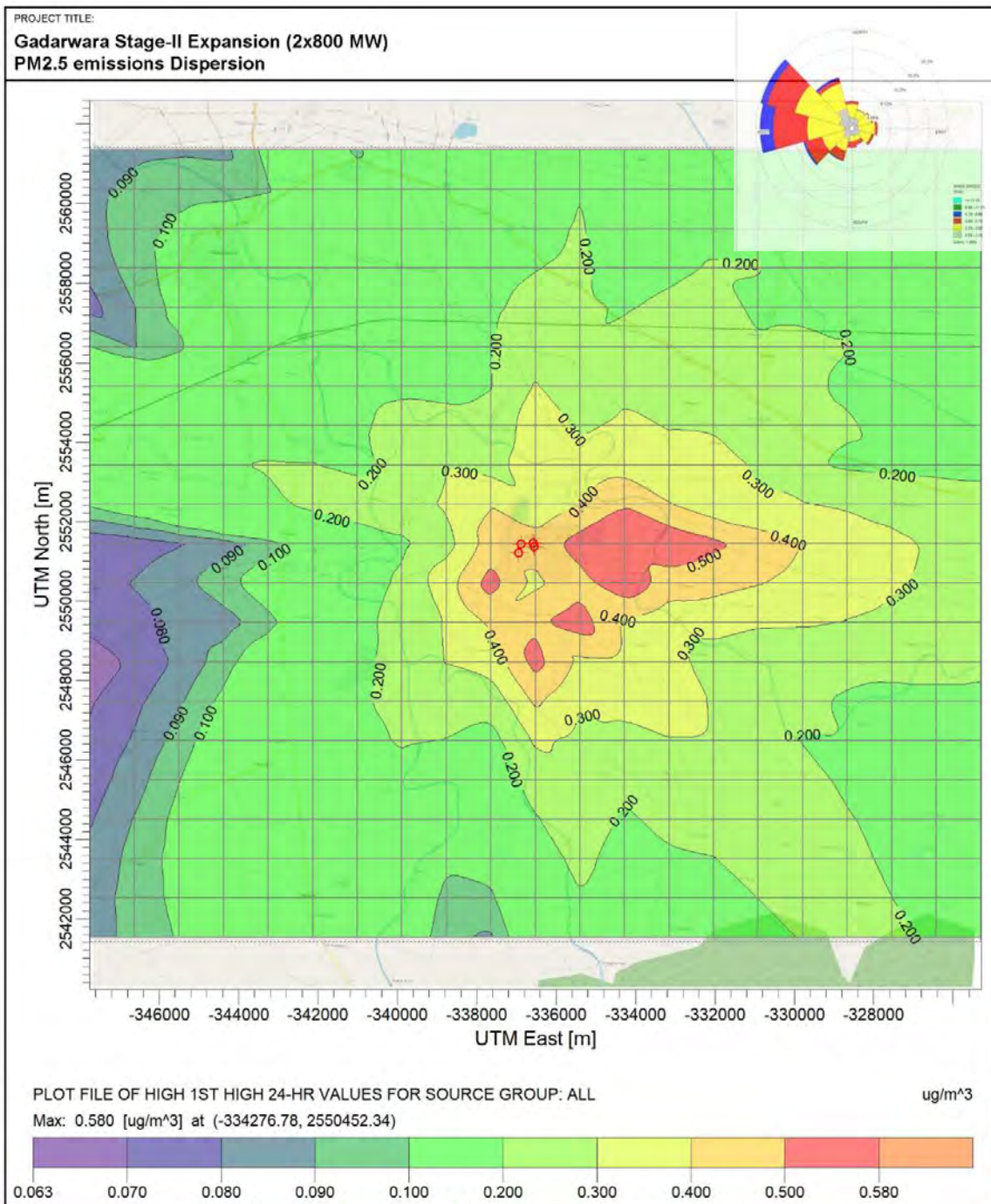


Figure 4-5: PM_{2.5} Incremental Ground Level Concentration (Max. GLC 0.58 $\mu\text{g}/\text{m}^3$ at 1.10 km in SSE direction)

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



The maximum resultant GLC's for parameters PM_{10} , $PM_{2.5}$, SO_2 , NO_x (@100mg/Nm³) & NO_x (@300 mg/Nm³) are observed to be 1.76 $\mu\text{g}/\text{m}^3$ at 1.10 km in SSE direction for PM_{10} , 0.85 $\mu\text{g}/\text{m}^3$ at 1.10 km in SSE direction for $PM_{2.5}$, 6.66 $\mu\text{g}/\text{m}^3$ at 1.10 km in SSE direction for SO_2 , 5.87 $\mu\text{g}/\text{m}^3$ at 1.10 km in SSE direction for NO_x (@100mg/Nm³) & 17.6 $\mu\text{g}/\text{m}^3$ at 1.10 km in SSE direction for NO_x (@300mg/Nm³) respectively. When the incremental GLC's are superimposed over the baseline concentrations, the resultant concentrations are well within the stipulated limits of NAAQS 2009 standards.

Whereas in worst case scenario (without FGD) the maximum resultants GLC's for parameters PM_{10} , $PM_{2.5}$, SO_2 , NO_x (@100mg/Nm³) & NO_x (@300 mg/Nm³) are observed to be 0.845 $\mu\text{g}/\text{m}^3$ at 1.82 km in SE Direction, 0.286 $\mu\text{g}/\text{m}^3$ at 0.90 km in SE Direction, 62.1 $\mu\text{g}/\text{m}^3$ at 1.82 km in SE Direction, 2.82 $\mu\text{g}/\text{m}^3$ at 0.9 km in SE Direction and 8.45 $\mu\text{g}/\text{m}^3$ at 1.82km in SE Direction respectively.

The baseline concentrations, the resultant concentrations are well within the stipulated limits of NAAQS 2009 standards.

Thus, from the prediction of the proposed project, it is clear that even the highest contribution on the ground level concentrations of PM_{10} , $PM_{2.5}$, NO_2 and SO_2 are very low. The resultant concentrations at all locations are found to be within the permissible limits of NAAQS. Therefore, after implementation of the units of project, the maximum GLCs for PM_{10} , $PM_{2.5}$, SO_2 and NO_x are predicted to be within the prescribed 24 hours NAAQS 2009.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)**

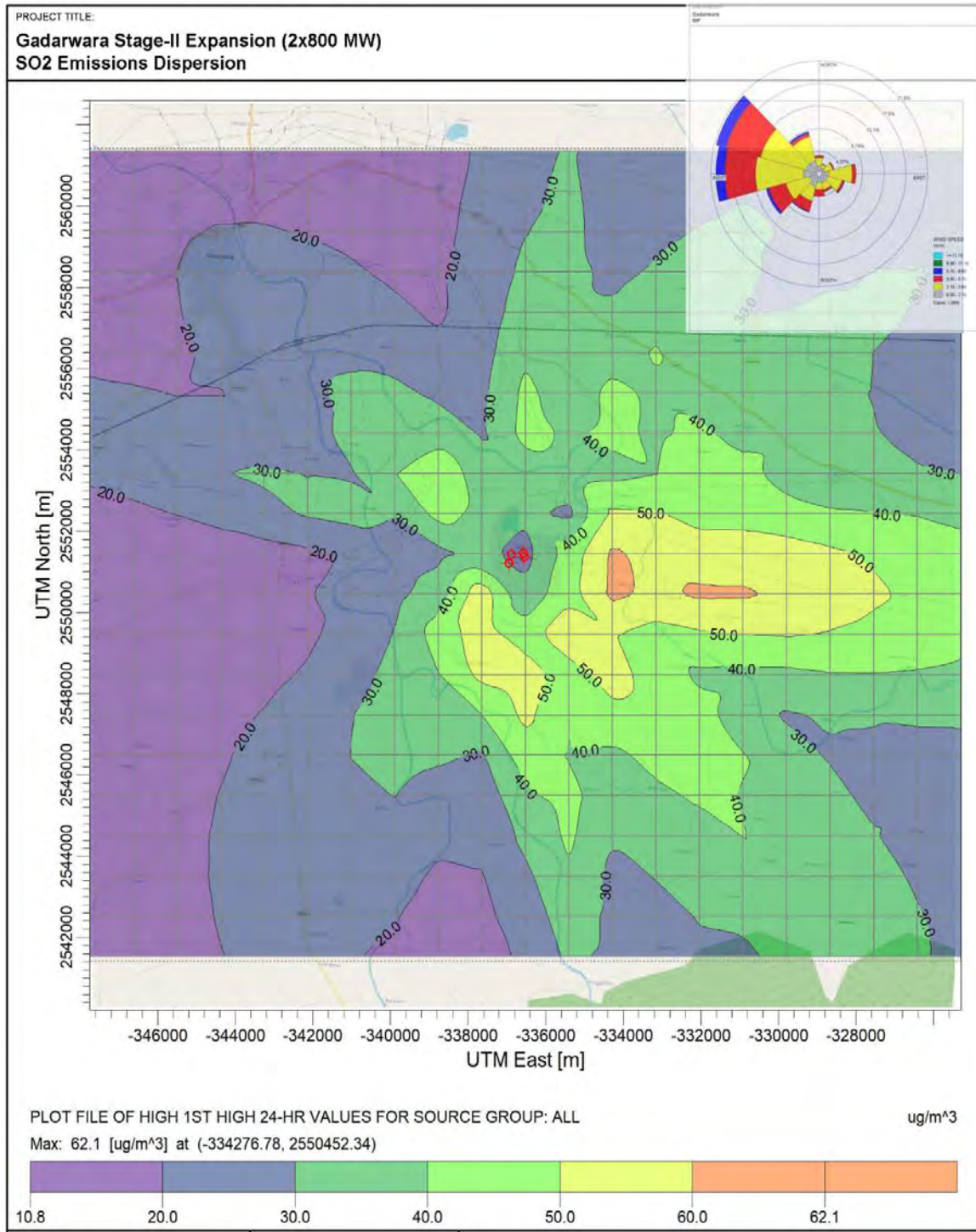


Figure 4-1A: SO₂ Incremental Ground Level Concentration (Max. GLC 62.1 $\mu\text{g}/\text{m}^3$ at 1.82 km in SE Direction) without control measures

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)**

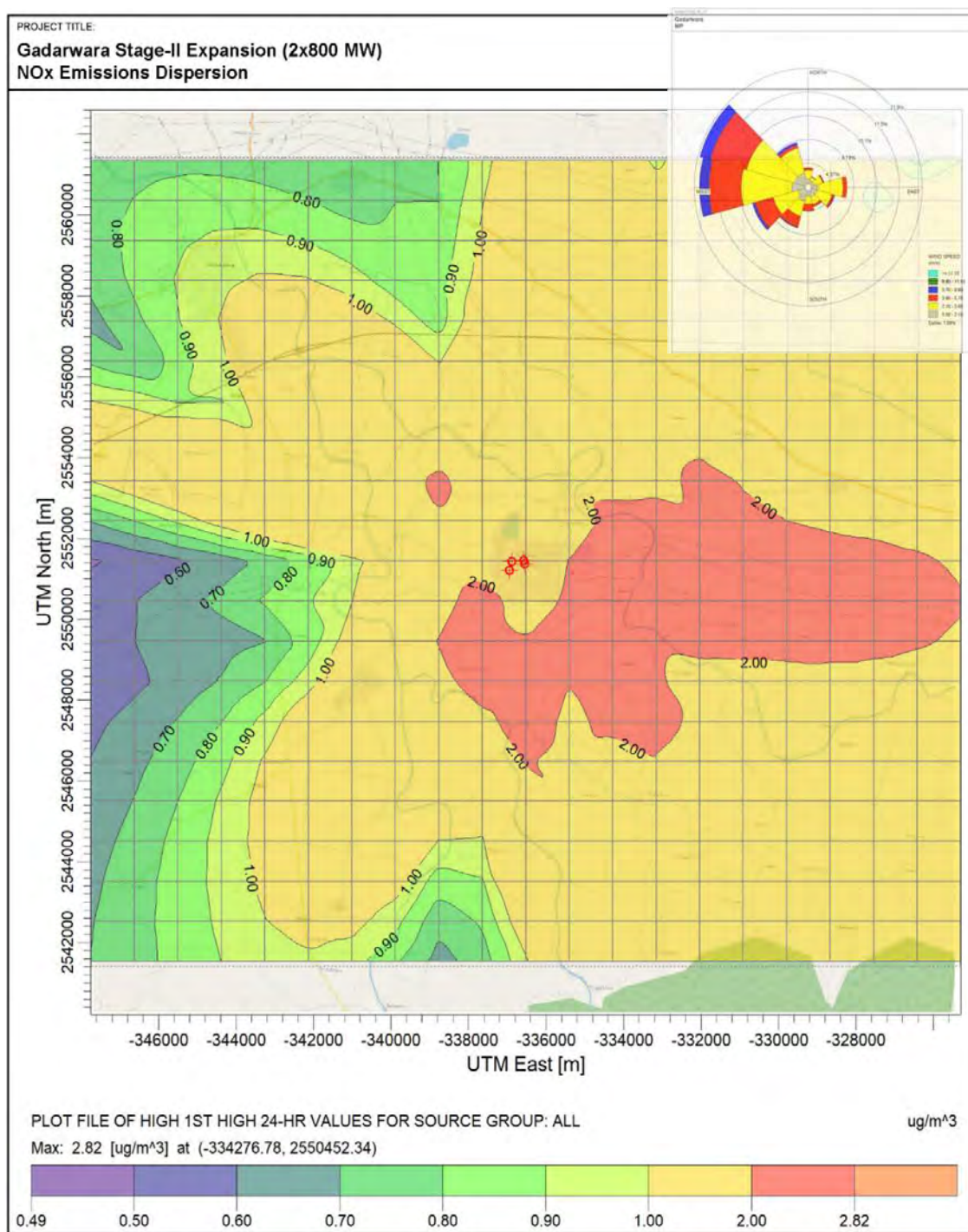


**Figure 4-2A: NO₂ Incremental Ground Level Concentration @100 mg/Nm³
(Max. GLC 2.82 µg/m³ at 0.9 km in SE Direction) without control measures**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)**

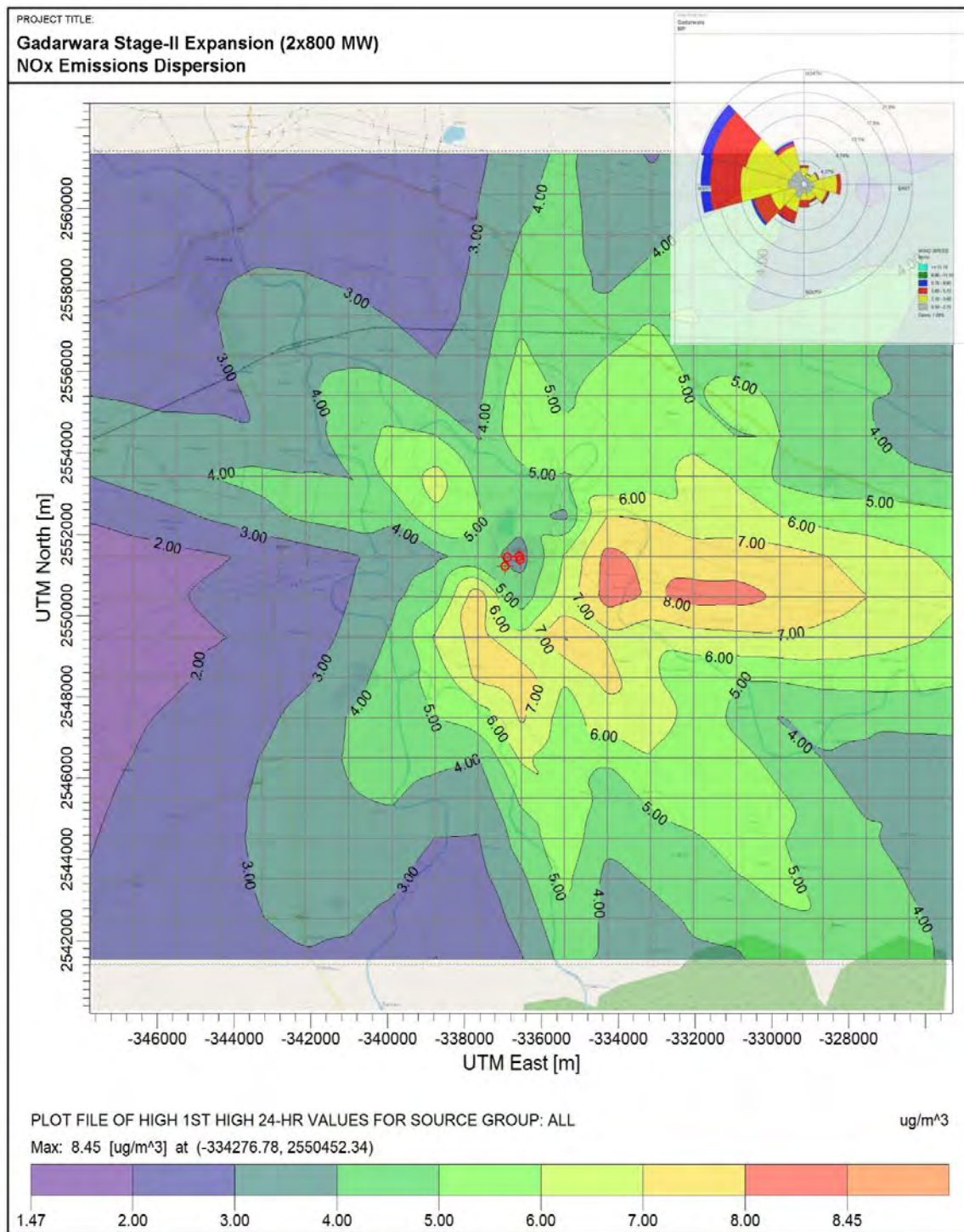


Figure 4-3A: NOx Incremental Ground Level Concentration @300 µg/m³ (Max. GLC 8.45 µg/m³ at 1.82km in SE Direction) without control measures

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)**

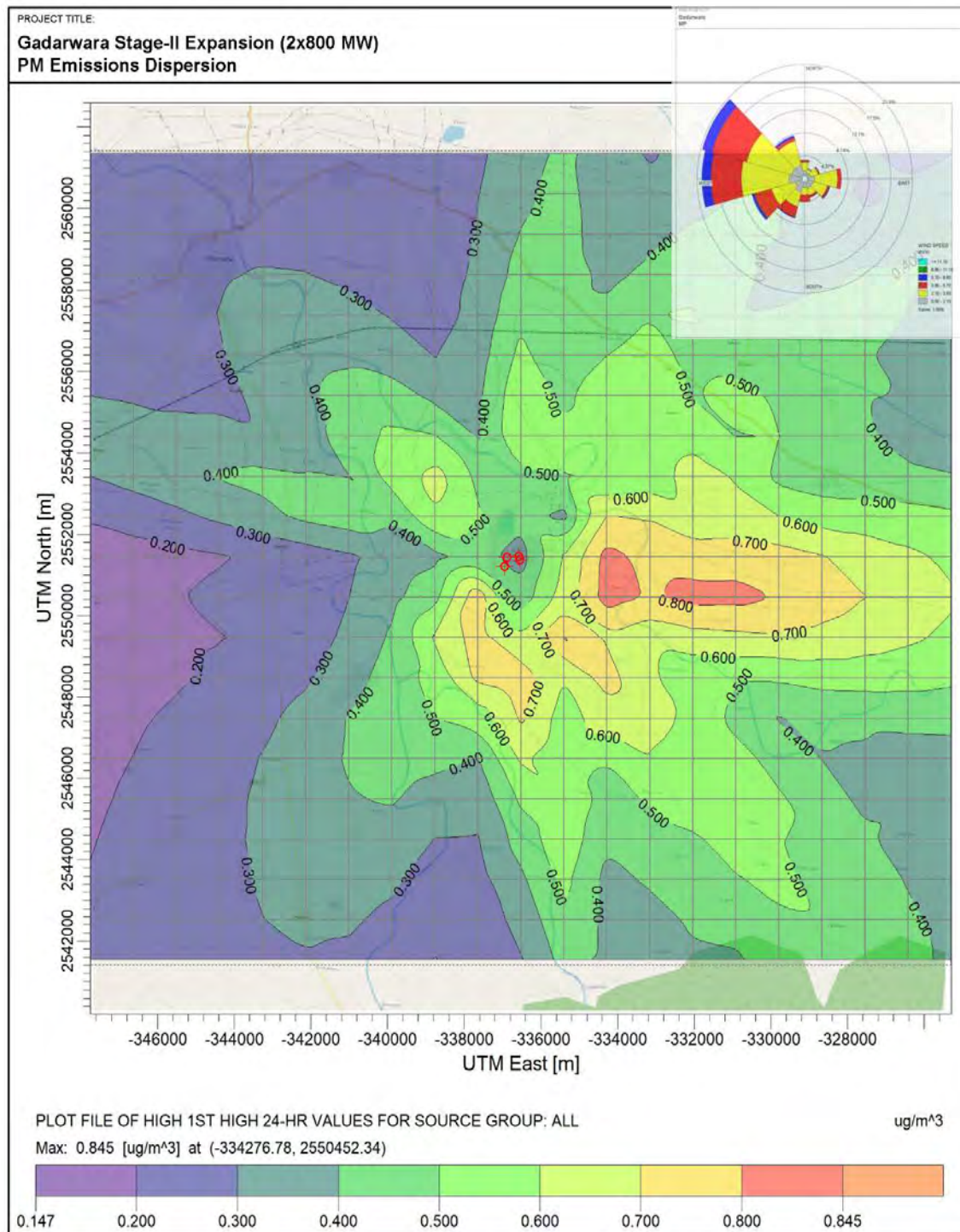


Figure 4-4A: PM₁₀ Incremental Ground Level Concentration (Max. GLC 0.845 $\mu\text{g}/\text{m}^3$ at 1.82 km in SE Direction) without control measures

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)**

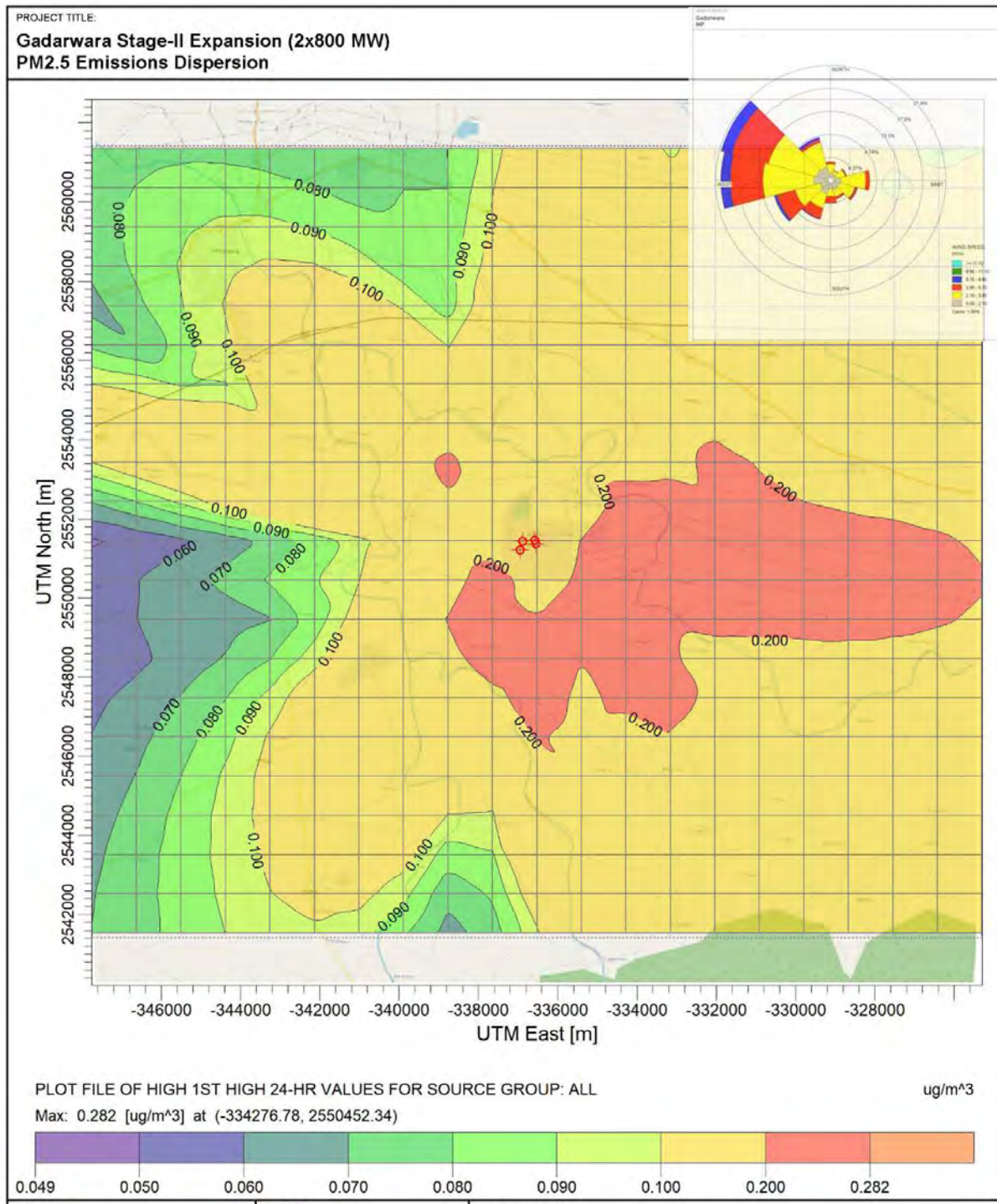


Figure 4-5A: PM_{2.5} Incremental Ground Level Concentration (Max. GLC 0.286 µg/m³ at 0.90 km in SE Direction) without control measures

4.5 IMPACT ON WATER RESOURCES-SURFACE & GROUND WATER

Most of the wastewater generated will be recycled and reused. The effluent recycling/ reuse system will be designed for maximum reuse of all the plant effluents. This system will not include storm water/ rainwater reuse in the plant during monsoon seasons. The sources of plant effluent are mainly: (i) ACW blow down; (ii) Effluent from WT plant; (iii) Coal pile area run off water and (iv) Plant drains (v) Ash water recirculation.

Particulars	Expansion
Quantity of waste water generation per day	1025 m ³ /Hr
Quantity of treated water proposed to use per day	1015 m ³ /Hr
Purpose for which treated water is proposed to use	Aux. Cooling makeup, Service water system, Ash handling system, Coal dust suppression
Treatment plant, STP	75 KLD, MBBR
Treatment plant, ETP	9,240 KLD
Technology	ETP, STP, Neutralization, Oil Removal, Lamella clarifier/Tube settler with chemical dosing

Air cooled condenser is envisaged for Gadarwara Stage-II (2x800 MW) units. The total makeup water requirement for Gadarwara Stage-II (2x800 MW) is ~2000 m³/Hr out of which 1950 m³/Hr will be used for industrial purposes and about 50 m³/Hr for domestic purposes.

The water system for the project has been developed with an aim to minimise the quantity of effluents generated and recycle and reuse the effluent at various stages to meet plant process requirements after necessary treatment. The project is Zero Liquid Discharge (ZLD) compliant. The proposed expansion project is expected to generate 1025 m³/hr effluent through different sources and the same shall be completely recycled/reused within plant. The domestic wastewater generated from the plant and township shall be treated in STP and utilized in development of green cover and horticulture.

The effluent generated from the project shall be suitably treated, meeting the re-use requirement in the various systems. Treatment and disposal of the wastewater generated from the proposed expansion unit is provided in following **Table 4.9**.

Table 4.9 Wastewater generation, Treatment and disposal (m³/hr)

Effluent	Qty. before Treatment	Treatment envisaged	Qty. after Treatment	Net Qty. Discharged	Remarks
Clarifier Sludge from CW clarifier	35	None	35	Nil	Total quantity shall be utilized in ash slurry disposal system.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Effluent	Qty. before Treatment	Treatment envisaged	Qty. after Treatment	Net Qty. Discharged	Remarks
Clarifier Sludge from DM clarifier	5	None	5	Nil	
DM Plant regeneration waste	5	Neutralization	5	Nil	Total treated quantity shall be utilized in ash slurry disposal system.
Power Cycle Blowdown	5	None	5	Nil	Total qty shall be used in Aux. Cooling makeup system.
Aux C.T. Blowdown	40	None	40	Nil	Entire quantity shall be used in in ash slurry disposal system.
Plant Service Water Effluent	100	Clarification in Tube settler & Waste water RO system	95	Nil	Treated water qty after clarification shall be recycled in plant service water system and remaining water shall be treated in WWRO system and re-used in Aux CT make-up. Sludge after treatment in clarifier shall be utilized in ash slurry disposal system.
AWRS water	735	None	735	Nil	Total water qty shall be recycled and re-used in ash handling system
Coal Stockpile run-off water	80	Settling Pond & Clarification	75		Coal Decanted water shall be recycled and re-used in CHP dust suppression. Remaining water qty (after evaporation loss) shall be treated in CSSP clarifier and recycled in Aux Cooling water Make-up system.
FGD	20	Treatment envisaged only when dry FA + dry BA	0	NIL	FGD waste water shall be normally disposed in ash slurry PH, the same shall be treated

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Effluent	Qty. before Treatment	Treatment envisaged	Qty. after Treatment	Net Qty. Discharged	Remarks
		envisaged			only when dry BA is envisaged for project.
Total	1025	-	1015	Nil	ZLD complied

Note: Clarifiers (1W+1S) each of capacity ~250m³/hr and UF-RO system of ~55m³/hr capacity for wastewater and (1) one no. CSSP clarifier of ~2200m³/hr capacity for CHP run-off water shall be provided in Effluent treatment plant.

The domestic sewage will be treated in the STP and treated sewage will be used for Horticulture. Provision is made for rainwater harvesting to collect stormwater from roof top, road/ paved areas, greenbelt and open areas. ETP and STP reports is enclosed as **Annexure 4.2**.

Rooftop Rainwater Harvesting Structure:

To accommodate the runoff from rooftops, rainwater harvesting is proposed through by constructing rainwater harvesting structures in all buildings. In the area where the shallow aquifer has dried up and existing tube wells are tapping deeper aquifer, roof top rain water harvesting through vertical shaft/ tube wells can be adopted to recharge the deeper aquifer.

Proposed recharge potential to be created by the project premises would improve ground water regime of the project area and would contribute to positive water environment.

4.6 IMPACT ON NOISE LEVELS

The main sources of noise and vibration during operations will be:

- Delivery of equipment and raw materials by trucks;
- Transfer of coal through railway line;
- Operation of generators and turbine inside the power house; and
- Operation of various pumps, fans and motors.

Turbines, cooling towers, transformers, compressors, pumps, vehicles and miscellaneous equipment during plant operation, will generate noise.

Also, the adoption of modern building design and the use of sound absorbing materials will minimize noise and vibration from the power house.

The noise levels at the source for these units will be in the range of 80-90 dB (A). The noise dispersion from the plant units has been computed based on the mathematical model.

The major noise generating sources from the proposed expansion plant are turbine, DG sets, cooling towers, CHP and compressors etc. These are considered as in put to the noise model. The following are the noise levels expected from the proposed plant where as the noise levels of operating plant are covered in baseline noise levels.

Table 4.10 Source Noise Levels from Proposed Plant

Sl. No.	Particulars	Source Noise Levels, dB(A)
1	Boiler	85.0
2	Turbine	90.0
3	Turbine Generator	85.0
4	Compressor	90.0
5	FD Fan	85.0
6	DM Plant	85.0
7	Air-Cooled Condenser	80.0

Noise Modelling for Plant Machinery

The impact from a continuous stationary noise source at observer's place, considering the hemispherical propagation of sound waves is represented by the following equation:

$$LR = LS + DI - 20 \log(r) - Ae - 8$$

Where:

LR: Sound pressure level at a receptor located at radial 'r', dB (A)

LS: Sound pressure level at the source, dB (A)

DI: Directivity index of the source (for hemispherical radiation DI = 3dB(A))

R: Radial distance of the receptor from the source, m

Ae: represents excess attenuation of sound caused by the environmental conditions such as:

- Absorption in air;
- Effect of rain, snow and fog;
- Reflections and refractions at barriers and buildings;
- Effect of the terrain, grass, shrubs, trees etc.; and
- Effect of wind and temperature gradient.

The absorption of the sound is generally a complex phenomenon. In general, for homogeneous loss free atmosphere $Ae = 0$.

The cumulative impact of multiple stationary noise sources (through hemispherical wave propagation) at a particular place can be calculated by:

$$L_p(\text{Total}) = 10 \log [10(L_{pi}/10)] \quad i=1$$

$L_p(\text{Total})$ is the resultant cumulative sound pressure level due to separate sources. The cumulative impact from different stationary noise sources at proposed project site has been predicted at 1m distance using the above model.

Presentation of Results

The noise levels at the plant boundaries are given below in **Table-4.11**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 4.11 Predicted Incremental Noise Levels at the Plant Boundaries

Sr. No.	Direction	Noise Level in dB(A)
1	N	30
2	NE	28
3	E	30
4	SE	<30
5	S	30
6	SW	<30
7	W	30
8	NW	28

The predicted noise levels at the boundary due to various plant activities do not exceed 30 dB (A). There will not be any adverse impact due to the noise generation on the habitations falling on the boundary of the proposed expansion project. It is seen from the simulation results that the noise levels are well within the CPCB standards. The noise contours are presented in **Figure-4.6**.

Presentation of Results

Ambient Noise Levels

The noise levels have been predicted with proposed values of different equipment for Gadarwara STPP, Stage-II (2x800 MW). The ambient noise level recorded during field study in the area varies between 50.0 dB(A) to 54.6 dB(A) during day time, whereas 41.7 dB(A) to 44.8 dB(A) during night time. The nearest village Dongargaon noise level varies from 44.8 dB(A) to 54.6 dB(A) located at a distance of 500 m. Hence, there will no significant impact on the villages due to masking effect. In addition, proper acoustic enclosures would be provided to control the noise level within 90 dB(A), as per the requirement of Occupational Safety and Health Administration Standard (OSHAS).

Impact on Work Zone and Community

Boilers and cooling towers are the high noise generating equipment in the power plant. However, impacts on the working personnel are not expected to be significant on account of the high level of automation of the plant, which means that lesser man power near the equipment will be exposed for short duration only and that too intermittently with suitable protection equipment for working in noisy area. The noise generation during operational phase would be at source itself through different measures such as inspection, operation and maintenance at regular intervals. The noise control measures as described in EMP will be fully followed. The occupational noise exposure to the workers in the form of 8 hourly time weighted average will be maintained well within the prescribed OSHA standards (<90 dB(A)). Hence, the impact on occupational health of workers would be less significant.

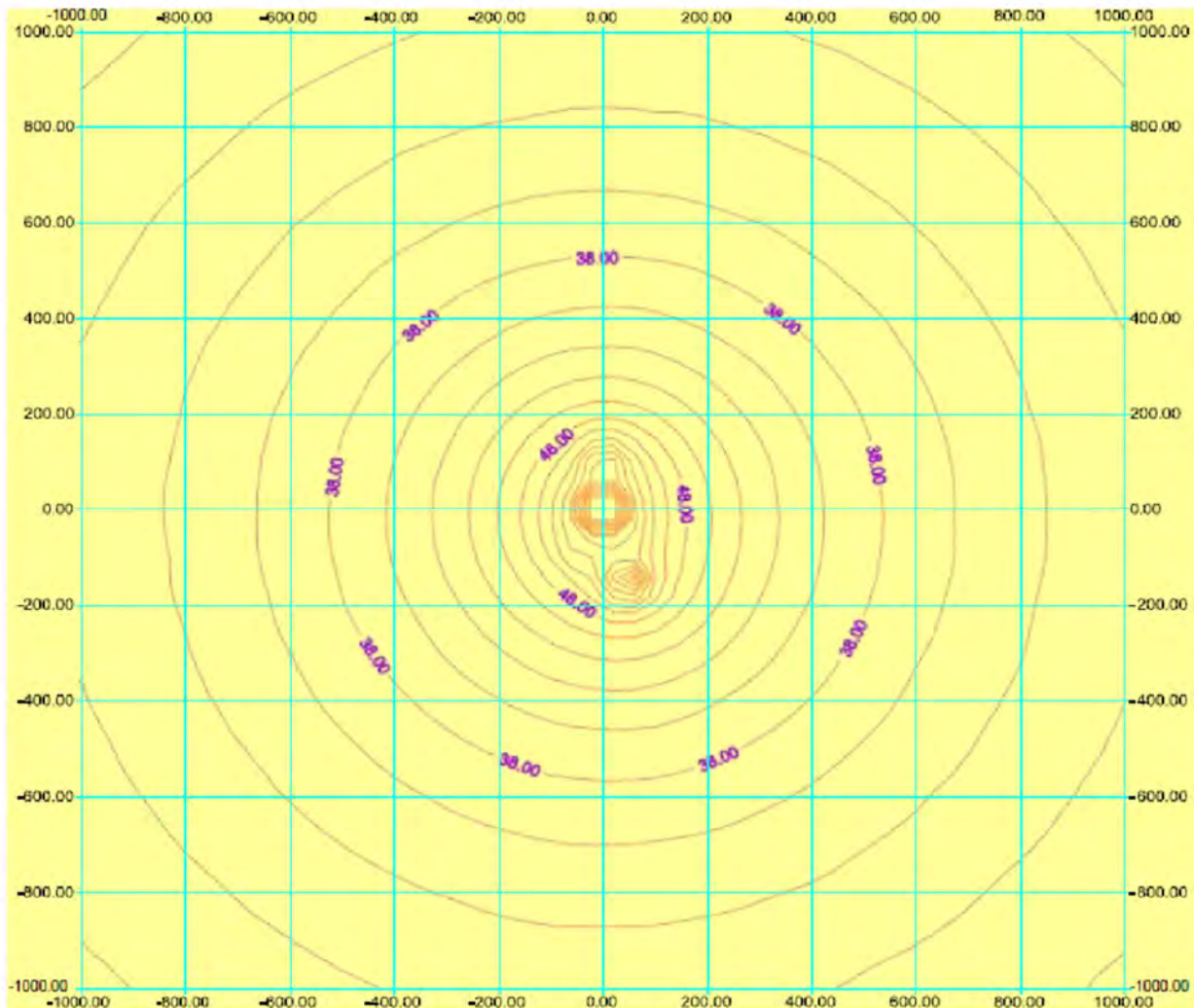


Figure 4-6: Noise Dispersion Counter

4.7 IMPACT ON ECOLOGICAL RESOURCES

The air pollutant which may generate from the plant activities are likely to affect the flora in surrounding area specifically in downward wind direction. The proposed new stacks are equipped with FGD which may reduce the quantum of pollutant in the air ensuring no adverse impact on ecology.

The impact on water resources shall be insignificant as wastewater generating within the project site is getting treated in the ETP & STP and is being recycled & reused following the Zero Liquid Discharge (ZLD) concept. Since, the impact on water quality is insignificant, it will not have any adverse impact on ecology.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Particulates and sulphur dioxide are major air pollutants of a coal based thermal power plant. The impact on the terrestrial ecosystem due to operation of a thermal power project may occur from deposition and absorption of air pollutants on flora and soil surfaces.

Provision of ESP, FGD Dust Suppression, NO_x control have been envisaged to control the air emissions.

Deposition of fly ash on leaves may interrupt gaseous exchange through stomata clogging, thereby affecting plant growth. However, the impact of Gadawara STPP, Stage-II is envisaged to be as maximum incremental ground level concentration of PM due to emissions from Gadawara STPP, Stage-II is predicted to be in the range of 1.76 µg/m³ only. The predicted maximum incremental ground level concentrations of SO₂ of Gadawara STPP, Stage-II is 6.66 µg/m³. This is within the National Ambient Air Quality Standards. Since most of the tree species occurring in the area are deciduous forest type, they have high Air Pollution Tolerance Index (APTI), and therefore, impact of SO₂ will not be significant.

The greenbelt shall have 3-tier plantation as per the CPCB guidelines with re-densification of existing greenbelt.

NTPC Gadawara has carried out plantation on 7.740 Ha inside the main plant premises and 58.628 Ha adjacent to the main plant and periphery. Approx. 83,639 trees have been planted under Gadawara STPP Stage-I. Further, 90.412 Ha of greenbelt is proposed adjacent to the main plant boundary and periphery. Total green belt area of 156.780 Ha has been identified within main plant premises out of which 66.368 ha. The greenbelt shall have 3-tier plantation as per the CPCB guidelines with re-densification & strengthening of existing greenbelt.

Afforestation efforts have been undertaken around the plant site. NTPC Gadawara has carried out plantation on 181.17 Ha outside the plant premises in consultation with State Forest Department. Approx. 4,50,000 trees have been planted under Gadawara STPP Stage-I. Additional afforestation initiatives will continue to be implemented across all feasible areas surrounding the project site in consultation with Madhya Pradesh Rajya Van Vikas Nigam Limited (MPRVVN). This includes the identification and utilization of any available spaces for planting trees and promoting green cover to enhance environmental sustainability and biodiversity in the region. Break-up of the existing and proposed Greenbelt/ plantation is enclosed as **Annexure-4.1**.

Plantation carried out through MPRVVNL is physically verified to ascertain survival rate of >90%.

Table 4.12 Year-wise plantation details

Financial Year	Plantation Inside Plant Premises, Nos.
2015-16	100
2016-17	20070
2017-18	-
2018-19	25156

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Financial Year	Plantation Inside Plant Premises, Nos.
2019-20	1300
2020-21	120
2021-22	18000
2022-23	9870
2023-24	2450
Township area (2015-2023)	6073
2024-25	500
Total	83,639

Table 4.13 Break-up of Plantation Area

S. No.	Location of Plantation	Plantation Completed, Ha.	Plantation proposed, Ha.	Total Area, Ha.
1.	Green belt along west wall in township	0.49	0.00	0.49
2.	South west boundary wall	0.00	4.62	4.62
3.	Green belt along south boundary wall Laydown and pre assembly	0.00	7.04	7.04
4.	Landscape area west of steel storage yard	0.00	0.86	0.86
5.	Green belt along South East boundary wall opposite to steel yard	1.91	0.00	1.91
6.	Along East boundary wall beside construction office	0.79	0.00	0.79
7.	Along East boundary wall beside BHEL laydown	0.84	0.00	0.84
8.	All along North boundary wall	3.00	1.65	4.65
9.	Green belt towards north of railway lines and loco shed	14.58	0.00	14.58
10.	Land South east corner towards south	0.16	0.00	0.16
11.	East of makeup water	0.00	0.29	0.29
12.	West of makeup water	0.00	1.64	1.64
13.	Inside Township at various locations- Area outside plant boundary, Park Areas, Plantation along roads	12.43	6.18	18.61

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Location of Plantation	Plantation Completed, Ha.	Plantation proposed, Ha.	Total Area, Ha.
14.	Along toe line of ash dyke between RCC drain and toe drain of dyke	0.81	0.00	0.81
15.	Area between ash dyke approach road and plant's outside peripheral road (arch portion)	1.21	0.00	1.21
16.	Area between acquisition line and RCC road north west of ash dyke	0.00	0.81	0.81
17.	Road side plantation inside plant covering both sides of 14km road(approx)	4.28	0.00	4.28
18.	Area in Stage II ash Dyke along Road from Helipad to Sudras	13.38	0.00	13.38
19.	Area in front of Police station, towards Ash Dyke IA	4.86	0.00	4.86
20.	Area along Road from Chor-Barheta to Station Building upto underpass	0.00	2.12	2.12
21.	Area Along Track both side upto Baranjh in Railway siding corridor	0.00	14.06	14.06
22.	Green belt towards north of railway lines near S & T Hut	5.08	0.00	5.08
23.	BHEL Yard	0.00	7.65	7.65
24.	Ash Dyke stage II Portion	0.00	33.54	33.54
25.	Ash Dyke to Gadarwara Road	2.55	0.00	2.55
26.	Green belt in plant Railway siding	0.00	0.96	0.96
27.	In Stage-II Plant Area	0.00	1.24	1.24
28.	In Stage-I Plant Area	0.00	6.50	6.50
29.	Construction Office Area	0.00	1.25	1.25
	TOTAL	66.368	90.412	156.780

Impacts on Aquatic Ecology

The project will draw water from intake point on Narmada River. Therefore, there is a likelihood of entrapment or impingement of phytoplankton/ zooplankton in the water intake system. However, as

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



the water system of the project has been designed with maximum recycle/ reuse of water, and a small quantity shall be drawn as a make-up to the system, this impact shall be negligible.

Further, as the project will have an Air - Cooled Condenser (ACC) system with Aux cooling towers and clarified water as make-up to the cooling system, there will be no thermal impact on aquatic ecosystem due to operation of the project. Also, the water balance scheme for the project is designed to achieve Zero Liquid Discharge (ZLD).

It may, therefore, be concluded that there would be no impact on aquatic life of the river.



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)**



Plantation beside railway line



Greenbelt near water treatment



Plantation near railway line



Plantation near railway line



Plantation outside plant boundary



4.8 IMPACT ON SOCIO-ECONOMIC ENVIRONMENT

No additional land is being acquired for Gadarwara STPP Stage-II (2x800 MW). Most of the people around the site have an income directly or indirectly from agriculture and other service-related work. Since, proposed brown field project will create employment opportunities for locals during both construction and operation phase, the socio-economic impact of proposed plant will be positive. Secondary employment will also be generated due to this project which will enhance the income of the surrounding population and raise the living standards in the region.

4.9 IMPACT ON TRAFFIC

The study has been done as per Indian Road Congress (IRC) Standards and based on the existing traffic scenario. This includes the traffic due to the existing plant for bringing raw materials and taking out solid waste. To & fro movement of vehicles are considered for carrying men & materials to plant. The Passenger Carrying Unit (PCU) due to existing and expansion of plant traffic. This will be considered as a theoretical baseline PCU without expansion of Gadarwara STPP. On this baseline, PCU due to expansion plant will be added to obtain PCU due to expansion plant when the number of trucks increases further.

(i) Change in Road Scenario: The traffic volume as surveyed during study has been projected till 2031-32 considering 5-7% growth each year. The projected figure and Level of Service (LoS) with and without Gadarwara STPP are mentioned in **Table 4-14**.

Relation between V/C ratio & LoS		
V/C Ratio	LoS	Performance
0.0-0.2	A	Represents a condition of free flow
0.2-0.4	B	Represents a zone of stable flow
0.4-0.6	C	The general level of comfort and convenience declines noticeably at this level
0.6-0.8	D	Represents the limit of stable flow
0.8-1.0	E	Represents operating condition when traffic volumes are at or close to the capacity level

Table 4.14: Existing Level of Service

Parameters	T1: Road Junction near 220 KV substation, Chichli	T2: SH 22, Panari	T3: SH 22, Gadarwara
Existing PCU/day during 2024	2439.5	2646	5658
Design capacity (C) PCU/day	15000	15000	15000
V/C	0.16	0.17	0.37
Existing LoS during 2024	A	A	B

(ii) Post-expansion change in road scenario: After expansion, there will be an increase in the number of vehicles. The contribution of additional 285, 231 and 574 PCU/day from the plant will be over andp

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



above the projected baseline PCU of 2031-32. It is being considered that 100% of this additional PCU shall travel thru the selected locations. The Level of Service in this scenario is outlined in **Table 4-15**.

Table 4.15: Level of Service after Project Expansion

Parameters	T1: Road Junction near 220 KV substation, Chichli	T2: SH 22, Panari	T3: SH 22, Gadarwara
Projected PCU/day during 2031-32 with 5-7% growth	2561.48	2778.3	6054.06
Additional PCU/day due to project expansion	285	231	574
Total PCU/day in 2031-32	2846.48	3009.3	6628.06
Design capacity (C) PCU/day	15000	15000	15000
V/C	0.19	0.20	0.44
LOS in 2031-32 due to project expansion	A	A	C

From the survey, it is clear that the LoS of the road will not change i.e. remains A, but in T3 station LoS increases as C only, during 2031-32 even if the project comes into operation.

(iii) Prediction of Incremental Air Pollution due to increase in Traffic

The emission factors reported in this study are based on BS-IV certified diesel trucks for which the predicted Ground level concentrations of Sulphur dioxide, CO, and HC+NO_x have been estimated on 24 hours basis. The model has been run on the basis of the number of trucks on which a survey has been done during the monitoring period from March to May 2024. For the expansion project, wind speed of 2.16 km/hr and stability class C has been considered. The predicted pollution load concentration of gases is given in **Table 4.16**.

Table 4.16 Emission norms for Heavy Diesel vehicles

Norms	CO (g/kmhr)	HC (g/kmhr)	NO _x (g/kmhr)
Bharat Stage-IV	1.5	0.96	3.5

Source As per CPCB

Table 4.17 Comparison between calculated Pollution Load before and after Project Scenario

Pollutant	Distance (m)	24hr (µg/m ³) emission load for BS IV Vehicles					
		T1: Road Junction near 220 KV substation, Chichli		T2: SH 22, Panari		T3: SH 22, Gadarwara	
		Existing	After expansion	Existing	After expansion	Existing	After expansion
NO _x +HC	100	125	140	166	196	227	256
	200	63	71	85	100	116	130
	300	42	47	56	67	77	87
	400	36	41	48	57	66	74

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)**



Pollutant	Distance (m)	24hr ($\mu\text{g}/\text{m}^3$) emission load for BS IV Vehicles					
		T1: Road Junction near 220 KV substation, Chichli		T2: SH 22, Panari		T3: SH 22, Gadarwara	
		Existing	After expansion	Existing	After expansion	Existing	After expansion
SO ₂	500	32	35	42	50	58	65
	600	28	32	38	44	51	58
	700	23	26	31	36	42	47
	800	21	24	28	33	39	43
	900	20	22	26	31	36	40
	100	0.2	0.2	0.2	0.2	0.4	0.5
	200	0.1	0.1	0.1	0.1	0.2	0.2
	300	0.1	0.1	0.1	0.1	0.1	0.2
	400	0.0	0.0	0.1	0.1	0.1	0.1
	500	0.0	0.0	0.1	0.1	0.1	0.1
CO	600	0.0	0.0	0.0	0.1	0.1	0.1
	700	0.0	0.0	0.0	0.0	0.1	0.1
	800	0.0	0.0	0.0	0.0	0.1	0.1
	900	0.0	0.0	0.0	0.0	0.1	0.1
	100	43	48	57	67	78	88
	200	21	24	28	34	39	44
	300	14	16	19	22	26	29
	400	12	14	16	19	22	25
	500	11	12	14	17	19	22
	600	9	11	13	15	17	19
	700	8	9	10	12	14	16
	800	7	8	9	11	13	15
	900	7	7	9	10	12	13

Due to the use of ultra-low sulphur diesel oil, the incremental emission load due to SO₂ emission (Pollution load emission – 24 Hrs) will be insignificant. The contribution of CO (Pollution load emission – 1 Hrs) is within prescribed NAAQs and HC+NO_x (Pollution load emission – 24 Hrs).

4.9.1 Ash Transportation Routes and Fugitive Dust Mitigation Measures

Distance from Plant to SH-44: 13 Km, villages/town settlements enroute: Dighori, Magarmuha, Imaliya, Gadarwara

Table 4-18 Action plan for controlling fugitive dust

S. No	Activity planned for controlling fugitive emission	Proposed Budget in lakhs
1.	Water Sprinkling through Tankers	On Regular basis
2.	Tree Plantation along Roadside	Included in the Greenbelt Action Plan
3.	Use of cover vehicle	On regular basis
4.	Strict monitoring of transportation route	On regular basis

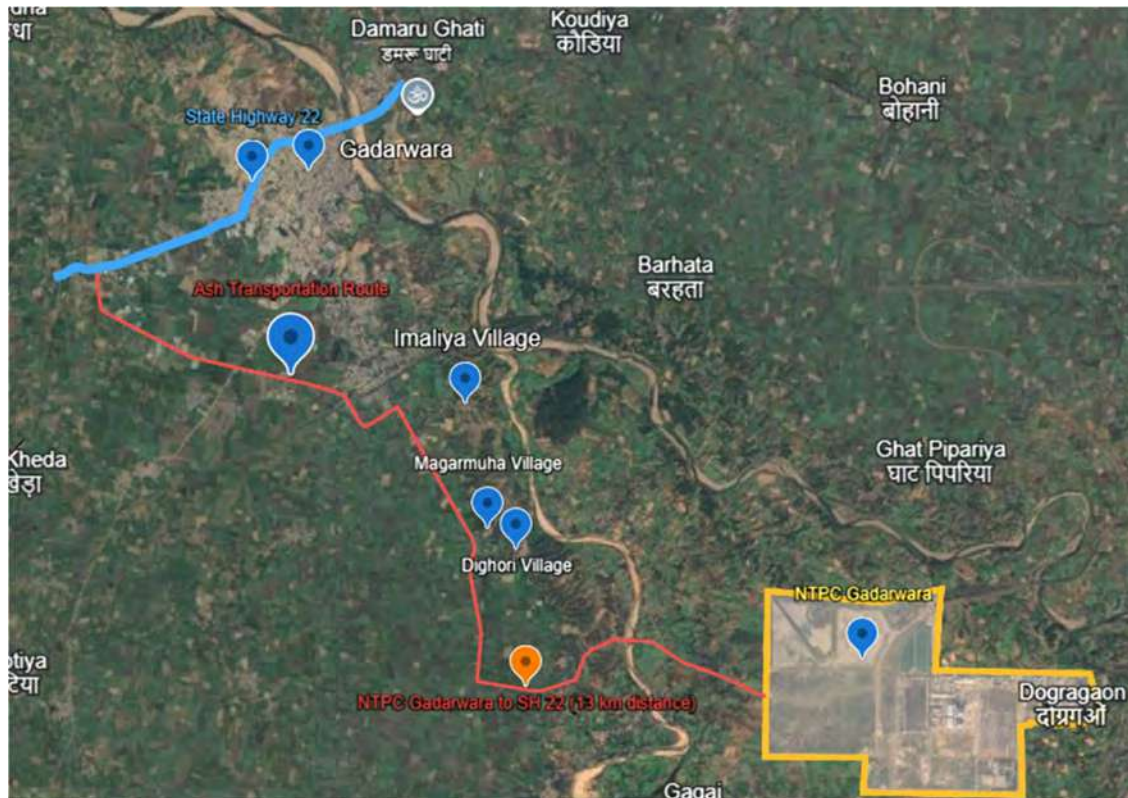


Figure 4-7 Ash transportation route map

4.10 CUMULATIVE ASSESSMENT STUDY

4.10.1 Introduction

The study observed that from an environmental perspective, the area can accommodate a few more industries without exceeding permissible limits. In this chapter, the proposed industries within a 10 km radius are identified, and a cumulative study is conducted to evaluate whether the proposed industries can coexist with the existing ones.

Cumulative impacts occur when a project activity interacts with other projects or third-party activities, affecting the same environmental or social resource or receptor. Cumulative impact is defined as 'impacts resulting from the incremental impact on areas or resources used or directly impacted by the project, from other existing, planned, or reasonably defined developments at the time the risks and impacts identification process is conducted. Significant cumulative impacts can result from individually minor but collectively major actions occurring over time.

Cumulative Impact Assessment (CIA) is an approach to environmental impact assessment (EIA) that considers the effects of multiple actions or impacts on the environment of proposed and ongoing activities within a given area. CIAs assess the actual and potential impacts of several activities or

projects that may combine over time and/or space with appropriate limitations based on the action being assessed and its foreseeable impacts¹.

Unlike an Environmental and Social Impact Assessment (ESIA), a CIA focuses on Valued Environmental and Social Components (VECs) as receptors of impacts from different projects and activities, rather than on a project as a generator of impacts on various environmental and social receptors. While VECs may be directly or indirectly affected by a specific development, they are often also affected by the cumulative effects of several developments. VECs are the ultimate recipients of impacts because they tend to be at the ends of ecological pathways.

For an environmental and social component to be included in this CIA, it must be valued by some identifiable stakeholder group, whether the scientific community or any group of national, regional, and local stakeholders. Additionally, the VEC must be reasonably expected to be affected by both the projects under evaluation (here, the Power Plant) and some combination of other projects and external drivers.



Figure 4-8 Difference in ESIA & CIA

Source: ifc.org

Other projects: There is an operating sugar mill plant within the 10 km study area which is at approximately 7.51 km distance in NNW. The plant has presently a capacity of 6000 TCD.

External Drivers: The project is located in the Narsinghpur District of MP, which falls under Seismic Zone III, indicating a moderate damage risk zone (MSK VII) according to the Seismic Zoning Map of India (IS: 1893:2002). Climate change further exacerbates these risks. Sand mining is prevalent throughout the district, especially along the stretch of the Sitarewa River a tributary of the Shakkar River. Industry development in MP is relatively limited compared to other Indian states. However, the state and its districts have been important suppliers of raw materials to other industrially developed regions in the country. Particularly in the MP region, agricultural land huge industries are rare, also most of the industrial institutions are agricultural oriented, Jaggery industries. Industries include agricultural equipment's, iron items, and Tendukheda and Dangidhana is well known for these

¹ Cumulative Environmental Impact Assessment Industry Guide, Mineral Council of Australia, July 2015.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



industries. The district has a thriving MSME sector and also hosts a few large and medium-scale industries.²

4.10.2 Background

Gadarwara Super Thermal Power Plant (STPP) proposes the expansion of the existing 1600 MW thermal power plant by the addition of 2 units of 800 MW each translating to a capacity addition of 3200 MW. As per the additional condition no. (i) Stipulated in the TOR granted on 30.09.2024 to conduct a cumulative assessment study considering a 10km study area. As such, the area will be a 10 km radius of the proposed Gadawara STPP Expansion Project site and all proposed activities needing environmental clearance and ongoing activities within the study area are to be identified. The Cumulative Impact Assessment (CIA) has been done considering all industries in the study area.

The Cumulative Impact Assessment Study of the area has been developed mainly considering the air, water, ecology and socio-economic status of the area. For air, in addition to the baseline study, a quantitative study has been done by studying the total contribution by all existing and proposed industries on the baseline which includes:

Table 4-19: List of Industries

Sl. No.	Project	Distance & Direction	Existing capacity	Proposed capacity
1	Gadarwara Super Thermal Power Plant	Project Site	2x800 MW	2x800 MW
2	Shakti Sugar Mill	7.51 km, NNW	6000 TCD	-

4.10.3 Objectives

Cumulative Impact Assessment is done to limit more regionally based impacts/system thresholds and provide certainty for future planning. Accordingly, NTPC has assigned consultancy services to Greencindia for EIA-EMP including Cumulative Impact Assessment (CIA) with the following objectives:

- Identification of existing & proposed industrial units falling within 10 km radius of the project site.
- Assessment of baseline environmental conditions for the terrestrial and aquatic environment within the study area of 10 km based on results of primary surveys carried out by Greencindia for a 10 km radius and Primary data generated by other Industrial units located within a 10 km radius for their EIA studies as available and from US EPA AP42 when no reliable EIAs are available. Other relevant secondary data published by different sources have been used as per requirement.
- Identification and prediction of significant impacts on the environment within a 10 km radius by using appropriate qualitative and quantitative models.

² Brief industrial profile of Narsinghpur District MP, MSME

4.10.4 CIA Study Area

4.10.4.1 Spatial & Temporal Boundaries:

From the information available, there is one existing sugar mill plant within 10 km radius. Apart from this, timeline for any other upcoming project could not be established. The timeframe being considered for this CIA begins with the operation of proposed Gadarwara Super Thermal Power Plant Stage-II in 2030.

4.10.4.2 Selection & Description of Valued Environmental and Social Components (VECs):

VECs are environmental and social components that reflect public concerns about social, cultural, economic, or aesthetic values, considered as the end receptors of cumulative impacts. A preliminary list of VECs was prepared based on the environmental and social receptors identified during the site visit and interviews.

Based on the definition of Valued Environmental and Social Components (VECs) and the available information, components with the greatest importance or value were identified. The list of VECs identified covers environmental, social, and cultural components:

Table 4-20: List of VECs

Sl. No.	Feature Name	Distance (in km)	Direction
Forests			
1	Chhawargaon Reserve Forest	4.33	S
2	Chaugan RF	8.90	SSE
3	Bargaon PF	9.80	S
4	Prempur Reserve Forest	8.94	SSE
5	Belkhedi Reserve Forest	6.72	SE
6	Bijanpur Reserve Forest	8.78	SE
Water bodies			
1	Shakkar River	0.60	NE
2	Sitarewa River	0.90	W
3	Sukha Nadi	2.30	SW
4	Sapan Nala	5.00	SE
5	Lendia Nadi	7.60	N
Socio Cultural component			
1	Bal Bharti Public school (BBPS), Gadarwara	0.52	Project site
2	Aditya Public school, Gadarwara	6.34	NW
3	BTI School	6.80	NW

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sl. No.	Feature Name	Distance (in km)	Direction
4	Tapovan school, Gadarwara	7.89	NW
5	Christ church higher secondary school	7.91	NW
9	Excellent school, chichli	2.78	SW
10	Shri Sai public school	2.95	SW
12	Saraswati Shishu Mandir	3.12	SW
13	Vidhya Bharti School	3.0	SW
14	Kautiya vidhyapith	3.67	SW
15	Sunbright higher secondary school	4.01	W
16	BRIJ PVT. I.T.I GADARWARA - Institute of technology, Gadarwara	7.36	NW
17	Shree vidhya paramedical institute	7.31	NW
18	Gadarwara Science College	8.66	NW
19	Maharana Pratap Private ITI	8.86	NW
20	Delhi Public school	8.63	NW
21	New era public school	8.45	NW
22	New age public school (NPS)	8.43	NW
23	Dakshi int. school Gadarwara & Aamgaon bada	9.40	NW

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)**

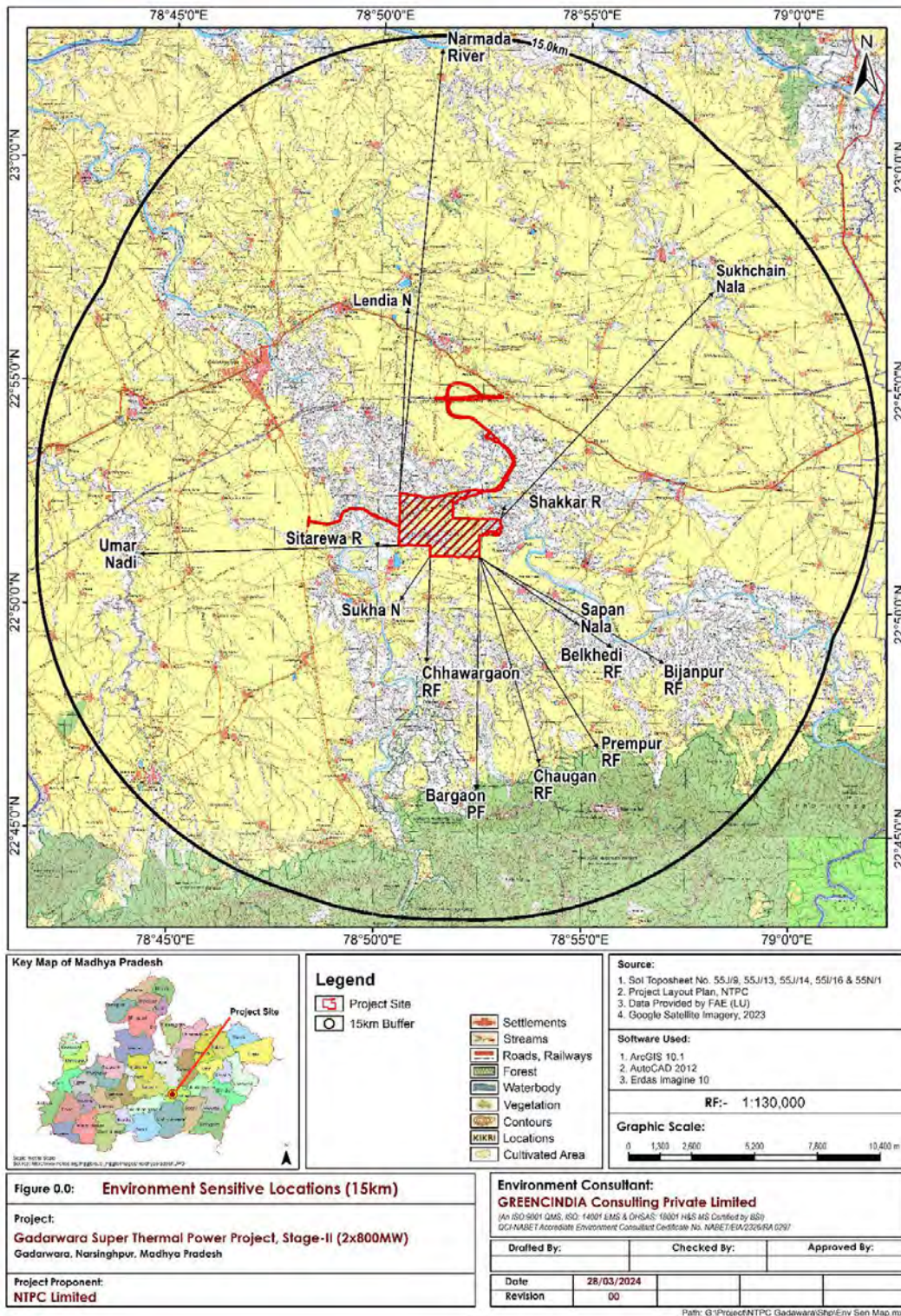


Figure 4-9: Environmental-sensitivity Map of 15 km radius of project site

4.10.5 General description of the buffer area

Baseline environmental data have been collected within the 10 km radius of the project site (March, 2024 to May, 2024) to determine the existing status of various environmental attributes viz., Air, Water, Soil, Land use pattern, Ecological and Socio- Economical environment. This study would help to undertake corrective mitigation measures for protection of the environment due to activities of the proposed project. The detailed baseline data is presented in the **Chapter-3** of this EIA/EMP report and the summary is given here.

4.10.5.1 Air Pollution:

From the baseline data on ambient air quality, it is observed that the ground level concentration of all criteria pollutants is within the permissible limits as shown in **Fig. 4.10 to 4.14**.

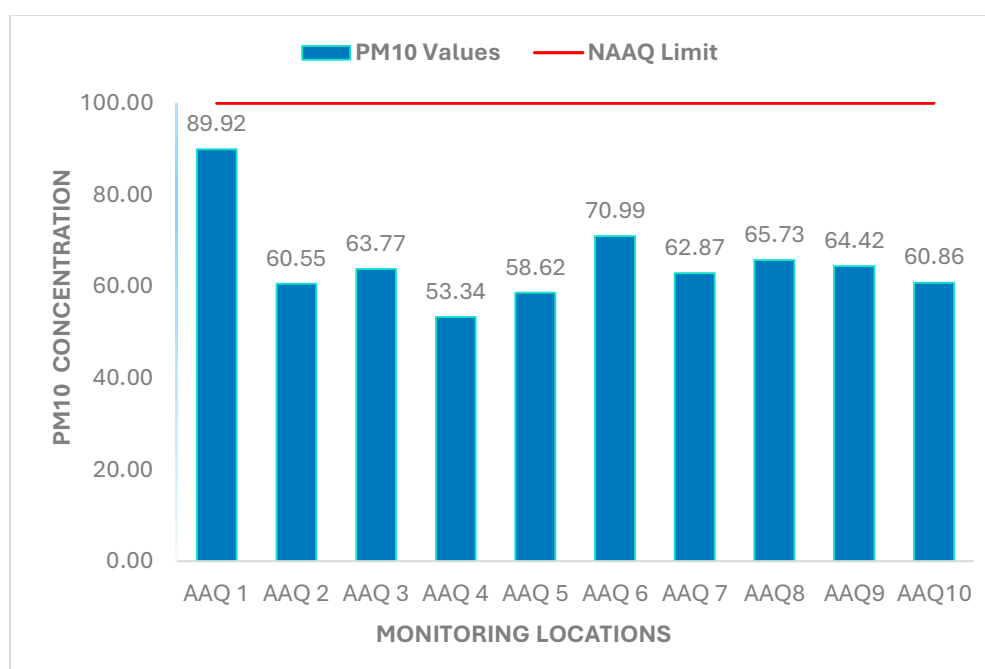


Figure 4-10: 98 Percentile of PM₁₀ in µg/m³

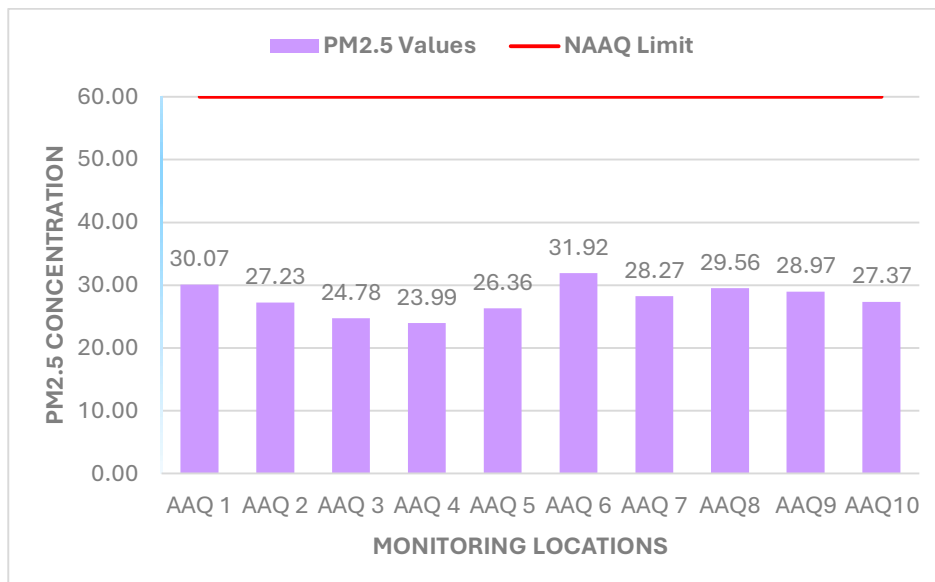


Figure 4-11: 98 Percentile of PM_{2.5} in µg/m³

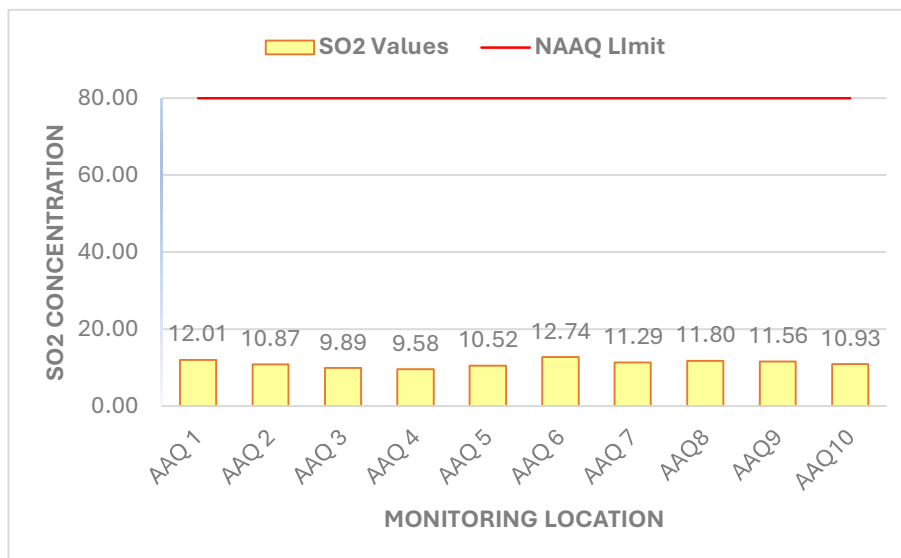


Figure 4-12: 98 Percentile of Sulphur Dioxide (SO₂) in µg/m³

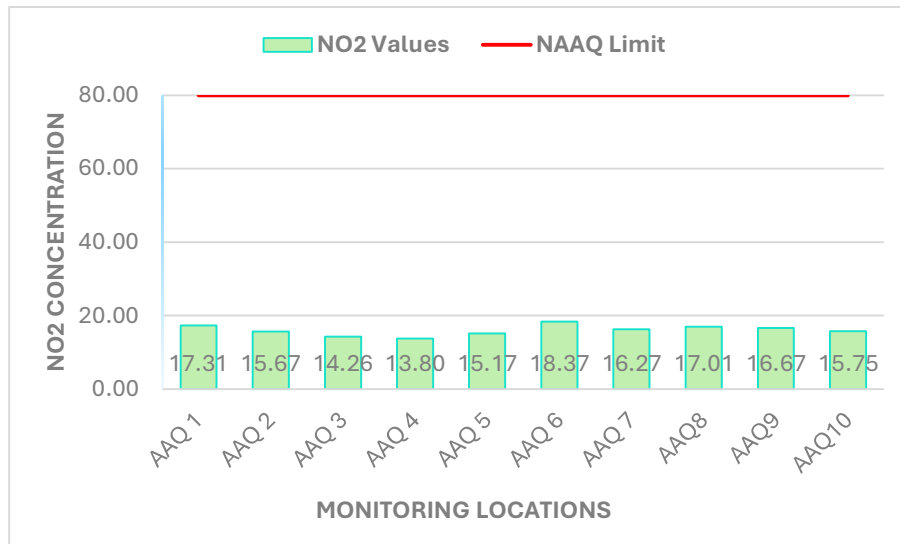


Figure 4-13: 98 percentiles of Nitrogen Dioxide (NO₂) in µg/m³

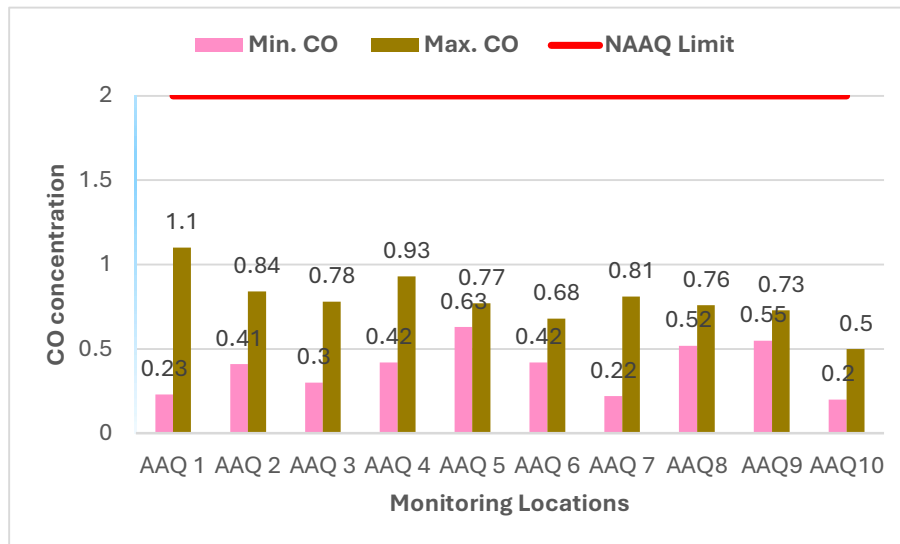


Figure 4-14: Carbon Monoxide (CO) in mg/m³

4.10.5.2 Water Pollution

The groundwater samples comply with the permissible limits set by IS 10500:2012, showing no signs of industrial contamination.

Based on the former CPCB standards (now discontinued) surface water is classified as category A, B,C,D & E. The surface water is deemed suitable for drinking after conventional treatment, as well as for the propagation of wildlife and fisheries.

Regeneration waste from DM (De-mineralized Water) Plant and CPU (Condensate Polishing Unit) will be collected in Neutralizing pit. After neutralizing the water will be pumped to CMB (Central Monitoring Basin). Boiler blow down collected in separate sump will be pumped to CMB. Boiler & ESP area wash water will be collected in pre settling pit. Water collected in CMB will be monitored and after pH correction water will be treated in UF & RO to make it suitable for reuse in DM Plant makeup / Aux. CT (Cooling Water) make-up. The sewage from plant shall be treated in a sewage treatment plant. The treated sewage conforming to prescribed standards shall be utilized for plantation & horticulture to the extent possible. The proposed plant will be designed for Zero Liquid Discharge (ZLD).

Additionally, the existing plants are operating on a Zero Liquid Discharge (ZLD) concept, ensuring no potential for water pollution in the study area.

4.10.5.3 Ecology

There are Schedule I species found as per the Indian Wildlife (Protection) Act, 1972 and its subsequent amendments. Total no. of species recorded were- 11 Species of mammals, 19 species of birds, 6 species of reptiles and amphibians. Species belonging to Schedule I- 2 reptilian species (*Naja naja* and *Python molurus*); 3 avian species (*Bubo bubo*, *Tachy spizabadia* & *Pavo cristatus*) and 3 mammalian species (*Antelope cervicarpa*, *Canis aureus* and *Herpestes edwardsii*) were recorded from the study area. Conservation plan has been prepared for Schedule I species.

However, the existing power plant and Sugar mill plant are not emitting air & water pollutants of significant amount to have any impact on ecology.

4.10.5.4 Socio Economic Condition

Based on the distribution of SC & ST population in the study area, it is observed that the Scheduled Tribe population has decreased from 2001 to 2011, while the Scheduled Caste population has seen only a marginal increase. The tribal population is lower than the national average of 10.4%. Literacy rates indicate significant improvement in women's education in the area, reflecting overall progress in the education sector.

The Work Participation Rate in the area remains low, with a concerning trend of negative growth among main workers, indicating a reduction in job opportunities. Establishing large projects in the area could help improve employment prospects. The socio-economic analysis of the Project Impact Area reveals poor development in terms of education and other sectors, with the overall socio-economic status of the target population being low in terms of literacy, work participation rate, and access to facilities. Greater attention and care are needed to provide the affected population with better access to modern education and development facilities.

Over the past decade, there has been a significant increase in the number of schools in the study area. Common diseases reported include fevers, dengue, and malaria, with medical facilities being inadequate. Inputs from the local population, gathered during public hearings for existing NTPC Units, indicate a positive public perception, which has been refined taken into consideration issue raised in public hearings for the expansion project. The area still has considerable carrying capacity for further industrialization, considering public opinion.

4.10.6 Existing Condition of VECs

The VECs (Valued Environmental and Social Components) within the 10 km radius of the NTPC project site are thoroughly discussed in Chapter 3 of this Final EIA-EMP report. The quality of flora and fauna in the study area indicates a well-functioning ecosystem. This study will assist in implementing corrective mitigation measures to protect the environment from any changes or deviations in attributes due to the proposed project's activities, enabling further industrialization in the area responsibly.

4.10.7 ASSESSMENT OF CUMULATIVE IMPACT OF VECs

The scope of the CIA study includes physical parameters like Source Emission Dispersion Modelling, AAQM, Water & Waste Water Elemental Analysis and Soil Analysis. The source dispersion study includes arriving at ground level concentrations as well as dispersion concentrations within a 10 km radius from all existing and proposed industries using AERMOD as per the US EPA/CPCB guidelines. In addition to the documentation of physical parameters, biodiversity and ecosystems, analysis in the study area has been done.

For the existing and proposed Gadawara STPP activity, the analysis is presented in **Chapter- 4** of this Final EIA report.

In this chapter, the cumulative impact due to major industries including the existing and proposed Gadawara STPP, the existing Shakti Sugar Mill Plant, which is likely to have a significant impact on the air quality of the area located within a 10 km radius study area has been carried out through cumulative air modeling. The input data for air modeling for the plant is based on information available from secondary sources.

As discussed, apart from the existing and proposed project of the Gadawara STPP, other industries like Shakti Sugar Mill Plant have been taken into consideration for cumulative air impact assessment. Shakti Sugar Mill Plant is at a distance of 7.51 km from Gadawara STPP in the NNW direction. The cumulative modelling has been undertaken assuming all 2 industries which have emission loads as per prescribed emission norms.

4.10.7.1 Air Environment:

PM, SO₂ and NO₂ are the major emission from industries in the study area. The impact has been predicted for air quality taking into consideration PM₁₀, PM_{2.5}, SO₂ and NO₂ in and around the Gadawara STPP project area. The impact assessment has been carried out considering the following points:

- Activity-wise emission rates have been estimated.
- Controlled emission from Gadawara STPP has been taken to generate the air pollution dispersion models.
- Proposed stacks of Gadawara STPP have been considered with FGD.

Contribution of SO₂ and NO₂:

It can be concluded that the cumulative impact will not be felt due to each of Gadarwara and Shakti Sugar Mill as both units are separated by a distance of 7.51km which is far enough to dilute the impacts due to each of the unit before reaching close to the other unit.

In the future, with the installation of FGD (Flue Gas Desulfurization) systems, there will be no possibility of an increase in pollution levels. On the contrary, pollution levels are expected to decrease post-installation of FGDs in existing Stage I and other pollution control measures resulting in reduced emissions from Gadarwara STPP.

4.10.7.2 Water Environment

The cumulative study of groundwater samples in study area concludes that water quality comply with the permissible limits set by IS 10500:2012, showing no signs of industrial contamination.

Based on the former IS:10500 and CPCB standards (now discontinued) classification for A,B,C,D & E category. As per the cumulative study of surface water, it is deemed suitable for drinking after conventional treatment, as well as for the propagation of wildlife and fisheries.

Regeneration waste from DM (De-mineralized Water) Plant and CPU (Condensate Polishing Unit) will be collected in Neutralizing pit. After neutralizing the water will be pumped to CMB (Central Monitoring Basin). Boiler blow down collected in separate sump will be pumped to CMB. Boiler & ESP area wash water will be collected in pre settling pit. Water collected in CMB will be monitored and after pH correction water will be treated in UF & RO to make it suitable for reuse in DM Plant makeup / Aux. CT (Cooling Water) make-up. The sewage from plant shall be treated in a sewage treatment plant. The treated sewage conforming to prescribed standards shall be utilized for plantation & horticulture to the extent possible. The proposed plant will be designed for Zero Liquid Discharge (ZLD).

Additionally, the existing plants are operating on a Zero Liquid Discharge (ZLD) concept, ensuring no potential for water pollution in the study area.

4.10.7.3 Ecology

There are Schedule I species found as per the Indian Wildlife (Protection) Act, 1972 and its subsequent amendments. Total no. of species recorded were- 11 Species of mammals, 19 species of birds, 6 species of reptiles and amphibians. Species belonging to Schedule I- 2 reptilian species (*Naja naja* and *Python molurus*); 3 avian species (*Bubo bubo*, *Tachy spizabadia* & *Pavo cristatus*) and 3 mammalian species (*Antelope cervicarpa*, *Canis aureus* and *Herpestes edwardsii*) were recorded from the study area. Conservation plan has been prepared for Schedule I species.

However, the existing power plant and sugar mill plant are not emitting air & water pollutants of significant amount to have any impact on ecology. As such, the area has considerable carrying capacity left for further industrialization as regards Ecology.

As such, the existing and proposed Gadarwara STPP, operational Shakti Sugar Mill Plant will not have any significant impact on ecology.

4.10.7.4 Socio Economic Environment:

The project activity is likely to impact through air & noise generated due to the existing project and upcoming projects in the future. Although, the inputs from the local population have been considered taking into account positive public perception during public hearing of existing Gadarwara STPP Units. Adequate mitigation measures has been incorporated in Chapter 7.

The socio-economic analysis of the Gadarwara STPP Impact Area shows that in terms of educational and other developments the area is poorly developed. The overall socio-economic status of the target population is low in terms of literacy, work participation rate, access to facilities, etc. Attention should be given so that the affected population can get more exposure to modern facilities of education and development. The medical facilities in the study area are also poor.

As such, if a proper EMP is recommended by apprising authorities, the existing and proposed plants are expected to improve the socio-economic conditions of the area after the start of proposed units of the Gadarwara STPP.

4.10.8 Management of Cumulative Impacts

Cumulative impact management can be done at project level & regional level. At project level, each industry prepares or furnishes Environment Management Plan in their EIA-EMP report based on the activity of that particular industry. The EMP for the proposed units of Gadarwara STPP of 2X800 MW is described in Chapter 10 of the draft EIA- EMP report.

Project Site Level

At the project level, impact management includes detailed information about the institutional arrangements, such as a multi-disciplinary Environmental Management and the roles of the staff involved:

- The construction and operation of a thermal power station entail significant environmental considerations, since it is an operative project, Gadarwara's Environmental Management Group (EMG) is already functional and led by Additional General Manager (EMG and AU) and supported by DGM (EMG) and qualified staff. The same group would be strengthened for the proposed Stage-II project. However, this group draws technical support from environmental engineering group, environmental management group and Rehabilitation & Resettlement groups at Corporate Centre. The head of site EMG is directly reporting to the Head of the Project/Plant who would be accountable for implementation of environmental regulations and social impact improvement/mitigation measures.
- Training programs will be conducted to educate staff on environmental monitoring, stack emission monitoring, AAQMS, CEMS, EQMS, ambient air & water quality assessments, municipal & hazardous waste management, noise reduction measures etc.
- Operation & Maintenance Head would represent the Project's Company's interest in the operation & maintenance of the power station and would oversee the functioning of O&M

Groups of the project. Head of O&M would be assisted by a team covering the following functional areas like Technical, Finance & Accounts, and Administration & Personnel.

- An environmental monitoring program is essential to provide scientific information for determining the environmental quality status around the power station and to ensure critical pollutants are within acceptable limits.
- In a power plant, safety hazards include burns, slips, falls, fire and explosions, electrical hazards, excessive noise, and heat stress. Safety measures are proposed to prevent and reduce accidents among employees.
- Management is responsible for educating and training employees in good safety practices. This includes proper equipment use, safe lifting practices, fire extinguisher handling, and personal protective equipment use.
- Office space, canteens, toilets, and restrooms will be provided per good practice and relevant factories act norms. These facilities will be adequately furnished and equipped.
- To address health hazards in coal handling areas, ash handling areas, acid and alkali using areas, and oil storage areas, measures such as frequent washing, good sanitary and washing facilities, and separate lunchrooms will be implemented. This will help reduce dermatitis and other skin issues due to contact with harmful substances.

Regional Level

- The environmental monitoring program is detailed in Chapter 6 of the EIA-EMP report, outlining the locations, duration, and frequency of the parameters to be monitored. Monitoring environmental components during both the construction and operation phases is integral to the environmental mitigation measures. Regular monitoring is essential to assess the functioning and efficiency of all pollution control equipment. Ongoing monitoring for the existing Gadawara STPP includes activities for air quality, water quality, soil quality, and noise levels, with data submitted to the Madhya Pradesh Pollution Control Board (MPPCB) regularly. This monitoring will be expanded and strengthened to include the proposed Gadawara STPP Stage-II 2x 800 MW.
- Green belt development through afforestation is crucial for environmental conservation and protection. Establishing vegetation in and around the proposed thermal power plant will bring numerous direct and indirect benefits. The green belt will consist of native, evergreen, and fast-growing trees. A mix of tree species will be preferred over monocultures, with rows of resistant tree species. This approach will enhance the green belt's lifespan by improving disease resistance.

4.10.9 CONCLUSIONS:

Following are the major conclusions from the Cumulative Study:

- i. The baseline values of air pollutants are within the limit.
- ii. Surface and Ground Water qualities are acceptable as per standards.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



- iii. Socio-economic quality indicates that the area needs more economic development.
- iv. There is no migratory corridor or wildlife sanctuary in the buffer area.
- v. The prediction of the existing Gadarwara STPP and existing Shakti Sugar Mill Plant indicate that negligible contribution to the GLC is associated with the study area.
- vi. The groundwater samples were found well within the permissible limit of IS 10500:2012 and do not indicate any industrial contamination. No leakage is expected from the existing and proposed projects in groundwater due to control measures applied. Also, there will be no extraction of groundwater for project activities.
- vii. Surface water samples indicated suitability for drinking with conventional treatment & for the propagation of Wildlife and Fisheries. The existing and proposed projects will run on the Zero Liquid Discharge (ZLD) concept.
- viii. The soil samples pH found neutral to slightly alkaline, highly saline in nature which can hinder the plant's ability to absorb water. Macronutrients such as N, P, K were also analyzed Nitrogen ranged from good to sufficient condition, whereas Phosphorus ranged from medium to average sufficient & Potassium ranged from very less to medium. No impact on soil due to the project is anticipated due to negligible contribution to the GLC of air pollutants from existing and proposed projects and Zero Liquid Discharge (ZLD) of wastewater from existing and proposed projects.
- ix. Land-use & landcover assessment of the study area reveals that the majority of the study area is under Agriculture Land (69.40%), thus, indicating its reliance on agriculture for economic activities, food production, and livelihoods. There are rivers & nallas flowing through the buffer area and water bodies comprising 2.53% of the total buffer area. Another major land-use after Agricultural lands is fallow land which covers 4.45% of the buffer area. Comparatively the area under forest (2.17%) at present due to which there is no significant impact on the agricultural lands at large.
- x. There are Schedule I species found as per the Indian Wildlife (Protection) Act, 1972 and its subsequent amendments. Total no. of species recorded were- 11 Species of mammals, 19 species of birds, 6 species of reptiles and amphibians. Species belonging to Schedule I- 2 reptilian species (*Naja naja* and *Python molurus*); 3 avian species (*Bubo bubo*, *Tachy spizabadia* & *Pavo cristatus*) and 3 mammalian species (*Antelope cervicarpa*, *Canis aureus* and *Herpestes edwardsii*) were recorded from the study area. Conservation plan has been prepared for Schedule I species. Many species are indicators of a polluted or degraded ecosystem. Many of them change their habitat depending upon the season, temperature and other environmental conditions. The presence of the floral & faunal diversity in the large number indicates the ecosystem of the region is functioning to its capacity and is not degraded.
- xi. The socio-economic study reveals the area has scope for development. With the industrialization of the region social & physical infrastructure has the potential to improve along with opportunities for employment of the local populace resulting in better living standards. Apart from that any concerns from the local farmers/ villagers surrounding the project area regarding adverse impacts from the existing and proposed projects on their health, farmlands, water sources etc. will be addressed adequately after the public hearing.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 4-21: Cumulative impact and mitigation measures (Existing Stage I, Proposed Stage II and Other industries)

S. No.	Aspect	Qualitative Impact	Quantitative Impact	Mitigation Measures
A	Air Quality			
1.	Emissions from coal combustion (Gadarwara STPP)	Degradation of air quality due to pollutants like SO ₂ , NO _x , CO ₂ , and particulate matter.	SO₂ emissions: 88.95 g/s NO_x emissions: 78.513 g/s (@100 mg/Nm³ and NO_x 235.54 (@300 mg/Nm³) Particulate matter: 23.554 g/s Without FGD SO₂ emissions: 1743.33 g/s NO_x emissions: 79 g/s (@100 mg/Nm³ and NO_x 237 (@300 mg/Nm³) Particulate matter: 23.702 g/s	• High efficiency Electrostatic Precipitator (ESP) to control PM emissions from TPP Stacks. • Installation of Flue Gas Desulfurization (FGD) units to reduce SO₂ emissions. • Use of Low-NO_x burners and Over Fire Air to control NO_x emissions. • Dust suppression system for coal handling and ash handling. • Regular maintenance of equipment to ensure efficient combustion. • Continuous air quality monitoring systems.
2.	Emissions from sugar mill operations	Release of particulate matter affecting local air quality.	Particulate matter: Levels exceeding permissible limits in nearby areas.	• Implementation of pollution control measures. • Regular monitoring and maintenance of emission control systems.
B	Water Quality			

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Aspect	Qualitative Impact	Quantitative Impact	Mitigation Measures
1.	Water withdrawal from Narmada River for Gadarwara STPP	Potential reduction in river flow affecting aquatic life and downstream users.	Estimated water consumption: 48,000 KLD for electricity generation.	• Adoption of air cooled condenser technology • Aux. cooling tower with 5 COC to minimize water withdrawal. • Ash water recirculation system, ETP and STP for waste water treatment. • Zero liquid discharge system. • Installation of rainwater harvesting. • Regular assessment of river flow and adjustment of water intake accordingly.
C	Noise Level			
1.	Operation of heavy machinery and boilers in Gadarwara STPP and sugar mill	Elevated noise levels affecting worker health and nearby communities.	- Noise levels: Exceeding near high noise generating equipment operational areas.	• Acoustic enclosures for equipment to control noise. • Regular maintenance of machinery to reduce noise generation. • Provision of personal protective equipment (PPE) like earplugs for workers. • Establishment of green belts around the facilities to act as noise barriers.
D	Soil Quality			

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Aspect	Qualitative Impact	Quantitative Impact	Mitigation Measures
1.	Deposition of airborne pollutants from emissions	Accumulation of heavy metals and other pollutants in soil affecting fertility.	Heavy metal concentrations may increase.	- To control PM emissions from TPP Stacks, high efficiency Electrostatic Precipitator (ESP) is proposed. For control of SO₂ emissions, Flue Gas Desulphurization (FGD) with lime scrubbing is proposed. To control NO_x emission provision of low NO_x burner and Over Fire Air has been envisaged. - Regular monitoring of soil quality in the surrounding areas. - Application of soil remediation techniques if contamination is detected.
2.	Disposal of solid waste (e.g., fly ash from Gadarwara STPP, bagasse from sugar mill)	Potential soil contamination and land degradation.	Fly ash generation: Approximately 370 kg of ash per ton of coal burned. Bagasse production: Approximately 30% of processed sugarcane weight.	- Safe disposal and management of fly ash, including its utilization in construction materials. - Use of bagasse as a biofuel or in the production of biodegradable materials. - Development of waste management plans adhering to environmental regulations.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Aspect	Qualitative Impact	Quantitative Impact	Mitigation Measures
E	Traffic			
1.	Transportation of fly ash	Increased vehicular movement leading to traffic congestion and elevated emissions.	Estimated increase in no. of vehicles at T1- 285 nos., at T2- 231 nos. and at T3- 574 nos. due to expansion of Gadawara STPP, Stage II.	• Installation of fly ash loading and transportation facility through rail. • Use of covered vehicles to prevent spillage and dust emission. • Regular maintenance of transport vehicles to ensure emission standards are met.
F	Socio Economics			
1.	Employment opportunities from Gadawara STPP and sugar mill	Job creation leading to improved local economy and livelihoods.	Employment: during construction phase of approximately are 96 and contractual employees approx.2000 and operation phases are 186 and 1500 respectively.	• Prioritizing local hiring and providing necessary training programs. • Development of community engagement initiatives to address local concerns.
2.	Influx of workers and associated population increase	Increased demand for local resources and potential strain on existing infrastructure.	Population increase including workers and families.	• Investment in local infrastructure development (e.g., roads, healthcare, education). Implementation of social welfare programs to support community well-being. Collaboration with local authorities to plan for sustainable community growth.

5. ANALYSIS OF ALTERNATIVE TECHNOLOGIES

5.1 INTRODUCTION

The consideration of alternatives is a proactive approach of an environmental assessment by enhancing the project design by examining alternates instead of only having a defensive approach to reduce adverse impacts from the project. This calls for the systematic comparison of feasible alternatives for the proposed expansion site and technology.

5.2 SITE ALTERNATIVES

Gadarwara STPP Stage-I (2x800MW) has been established and both the units are under commercial operation. NTPC now intends to expand the capacity of the project by adding Gadawara STPP Stage-II 2x800 MW units based on air cooled condenser system under Stage-II thereby making the total capacity as 3,200 MW. Main Plant and ash dykes of Gadawara STPP Stage-II (2x800MW) are proposed to be located within the available area and no additional land is proposed to be acquired.

NTPC Gadawara is planning to expand the Gadawara Super Thermal Power Plant by adding 1600 MW (2x800 MW) of Ultra Super Critical Technology to the existing 1600 MW (2x800 MW) capacity within the current plant boundary in Village Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon etc., Tehsil: Gadawara Dist. Narsinghpur in Madhya Pradesh.

5.3 TECHNOLOGY ALTERNATIVE

5.3.1 DESCRIPTION OF EACH ALTERNATIVE

5.3.1.1 SUB-CRITICAL BOILER

Subcritical boilers are boilers that work at temperatures up to 374°C and at a pressure of 3,208 psi (the critical point of water). These boilers compose a system with constant evaporation endpoint. A typical example for a subcritical boiler is the drum-type steam generator.

Inside the boiler, the natural circulation of the fluid is generated by heating the risers. The water and steam mixture that is leaving this riser is then separated into water and steam in the drum. Water is circulated, water returns to the evaporator inlet through down corners while steam flows into the super-heater chamber.

If the fluid is allowed to undergo natural circulation, the application range is limited to about 190 bar as the maximum drum pressure. But if the circulation is done using a circulating pump, (known as forced circulation), this range can be extended. This extension happens because of the fixing of the endpoint of evaporation in the drum. And also, it sets the size of the heating surface in the evaporator and in the super-heater. A major drawback of the subcritical boiler is, in these boilers, bubble formation can occur which leads to more water consumption.

5.3.1.2 SUPER CRITICAL BOILER

A supercritical boiler burns pulverized coal and is a once-through boiler, meaning that it doesn't require a drum to separate steam from water. Rather than boiling water to produce steam and then using that steam to turn a plant's turbine, a supercritical boiler operates at such high pressure i.e. above critical point of water.

This supercritical fluid turns the turbine that generates electricity. As it does so, it drops below the critical pressure point and becomes a mix of steam and water, passing into a condenser. In the process, less fuel is consumed than in a traditional drum boiler, making supercritical boilers more efficient than their subcritical counterparts.

Supercritical boilers offer benefits in the three interrelated areas that mean the most to plant owners and operators today: efficiency, emissions, and cost. While supercritical boilers cost more than comparably sized subcritical boilers, the larger initial capital investment can be offset by the lifecycle savings yielded by the technology's improved efficiency, reduced emissions, and lower operating costs all due to its higher steam temperature and pressure parameter.

Improved Efficiency	Reduced Emissions	Lower Operating Costs
• Supercritical and ultra-supercritical boilers' ability to operate at much higher pressures and temperatures than subcritical boilers translate into noticeably better efficiency ratings. • Ultra-supercritical units reach pressures and temperatures as high as 279kg/cm², 603-613°C.	• Improved plant efficiency also translates into reduced emissions. The general rule of thumb is that each percentage point of efficiency improvement yields and less CO₂.	• For all fossil fuel-fired plants, fuel represents the largest operating cost. By reducing the amount of fuel needed to yield the requisite energy, cost of the power generation reduces considerably.

5.3.1.3 ULTRA-SUPER CRITICAL BOILER

Ultra-supercritical boiler is essentially "once-through type". The volume of the evaporator system of once-through boiler is much smaller compared to a natural circulation boiler. This leads to smaller amount of water in the evaporator. Due to smaller inventory of stored water and steam, theoretical rate of response of supercritical and ultra-supercritical units are much faster than drum type unit.

With ultra-supercritical parameters, there is an improvement of cycle efficiency attributable to elevated pressure and temperatures. However, for smaller units the improvement in heat rate is marginal.

5.3.2 Comparative ANALYSIS OF TECHNOLOGIES

The adverse impact of the sub-critical and super critical technology is mentioned in Table 5.1.

Table 5.1: Comparative analysis of different technologies

Option-1: Sub-Critical Technology	Option-2: Super-critical Technology	Option-3: Ultra Super-critical Technology
High coal consumption	Material limitation, due to high thermal stress	Coal consumption is Lower due to high efficiency Requires high-quality, heat-resistant materials that are expensive and not widely available.
Low efficiency	Water chemistry is more stringent	High efficiency
Emission of high pollutant	High levels of corrosion	Reduced emissions with advanced control technologies
Large boiler size	Increased supervision and maintenance cost	Compact (due to high-pressure steam cycle)
High start-up time required.	Limited scope for retrofitting opportunities	Fastest (due to advanced materials and higher temperatures)
	Tube leakages are very frequent due to localized heating	

5.3.3 SELECTED TECHNOLOGY - ULTRA-SUPER CRITICAL TECHNOLOGY

The ultra-super critical technology has been proposed for expansion. The ultra-supercritical units have low thermal inertia resulting in a shorter start-up time, faster rates of load change and shorter time of forced cooling operation during emergency shutdown. Pressure changes could be achieved more easily and a true sliding pressure operation mode with reasonable load change capabilities becomes possible. In ultra-supercritical units, main steam temperature is controlled by water-fuel ratio control with back up spray at attemperation. As a result, rated steam outlet temperature could be achieved at all loads with all types of fuel.

Using ultra-supercritical parameters is more advantageous for larger units where thermal efficiency improvement is more pronounced. An approximate efficiency gains of 3-5% points compared to conventional supercritical technology can be obtained by selecting ultra-supercritical steam parameters.

In addition to faster response times, ultra-supercritical technology, increase in overall plant thermal efficiency results in reduction of fuel consumption per unit of electricity generated, which in turn also reduces CO₂ emissions in coal fired power plant. Ultra-supercritical units also emit less SO_x and NO_x. Improvement in thermal efficiency also causes substantial reduction in emission of suspended particulate matter to the environment. Lastly, better efficiency is associated with lower fuel costs.

5.3.3.1 SUMMARY OF ADVANTAGES OF ULTRA SUPER CRITICAL THERMAL POWER PLANT

The benefits of ultra-supercritical technology, may be summarized as:

- Improved thermal efficiency attainable.
- Reduced fuel cost.
- Reduction of CO₂ emission per unit of electricity generated compared to typical sub-critical units. This may help in meeting country's GHG Reduction target.
- Very good part load efficiency.
- Very low emissions of NO_x, SO₂ and PM achievable using modern flue gas clean-up equipment.
- Initial investment requirement marginally higher than super critical technology and less than other clean coal technology. This, however, depends on the unit size considered.

5.3.4 AIR COOLED CONDENSER SYSTEM

In a thermal power plant, condenser is used to dissipate the heat from the steam coming out from LP turbine exhaust in order to condense it and make a close cycle. This heat can either be removed using water or air as cooling medium. When, water is used as cooling medium, the condenser is termed as water cooled condenser and in case cooling medium is air, it is called Air Cooled Condenser (ACC). The design, construction and size of both type of condensers are entirely different.

5.3.4.1 A COMPARATIVE OVERVIEW OF TWO TYPES OF CONDENSERS

1) Water Conservation:

- I. **Primary Benefit:** ACCs eliminate the need for water in the condenser cooling process, which is critical in water-scarce regions.
- II. **Environmental Impact:** Reduced water withdrawal and consumption to avoid the impact on local water resources and ecosystems.

2) Technical Considerations:

- I. **Efficiency:** ACCs are generally less efficient than water-cooled systems due to high condenser back pressure. It is further less efficient in high ambient temperature regions like in Indian condition where the ACC design temperature has to be considered higher. This leads to higher operational costs and reduced plant efficiency.
- II. **Heat Rejection:** ACC rely on ambient air to dissipate the waste heat of condenser, which can be challenging in hot climates where air temperatures are high, potentially leading to reduced plant performance during peak summer months.

3) Economic Factors:

- I. **Capital Costs:** Initial installation of ACC is generally more expensive compared to traditional water-cooled systems due to the need for larger heat exchange surfaces, fans and structural civil cost.
- II. **Operational Costs:** Although water costs are minimized, the poor unit heat rate increases the operating cost for the lifetime.

4) Location Suitability:

- I. **Climate:** Dry cooling is more suitable for regions with moderate ambient temperatures. In extremely hot climates, the efficiency losses may be higher. The Unit output may be derated for those extreme hot climate operating hours.
 - II. **Water Availability:** ACC adoption may be ideal for those areas where water resources are limited or where regulatory constraints on water use are stringent.
- 5) Capital cost is more in case of ACC compared to WCC although it depends on other factors also e.g. proximity of water source, requirement of water reservoir (in case it is mandatory in water allocation). Land requirement is less in case of ACC.
- 6) Layout feasibility is also an important factor while deciding about ACC.

6. ENVIRONMENT MONITORING PROGRAMME

6.1 NEED FOR ENVIRONMENT MONITORING

The monitoring program is designed to verify the implementation of environmental measures and confirm their effectiveness in delivering the intended benefits to the target population. To ensure proper implementation of the Environment Monitoring Programme, it is essential that an effective monitoring program is designed and carried out.

The primary aims of the environmental monitoring initiative include:

- To monitor impacts on the surrounding environment and the effectiveness of mitigation measures during the construction and operation phases.
- To ensure that the environmental control systems are installed and operating satisfactorily.
- To suggest ongoing improvements in mitigation measures, if required, for subsequent effective monitoring.

In the sections below the proposed environment cell, its functions and financial implications are described. The monitoring program will be implemented in consultation with MPPCB before the start of operation of plant.

The construction and operation of the thermal power station will be overseen by a dedicated Environmental Management Group (EMG), which will handle key functions related to environmental performance monitoring and regulatory compliances.

Regularly periodic environmental monitoring is being done for existing power plant as per the Environmental Clearance & its amendments and reports are being submitted to MoEF&CC & MPPCB/CPCB along with EC compliance reports. The Latest EC compliance report was submitted for the period of April'2024 to September'2024 vide letter no. NTPC-Gadarwara-HYC-2024, dated 31.12.2024 for existing Gadawara Super Thermal Power Plant Stage-I 2x800 MW (**copy enclosed as Annexure-1.5**).

6.2 ENVIRONMENT MONITORING PROGRAMME

The monitoring program has been formulated to take care of impact of proposed expansion project. The monitoring program for different parameters of environment, outlined in the following sections, is based on the findings of the impact assessment. Environment Monitoring Plan during Construction Phase is given in **Table 6.1**. The final post-study environmental monitoring program including number and location of monitoring stations, frequency of sampling and parameters to be covered have been summarized and presented in **Table 6.2**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 6.1: Environment Monitoring Program during Construction Phase

Sl. No.	Aspect	Parameters	Frequency	Location
1	Meteorological aspects	Wind speed & direction, temperature, rainfall, and humidity	Continuous hourly monitoring	Project Premises
2	Ambient Air quality	PM ₁₀ , PM _{2.5} , SO ₂ and NO _x and other parameters as per CPCB notification 2009	Twice in a week / As per CTE Condition.	Project Premises
3	Noise	Equivalent noise pressure level	Quarterly	Project Premises
4	Ground water quality	Physical, chemical and biological parameters including heavy metals as per IS 10500:2012	Quarterly	Five locations
5	Surface water quality	Physical, chemical and biological parameters including heavy metals as per IS 10500 & CPCB criteria.	Quarterly	Two locations

Table 6.2: Environment Monitoring Program during Operation Phase

S. N.	Aspect	Parameter	Location	Monitoring & Frequency	Responsible Person/ Organization
1	Meteorology	Wind speed & direction, temperature, rainfall and Humidity	At project site	Continuous automatic monitoring	NTPC
2	Ambient Air Quality	PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂	One within plant area Continuous Ambient Air Quality Monitoring Station	Continuous on-line monitoring	NTPC/ NABL Accredited laboratory
		PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , Hg & other parameters as per NAAQ Standard	One at project site (offline)	Offline/ Twice a Week	
		PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , Hg & other parameters as per NAAQ	Three nearby	Twice a week / As	MoEF&CC / NABL

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. N.	Aspect	Parameter	Location	Monitoring & Frequency	Responsible Person/ Organization
		Standard	locations (offline)	per CTO Condition.	Accredited laboratory
3	Stack Emission	PM ₁₀ , SO ₂ , NO ₂ The project proponent shall install a 24x7 continuous emission monitoring system at main process stacks to monitor stack emission concerning standards prescribed in Environment (Protection) Rules 1986 and connected to MPPCB and CPCB online servers and calibrate these systems from time to time according to equipment supplier specification. Hg (offline) emission Monitoring	All Process Stacks.	Continuous on-line monitoring. Offline monitoring :Twice a month for each unit. Incl. Hg	NTPC
4	Noise	Noise	05 locations near the noise generating equipment and 05 locations outside in a nearby residential area, township etc.	Monthly	MoEF&CC / NABL Accredited laboratory
5	Surface Water Quality	Physical, chemical, and biological parameters including heavy metals.	5 locations near to project site	Monthly	MoEF&CC / NABL Accredited laboratory
6	Ground Water Quality & Level	Physical, chemical, and biological parameters including heavy metals	5 locations near to project site	Monthly Quarterly	MoEF&CC / NABL Accredited laboratory

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 6
ENVIRONMENT
MONITORING PROGRAMME**

**Page
6-3**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. N.	Aspect	Parameter	Location	Monitoring & Frequency	Responsible Person/ Organization
			6 locations under 2km hotspot area (hospital/institute/school)		
		Piezometer/ Dug/ Tube well to be included for long-term monitoring of groundwater table.	4 locations around Ash Dyke.	Monthly	NTPC/ NABL Accredited laboratory
7	Soil	Physical and chemical parameters with organic content	2 locations.	Quarterly	MoEF&CC / NABL Accredited laboratory
8	Ecology	Visible damage to crops, density and diversity of local fauna	Buffer zone within 10 km radius of the project site	Once in two years or as and when required.	Through Reputed Institute.
9	Coal	Heavy Metals & Radio activity Parameters	Plant-2 samples	Yearly	Through Reputed Institute
10	Fly Ash & Bottom ash	Heavy Metals & Radio activity Parameters	Plant- 2 samples	Yearly	Through Reputed Institute

Maintenance of Air Pollution Control Equipment

Concerned Departments at site will ensure that all air pollution control devices, wastewater treatment and water re-circulating systems function effectively. Exceptions on daily basis will be discussed in Daily Planning meeting chaired by Head of the Project / Head of the Operations & Maintenance.

Contractor under the supervision of the concerned engineer-in-charge will do implementation of pollution control measures during construction phase. Periodical maintenance shall be done as per the O&M Manual by concerned depts. or through the concerned contracting agency. Air pollution control equipment (ESP, FGD, NOx Control and Dust equipment/Suppression system) are integral part of main plant equipment and the same are being/shall be maintained as per operation and maintenance philosophy of NTPC. AMC for all pollution control equipment shall be done through the contractor.

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 6
ENVIRONMENT
MONITORING PROGRAMME**

**Page
6-4**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Half-yearly Compliance report with records shall be submitted to the regulatory authorities (State Pollution Control Board), and uploaded on company's website. Critical parameters shall be displayed at company gate for the information of general public. **Tentative schedule for maintenance of Pollution Control Equipment is provided below: -**

S. No.	Description/ Pollution Control Equipment	Remarks	Check/Maintenance Schedule
1.	ESP, FGD, NO _x controller Preventive maintenance check for ESP.	ESP operating and performance parameters are checked daily, weekly, monthly, quarterly and yearly for different parameters and if any irregularity noted, schedule maintenance done accordingly.	Daily Check: Record Electrical Readings and transmission meter data, Any ash leakage raised by Operation will be attended immediately. Weekly Check for rapping system operating condition. Quarterly Check for control panels Yearly Check for: Clean insulator rooms and all insulator surfaces. Examine and clean all contactors and inspect tightness of all electrical connections and Clean and inspect all gasket connections check and adjust operation of switchgear check and tighten rapper insulator connections.
2.	Dust Extraction System - Coal Crusher House	Extracts dusts from various equipment like Reversible Belt Feeders, Belt Feeders, VSF in coal crusher house	Periodic Maintenance
3.	DFDS (Dry Fog Dust Suppression) system	Sprays mix of water and air in every coffin box near coal chute	Periodic Maintenance
4.	DSWT (Dust suppression Wagon Tippler)	Sprays service water at WT area above and in hopper	Periodic Maintenance
5.	DSTH (Dust	Sprays water for dust	Periodic Maintenance

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 6
ENVIRONMENT
MONITORING PROGRAMME**

**Page
6-5**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Description/ Pollution Control Equipment	Remarks	Check/Maintenance Schedule
	Suppression Track Hopper) pumps are available	suppression during the unloading of rake.	
6.	Sprinkler pumps for stockpile dust suppression	Sprays water for dust suppression in all Coal yard.	Periodic Maintenance
7.	Ash Dyke Dust Suppression System	Sprays water for Dust suppression.	Periodic Maintenance

6.3 WASTEWATER QUALITY MONITORING

The wastewater quality monitoring programme consists of treated wastewater parameters monitoring prior to reuse, recycle & recirculation. Surface water and groundwater quality monitoring will also be covered. The monitoring schedule for treated water generated from various sources and the parameters to be analysed are shown in Table 6.3.

Table 6.3: Wastewater monitoring schedule

Waste water source	Frequency of analysis	Parameter of examination	Responsible Person
Boiler blow down	Monthly	pH, Temperature, suspended solids, oil & grease, dissolved solids, copper, iron etc.	MoEF&CC / NABL Accredited laboratory.
Waste Water treatment plant effluent	Monthly	Physical, chemical, and biological parameters including heavy metals	MoEF&CC / NABL Accredited laboratory.
Ash pond effluent	Monthly	Physical, chemical, and biological parameters including heavy metals	MoEF&CC / NABL Accredited laboratory.
STP Effluent	Monthly	Physical, chemical, and biological parameters including heavy metals	MoEF&CC / NABL Accredited laboratory.

The assessment of surface and groundwater quality (e.g.) drinking and irrigation wells, ponds, tube wells etc.) of surrounding areas will be carried out at 10 different locations, within a 10 km radius of the proposed power plant once in a month. The parameters to be monitored encompass dissolved solids, oxygen levels, bacterial contamination, and heavy metals etc as per IS 10500 Standards.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



6.4 DATA ANALYSIS

Data generated from monitoring and analysis of the samples will be compared with the prescribed/stipulated limits. If any parameter is not found within the prescribed/stipulated limit appropriate control measures will be taken.

6.5 REPORTING SCHEDULE

Regular monitoring and data analysis shall be followed through proper documentation and reporting system. Provision will be made for online monitoring of emission and effluent data is already available for the existing unit and same arrangements shall be made for the upcoming expansion units and the data shall be uploaded to MPPCB/CPCB server to make them available on real-time basis as public disclosure.

Monitoring program will be managed by the Environment management group (EMG) having qualified manpower at the project site. This department will oversee all monitoring activities to ensure effective implementation of environmental monitoring plan. Additionally, the on-site EMG will engage with the State Pollution Control Board and other regulatory bodies to address any environmental issues that may arise during the project's operation. This collaborative approach ensures comprehensive oversight and compliance with environmental regulations throughout the station's operational phase.

6.6 EMERGENCY PROCEDURES

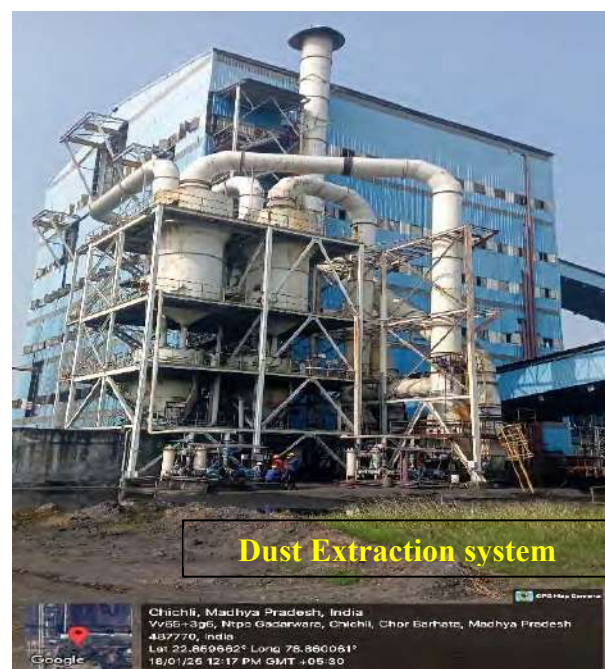
Well planned emergency procedures, drills shall be employed viz, Emergency Evacuation Plan, Disaster Management Plan and Industrial Safety plan to meet the requirement in case of failure of any pollution control equipment. In case it is not possible to take appropriate corrective measures immediately, the unit will be shut down.

6.7 INFRASTRUCTURE

Gadarwara STPP has established online and offline monitoring system for stack emissions, waste water, noise and ambient air quality monitoring given in **Figure 6.1**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 6.1 Infrastructure at Plant

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



The list of equipment required for environment monitoring is given in **Table 6.4**.

Table 6.4: General Equipment Required for Environment Monitoring Laboratory

Sl. No.	Equipment	Quantity
I	Meteorology	
1	Automatic Weather Station with data logger	1 set
II	Stack & Ambient Air	
1	Respirable Dust Sampler/Fine Particulate Sampler	5 sets
2	Vacuum Pump with Electric Motor	2 sets
3	Ammeter and Voltmeter	1 set
4	Online Stack monitoring Kit with necessary Accessories	2 sets
III	Noise	
1	Integrated Noise Level Meter with Frequency Analyzer and data logger	1 set
IV	Water	
1	BOD Incubator	1 set
2	Bacteriological Incubator	1 set
3	Oven	1 set
4	Muffle Furnace	1 set
5	Analytical Balance (Single Pan Digital)	1 set
6	Spectrophotometer (Spectronic 20)	1 set
7	pH Meter	1 set
8	Turbidity Meter	1 set
9	Conductivity Meter	1 set
10	Thermometer	1 set
11	Flame Photometer	1 set
12	Atomic Absorption Spectrophotometer	1 set
13	Distillation Apparatus	2 sets
14	Hot Plate	4 sets
15	Regents and Chemicals	As required
16	COD Assembly	1 set

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Laboratory Facilities for Environmental Testing

Testing paramete	Testing equipment picture
pH analyser	
Turbidity analyser	

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



BOD
analyser



COD
analyser



**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 6
ENVIRONMENT
MONITORING PROGRAMME**

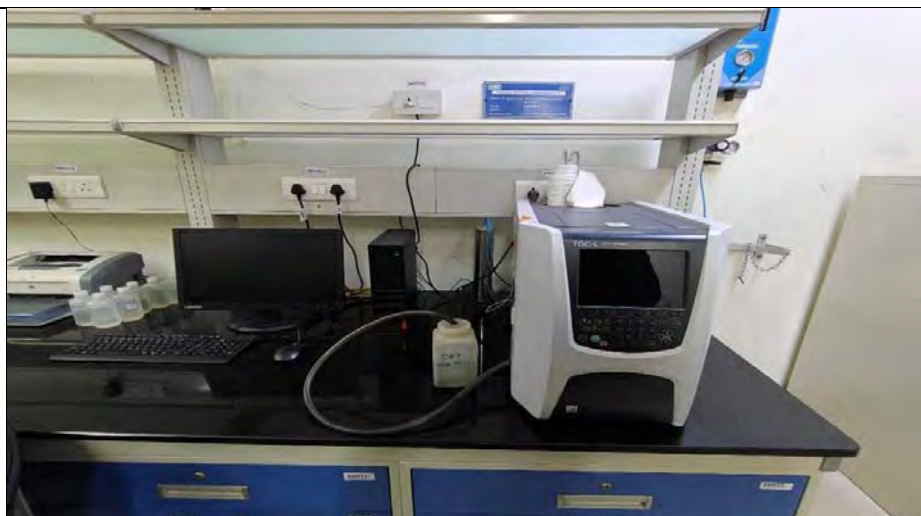
**Page
6-12**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



TOC
analyser



Heavy
metal
testing- ICP
OES



TSS
analyser



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Conductivity
analyser



Oil and
Grease
testing



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Stack emission testing parameters and equipments:

Testing parameter	Testing equipment picture
Particulate matter (PM)	

6.8 ENVIRONMENT MONITORING COST

The estimated capital costs to be incurred by the Project Proponent for undertaking monitoring cost are provided in **Table 6.5**.

Table 6.5: Environment Monitoring Cost

Component	Locations	Frequency	Total no. of samples annually	Cost per Sample (Rs)	Recurring cost (Rs)	Capital Cost (Rs)
Construction Phase						
Air	1	Once in two weeks	104	5000	5,20,000	0.00
Water	2 surface water samples	Once in three months	8	6000	48,000	0.00
	5 ground water samples	Once in three months	20	5500	1,10,000	0.00

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Component	Locations	Frequency	Total no. of samples annually	Cost per Sample (Rs)	Recurring cost (Rs)	Capital Cost (Rs)
Noise	1	Once in three months	4	2000	8,000	0.00
Total Environment Monitoring Cost during Construction Phase				--	6,86,000	0.00
Operation Phase						
Air	Continuous online monitoring station	Continuous	0	0.00	0.00	0.00
	3 nearby locations (offline)	Twice a week	312	5000	1560000	0.00
Water	5 surface water samples	Monthly	60	6000	3,60,000	0.00
	5 groundwater	Monthly	60	6000	3,60,000	0.00
	4 Wastewater/ ETP	Monthly	48	4000	1,92,000	0.00
	Piezometer	Long term assessment	4	-	-	1,20,000
	6 GW in hotspot area	Quarterly	24	4000	96,000	0.0
Noise	10	Monthly	120	2000	2,40,000	0.00
Soil	2	Quarterly	8	6000	48,000	0.00
Ecology	Study Area	Once in Two years	1	-	3,50,000	0.00
Total Environment Monitoring Cost during Operation Phase				--	32,06,000	1,20,000

Source CPCB, 23rd. Feb, 2022

During the construction phase of the project, the recurring cost for environment monitoring is estimated to Rs. 6,86,000. This expense covers the ongoing monitoring activities that are necessary to assess and ensure environmental compliance and impact during the construction period.

Once the project enters the operational phase, the recurring environment monitoring cost is estimated to be Rs. 32,06,000. This higher amount reflects the continued need for environmental monitoring and maintenance during the operational lifespan of the project.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



In addition to the recurring monitoring costs, the project incurs a capital cost of Rs. 430 lakhs on Continuous Environmental Management System (CEMA) and Effluent Quality Management System (EQMS) installation etc. This capital expenditure represents the initial investment or one-time expense related to establishing the necessary environmental monitoring infrastructure or systems required for the project.

Overall, the environmental monitoring costs during both the construction and operation phases are significant, with the operational phase bearing a higher recurring expense due to ongoing monitoring and compliance requirements. The capital cost represents the upfront investment necessary to initiate the environmental monitoring activities essential for the project's environmental sustainability and compliance throughout its lifecycle.

7. ADDITIONAL STUDIES

7.1 INTRODUCTION

The additional studies as suggested in Para 7 & Appendix-III of EIA Notification 2006 amended to date are (i) Public Consultation; (ii) Risk Assessment; (iii) Social Impact Assessment and (iv) Rehabilitation & Resettlement (R&R) Action Plan. As the expansion will take place within the area of existing plant, there will be no applicability of R&R.

Based on the TOR specified by the Ministry of Environment, Forest, and Climate Change (MoEF&CC) issued vide letter no. J-13012/125/2009-IA.II(T) dated 30.09.2024 for preparation of EIA&EMP report for the proposed expansion project, Gadarwara is carrying out several additional studies besides Hydrogeology study, Wildlife conservation plan, Watershed Management Plan etc. which will help in understanding the environmental impact of the expansion project in better ways. Summary of all the additional studies is presented in this chapter. The separate cumulative environmental impact assessment study which is considered as another Specific condition as prescribed in the TOR condition no. 4.1 is presented in chapter 4.

7.2 PUBLIC HEARING & CONSULTATION

As per the conditions of the ToR accorded by MoEF&CC vide letter dated 30.09.2024 and the EIA Notification 2006 & its subsequent amendments, **Public Hearing** for expansion of project was conducted on Monday, December 30, 2024, from 11:00AM at the Police Station Dongargaon, village Mehrakheda, NTPC Station Bhawan, near Gadarwara, Narsinghpur under the chairmanship of the Sub **Divisional** Magistrate, Gadarwara organized by Madhya Pradesh Pollution Control Board (MPPCB), Jabalpur. Local villagers, citizens of Gadarwara, and representatives of non-governmental organizations also participated.

The publicity for the Public Hearing was done through advertisement published in leading newspapers – (1) Dainik Bhasker, dated 26/11/2024, (2) Patrika, dated 26/11/2024, (3) Swadesh, dated 28/11/2024, (4) Haribhoomi, dated 28/11/2024, (5) Agniban, dated 28/11/2024 giving a notice period of more than 30 days by Madhya Pradesh Pollution Control Board and public announcement (Munadi) in villages informing the details of Public Hearing to be held on 30/12/2024.

Table 7.1 Details of Public Hearing Advertisement

S. N.	Particulars	Dates
1.	Dainik Bhasker	26/11/2024
2.	Patrika	26/11/2024
3.	Swadesh	28/11/2024
4.	Haribhoomi	28/11/2024
5.	Agniban	28/11/2024

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. N.	Particulars	Dates
6.	Public Hearing	30/12/2024 & 11:00AM
7.	Venue: Police Station Dongargaon, village Mehrakheda, NTPC Station Bhawan, near Gadarwara, Narsinghpur	30/12/2024 & 11:00AM

7.2.1 PROCEEDINGS DETAILS

7.2.1.1 Public hearing regarding environmental clearance

Gadarwara Super Thermal Power Project's Expansion From 2x800 MW (Stage-I) to additional 2x800 MW (Stage-II) in an area 910.706Hect. Located at village Gangai, Mehrakheda, Chorbarheta, Dongergaon etc., Tehsil Gadarwara, District Narsinghpur (M.P.) by National Thermal Power Corporation (NTPC)

Location – M/s Gadarwara Super Thermal Power Project's (Stage-II), Village Dongergaon, Tehsil Gadarwara, District Narsinghpur, dated 30.12.2024, Time: Morning 11:00 AM.

As per the provisions of Environmental Impact Assessment (EIA) Notification No. S.O. 1533 dated 14.9.2006 of the Government of India, Ministry of Environment, Forest and Climate Change, New Delhi, M/s. Gadarwara Super Thermal Power Project's Expansion From 2x800 MW (Stage-I) to additional 2x800 MW (Stage-II) in an area of Area 910.706 Ha. Public hearing regarding obtaining environmental clearance from Central Level Expert Appraisal Committee, New Delhi constituted by Central Government Ministry of Environment, Forest and Climate Change, New Delhi for M/s Gadarwara Super Thermal Power Project (Stage-II) located at Village Gangai, Mehrakheda, Chorbarheta, Dongergaon etc, Tehsil Gadarwara, District Narsinghpur (M.P.) by National Thermal Power Corporation (NTPC) Limited was organized on 30.12.2024 at 11.00 AM, near Police Station Dongargaon, Village Mehrakheda NTPC Loco Shed Station Bhawan, District Narsinghpur. In this regard, the date and time of public hearing was fixed by the Additional Collector Narsinghpur. The letter is attached. **(Annexure No.-1)**

As per the provisions of the notification, general notice regarding public hearing was published in the newspapers Dainik Bhaskar, Patrika dated 26.11.2024 and Agnibaan, Haribhoomi, Swadesh and Pradesh Today dated 28.11.2024 distributed in the area. A copy of the general notices published in the newspapers **(Annexure No. 2)** is attached. Banners were put up in the area for publicity and public announcement was made on 29.12.2024.

The public hearing was held on 30.12.2024 under the chairmanship of Smt. Kalavati Byare, Sub-Divisional Magistrate, Gadarwara, District Narsinghpur in which Mr. Alok Kumar Jain, Regional Officer, MP Pollution Control Board, Jabalpur, Mr. Rajkumar Jain, Laboratory In charge and other officers were present. Representatives of the project management and their environmental advisory agency and nearby villagers were present. Attendance sheet is attached. **(Annexure No.-3).**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



First of all, Shri Alok Kumar Jain, Regional Officer, MP Pollution Control Board, informed the public present about the organization of public hearing and gave brief information about Environmental Impact Assessment Notification No. SO 1533 dated 14.9.2006 and the procedure of public hearing. Thereafter, Shri Alok Kumar Jain, Regional Officer, MP Pollution Control Board, gave information about the action taken by the Board under the prescribed legal arrangements in the context of organizing public hearing.

The Sub-Divisional Magistrate called the Environmental Consultant of the project to give detailed information of the EIA summary regarding the project. Thereafter, the Environmental Consultant M/s Greencindia, Ghaziabad gave information regarding proposed project (Stage-II) focusing on general regarding in environment, tree plantation, social development etc.

After this, Smt. Kalavati Byare, Sub-Divisional Magistrate, Gadawara, District Narsinghpur addressed the people present and invited them to get any other information, suggestions, objections or comments regarding the project. The main points of the suggestions, objections, comments presented verbally/in writing by the people present are as follows-

- People will be affected through Ash, pond pollution, people are being affected by dust, different diseases are occurring, diseases like asthma, skin disease, heart disease etc. will occur after the plant becomes operational. Affected people are not getting employment, crops are not being produced. Either a bridge should be built from Mehara Ghat to Ghat Pipariya or the village should be relocated/displaced. Water level is going down. Fruitful and shady trees should be planted. Polythene bags are not properly fitted on ash trucks, transport arrangement should be improved. Noise pollution is very high, 24 hour electricity is promised but electricity is not provided. Work realistically on ground.
- Dams should be built on the Shakkar and Sita Reva rivers. An ITI college should be opened so that students can study. The school should be upgraded, and a cowshed should be built nearby.
- Coal dust goes to the surrounding areas, it should be controlled.
- A bridge should be constructed on the Shakkar river, and it should be given in writing in every village what development works will be done.
- The water line coming from the Narmada River causes damage to the crops due to leakage. The land is not levelled, and during repairs, NTPC harass them.
- Employment opportunities should be given to local people. Meetings of local people should be held from time to time.
- Make arrangements for school and drains, dust should be controlled by trucks.
- Only the affected Panchayats should be developed using NTPC's CSR funds.
- Information should be given about dams and step dams and what will be the impact of Stage-II on agriculture. Grass from the plant should be delivered to the Gaushala.
- Safety measures should be taken against cows and wild animals. Transportation of gravel is a risk of accidents. Good work is being done in the field of education. Good arrangements have been made for health. We welcome Station-II.
- A road should be constructed to go to the village.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



- Ashy water goes into the pond through the ash dyke.
- Upgradation of roads, infrastructure, reduced travel time, drinking water improvement, clean drinking water, significant improvement, better health, direct employment to youth, training programs should be done.

In the context of the hearing, a total of 14 oral objections/suggestions and comments were received. The representative of the environmental advisory agency of the project was asked to submit a reply regarding the resolution of the above objections, suggestions, views and comments received by the officer. Regarding the resolution of the oral objections/suggestions received, the representative of the environmental advisory agency of the project gave information verbally in the public hearing and also gave a written reply which is attached with this proceedings report. **(Annexure No. 4)**

A total of 26 written objections/suggestions were received during the public hearing. Industry representatives Mr. Ashish Verma, Mr. Ritesh Rai and the representative of the environmental advisory agency of the project gave information verbally in the public hearing regarding the resolution of the objections/suggestions received in writing and also gave a written reply which is attached with these proceedings report along with the sheets of written objections/suggestions/comments. **(Annexure No.-5)**

After receiving the objections/suggestions of the public present in the public hearing, Shri Alok Kumar Jain, Regional Officer, M.P. Pollution Control Board, Jabalpur, informed the general public about the proceedings of the public hearing. It was also informed that the objections/suggestions received during the public hearing along with the proceedings along with the video recording of the public hearing will be sent to the Central Level Expert Appraisal Committee New Delhi constituted by the Government of India, Ministry of Environment, Forest and Climate Change, New Delhi through proper medium. The general public was also informed that the proceedings will be kept for public viewing at Collector Office Narsinghpur, District Panchayat Office Narsinghpur and Gram Panchayat Offices Village Gangai, Mehrakheda, Chorbarheta and Dongargaon, Tehsil Gadwarwa, District Narsinghpur.

After expressing gratitude to the officials and all the citizens present in the public hearing, the proceedings of the public hearing were concluded.

Rajkumar Jain Laboratory In-charge Madhya Pradesh Pollution Control Board District Jabalpur	Alok Kumar Jain Regional Officer Madhya Pradesh Pollution Control Board District Jabalpur	Kalavati Byare Sub-Divisional Magistrate Gadarwara District Narsinghpur

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



Table 7.2 Issues raised during Public Hearing and Response with budget and Timeline given by NTPC Gadarwara STPP

S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
Response to the Oral representation received during Public Hearing held on 30.12.2024 at Police Station, Dongargaon, Village: Mehrakheda, NTPC Station Bhawan near Gadarwara, Narsinghpur					
1.0	Shiv Kumar Kaurav/ 9575052124/ Umariya	1.1 The dust coming out of Ash Dyke is spreading pollution, due to which people are falling ill.	NTPC is very sensitive and serious about preventing any dust pollution from ash dyke and many measures are implemented to avoid dust pollution. These measures ensure minimal impact due to dust pollution on the environment and there is no possibility of air, water, soil pollution, spreading of illness and cultivable land of the concerned villages being affected due to this. Some of the mitigation measures for preventing dust pollution are as follows: 1. Maintaining the water level to avoid ash dust blowing in the air. 2. Water sprinkling in Ash dyke through sprinklers during Ash Excavation.	-	Regular Dust suppression measures and Air quality monitoring is being done regularly through authorized laboratory and shall be continued.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			3. Water sprinkling is done during ash filling in the ash pond area. 4. Sufficient Water tankers have been deployed around ash dyke, enroute to Gadarwara and in Tendukheda village. 5. Water spraying and proper cleaning are also done on the transport routes of trucks. 6. Ash transportation trucks are covered with 400 GSM tarpaulin. 7. Compressed air cleaning is used to clean the Ash transportation truck at loading point. 8. Plantation has been done in the available areas around the ash pond and provision has been made to plant more trees. 9. The ambient air quality is being monitored by an accredited laboratory and the report is submitted to the MPPCB. 10. Teams have been formed to	1.34 Lakh 13.00 Lakh	Under Procurement. Work Order has been Placed. Miyawaki plantation to be done through forest dept near ash dyke on Govt land.

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
 NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-8

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			monitor the movement of trucks and ensure 24x7 transport routes. Water sprinkling is done regularly while during ash filling and transportation in the ash pond area. Water spraying and proper cleaning are also done on the transport routes of trucks. Intensive plantation has been done in the available areas around the ash pond and provision has been made to plant more trees. The ambient air quality is monitored by an accredited laboratory for monitoring and the report is transmitted to the MPPCB. Stations have been set up to check the ambient air quality which are monitored by the MPPCB and CPCB. The quantity of pollutants has been found to be in compliance with the prescribed standards. There has been no complaint of illness due to dust		

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
 NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-9

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			pollution.		
		1.2 People of Mehra Kheda and Dongargaon are facing noise pollution.	Provision of Acoustic Enclosures has been made for all the noise generating equipment at NTPC Gadarwara. Regular checks are carried out in the plant premises and surrounding areas to check the noise pollution in which the level of noise pollution is found to be well within the prescribed standards.	-	Regular monitoring
		1.3 A bridge should be constructed over shakkar river to connect Mehra Kheda to Ghat Pipariya	Feasibility assessment is already done on 14/12/2018 by P.W.D. Bridge Construction Division, Jabalpur. Issue discussed many times with DM and CEO Zila Panchayat, they have a concern regarding Various approach road and high cost of bridge construction. However, in public interest, Pontoon bridge like arrangement can be made based on consultation in the VDAC meeting, and the	50 Lakh	1-5 years from beginning of construction of Project

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			recommendations of the district administration under community development work.		
		1.4 The entire cost of CSR should be spent in 06 affected villages.	The entire expenditure of CSR is being incurred as per administrative approval based on excerpt of VDAC meetings, directives from District Administration and peoples representatives recommendation. Under CD budget many development works have been executed like construction of Community halls, Welcome Gates, connectivity Roads, Schools, Additional classrooms etc. are in six affected village Chorbarheta, Umariya, Mehrakhera, Dongargaon, Kudari & Gangai. As per the NTPC CSR Policy 2022, the formulation, implementation, monitoring, evaluation, documentation, and reporting of CSR activities undertaken by NTPC across		

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			India are governed by the policy.		
		1.5 The girl who tops in GEM should be admitted to the BBPS school	There is ceiling in strength of each classroom as per CBSE norms. However, as on date relevant class strength, where GeM Girls are to be admitted, operating at ceiling limit.		
		1.6 Eucalyptus plants are depleting groundwater levels	The plantation has been done by Madhya Pradesh Rajya Van Vikas Nigam Limited. In the future plantation, saplings of local species will be planted.		
		1.7 Ash are causing pollution and the transport system of trucks powered by ash should be improved	As per response given at Sr. No. 1.1	-	-
		1.8 Skill Development Centre to be set up in 6 affected villages	One Skill development centre is already developed at village Gangai. Further to this, in line with the need assessment report, consultations in the VDAC meeting, and the recommendations of the district	50 Lakhs	1-5 years from beginning of construction of Project

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			administration, Skill Development centers will be set up in entire six villages.		
		1.9 Provide 24-hour electricity to all affected villages	NTPC Ltd. is not in electricity distribution business. As per regulations, the work of electricity distribution is the responsibility of the State DISCOMs.	-	-
2.0	Abhishek Tiwari/ 8103831278/ Gangai	2.1 Dams should be built on both the Shakkar and Sitareva rivers	Dams will be built at appropriate location in public interest through need assessment report, consultations in the VDAC meeting, recommendations of the district administration and approval of competent authority.	200 Lakhs	1-6 years from beginning of construction of Project
		2.2 Take our remaining land	No additional land acquisition has been envisaged for the proposed expansion.	-	-
		2.3 A cowshed should be constructed near Gate No. 1	In line with the need assessment report, consultations in the VDAC meeting, and the recommendations of the district administration, cowshed will be constructed.	10 Lakhs	1-2 years from beginning of construction of Project

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		2.4 An ITI college should be opened so that we can study	Two ITIs have been adopted by NTPC-Gadarwara at Gadarwara and Narsinghpur. Beneficiaries may avail facility.	-	-
		2.5 The temperature is rising because of the NTPC plant.	NTPC Gadarwara has implemented adequate Pollution control measures and ensuring compliance to emission standards/norms. Plantation has also been done in the available areas inside plant premises and surrounding areas. Further, there are no evidence of rise in temperature of the region due to project activities.	-	-
3.0	Neeraj Kaurav/ 6263889692/ Chor Barhata	3.1 Dust emanating from the crusher house is affecting the crops, either compensation should be given or control should be done.	NTPC Gadarwara has implemented adequate Pollution control measures and ensuring compliance to emission standards/norms. For Crusher House and Coal Handling Systems, provision of Dust Pollution Control System like DEDS, DFDS and sprinklers are in place to control fugitive coal dust emission. Further, plantation has also	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			been done in the plant premises and surrounding areas.		
4.0	Ajeet Kaurav/ 9669117403/ Ghat Pipariya	4.1 Bridge should be constructed on the Shakkar River	As per response given at Sr. No. 1.3 Feasibility assessment is already done on 14/12/2018 by P.W.D. Bridge Construction Division, Jabalpur. Issue discussed many times with DM and CEO Zila Panchayat, they have a concern regarding Various approach road and high cost of bridge construction. However, in public interest, Pontoon bridge like arrangement can be made based on consultation in the VDAC meeting, and the recommendations of the district administration under community development work.	-	-
		4.2 Every village should be given a written account of what development works will be done.	Based on VDAC meetings, directives from District Administration and peoples representatives recommendations, list of developmental activities to be taken up	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			shall be finalized and provided to concerned authorities.		
5.0	Pradeep Kaurav/ 9584536368/ Chor Barhata	Crop loss due to water line leakage, do not level the land after repair.	After the assessment of crop loss by the District Authorities, necessary steps have been undertaken to compensate the loss due to water line leakage and compensation deposited by NTPC station to SDM official bank account. After repairing of the water line, the area is being levelled to restore to the original ground condition except in the area wherein there is resistance/obstruction/ objection by the affected farmer.	-	-
6.0	Sunil Kumar Sharma/ 9424662525/ Gangai	6.1 We are not opposed to NTPC, we have given employment to people and also give employment to local people	In the coming years, employment opportunities to the project affected people will be provided through various contracting agencies, based on their educational qualifications, experience and skills set subject to requirement. Efforts will be made to provide unskilled employment to claimants	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.		
		6.2 Build a playground	Playgrounds will be constructed in public interest through need assessment report, consultations in the VDAC meeting, and the recommendations of the district administration subject to availability of Land by Village Authority.	10 Lakhs	1-2 years from beginning of construction of Project
		6.3 Open gym should be opened	Open gym will be installed in public interest through need assessment report, consultations in the VDAC meeting, and the recommendations of the district administration subject to availability of space by Village Authority.	10 Lakhs	1-2 years from beginning of construction of Project
		6.4 Meetings of regional people should be held from time to time	VDAC meetings are being regularly conducted in the Chairmanship of DM and CEO (Zila Panchayat) wherein heads of village and people representatives.	-	1-2 years from beginning of construction of Project
7.0	Pahalwan	7.1 The drain system in the school should be repaired	Based on need assessment report and consultation with stakeholders,	10 Lakhs	1-2 years from

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 7
ADDITIONAL STUDIES**

**Page
7-17**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
	Kaurav/9165381016/ Dongargaon		construction of drains in public interest will be done under community development work.		beginning of construction of Project
		7.2 Pay attention to the dust that is flying from the truck	As per response given at Sr. No. 1.1 All the ash trucks are being covered with 400 GSM tarpaulin to avoid any ash spillage. Water sprinkling is done regularly during ash filling and transportation in the ash pond area. Water spraying and proper cleaning are also carried out regularly on the transport routes of trucks. Intensive plantation has been done along the route to Gadarwara on both sides of the road. A compressed air cleaning system is under procurement and shall be installed to clean the truck before leaving the weigh bridge.	-	-
8.0	Santosh Mehra/ 9926520982/ Kaudiya	8.1 Panchayats should be developed in the affected villages	Based on need assessment report and consultation with stakeholders, necessary action will be taken up.	-	1-5 years from beginning of construction of Project

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-18

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		8.2 The VDAC committee should be reconstituted	Process for constitution of VDAC is already initiated by District Administration.	-	-
		8.3 Development related information should be shared	Based on VDAC meetings, directives from District Administration and people's representatives recommendations, list of developmental activities to be taken up shall be finalized and provided to concerned authorities.	-	-
9.0	Manoj Kumar Sharma/ 9009479011/ Chichli	9.1 Information related to the construction of stop dams should be given.	Dams will be built at appropriate location in public interest through need assessment report, consultations in the VDAC meeting, recommendations of the district administration and approval of competent authority. On finalization and approval by the competent authority, information shall be shared with concerned authorities.	-	-
		9.2 Information should be given regarding making the land fertile	Skill development training on improvement of agriculture and land will be conducted for the farmers.	-	1-4 years from beginning of construction of Project

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-19

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		9.3 A cowshed should be built and the grass cut from the plant should be sent to the cowshed.	In line with the need-based assessment report, consultations in the VDAC meeting, and the recommendations of the district administration, cowshed will be constructed.	-	1-5 years from beginning of construction of Project
		9.4 The advisory committee should meet from time to time.	After the reconstitution of the VDAC, the meeting will be held from time to time.	-	1-5 years from beginning of construction of Project
10.0	Ramkumar Kaurav/ 9165480828/ Dongargaon	10.1 A lot of trees have been planted by NTPC, trees have been planted on both sides of the road from the plant to Gadarwara.	NTPC welcomes your statement and is committed to planting more trees.	-	-
		10.2 Measures should be suggested for the protection of cows and wild animals.	Provisions have been made for the protection of wildlife and a proposal 'Wildlife Conservation Action Plan' has been prepared with adequate budget provision. The proposal shall be implemented on approval by Forest Department after accord of	-	1-5 years from beginning of construction of Project

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-20

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			Environmental Clearance. Budget for the same is covered in EMP budget.		
		10.3 Road safety system should be improved with trucks going from ash.	All the transporting agencies have been instructed strictly to control the speed. Pep talks have been conducted regularly of all the drivers and cleaners regarding road safety and speed limit, use of low beam. Teams have been formed to monitor the movement of trucks and monitor the transport routes 24x7 and ensure transport safety.	-	-
		10.4 NTPC is doing a very good job in the field of education	Various education related materials have been provided by NTPC in the project affected villages and NTPC will continue to do similar efforts in public interest under CSR.	-	-
		10.5 There is a very good system in the health sector.	NTPC organizes health camps from time to time in the project affected villages.	-	-
		10.6 NTPC is doing a good job but the implementation should be done well.	NTPC has monitoring mechanisms for ensuring timely completion of CSR/CD works. NTPC shall make further efforts for better implementation of the CSR-CD	-	-

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 7
ADDITIONAL STUDIES**

**Page
7-21**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			works.		
11.0	Moolchand Kaurav/ 7697053258/ Mehra Kheda	11.1 A road should be built to reach the village	In line with the need-based assessment report, consultations in the VDAC meeting, and the recommendations of the district administration, road will be constructed under community development work.	40 Lakhs	1-5 years from beginning of construction of Project
12.0	Lokesh Kaurav/ 7974752835/ Mehra Kheda	12.1 Poison is dissolving in the water from the ash pond	The construction of the ash pond has been done as per proper standards to ensure no contamination of ground and surface water. The quality of surface and ground water of the surrounding area has been tested by recognized institutions such as NIH-ROORKEE in which the quality of water has been found to be as per the standards. Surface and Ground Water quality testing is being done from time to time by a recognized laboratory and the report is sent to MPPCB.	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		12.2 There is a problem of employment, jobs should be given to the people of the affected village.	In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications, experience and skills set subject to requirement. Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.	-	1-5 years from beginning of construction of Project
13.0	Ajay Kaurav/ 7047500555/ Dongargaon	13.1 The VADC committee should be reconstituted and meetings should be held from time to time	After the reconstitution of the VDAC, regular meetings shall be held from time to time.	-	1-5 years from beginning of construction of Project
14.0	Pragati Sharma/ 9424201649/ Bohani	14.1 The work done by NTPC has led to development in the area such as Upgradation of roads, infrastructure development, reduction in travel time, improvement in drinking water and health facilities, direct	NTPC welcomes your statement and is committed to work in this direction even further.	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		and indirect employment to youth, skill development, training programmes, social and economic development etc.			
Response to the Written representation received during Public Hearing held on 30.12.2024 at Police Station, Dongargaon, Village: Mehrakheda, NTPC Station Bhawan near Gadarwara, Narsinghpur					
15.0	Ankit Rathore/ 9691490096/ Chorbarheta	15.1 Provide sports material in the village	In line with the need-based assessment report, consultations in the VDAC meeting, and the recommendations of the district administration, sports materials would be provided.	20 Lakh	1-2 years from beginning of construction of Project
		15.2 Why is it taking so long and difficult to give compensation to a person who died after falling inside a few days ago ?	The amount of compensation can be released only after due process. After completion of the process, the compensation amount of Social Security Benefit from NTPC Ltd has been released on 31.12.2024.	--	--
		15.3 A selfie point should be made near the river in Chorbarheta, and chairs should be installed for sitting	In line with the need-based assessment report, consultations in the VDAC meeting, and the recommendations of the district administration, selfie point will be	10 Lakh	1-2 years from beginning of construction of Project

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			constructed under community development work.		
16.0	Santosh Mehra/ 9926520982/ Kaudia	16.1 The pond should be deepened.	As per ongoing Hydrogeological study report and watershed report, pond deepening/rejuvenation will be done in consultation with VDAC meeting and the recommendations of district administration, under community development work.	10 Lakh	1-2 years from beginning of construction of Project
17.0	Arjun Singh Rajput/ 7064508797/ Gangai	17.1 Land has been acquired but so far no one in the family has been given employment.	In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications, experience and skills set subject to requirement. Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.	-	-
18.0	Rupa Keer/ Kudari	18.1 Give industry and business to the women of the village and	Two Women Self Help Groups have already been formed for sustainable	-	1-5 years from beginning of

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-25

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		give educated women a chance to move forward and employment	livelihood of villagers. More so, various skill upgradation trainings along with necessary equipment and machineries are being equipped. Further, as per directions of District Administrations and requirement emerging out from various meetings with Panchayat Heads/VDAC committee necessary action shall be taken up		construction of project
		18.2 The 35 women who were trained in sewing in village Kudari have not yet been provided with the machine	The very purpose of training in sewing was to upgrade and honing of basic skills. However, distribution of machines and other amenities shall be taken up in consultation with District Administration and Panchayat Heads.	10 Lakh	1-2 years from beginning of construction of Project
19.0	Revaram Jatav/ 8815949660/ Cajarota	19.1 I have worked in SRC company, I have experience of railway work, I should be given a job in railway track maintenance.	As per response given at Sr. No. 6.1. In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications, experience and skills set subject to	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			requirement. Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.		
20.0	Pooja Vishwakarma/ 8103422728/ Kudari	20.1 Trained women want a sewing center to be built in the village, women should be given sewing work and the sewing work done by us should be delivered to the market.	The construction of a sewing centre in village Gangai has been completed in the year 2024. Under the agreement with EDII (Entrepreneurship Development Institute of India), the process of skill development of women and market linkage with online platforms has been ensured. At the same time, many self-help groups have been formed in the direction of self-employment of women.	-	-
		20.2 Shivshakti Self Help Group should be given a flour mill shop in Narmada Vihar and flour mill machine should	Requirement to be assessed from the point of view of quantity and Break-even volume analysis.	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		be provided by the group and NTPC			
21.0	Manish Kumar Mehra/6261838640/Cajarota	21.1 The village should be added to the affected village	The matter shall be taken up with District Administration.	-	-
22.0	Sarvesh Kaurav/ Mehrakheda	22.1 Dust blowing from NTPC is spoiling the crop	As per response given at Sr. No. 1.1	-	-
		22.2 NTPC to appoint an officer to listen to issues of PAPs	The Department of Rehabilitation and Resettlement has been setup to hear the issues of PAPs. In addition, all kinds of issues are being heard by the HR-IR group on every Tuesday.	-	-
23.0	Shiv Prasad Jatav/ Chorbarheta	23.1 Due to the fall of black ash in the field, crop yield is decreasing, proper compensation should be given by conducting a survey.	As per response given at Sr. No. 1.1 & 3.1 Pollution control is being carried out by NTPC with high efficiency pollution control equipment. All the trucks are being covered with 400 GSM tarpaulin. Provision of Dust Pollution Control System (DEDS, DFDS) in the crusher house and Water Sprinkler in the ash pond and	-	-

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-28

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			on the surrounding roads is ensured. Intensive plantation has also been done in the plant premises and surrounding areas. However, if the crop is getting spoiled, it will be investigated.		
24.0	Santosh Mehra/ 9926520982/ Kaudia	24.1 Beautification of crematorium in Kauria village should be done	Based on need assessment report and consultation with VDAC meeting and the recommendations of district administration, work of crematorium, CC-Road, Plantation work, Community Hall and Playground will be taken up under community development work.	10 Lakh	1-5 years from beginning of construction of Project
		24.2 CC road should be constructed in Kauria village			
		24.3 Plantation work should be done in Kauria village			
		24.4 Community hall should be provided in Kauria village			
		24.5 A playground should be provided in Kauria village.			
25.0	Shailendra Kaurav/ Dongar Village	25.1 Narmada water should be given to all 6 villages affected	Based on VDAC meetings and directives from District	10 Lakh	1-3 years from beginning of construction of

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-29

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		by the project.	Administration, necessary action shall be taken up.		Project
		25.2 A playground should be built	Playgrounds can be constructed in public interest through need assessment report, consultations in the VDAC meeting, and the recommendations of the district administration subject to availability of Land by Village Authority.	10 Lakh	1-5 years from beginning of construction of Project
		25.3 Dams should be built on both the Shakkar and Sitareva rivers.	As per response given at Sr. No. 2.1 Dams will be built at appropriate location in public interest through need assessment report, consultations in the VDAC meeting, recommendations of the district administration and approval of competent authority.	-	-
		25.4 Don't be misled by HR department in the name of employment	As per response give at Sr. No. 17.1 In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications,	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			experience and skills set subject to requirement. Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.		
		25.5 Street lights should be installed in the village.	Streetlight will be installed in public interest through need assessment report, consultations in the VDAC meeting, and the recommendations of the district administration.	30 Lakh	1-2 years from beginning of construction of Project
		25.6 NTPC's polluted water comes out and flows into the Sitareva river.	NTPC Gadarwara is a "Zero Liquid Discharge" compliant plant. Provision of ETP, STP, CSSP, AWRS etc. are in service for reuse of wastewater. Apart from this, a system is being developed to collect storm water in the pond for reuse to conserve rainwater. No water is sent out of the plant premises, for which an online camera has also been	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			installed for monitoring by state PCB. The water of both the rivers is being examined by the third party regularly and no pollution has been reported so far.		
26.0	Mukesh Kaurav/ 8435452009	26.1 The grass that comes out from inside the plant should be given to cowsheds and local villages	Based on VDAC meetings and directives from District Administration, necessary action shall be taken up.	-	-
		26.2 Ash trucks should be properly covered so that people walking on the road do not suffer	As per reply given at Sr. No. 1.1 All the trucks are covered with a 400 GSM tarpaulin before leaving the weigh bridge area. All the trucks are loaded as per RTO norms. Water sprinkling is done during ash filling and transportation in the ash pond area. Water sprinkling and proper cleaning is also done on the transport routes of trucks.	-	-
		26.3 How many days is the water sprayed?	Water sprinkling is done regularly during ash filling and transportation	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			in the ash pond area. Water sprinkling and proper cleaning is also done on the transport routes of trucks. Water is sprayed on the ash all months except the rainy days.		
27.0	Saurabh Kaurav/ 9303360926/ Dongar Village	27.1 Affected farmers should be informed about pollution control	Proper awareness programs for pollution control will be carried out regularly.	5 Lakhs	1-2 years from beginning of construction of Project
28.0	Shiv Kumar Kaurav/ 9575052124/ Umaria	28.1 The school building is damaged and a new building should be provided.	School building repair /construction of new building will be done in public interest through need assessment report, consultations in the VDAC meeting, and the recommendations of the district administration.	50 Lakhs	1-2 years from beginning of construction of Project
		28.2 Umaria mouza has government land on which you can conduct playgrounds, ponds, cowsheds, plantation or any other industrial activities	Based on need assessment report and consultation with stakeholders, work on playgrounds, ponds, cowsheds, plantation will be taken up in public interest under community development work.	30 Lakhs	1-2 years from beginning of construction of Project
29.0	All the villagers/ MehraKheda	29.1 The assurances given by NTPC should be fulfilled such	As per response given at Sr. No. 1.3	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		as construction of bridge between Ghat Pipariya and Mehrakheda, construction of road and drain in the village and employment	Feasibility assessment is already done on 14/12/2018 by P.W.D. Bridge Construction Division, Jabalpur. Issue discussed many times with DM and CEO Zila Panchayat, they have a concern regarding Various approach road and high cost of bridge construction. However, in public interest, Pontoon bridge like arrangement can be made based on consultation in the VDAC meeting, and the recommendations of the district administration under community development work.		
		29.2 Many types of pollution and diseases are spreading due to the dust emanating from the plant.	As per response given at Sr. No. 1.1 The plant has been fitted with high efficiency ESPs and a 275M high chimney which reduces pollution levels beyond the standards. Water sprinkling is done during ash filling and transportation in the ash pond area. Water spraying and proper	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			cleaning are also done on the transport routes of trucks. Intensive plantation has been done in the available areas around the ash pond and provision has been made to plant more trees. The ambient air quality is monitored by an accredited laboratory for monitoring and the report is transmitted to the MPPCB. Stations have been set up to check the ambient air quality which are monitored by the MPPCB and CPCB. The quantity of pollutants is found to be within the prescribed norms. There has been no complaint of illness or disease which can be ascribed to the pollution from the power plant.		
		29.3 The production of crops is decreasing	As per response given at Sr. No. 1.1	-	-
		29.4 Employment should be provided to the people of the	As per response given at Sr. No. 6.1	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		village	In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications, experience and skills set subject to requirement. Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.		
30.0	Rajesh Mehra/ Chorbarheta	30.1 It was announced that village Mehrakheda would be made a model Gram Panchayat.	Based on need assessment report and consultation with VDAC meeting and the recommendations of district administration, work on model Gram Panchayat will be taken up in public interest under community development work.	20 Lakh	1-5 years from beginning of construction of Project
		30.2 Trees should be planted for beautification and enrichment in the village	Based on need assessment report and consultation with stakeholders, work on tree plantation will be taken up in public interest under community	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			development work.		
		30.3 New ponds, playgrounds and streetlights should be provided in the village under the help of NTPC.	Based on need assessment report and consultation with VDAC meeting and the recommendations of district administration, work on ponds, playgrounds and streetlights will be taken up in public interest under community development work.	30 Lakh	1-5 years from beginning of construction of Project
		30.4 Water is being collected from NTPC Narmada Water Project; water should be provided to the villages included in the Gram Panchayat by connecting that line with the tap water scheme.	Based on VDAC meetings and directives from District Administration, necessary action shall be taken up.	-	-
31.0	Sunil Kaurav/9669117403/ Mankavara	31.1 Construction of CC road from Ghat Pipariya to Kahartola	Based on need assessment report and consultation with VDAC meeting and the recommendations of district administration, work on CC road, renovation of school, boundary construction, paving, Playground, installation of solar lights and	100 Lakhs	1-5 years from beginning of construction of Project
		31.2 Construction of CC road from Mankwara to Adivasi Tola		150 Lakhs	1-5 years from beginning of

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-37

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			Construction of Pitching and Returning Wall will be taken up in public interest under community development work.		construction of Project
		31.3 Renovation of Government School at Kahartola in village Ghatpipariya		-	1-5 years from beginning of construction of Project
		31.4 Boundary construction and paver work in Mangal Bhawan		20 Lakhs	1-3 years from beginning of construction of Project
		31.5 Construction of a sports field		10 Lakhs	1-2 years from beginning of construction of Project
		31.6 Regarding installation of solar energy		30 lakhs	1-2 years from beginning of construction of Project
		31.7 Construction of Pitching and Returning Wall on the banks of Shakkar River		20 Lakhs	1-4 years from beginning of construction of Project
32.0	All Villagers/ Mehrakheda Sunil Kaurav	32.1 The ash emanating from the plant and the coal coming out of the crusher house are having a	As per response given at Sr. No. 1.1 & 3.1	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		bad effect on life and health.	All the Pollution control measures are in place and are operating with high efficiency. Provision of Dust Pollution Control System (DEDS, DFDS) in the crusher house is ensured and is operational. Water sprinkling is also carried out in automatic mode whenever coal is unloaded from the wagon. One water bowser is also deployed which continuously sprinkles water during dry season all around the plant boundary. Intensive plantation has been done in the available areas inside and around the ash pond and provision has been made to plant more trees near ash dyke. The ambient air quality is monitored by an accredited laboratory for monitoring and the report is transmitted to the MPPCB.		
		32.2 Problems of employment for the affected	As per response given at Sr. No. 6.1	-	-

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-39

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications, experience and skills set subject to requirement. Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.		
		32.3 Loss of productivity of crops due to climate contamination	As per response given at Sr. No. 1.1 Pollution control is being carried out by NTPC with high efficiency pollution control equipment. All the trucks are being covered with 400 GSM tarpaulin. Provision of Dust Pollution Control System (DEDS, DFDS) in the crusher house and Water Sprinkler in the ash pond and	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			on the surrounding roads is ensured. Intensive plantation has also been done in the plant premises and surrounding areas. However, if the crop is getting spoiled, it will be investigated.		
		32.4 A bridge should be constructed between Ghat Pipariya and Mehrakheda, otherwise village Mehra Khara should be shifted to another place	As per reply at Sr. No. 1.3 Feasibility assessment is already done on 14/12/2018 by P.W.D. Bridge Construction Division, Jabalpur. Issue discussed many times with DM and CEO Zila Panchayat, they have a concern regarding Various approach road and high cost of bridge construction. However, in public interest, Pontoon bridge like arrangement can be made based on consultation in the VDAC meeting, and the recommendations of the district administration under community development work.	-	1-5 years from beginning of construction of Project
33.0	Bharat Rathore/ Chorbarheta	33.1 There is a field near the water pond in which coal ash is	As per response given at Sr. No. 1.1 & 3.1	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		falling, it should be disposed of.	All the Pollution control measures are in place and are operating with high efficiency. Provision of Dust Pollution Control System (DEDS, DFDS) in the crusher house is ensured and is operational. Water sprinkling is also carried out in automatic mode whenever coal is unloaded from the wagon. One water bowser is also deployed which continuously sprinkles water during dry season all around the plant boundary. Intensive plantation has been done in the available areas inside and around the ash pond and provision has been made to plant more trees near ash dyke. The ambient air quality is monitored by an accredited laboratory for monitoring and the report is transmitted to the MPPCB.		
34.0	Yogesh Kumar /7740952878/	34.1 Special attention should	Work on education, health and sanitation will be taken up, based on	40 Lakhs	1-5 years from

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-42

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
	Dongar Village	be paid to education, health and sanitation.	need assessment report and consultation with VDAC meeting and the recommendations of district administration, under community development work.		beginning of construction of Project
		34.2 Maximum benefit in Unit 2 should be given to the affected villages	Based on need assessment report and consultation with VDAC meeting and the recommendations of district administration, the development work will be taken up in affected villages under community development work.	-	-
35.0	Narendra Kaurava/9407049253/ Ghat Pipariya	35.1 At present, Mata ji was supposed to receive a cheque of Rs 50,000 for old age pension from NTPC, which is still unreceived	This benefit given one time to dependents of PAPs who are over 60 years old, widows, persons with disabilities, and those who have abdicated. However, no land acquisition is required for Stage-2.	-	-
		35.2 Please link with employment	As per reply at Sr. No. 6.1 In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			educational qualifications, experience and skills set subject to requirement. Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.		
36.0	Santosh Singh Kaurav/ 6265510595/ Dongar Village	36.1 Employment problem	As per reply at Sr. No. 6.1 In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications, experience and skills set subject to requirement. Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
37.0	Nilesh Kaurav/ Mehra Khera	37.1 The promises and guidelines and facilities related to the project should be publicized in writing in all the gram panchayats.	Based on VDAC meetings, directives from District Administration and people's representatives' recommendations, list of developmental activities shall be finalized and shared with concerned authorities.	-	-
		37.2 Water pollution and air pollution should be protected by installing special equipment	As per reply at Sr. No. 1.1 Water sprinkling is done during ash filling and transportation in the ash pond area. Water spraying and proper cleaning are also done on the transport routes of trucks.	-	-
		37.3 Affected farmers should be given priority in employment	As per reply at Sr. No. 6.1 In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications, experience and skills set subject to requirement.	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadawara STPP.		
		37.4 Unemployed in Gram Panchayats. The list of employment should be pasted and the villagers should be made aware	In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications, experience and skills set subject to requirement. Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadawara STPP.	-	-
		37.5 Health facilities should be improved.	Jeevan Jyoti Hospital in the Project provides OPD, IPD, Pathology, and X-Ray services, 24X7 emergency services to the displaced people at concessional rates at the rate of 20% of Non-entitled charges for OPD.	20 Lakhs	1-3 years from beginning of construction of Project

ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

CHAPTER – 7
ADDITIONAL STUDIES

Page
7-46

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			Apart from this, from time to time, rural medical camps (with free medicine distribution), specialty camps (anemia identification, NCD screening, etc.), health awareness camps (common diseases, prevention of anemia, etc.), free TB testing (National TB Control Program), breast cancer awareness and screening, anemia identification and iron distribution camps, menstrual hygiene awareness and sanitary kit distribution are organized in the nearby villages. Apart from the above, NTPC Gadarwara is also going to install mobile health vans under community responsibility. Essential basic medical facilities are provided at Jeevan Jyoti Hospital in NTPC Gadarwara. In addition, NTPC regularly organizes health camps and distribution of free medicines in project affected villages.		

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
		37.6 Playgrounds, electricity lines and other basic facilities should be provided in the affected villages.	Work on Playgrounds, electricity lines and other basic facilities will be taken up, based on need assessment report and consultation with VDAC meeting and the recommendations of district administration, under community development work.	30 Lakhs	1-4 years from beginning of construction of Project
38.0	Prashant Kaurava/ 8226019117	38.1 Ash trucks should be properly covered and removed from the plant.	As per response given at Sr.No. 1.1 All the Ash filled trucks are covered with 400 GSM tarpaulin as per SPCB guidelines. All the ash bulkers are first washed off under automated water sprinklers inside the plant and are released. Water sprinkling is done during ash filling and transportation in the ash pond area. Water sprinkling and proper cleaning is also done on the roads where these trucks ply.	-	-
		38.2 Employment should be provided to village women.	In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications, experience and skills set subject to requirement.	-	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.		
39.0	Mani Raj Gaur/ Gangai	39.1 Machines should be arranged in the sewing center	The construction of a sewing centre in village Gangai has been completed in the year 2024. Under the agreement with EDII (Entrepreneurship Development Institute of India), the process of skill development of women and market linkage with online platforms has been ensured. At the same time, many self-help groups have been formed in the direction of self-employment of women.	-	-
		39.2 Employment other than tailoring should be arranged	As per response given at Sr. No. 6.1 In the coming years, employment opportunities to the project affected people will be provided through various contractors based on their educational qualifications, experience and skills set subject to requirement.	-	-
		39.3 Employment problem		-	-

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 7
ADDITIONAL STUDIES**

**Page
7-49**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			Efforts will be made to provide unskilled employment to claimants from the project affected families as far as possible in the contract agencies involved in construction and operation of Gadarwara STPP.		
		39.4 The new road which has been built by connecting with Gangai and NTPC is still incomplete, that road should be extended to the school.	Work on roads will be taken up, based on need assessment report and consultation with VDAC meeting and the recommendations of district administration, under community development work.	10 Lakh	1-3 years from beginning of construction of Project
40.0	All Villagers/ Chorbarheta	40.1 The water line that has been laid through the area has a problem of leakage and damage to crops	As per response given at Sr. No. 5.0 After the assessment of crop loss by the District Authorities, necessary steps have been undertaken to compensate the loss due to water line leakage and compensation deposited by NTPC station to SDM official bank account. After repairing of the water line, the area are being levelled to restore to the original ground condition except in the area wherein there is	-	-
		40.2 After repairing the leakage, the land is not leveled		-	-

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 7
ADDITIONAL STUDIES**

**Page
7-50**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**



S. No.	Name/ Mobile/ Address	Query Raised	NTPC Response	Approx. Amount (CD Works) in Lakhs	Approx. Timeline
			resistance/obstruction/ objection by the affected farmer.		
		40.3 No development work has been done by NTPC in our area	Various works of development have been carried out by NTPC in Chorbarhata village like construction of community hall, roads, toilets, welcome gate, street lights etc. Any further development required in the village will be taken up based on need assessment report and consultation with VDAC meeting and the recommendations of district administration, under community development work.	-	-
41	General issues by Local People	CSR-CD works in nearby villages	Miscellaneous works	100 Lakhs	1-5 years from beginning of construction of Project

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 7.3 Action plan to resolve the issues raised during Public Hearing of proposed Stage -II (Activities under Public Hearing and Written Demands given by Sarpanchs & Individuals-CD)

S. N.	Physical activity and action plan		Year of implementation (Budget in INR)					Total Expenditure (Rs. in Lakhs)	Recurring Expenditure (Rs. in Lakhs)
	Name of the Activity	Physical Targets (Tentative)	1 st	2 nd	3 rd	4 th	5 th		
1	Open Gym at village Gangai, Playground at village Chorbarheta & Manakwara and providing Sports materials at Chorbarheta	Oct'2027	50	50	-	-		100	-
2	Construction of Dam at Sakkar river and Sita-Rewa River at Village Ghatpipariya & Gangai, construction of Pitching and retaining wall at Ghatpipariya (100 Mtr.), Construction of Cow shed (03) at village Dongargaon, Chichli & Gangai and ponds (02) in village Chorbarheta & Dongargaon.	July 2028	100	120	120	-	-	340	-
3	Installation of Solar Lights (07) and streetlights (70) at PAVs and vicinity area (Village - Gangai, Chorbarheta, Dongargaon, Kudari, Mehrakheda, Umariya, Ghatpipariya & Manakwara).	Sept'2029	10	20	15	15	-	60	-
4	Construction work of public roads at Ghatpipariya to Kahartola (1.5 Km.) and Village Manakwara to Adiwasi	April'2030	20	60	120	120	65	385	-

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 7
ADDITIONAL STUDIES**

**Page
7-52**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. N.	Physical activity and action plan		Year of implementation (Budget in INR)					Total Expenditure (Rs. in Lakhs)	Recurring Expenditure (Rs. in Lakhs)
	Name of the Activity	Physical Targets (Tentative)	1 st	2 nd	3 rd	4 th	5 th		
	Tola (950 mtr.), Connectivity Road Gangai to NTPC main road (300 mtr.), drinking Water supply in village Ghatpipariya and construction of drainage at Village Dongargaon (200 Mtr.)								
5	Vocational Trainings / Capacity Building of SHGs, Youths and farmers in 07 PAVs Chorbarheta, Mehrakheda, Umariya, Gangai, kudari, Dongargaon, and Ghatpipariya.	Nov'2030	5	10	12	17	11	55	-
6	Construction of School Buildings and additional classrooms at Village (Umariya, Ghatpipariya, Mehrakheda) and other educational activities like distribution of school bags, Notebook and stationary materials.	Aug'2029	10	12	16	12	-	50	-
7	Preventive health Care & Sanitation activities in 07 PAVs Chorbarheta, Mehrakheda, Umariya, Gangai, kudari, Dongargaon, and Ghatpipariya like Health Camps, medical facilities at	Dec'2029	10	14	16	20	-	60	-

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT
MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. N.	Physical activity and action plan		Year of implementation (Budget in INR)					Total Expenditure (Rs. in Lakhs)	Recurring Expenditure (Rs. in Lakhs)
	Name of the Activity	Physical Targets (Tentative)	1 st	2 nd	3 rd	4 th	5 th		
	hospitals, Awareness campaigns under swachhta Pakhwara etc.								
8	Miscellaneous Work: Works related to community development like construction of welcome gate, Welfare activities, renovation of school buildings, Construction of drainage, construction of Culvert etc.	Oct'2030	20	20	20	20	20	10	-
	TOTAL		225	306	319	204	96	1150	-
<i>*The amount and year-wise phasing is tentative which shall be finalized after consultation with stakeholders and District Administration</i>									

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 7.4 Activity wise capital budget provision for Public Hearing issues for Gadarwara STPP for Stage-II, (CD - Capital nature)

S. No.	Proposed works to address the issues raised during Public Hearing and written demands given by Gram Pradhan's & individual's	Estimated Cost (In Lakhs Rs)	Estimated Time
1	Infrastructure development - construction of Model Village, Welcome gate and Community Centre in project affected villages	340.00	01-05 years
2	Road – construction/repairing of roads, drains, toilets and related infrastructure etc .	385.00	01-05 years
3	Renewable Energy – installation of solar high mast light and street light	60.00	01-05 years
4	Health - Development of health infrastructure, conducting medical camps etc .	60.00	01-05 years
5	Education & Sports - renovation of school, playground, smart class, distribution of educational materials etc .	150.00	01-05 years
6	Skill Development and capacity building – To enhance self-employment	55.00	01-05 years
7	Miscellaneous Work	100.00	01-05 years
TOTAL		1150 .00	
<i>* CER activities cover in line with MoEF&CC OM dated 1-5-2018 and OM dated 30-9-2020</i>			

Note: I. Finalization of Village wise CD works shall be done in consultation with VDAC and Need Assessment Survey.

II. Infrastructure development under Community Development (CD) works shall be executed after the allotment of Govt. Land.

7.3 CORPORATE ENVIRONMENT RESPONSIBILITY

NTPC has been pioneers in implementing Environmental & Social Responsibility/Corporate Environmental Responsibility and made significant contribution to improve quality of people's life and Environment in all the regions they are operating in, around the nearby villages, Gadarwara STPP have started key initiative in support of sustainable development.

Based on the Social Impact assessment and need assessment for villages surrounding the NTPC Gadarwara project, a village-wise plan for implementing initiatives through NTPC Gadarwara under CER activities which focuses on key areas like education, healthcare, infrastructure, employment, and community development based on the specific needs of the villages. The activities are tentative and subject to approval by competent authorities within NTPC as well as District Authorities.

1. Mehrakheda

- **Infrastructure:** Construction of 1 km tarmac road and 500-meter access road to Chichli & a bridge to prevent flooding and ensure connectivity.
- **Education:** Renovation of the primary school and a middle/high school. Provision of resources for Aanganwadi centre.

- **Employment:** Vocational training programs for youth in computer skills, spoken English, and personality development.
- **Water Supply:** Installation of an RO water plant and maintenance of the Nal Koop.
- **Agricultural Support:** Provision of training in hybrid seeds, drip irrigation, and soil testing.

2. Chorbarheta

- **Infrastructure:** Completion of the CC road from the community centre to Baddkahar Ghat. Development of proper drainage system.
- **Education:** Establishment of a secondary school to reduce dropout rates.
- **Skill Development:** Introduction of vocational training in animal husbandry, fish farming, and tailoring.
- **Healthcare:** Small clinic or "Mohalla Clinic" and veterinary facilities.
- **Employment:** Modern agricultural and livestock farming training for local employment.

3. Umariya

- **Roads:** Construction of a pucca road to the village and improve drainage infrastructure.
- **Education:** Provision of school up to 10th grade and an Aanganwadi Kendra.
- **Skill Development:** Provision of training in tailoring, embroidery, and food production for women and technical training for youth.
- **Healthcare:** A small clinic to provide basic health services.

4. Dongargaon

- **Roads:** Pucca roads connecting to NTPC and other nearby areas.
- **Electricity:** Expansion of electricity infrastructure to cover all households.
- **Skill Development:** Computer training Center and vocational programs in tailoring, animal husbandry, and beekeeping.
- **Healthcare:** Organizing of weekly medical camps and establishment of a small clinic.

5. Kudari

- **Infrastructure:** Construction of roads and drainage systems. Upgradation of electricity infrastructure.
- **Education:** Renovation of primary and middle schools. Establishment of a library and extension of school to Class XII.
- **Vocational Training:** Tailoring, computer literacy, and trade skills programs.
- **Healthcare:** A small clinic with regular medical camps.

6. Gangai

- **Roads & Drainage:** Improvement of Road connectivity and drainage systems.
- **Education:** Upgradation of the high school to a senior secondary level. Provision of vocational and technical training.
- **Healthcare:** Building a clinic and organizing weekly medical camps.
- **Women Empowerment:** Introduction of vocational training in tailoring and promote female literacy programs.

7. Ghat Pipariya

- **Infrastructure:** 2.5 km and 1.5 km roads for village connectivity. Construction of a bridge over the Shakkar River.
- **Education:** Improve school facilities and set up a computer training center.
- **Employment:** Provision of agricultural training in organic farming and animal husbandry.
- **Healthcare:** Establishment of a small clinic and conducting of regular medical camps.

7.4 RISK ASSESSMENT

A hazard is something that can potentially cause harm, and a risk is the chance, high or low, that any hazard will actually cause somebody harm. Industrial disaster may arise when a major accident occurs and becomes uncontrollable resulting in the consequences spreading out of the project boundary. Hazards are inherent to all industrial operations since they involve handling of hazardous materials (flammable, explosive, corrosive and toxic materials), heavy machineries & technical units. Thus, risk assessment becomes an important part of the EIA-EMP study. Risk Assessment is a methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods, and the environment on which they depend.

Risks are inherent in thermal power plant operations since they involve working with many Hazards such as (i) High pressure super-heaters, re-heaters, economizer units exchanging heat with the hot flue gases; (ii) Turbines that utilize the HP steam to generate power; (iii) Fuel oil storage and handling units; (iv) Coal handling units; (v) Hydrogen as a coolant in turbo generators drawn from hydrogen cylinders; (vi) Water treatment chemical and (vii) Switchyard including transformers, isolators etc.

Nevertheless, a properly designed and operated potentially hazardous unit of a thermal power plant will have a very low probability (to a level of acceptable risk) of a threat. Subsequently, a properly designed and executed management plan can further reduce the probability of a threat turning into an on-site emergency and /or an off-site emergency.

The four major steps in risk assessment are:

- Hazard identification
- Dose response assessment
- Exposure assessment
- Risk characterization

Hazard identification is a process that determines the probable risk on human health or properties that could result from exposure to a potential hazard. This process requires a review of the scientific literature. The literature could include information published by the national and international organizations like US Environmental Protection Agency (EPA), state agencies, and health organizations. Identification of causes and types of potential hazards is the primary task for planning for consequential risk assessment.

Dose-response or toxicity assessment is the determination of how different levels of exposure to a hazard or pollutant affect the likelihood or severity of health effects. Responses/effects can vary widely since all chemicals and contaminants vary in their capacity to cause adverse effects. The dose-response relationship can be evaluated for either carcinogenic or non-carcinogenic substances.

Exposure assessment is the determination of the magnitude of exposure, frequency of exposure, duration of exposure, and routes of exposure by contaminants to human populations and ecosystems. There are three components to this step: **Component-1:** Identification of contaminants being released which are hazardous; **Component-2:** Estimation of the amounts of contaminants released from all sources or the source of concern and **Component-3:** Estimation of the concentration of contaminants.

7.4.1 COMPONENT-1 IDENTIFICATION OF CONTAMINANTS/HAZARDS

A classical definition of hazard states that it is the characteristic of system/process that presents potential for an accident. Hence, all the components of a system/process need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident.

Estimation of probability of an unexpected event and its consequences form the basis of quantification of risk in terms of damage to property, environment, or personnel. Therefore, the type, quantity, location, and conditions of release of a toxic or flammable substance have to be identified in order to estimate its damaging effects, the area involved, and the possible precautionary measures required to be taken. Based on the areas and unit operations involved in generation of power from a coal fired thermal power plant, various hazards are identified which are given in **Table 7.5**.

Table 7.5 Potential Hazards

Sl. No.	Blocks/Areas	Hazards Identified
1	Coal storage in open yard	Fire, Spontaneous Combustion
2	Coal handling plant	Fire and/or Dust Explosions
3	Boilers	Fire (mainly near oil burners), steam; Explosions, Fuel Explosions
4	Turbo-generator buildings	1. Fires in a) Lube Oil systems; b) Cable galleries c) Short circuits in (i) Control rooms(ii) Switchgears 2. Explosion due to leakage of hydrogen and fire following it. 3. Fire in oil drum storage
5	Power transformer	Explosion and fire
6	Switch yard control room	Fire in cable galleries and Switchgear/ Control Room
7	Hydrogen Plant	Explosion and/or fire, Physical dangers
8	LDO	Fire
9	FGD	FGD effluent –Corrosive

7.4.2 COMPONENT-2 ESTIMATION OF AMOUNT OF CONTAMINANTS

In a coal based TPP, fuel oils are needed for start-up operations. Hazardous substances in fuel oil storage may be classified into three main classes namely flammable substances, unstable substances and toxic substances. The fuel storage details of the project and properties are LDO which falls under Class B Flammable Liquids (**Table 7.6**).

Table 7.6: Flammability Classification Criteria

Sl. No.	Flammability Class	Flash point (°C)
1	Class A Flammable Liquid	FP < 23
2	Class B Flammable Liquid	23 > FP < 65

Fuel oils (LDO) will be used in small quantity for initial start-up. Acid, alkalis and other chemicals are used in the makeup water treatment & DM Plant. The hazards associated with the use of these materials would be taken careful consideration and due precaution would be taken for its safe handling at various stages of usage.

Coal dust when dispersed in air and ignited would explode. Crusher house and conveyor systems are most susceptible to this hazard. To be explosive, the dust mixture should have: (i) Particles dispersed in the air with minimum size (typical figure is 400 microns); (ii) Dust concentrations must be reasonably uniform; and (iii) Minimum explosive concentration for coal dust (33% volatiles) is 50g/Nm³. Failure of dust extraction and suppression systems may lead to abnormal conditions and may increase the concentration of coal dust to the explosive limits

Sources of ignition present are electric equipment and cables, friction, spontaneous combustion in accumulated dust. Dust explosions may occur without any warnings with Maximum Explosion Pressure up to 6.4 bar. Another dangerous characteristic of dust explosions is that it sets off secondary explosions after the occurrence of the initial dust explosion. Many a times the secondary explosions are more damaging than primary ones. The dust explosions are powerful enough to destroy structures, kill or injure people and set dangerous fires likely to damage a large portion of the Coal Handling Plant including collapse of its steel structure which may cripple the lifeline of the power plant.

Thus, storage of coal would be designed in such a way that the air content in the coal pile is minimized. Dimension of the coal stack, particularly the height, is a very important parameter for making storage of coal safe and adequate care would be taken while designing the same. Regular watering of stockpile will be done to keep temperature within limits.

7.4.3 COMPONENT-3: ESTIMATION OF THE CONCENTRATION OF CONTAMINANTS

Preliminary Hazard Analysis: Two scenarios are considered for the **Preliminary Hazard Assessment (PHA)**: (i) Spillage of chemicals while handling.

Table 7.7: Preliminary Hazard Assessment for Power Plant: Environmental Factors

PHA Category	Description of Plausible Hazard	Recommendation
Environmental factors	Spillage of chemicals (HCl, NaOH, FeCl ₃ and H ₂ SO ₄) from tanks and while handling	- Any unintentional spills must be handled in accordance with the MSDS for each chemical. - All chemical storage tanks must be housed inside a ditch with dike wall according to volume of tank to prevent spills from occurring from ruptures or leaks in joints. - A copy of the MSDS must be maintained in the warehouses and chemical laboratory.
	Spillage of chemicals or baths into trench	- All tanks storing chemicals shall be kept within Dyke with wall so that spillage due to rupture or leakages in joints does not take place. - The source of the spillage shall be immediately identified and plugged. - The spilled chemical shall be washed with water and the washed water shall be collected and treated.

7.4.4 HAZARDS FROM LDO HANDLING & STORAGE

ALOHA® is the hazard modelling program for the CAMEO® software suite, which is used widely to plan for and respond to chemical emergencies and approved by USEPA. The same is used here.

7.4.4.1 POOL FIRE OF LDO STORAGE (N-Heptane)

CHEMICAL DATA:

Chemical Name: N-HEPTANE

CAS Number: 142-82-5 Molecular Weight: 100.20 g/mol

PAC-1: 500 ppm PAC-2: 830 ppm PAC-3: 5000 ppm

IDLH: 750 ppm LEL: 10500 ppm UEL: 67000 ppm

Ambient Boiling Point: 96.9° C

Vapor Pressure at Ambient Temperature: 0.020 atm

Ambient Saturation Concentration: 21,154 ppm or 2.12%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 2.16 meters/second from 292.5° true at 3 meters

Ground Roughness: open country Cloud Cover: 5 tenths

Air Temperature: 41° F Stability Class: C

No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:

Burning Puddle / Pool Fire

Puddle Diameter: 18 meters

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Initial Puddle Temperature: 28° C

Flame Length: 32 meters

Burn Duration: ALOHA limited the duration to 1 hour

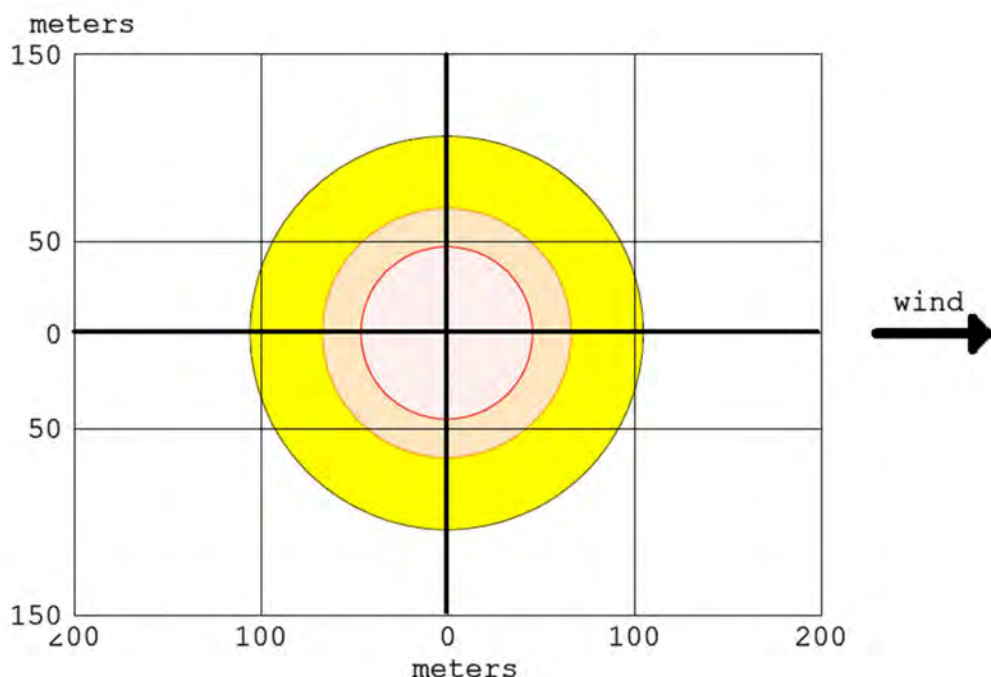
Burn Rate: 1,440 kilograms/min

Total Amount Burned: 86,311 kilograms.

THREAT ZONE:

Threat Modelled: Thermal radiation from pool fire

Colour code	Time	Intensity	Distance
Red	Potentially lethal within 60 sec	10.0 kW/(sq m)	46 meters
Orange	2nd degree burns within 60 sec	5.0 kW/(sq m)	67 meters
Yellow	Pain within 60 sec	2.0 kW/(sq m)	105 meters



Two number of existing storage tank of capacity 250 M³ (earlier provided for HFO) will be used. Additional two number of storage tanks each of capacity 2500 KL are envisaged for LDO for the Stage-II. The tanks will be kept within Dyke. In the event of spilling its contents through a small leakage or due to rupture of the pipeline connecting the tank and on ignition, fire will eventuate. As a worst case, it is assumed that the entire contents are leaked out from the storage tank into the tank bund.

7.4.4.2 Thermal Radiation from Jet Fire (AMMONIA)

CHEMICAL DATA:

Chemical Name: AMMONIA

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



CAS Number: 7664-41-7 Molecular Weight: 17.03 g/mol

Ambient Boiling Point: -34.3° C

Vapor Pressure at Ambient Temperature: greater than 1 atm

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA):

Wind: 2.16 meters/second from 292.5° true at 3 meters

Ground Roughness: open country Cloud Cover: 3 tenths

Air Temperature: 41° F Stability Class: E

SOURCE STRENGTH:

Flammable chemical is burning as it escapes from tank

Tank Diameter: 4.5 meters Tank Length: 6.29 meters

Tank Volume: 100 cubic meters

Tank contains liquid Internal Temperature: 41° F

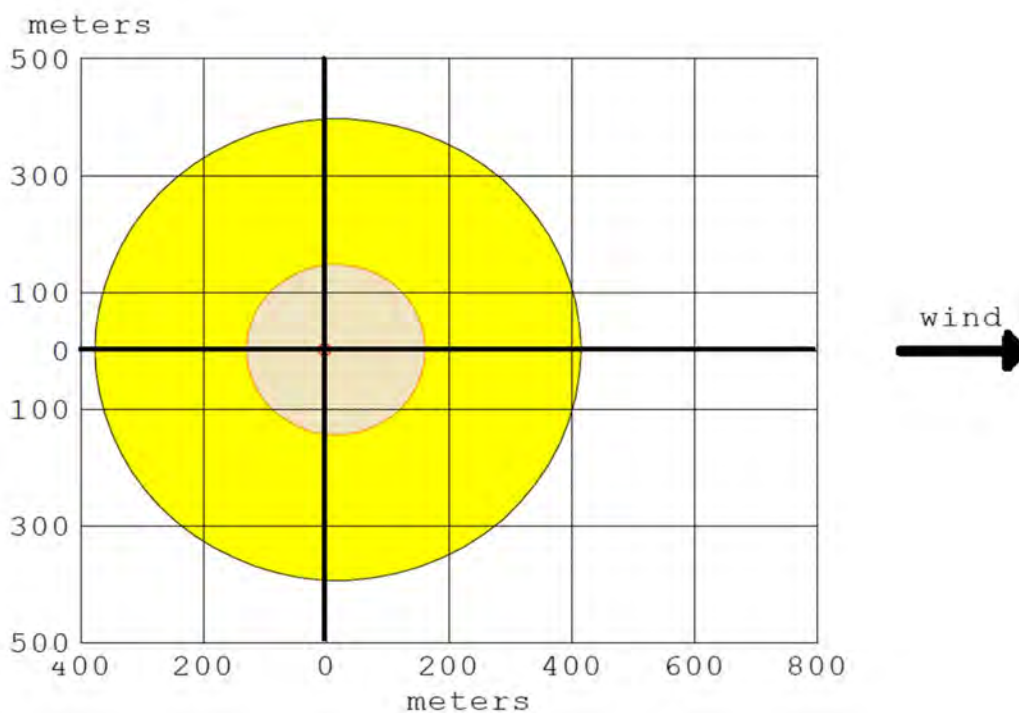
Chemical Mass in Tank: 62.6 tons Tank is 90% full

Circular Opening Diameter: 2.5 meters

THREAT ZONE:

Threat Modelled: Thermal radiation from jet fire

Colour code	Time	Intensity	Distance
Red	Potentially lethal within 60 sec	10.0 kW/(sq m)	10 meters
Orange	2nd degree burns within 60 sec	5.0 kW/(sq m)	165 meters
Yellow	Pain within 60 sec	2.0 kW/(sq m)	418 meters



4.4.4.3 BLEVE of flammable liquid in horizontal cylindrical tank

SOURCE STRENGTH:

BLEVE of flammable liquid in horizontal cylindrical tank

Tank Diameter: 4.5 meters Tank Length: 6.29 meters

Tank Volume: 100 cubic meters

Tank contains liquid

Internal Storage Temperature: 41° F

Chemical Mass in Tank: 62.6 tons Tank is 90% full

Percentage of Tank Mass in Fireball: 100%

Burn Duration: 14 seconds

THREAT ZONE:

Threat Modelled: Thermal radiation from fireball

Colour code	Time	Intensity	Distance
Red	Potentially lethal within 60 sec	10.0 kW/(sq m)	325 meters
Orange	2nd degree burns within 60 sec	5.0 kW/(sq m)	470 meters
Yellow	Pain within 60 sec	2.0 kW/(sq m)	744 meters

Hazards due to Coal Stock

Coal does not meet criteria for any Physical Hazards as per the MSDS. Chances of catching fire is remote unless fine coal dust is dispersed in the air. Lower flammable limit of finely- dispersed bituminous coal dust is approximately 130 g/m³ in air containing no coexisting methane gas. Upper flammable limit not established. It is unlikely that coal dust can catch fire in the absence of source of fire as Auto-ignition Temperature is 390 – 425°C. Further, open storing (open under sky or open in covered sheds but not confined spaces) will lower the chances of explosion. By eliminating the possibility of either suspension or confinement, an explosion cannot occur.

Coal in stockyard is usually stores coal for 10-15 days stock and will stored in open it is ready to be fed into the boiler. The CHP ensures that the coal is stored safely and transported without mishaps. CHP has measures to prevent the accumulation of coal dust and ensures safe handling. The fire and explosion hazards associated with this stockpile are usually limited to spontaneous combustion.

When good housekeeping practices have eliminated coal dust in the plant and with water sprinkling arrangements in CHP, there would be remote chances of fuel to allow a continuation of the explosion flame.

Further, Fire in Coal storage and Coal dust explosion in coal conveyer bunker are classified as Moderate Risks that Required minor risk reduction improvements; generally addressed by codes, standards, company or industry practices.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Hazardous substance On-Site

Table 7.8: On-Site Hazardous Chemicals

S. No.	Material	Type of container	Location & Nos. of containers/ tanks	Max. storage capacity	Normal Inventory
1.	HCl	Horizontal tank with dish ends & 4.5 mm rubber lined	DM Plant, 2 Nos.	170	Bulk tanks: 2x50 m ³ in DM Plant+ 2x35 m ³ in ClO ₂ dosing plant
2.	NaOH	Horizontal tank with dish ends & 4.5 mm rubber lined	DM Plant, 2 Nos.	100	Capacity of Bulk tanks: 2x50 m ³
3.	H ₂ SO ₄	Horizontal tank with dish ends & 4.5 mm rubber lined	CW Chemical Treatment plant 3 containers	100	Bulk tanks: 2x50 m ³
4.	NaClO ₂	Tanks	DM Plant, 2 Nos.	70	Bulk tanks: 2x35 m ³
5.	Ammonia Solution 25%	HDPE Jerry cans (25 Lts.)	DM Plant & Central Stores 200 cans	--	--

Table 7.9: Chemicals and Risk hazards with Mitigation measures

Chemical	Risk Hazards	Mitigation Measures
Sodium Hydroxide (NaOH)	- Highly corrosive: Causes severe burns and eye damage. - Exothermic reaction with water, can cause violent splashing. - Inhalation hazard: Aerosols cause respiratory irritation. - Reacts with acids and organic materials.	-Wear chemical-resistant gloves, goggles, and face shields. -Add NaOH to water slowly, never the reverse. -Store in airtight, corrosion-resistant containers. -Provide eyewash stations and safety showers nearby.
Sodium Chlorite (NaClO ₂)	- Strong oxidizer: Intensify fires when in contact with combustible materials. - Toxic: Inhalation or skin exposure can cause poisoning. - Reacts with acids, producing chlorine dioxide gas (toxic & explosive).	-Store away from heat, flames, and organic materials. -Avoid mixing with acids to prevent toxic gas release. -Use chemical-resistant gloves, goggles, and protective clothing. - Handle in a well-ventilated area.
Sulfuric Acid (H ₂ SO ₄)	- Highly corrosive: Causes severe burns and eye damage. - Exothermic reaction with water, may cause violent splashing. - Inhalation hazard: Vapors can damage respiratory tracts. - Reacts violently with bases, metals, and organic materials.	-Use acid-resistant gloves, goggles, and full-body protection. -Always add acid to water, never water to acid. -Store in corrosion-resistant containers away from bases and flammable materials. -Ensure proper ventilation and emergency response.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Chemical	Risk Hazards	Mitigation Measures
Hydrochloric Acid (HCl)	- Highly corrosive: Causes burns, eye damage, and severe irritation. - Toxic fumes: Inhalation can cause respiratory distress and lung damage. - Reacts with metals, releasing hydrogen gas (flammable).	-Use acid-resistant gloves, goggles, and chemical aprons. -Work in a well-ventilated area or use fume hoods. -Store in acid-resistant containers, away from metals. -Have eyewash stations and spill control kits nearby.

Table 7.10: Risk categories with impact, mitigation measures and timeline

Sr. No.	Items Proposed	Financial Outlay (in Cr.)					Financial Outlay (in Cr.)
		1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year	
1	Fire service facility including • Smoke and fire detection alarm system • Water supply • Fire hydrant and nozzle installation • Foam system • Water fog and sprinkler system • Mobile Firefighting equipment • First aid appliances	10.5	8	2	2	2	24.5
2	Periodic maintenance of all protective and safety equipment	1.5	1.5	1.5	1.5	1.5	7.5
3	Installation of Windsocks/wind cock	0.01	--	--	--	--	0.01
4	Periodical training/awareness to work force	0.25	0.25	0.25	0.30	0.30	1.35
5	Periodic mock drills	0.05	0.05	0.05	0.05	0.05	0.25
6	Signboards including emergency phone numbers and no smoking signs	0.12	0.12	0.12	0.12	0.20	0.68
7	Proper earthing	2.5	2.5	1.5	0.5	0.5	7.5
8	Emergency lighting	2.5	2.5	1.5	0.5	0.5	7.5
Total (Fifty Two Crores Twenty Nine Lakhs)							52.29

7.4.5 MITIGATION MEASURES OF FIRE & EXPLOSION HAZARDS

7.4.5.1 GENERAL MITIGATION MEASURES

- Fire is one of the major hazards, which can result from auxiliary fuel (LDO) storage Tanks. Fire prevention and relevant code enforcement is one of the major responsibilities of project proponent. The fire service facility shall be equipped with:
 - Smoke and fire detection alarm system
 - Water supply
 - Fire hydrant and nozzle installation
 - Foam system
 - Water fog and sprinkler system

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



- Mobile Firefighting equipment
- First aid appliances
- Smoke and fire detection, fire hydrant & nozzle installation etc. as indicated above shall be included as part of all major units.
- Periodic maintenance of all protective and safety equipment shall be done.
- Windsocks/wind cock should be operational at suitable height and with proper visibility to check the prevailing wind direction at the time of accident.
- Periodical training/awareness shall be given to work force at the project to-as refresh courses in order to handle any emergency situation.
- Periodic mock drills shall be conducted so as to check the alertness and efficiency of the DMP and EMP and corresponding records should be maintained.
- Signboards including emergency phone numbers and no smoking signs shall be installed at all appropriate locations.
- Plant shall have adequate communication system.
- All major units/equipment shall be provided with smoke/fire detection and alarm system.
- All electrical equipment shall be provided with proper earthing. Earthed electrode shall periodically tested and maintained
- Emergency lighting shall be available at all critical locations including the operator's room to carry out safe shut down of the plant and for ready identification of firefighting facilities such as fire water pumps, fire alarm stations, etc.
- In addition to normal lighting, each installation shall be equipped with emergency (AC) and critical (DC) lighting.
- All electrical equipment shall be free from carbon dust, oil deposits, grease etc.
- Cable routing shall be planned away from heat sources, gas, water, oil, drain piping, air conditioning ducts etc.

FIRE HAZARDS AND PREVENTION FOR COAL AND OIL STORAGE AREAS

Fire Detection and Prevention System in Coal Handling Plants to have provisions of

- a. Hydrant System
- b. Spray system
- c. Infrared Detectors in critical Conveyors
- d. Measurement of CO in the vicinity of coal stockpile need to be done on regular intervals

S No	Area	Fire Hazard	Fire Prevention
1.	Coal Stockyard & Stacker Reclaimer	Self-ignition due to coal air interaction	- Coal to be visible wet while stacking. - Fresh coal is not to be stacked over old coal. - Coal to be stacked layer by layer (each of 1-1.5M height) with compaction of each layer - Regular spray of water over coal

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S No	Area	Fire Hazard	Fire Prevention
			yard to be done. 5. Stacking to be done in trapezoidal stockpile and not in conical. 6. Proper records of period of stacking to be maintained and the principle of FIFO (First in First Out) to be adopted.
2.	Bulldozers, Pay-loaders etc.	Coal dust and oil deposits combined with hot exhaust pipes, fuel oil tank, fuel oil leakages, cables	Regular cleaning of engine compartment, inspection to check for any fuel leakage.
3.	Coal Conveyors	1. Maintenance activities involving welding / gas cutting leading to weld spatter on coal / Conveyor due to Friction caused by Belt, Jammed idler, Jammed conveyor belt 2. Fluid coupling failures 3. Overfilled gear box 4. Self-ignition of accumulated coal dust at concave contours of conveyors. 5. Loosely laid wires / cables / welding cables with exposed joints	1. Regular cleaning and inspection of all areas of CHP. 2. Chute block switches to be kept in service to alarm chute choking. 3. Pulley, idlers, gear boxes, fluid couplings not to be over greased/over filled. 4. System of hot work permit to be followed during welding / cutting job 5. Only fire retardant (FR grade) belt to be used including bunker sealing belt, ILMS belt. 6. Belt not to rub steel structure. 7. While welding any chute/hopper lined with rubber / polymer liners, special care to be taken to cool the liner. 8. Adequate illumination in all areas of CHP. 9. Coal dust accumulation on magnets and its cleaning belt to be avoided as temperatures are high there. 10. Loose wires / cable/welding leads with open joints to be avoided. 11. Fire Blanket to be used in case welding/cutting on Belt
4.	Coal Bunkers	1. Feeding of hot coal from stockyard, which may be	1. Residual, coal should be avoided in bunkers and bunkers

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S No	Area	Fire Hazard	Fire Prevention
		about to burn. 2. Residual coal sticking to bunker walls for a long periods resulting in self-ignition 3. Long period coal holding in bunkers particularly top mills. 4. Any draught of air through the coal in bunkers, particularly compressed air from air blast equipment 5. Low bunker level coupled with unsatisfactory isolation from feeder / mill with subsequent pressurization of furnace causing hot gases to pass through the bunker 6. Bunker conveyor fires	should be emptied and cleaned thoroughly during overhaul of unit monsoon preparation. 2. Bunker gates to be maintained to ensure that they close properly when bunker is not in use. 3. Hot coal should not be fed into the bunkers from stockyard. 4. System of hot work permit to be followed during welding/cutting job in bunker floor. 5. Availability of bunker level indication along with annunciation for low bunker level to be ensured. 6. Mill changeovers so that no bunker hold coal for long durations.
5.	Coal Feeders	1. Hot or burning coal passing from coal bunkers 2. Fires in mills particularly during start-up or shut down periods 3. Friction due to mechanical failure 4. Welding / gas cutting etc. 5. Residual coal in pockets of feeder	1. Routine cleaning of feeder from inside to reduce extent of residual coal left compacted in dead spaces within the feeder. 2. Feeder inlet and outlet gate should be in healthy condition. Feeder Water spray nozzle (if provided) to be checked physically during preventive maintenance. Water line choking to be checked by charging line during Unit overhauling. Coal feeder should be kept empty when not in service. Mill inerting should be in healthy condition. Inerting Valve should operate from control room in case of biomass firing 3. Bunker gates and mill dampers to be maintained to prevent the passage into the feeder of combustion products from fires elsewhere in the system. 4. The system of hot work permit

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S No	Area	Fire Hazard	Fire Prevention
			to be strictly followed during welding / gas cutting jobs. 5. Periodic checking of feeders protection on "No Coal on Belt" to be ensured.
6.	Coal Mills and Piping.	1. High mill outlet temperature due to coal flow interruption 2. Low level of coal in ball mills	1. Appropriate fire detection system to be maintained in running and standby mills. 2. Instrumentation of measuring / maintaining level of coal in ball mills and of measuring sound level to be maintained. 3. Proper start-up and shut-down procedures to be maintained. 4. Mill inerting system to be always kept in service. 5. Auto closing from mill outlet temp. high protection is to be kept in service.
7.	Fuel Oil Storage Tanks	1. Greater risk during venting, gassing and filling operations of light fuel oil. 2. Leakage of tank. 3. Dry grass around tanks. 4. Oil spillage 5. Unclean surroundings 6. Soaked insulation 7. Electrical tracing	1. Precautions to be taken during tank emptying, cleaning, tank inspections, vent inspections, other maintenance works (including electrical / lighting works). Welding/cutting to be avoided. If carried out, all precautions to be taken. 2. Entry to bunded area to be restricted to authorised persons only. 3. Filling lines to be purged and road tanker connections should be kept secure when not in use. 4. Recycled oil to be cooled to below the flash point before returning to storage tanks. 5. Excess temperature safety systems and alarms to be installed on heater banks. 6. All areas within the bund walls must be free of vegetation and other combustible materials.
8.	Fuel Oil Unloading and Transfer Pump House	1. Oil spillage or leakage due to failure of joints or of venting due to overheating or	1. Adequate ventilation in the enclosed pumphouse to keep the concentration of oil vapours within safe levels.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S No	Area	Fire Hazard	Fire Prevention
		restrictions in system. 2. Heaters 3. Loosely laid electrical cables/welding cables. 4. Drain oil stagnant in unloading pipe trenches /drains	2. Proper smoke vents and adjustable louvers at high and low level. 3. Proper earthing of all electrical systems. 4. Use of flame proof lighting/ electrical appliances only in the pump house. 5. Trenches to be filled with sand and PCC on top to prevent contamination with oil. 6. Oil waste, rag, other combustible materials are not allowed to accumulate. 7. No spillage of oil. 8. Prompt attention to defects on oil pipe sheaters etc. 9. Oil absorbing granules if used, should be removed immediately after use. Wood dust not to be used as it is an oil absorbing medium.
9.	Cable Galleries / Vaults	1. Overheating of cables/cable joints up to temperature conditions high enough to bring the plasticizers of PVC compound into a volatile state 2. Short-circuit creating sufficient heat 3. Accumulation of coal dust, flammable debris, cardboard packages, fuel & lubricating oils 4. Welding/cutting inside cable gallery 5. Heating during installation of heat-shrinkable cable joints	1. Cable galleries/vaults to be kept clean and free of all extraneous combustible materials and not to be used as storage and office areas. 2. Regular inspection of cable galleries. 3. Access to cable galleries to be restricted. 4. Proper ventilation to be provided. 5. All cable entry points to cable gallery to be fire sealed. 6. Fire barrier walls to be provided between cable tunnels of units and fire doors to be kept closed. 7. Loosely laid wires to be avoided. 8. Lighting fittings, lighting wires to be inspected regularly. 9. No welding work to be done in cable galleries. 10. Any leakage of fuel/lubricating oil into cable gallery to be immediately attended.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S No	Area	Fire Hazard	Fire Prevention
			11. Ingress of coal dust from boiler side must be avoided. 12. Any overheated joint should be repaired at the earliest. 13. Proper illumination in the cable gallery to be maintained.
10.	Switch- gears	1. Insulating oil of circuit breakers. 2. PVC cables, epoxy resin based and paxolin/melamine insulating material, PVC wiring, solenoids and plastic encased relays.	1. Switchgear rooms to be kept clean and free of flammable debris. 2. Regular inspection of switchgear rooms to be done. 3. Switchgear rooms not to be used as storage areas or office space. 4. Proper maintenance of switchgears and regular testing of protection relays. 5. Proper ventilation of switchgear rooms.
11.	Diesel Generators & Diesel Engines Driven Fire Pumps	1. Leakage of fuel oil 2. Lubricating oil getting overheated & leaked 3. NRV of diesel return line to tank not working	1. Permanent natural ventilation should be provided in the diesel engine room at high and low levels to disperse vapours and fumes. 2. Exhaust pipes should be suitably insulated to prevent ignition of flammable materials. 3. Fuel, lubricating oil leakages should be immediately attended to. 4. Fuel tanks should preferably be sited outside the building. 5. Instrumentation and controls of diesel engine to be regularly checked and maintained. 6. Overloading to be avoided. 7. NRV of diesel return line to tank to be checked regularly. 8. Engine oil sample to be tested regularly. 9. Battery and diesel tank should be sufficiently apart.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



FIRE DETECTION AND PROTECTION SYSTEMS

S. No	Area	Detection System	Protection System
A.	Coal Conveyors	a. LHS (linear Heat sensing cable) b. IRD (Infra Red detectors) QB (Quartzoid bulb)	a. Hydrants / Water Monitors b. Sprinkler system Solenoid /Manual /QB actuated automatic MVW spray system
B.	Transfer points & crusher houses	Quartzoid bulb type heat detectors	Automatic MVW spray / sprinkler system and hydrant system
C.	Coal Handling plant Control rooms, MCC and Switchgear rooms	smoke detectors	a) Fire Extinguishers b) Hydrants (outside)
D.	Cable galleries in CHP Control/ Switchgear rooms (if any)	Linear heat sensing cable type heat detectors; smoke detectors	a) Automatic MVW Spray System and Fire Extinguishers b) Hydrants (outside)
E.	Transformers of rating 10 MVA and above within the plant premises	Quartzoid bulb type heat detectors (With hydraulic detector pipe network)	Automatic HVW spray system and fire extinguishers hydrant system
F.	Stacker Reclaimer Machines	Quartzoid bulb type heat detectors	a) Hydrants / Water Monitors b) Automatic MVW Spray System and Fire Extinguishers
a.	Fuel Oil Tanks LDO	Linear heat sensing cable type heat detectors, Quartzoid bulb type (With pneumatic detection pipe network) heat detectors	Foam injection system and automatic / manual MVW spray system (for uninsulated tanks)
b.	Fuel oil dyke	-	Hydrant system (Hydrants & water monitors) Foam water hydrants/ Monitors
c.	Fuel oil pump house equipments	'Quartzoid bulb' type heat detectors (with hydraulic detector pipe network)	a) Automatic MVW / foam spray system Fire extinguishers, foam hydrants
d.	Control rooms, MCC/ Switchgear rooms if any	Ionisation type smoke detectors/ Multi sensor smoke detector/ Photo electric smoke detector above false ceiling	Fire extinguishers

7.4.6 PROJECT SPECIFIC MITIGATION MEASURES

- The LDO storage shall be located away from coal storage area in view the predicted heat radiation contour distance.
- Protective systems with high reliability and availability should be designed to ensure that these physical conditions are maintained.
- Dyke shall be provided for LDO Storage Tanks

- Co-ordination with local authorities such as fire, police, ambulance, district administration and nearby industries would be ensured to manage / control meet any eventuality.
- To prevent the hazard of static electricity, the fill and recirculation lines to the Storage Tanks shall be located below the liquid level.
- The following arrangements are suggested for LDO Storage Tanks:
 - One independent high-level alarm and trip off liquid inlet-line.
 - One low level alarm with trip off device.
- Provision of auto deluge Water Sprinkler system for each bulk Storage Tank. In case of any Tank on fire or fire in the vicinity, the cooling of adjoining tank shall be resorted promptly in addition to Tank on fire so that the affected tanks well as the neighbouring Tanks does not give away.
- The night vision wind stocking be mounted on top of administrative building, main plant building and storage tanks is preferred so that people can move in upwind directions in the event of massive spillage from tank on fire.

It is recommended that strict adherence to standards and accepted maintenance and operation of the plant plays a vital role in proper up-keep of the plant. Regular checking and monitoring of the health of equipment, pipeline and machines, thickness survey etc. will improve plant performance and safety.

7.5 DISASTER MANAGEMENT PLAN

7.5.1 INDUSTRIAL DISASTERS

Industrial hazards are threats to people and life-support systems that arise from the mass production of goods and services. When these threats exceed human coping capabilities or the absorptive capacities of environmental systems, they give rise to industrial disasters.

Gadarwara STPP has already implemented a Disaster Management Plan for existing unit. New units shall also be included in the same plan.

Events like explosion pool fire, toxic release and fireball are such calamities, which had never been foreseen, and for the persons working in the plant doing routine type of operations, the procedure becomes so monotonous that they forget that such type of events could occur any moment. Under these circumstances, as the people are unaware, they flee in all directions by vehicles or on foot. Although the traffic is halted, it leads to a massive jam making access to the site impossible for the rescue team. Due to explosions and smoke leading to confusion of common people, coordination becomes difficult and without the cooperation of these persons, the situation becomes uncontrollable. Emergency preparedness planning can be divided in two subsections: **(i) Onsite Disaster Management Plan and (ii) Off-site Disaster Management Plan**

On-site Emergency Scenario-1:

Hydrogen gas is used in the Generator for stator cooling. Gadawara STPP has a Hydrogen plant to generate 10 M³/Hr, where the hydrogen is produced by means of water electrolysis in the Electrolyser using KOH solution. The hydrogen generated is stored in the holder after purity checks and oxygen thus generated is vented out to the atmosphere. Fire and explosion in H₂ Plant and H₂ gas cylinder

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



storage room is possible in case of total failure of entire protection systems or due an illicit act/sabotage.

On-site Emergency Scenario-2:

Major fire and explosion in LDO tanks or major pool fire may take place at fuel oil pump house (FOPH) due to total system failure or an illicit act/sabotage.

Onsite Disaster Management Plan: The Onsite Disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operation in this same order of priorities. Considering the process and the material used at Gadarwara STPP, the following hazards are identified along with the probable areas of occurrence as summarized in **Table 7.11**.

Table 7.11: Identification of Hazards and Potential/Probable Locations of Occurrence

Nature of Hazard	Potential Areas / Locations of Occurrence
Fire in Coal handling plant	Fires may occur due to over friction in the belt conveyors, spontaneous fire in the coal lumps/oil-soaked waste in the surroundings of conveyor belt, hot works without precautions, poor housekeeping practices in the wagon tippler, conveyor galleries, crusher house and Transfer Points. Initially the fire may be a slow and isolated but over a period of time, if a running conveyor catches this fire, it spreads rapidly and engulf the whole conveyor gallery.
Fire in Cable Galleries/ Plant Control Room	Cable Galleries/Plant Control Room at Turbo generator (TG) Building can be turned in an emergency situation in case the protection systems fail. The fire may originate from overheating of cables, short circuits, etc
Oil Tanks in TG (Turbo generator) Building and Transformers	Failure of terminal bushings and flash-over; Sudden gas pressure formation due to transformer internal faults and subsequent failure of explosion vents and pressure release devices may cause explosion of transformer and fires; Accumulated leakage of oil from different parts of transformers and spurious sparking nearby
Boiler Explosion	Boiler is pressurized due to non-evacuation of steam, there are chances of Boiler explosion. However, various interlocks and protections are available for Boiler to taken care off to avoid any chance for Boiler explosion
Release of Liquid	There are chances of spill-over/leakage of HCl, H ₂ SO ₄ , FeCl ₃ & NaOH from storage tanks and also due to bursting of acid/alkali lines in DM Plant. There are chances of chemical burns due to contact with acid/alkali. However, all storage and handling areas are provided with

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Nature of Hazard	Potential Areas / Locations of Occurrence
	eye washers and drench showers, neutralization pit, transfer pumps, PPEs etc
Turbo-Generator Explosion	H ₂ gas explosion is a possible hazard in Generator. Various interlocks and protections are available to taken care off to avoid generator explosion. Oil sealing of generator rotor prevents the escape of hydrogen from generator.

The Emergency Control Centre (ECC) is the place from where the operations to handle the emergency are directed and co-ordinated. In the event of any emergency the ECC will be manned by Chief Incident Controller (CIC), his support team and the senior officers of District Administration

During normal working days, ECC will be under the control of Executive Secretaries (2 nos) to CGM(CIC) in the day time. During an emergency, the ECC will be manned by the following personnel. However, no other personnel shall have access to the Control Centre.

1. Chief Incident Controller (CIC), i.e., Chief General Manager or his Alternate
2. Executive Secretary to CGM
3. Members of Support team to CIC
4. Telephone Attendant
5. Three Messengers
6. Sr. Officers of outside services called in for assistance.

SEQUENCE OF ACTION

The primary purpose of the Disaster Management Plan is to control and contain the incident so as to prevent it from spreading to nearby population centres. It is not possible to cover every eventuality in the plan. However, the successful handling of emergency will depend on appropriate action and decisions being taken on the spot. For effective control and management of On-site emergency arising out of potential emergency situations in a power plant, an action process flow is drawn out, as illustrated is given in **Figure 7.1**

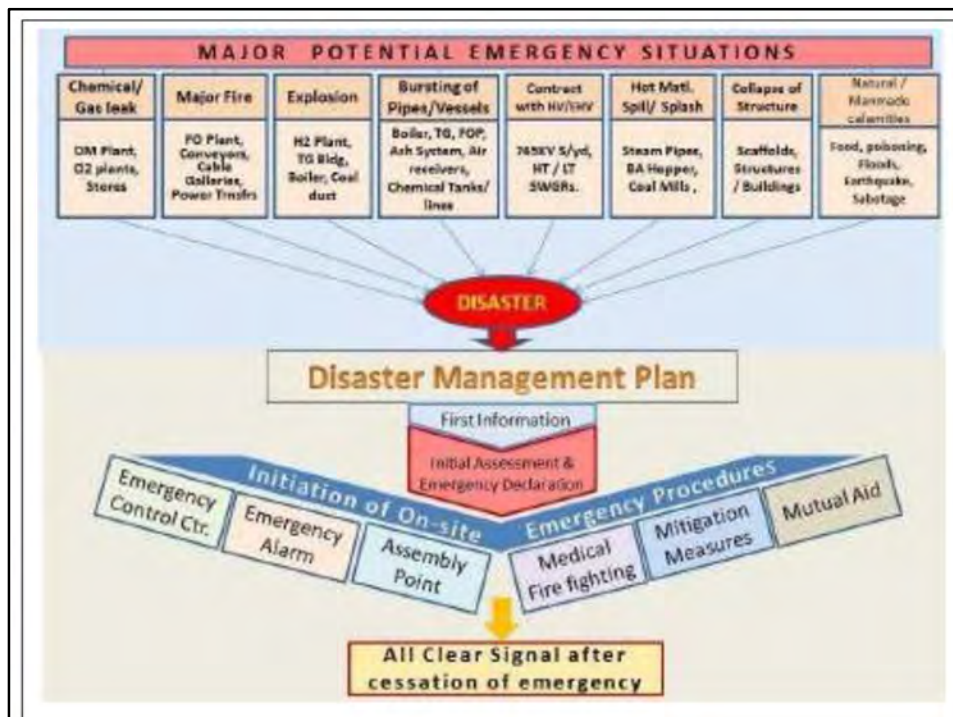


Figure 7-1 Structure of Disaster Management Team

Plant Emergency Organization: Various teams have been identified and their roles & responsibilities are explained in the action plan. The organization chart (**Figure 7.2**) illustrates the reporting system in case of emergency.

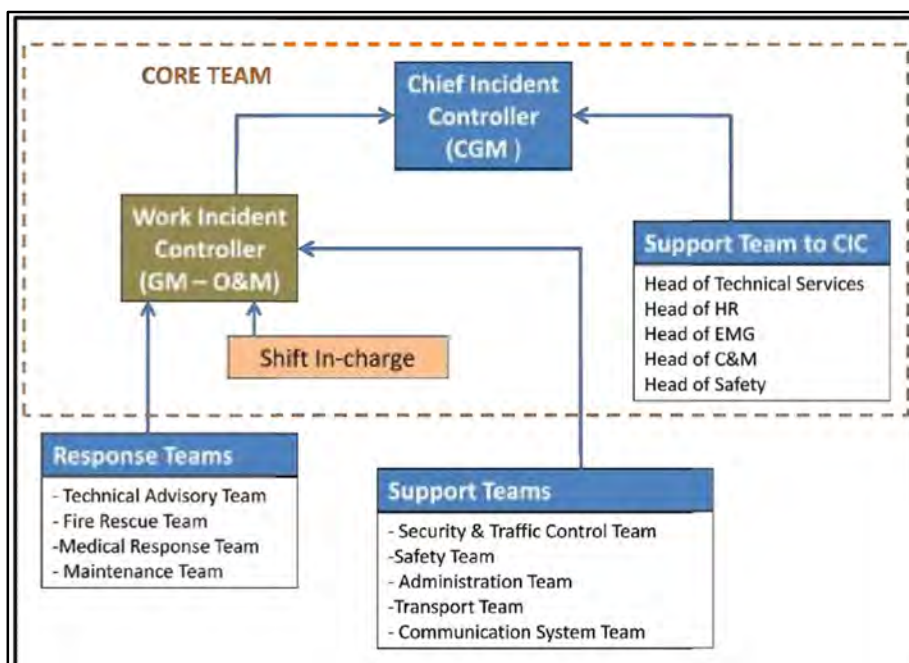


Figure 7-2: Structure of Disaster Management Team

COMMUNICATION AND SEQUENCE OF ACTIONS DURING AN EMERGENCY

The Action Plan for effective communication and sequence of actions during and after an emergency consists of:

- a. First Information & Assessment of emergency.
- b. Responsibilities for Declaration of Emergency.
- c. Handling of Emergency
- d. Responsibility for All Clear Signal.

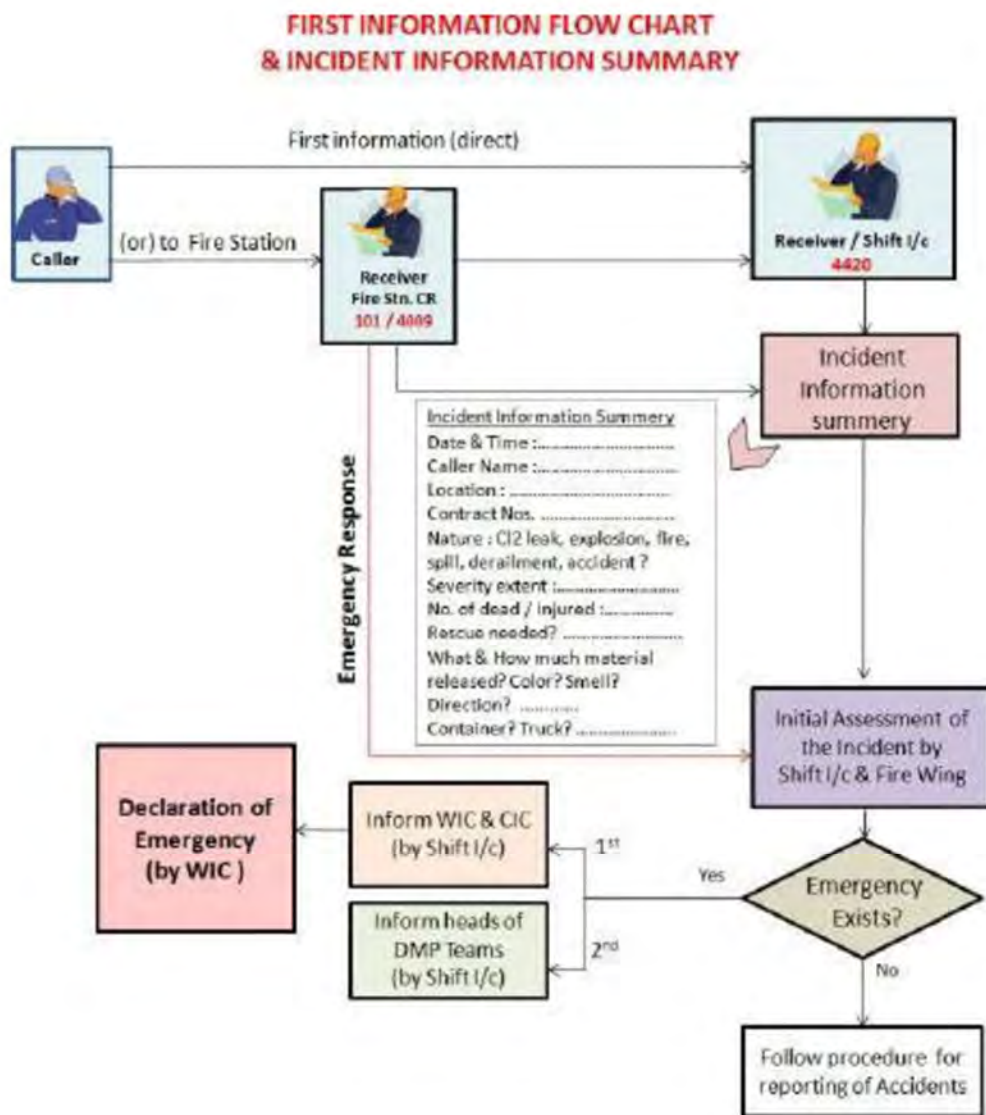


Figure 7-3: First information chart and incident information

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Off-site Emergency Scenario:

In the case of water release / ash slurry release due to bund failure from the reservoir / ash pond, which are located away from the plant boundaries, would lead to emergency situations in the villages and fields in the vicinity of the reservoir / ash pond.

NOTIFICATION PROCEDURE AND COMMUNICATIONS SYSTEMS

ALARM SYSTEMS

The emergency siren will be sounded by the Shift Incharge from the Plant Control Room which is manned round the clock with responsible executives of Operation Department.

The emergency siren audible to a distance of 3 Kms range will be installed at the roof top of Service Building in the Main Plant area.

The emergency alarm shall consist of repeated long and short blast for continuous period of 2 minutes. The purpose is to communicate all persons inside the plant about major emergency occurred in the plant.

The siren is sounded such that the nature of emergency can be distinguished as a major fire. The Siren is tested once in every three months for its effective functioning during emergencies

SI. NO.	T Y P E	DURATION
1.	FIRE	15 SECONDS ON, 5 SECONDS OFF (3 TIMES)
2.	ALL CLEAR SIGNAL	CONTINUOUS SIREN FOR THREE MINUTES (ONLY ONCE)

EVACUATION, ASSEMBLY POINTS AND HEAD COUNT

Evacuation & Assembly Points:

In case of emergency, the non-essential personnel should be evacuated from the incident area and also from adjacent areas. Evacuation should be to a predetermined assembly point in a safe part of the works. Considering such particular cases, two Assembly Points have been identified at Gadarwara.

The persons, those are not part of immediate response teams, would evacuate their work area and report at the designated Assembly Point. The decision to evacuate the work area will be taken by CIC after getting feedback from the WIC/Shift In-charge. Evacuating visitors would be the responsibility of the concerned officer. Department Head should take care to evacuate any handicapped person in his area

Assembly Points:

There are two assembly points AP-1 and AP-2 have been identified in the plant. These points are also indicated in the Plant Layout drawing.

SI. NO.	T Y P E	DURATION
AP-1	Along Compressor House	Decision would be taken by the CIC after consulting the WIC
AP2	Safety Excellence Centre	
AP-3	Along CHP Control Room	

Head Count Team & Its Functions:

A two-member team headed by HR Officer (Time Office) will man the designated Assembly Point. These persons would carry out the head-count and report any unaccounted person to the ECC. He will take the help of concerned HODs/Sectional Heads for employees, contractors' employees and visitors.

Fire in Coal handling plant:

Gadarwara Super Thermal Power Station and its auxiliary plants are provided with adequate Fire detection alarm systems and protection Systems to detect and extinguish any out break of fire. A well-designed fire detection and fire-fighting systems have been provided all over the conveyor galleries, viz., Linear heat sensing cables, Infra-red cameras, medium velocity water spray system with quartzite bulbs/deluge valves, dust suppression system, hydrant water system, portable fire extinguishers etc. Additionally, hot work permit system is in vogue and good housekeeping practices are in place. Scheduled preventive maintenance and protocol inspections of detection & protection systems are conducted to ensure healthiness of the systems.

7.5.2 NATURAL DISASTERS

A natural disaster is the result of a natural phenomenon (e.g. flood, tornado, earthquake, Tsunami, Cyclone and land slide, epidemics, pandemics etc.). It leads to financial, environmental or human losses. The resulting loss depends on the vulnerability of the affected population to resist the hazard, also called their resilience. Madhya Pradesh State Disaster Management Authority is a nodal agency for preparation of disaster management plan of natural disaster for Madhya Pradesh.

Earthquake: As per the recent categorization, the country has been divided into four zones (II, III, IV and V) and the project site is coming under Moderate Earthquake Zone (i.e. Zone-III). The plant and surrounding area fall in a moderate damage risk zone as per the recent earthquake categorization zone.

Objectives

- Minimize the risk to human life and property.
- Ensure the continuous operation of critical plant functions.
- Facilitate a coordinated and efficient response to earthquake events.
- Promote rapid recovery and return to normal operations.

Before an Earthquake (Preparedness and Mitigation)

A. Risk Assessment and Planning

1. Seismic Hazard Analysis:

- Conduct regular seismic hazard assessments to understand the potential impact of earthquakes.
- Identify and map out high-risk areas within the plant.

2. Structural Safety:

- Ensure all buildings and structures meet seismic design standards.

- Retrofit vulnerable structures to enhance earthquake resistance.

3. Emergency Planning:

- Develop and regularly update an Earthquake Emergency Response Plan.
- Establish clear evacuation routes and assembly points.
- Prepare an inventory of emergency supplies, including first aid kits, water, food, and communication devices.

B. Training and Drills

1. Employee Training:

- Conduct regular training sessions for employees on earthquake preparedness, response, and evacuation procedures.
- Train personnel in first aid and basic search and rescue techniques.

2. Drills and Simulations:

- Organize periodic earthquake drills to test the effectiveness of the emergency response plan.
- Evaluate and improve response strategies based on drill outcomes.

C. Infrastructure and Equipment

1. Equipment Safety:

- Secure heavy machinery and equipment to prevent movement during an earthquake.
- Install automatic shut-off systems for gas, electricity, and other critical utilities.

2. Communication Systems:

- Ensure reliable communication systems are in place for internal and external coordination.
- Maintain backup communication systems in case of primary system failure.

During an Earthquake (Immediate Response)

A. Initial Actions

1. Drop, Cover, and Hold On:

- Instruct all personnel to drop to the ground, take cover under sturdy furniture, and hold on until the shaking stops.

2. Emergency Shutdown:

- Implement automatic or manual shutdown procedures for critical operations to prevent accidents.

B. Evacuation and Safety

1. Evacuation:

- Evacuate non-essential personnel to predetermined safe areas following established routes.
- Ensure the safe evacuation of visitors and contractors on-site.

2. Emergency Response Team:

- Activate the Emergency Response Team to assess damage and initiate immediate response actions.
- Coordinate with local emergency services for additional support if necessary.

After an Earthquake (Recovery and Rehabilitation)

A. Damage Assessment and Repair

1. Inspection:

- Conduct a thorough inspection of all plant facilities and infrastructure to identify damage.
- Prioritize the assessment of critical systems and structures.

2. Repairs and Restoration:

- Initiate repair work to restore essential services and operations.
- Engage qualified engineers to ensure repairs meet safety standards.

B. Communication and Coordination

1. Internal Communication:

- Keep all employees informed about the status of recovery efforts and any safety advisories.
- Use multiple communication channels to ensure messages reach everyone.

2. External Coordination:

- Liaise with local authorities, emergency services, and stakeholders to coordinate recovery efforts.
- Provide regular updates to the community and regulatory bodies.

C. Support and Counselling

1. Employee Support:

- Offer counselling and support services to employees affected by the earthquake.
- Provide assistance for temporary housing and other essential needs if required.

2. Community Support:

- Participate in community recovery initiatives and offer support to affected residents.

Review and Improvement

1. Post-Event Analysis:

- Conduct a detailed analysis of the earthquake response to identify strengths and areas for improvement.
- Document lessons learned and update the Disaster Management Plan accordingly.

2. Continuous Improvement:

- Regularly review and revise the DMP based on new information, technological advancements, and feedback from drills and actual events.
- Ensure ongoing training and awareness programs for all employees.

General precautions by people before the earthquake: Following safety measures has been suggested.

- Keep the following in a designated place: bottled drinking water, non-perishable food, first aid kit, torchlight, and battery-operated radio with extra batteries.
- Awareness to people about everybody how to turn off electricity, gas, etc.
- Identify places in the plant as well as house that can provide cover during an earthquake.
- It may be easier to make long distance calls during an earthquake. Identify an out of- town relative or friend as your family's emergency contact. If the family members/colleague get separated after the earthquake and are not able to contact each other, they should contact the designated relative/friend.
- The address and phone number of the contact person/relative should be with all the family members.

General precaution by people after the earthquake: Here are a few things to keep in mind after an earthquake. The caution by people should display in the aftermath can be essential for their personal safety.

- Wear shoes to protect their feet from debris.
- After the first tremor, be prepared for aftershocks.
- Though less intense, aftershocks cause additional damages and may bring down weakened structures.
- Aftershocks can occur in the first hours, days, weeks, or even months after the quake.
- Check for fire hazards and use torchlight instead of candles or lanterns.
- If the building is in a good shape after the earthquake, stay inside and listen for radio announcements.
- If one is not certain about the damage to his/her building, evacuate carefully. Do not touch downed power lines, if any.
- Help injured or trapped persons.
- Give first aid where appropriate. Do not move seriously injured persons unless they are in immediate danger of further injury. In such cases, call for help.
- Remember to help neighbours who may require special assistance-infants, the elderly, and people with disabilities.

Wind Storm / Heavy Rain

An independent plant effluent drainage system is constructed to ensure that plant effluents do not mix with storm water drainage. Storm water drains shall be attended immediately to avoid clogging of drains. The possibility of reverse flow of water from the factory premises outlets shall be examined and effective steps like provision of isolation etc shall be ensured.

7.6 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT PLAN

Large industries, in general, and power plants in particular where multi-functional activities are involved during construction, erection, testing, commissioning, operation and maintenance,

occupational health needs attention during all phases. However, the problem varies both in magnitude and variety in the above phases.

7.6.1 CONSTRUCTION & ERECTION PHASE

The problems envisaged at construction and erection stage can mainly be due to accident, fugitive dust emissions and noise. To overcome these hazards, the contractors in charge of construction and erection activities have to maintain noise levels within threshold limit values and the workers should be provided with personnel protective equipment. Mobile water sprinkler and wet drilling will be used to control dust emissions.

7.6.2 OPERATION & MAINTENANCE PHASE

The problems envisaged during the operation and maintenance phase are accident, exposure to heat, noise, chemicals etc. Suitable personnel protective equipment's should be provided to all employees, likely to be exposed to these situations. The working personnel should be given the personnel protective equipment as listed in **Table 7.12**. In addition, medical facilities should be made available round the clock for attending any medical emergency.

Table 7.12: Personnel protective Equipment

Protection For	Equipment	Protection Against
Head	Helmet	Fall of objects / hitting against objects during construction, maintenance, etc.
	Electrical resistance helmet	Electrical Shock
	Welder's leather cap	Splashing of liquid etc.
Eye	Panorama goggles with clear plastic vision	Oil and paint splashes, dust and chips
	Leather mask goggles	Foreign bodies entering the dyes and smoke.
	Spectacles type goggles with plain shatter proof lens	Foreign bodies entering the eyes and reflected arc rays
	Spectacle type goggles, with blue lens	High temperature flame during furnace work
	Panorama goggles with green plastic visor	Reflected arc rays during arc welding job.
Ear	Ear plugs or muffs	High noise level
Nose	Dust respirators	Fine dust particles
	Light fume mask	Acid fumes, vapours and gases (2.0%)
	Heavy fume mask	Toxic gases (0.1%)
	Canister gas mask	Acid fumes, vapours and gases (2.0%)
Face	Plastic face shield	Liquid chemicals, dust particles
	Welding helmet and shield	Welding fumes, sparks and UV rays
	Asbestos hood	Heat radiation during furnace work
Body	Leather apron	Falling of hot chips, slag's etc.
	Asbestos apron	Heat radiation
	PVC apron	Splashing of chemicals

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Protection For	Equipment	Protection Against
	Safety Belt	Falling of persons from height
Hand	Leather gloves	Cuts due to handling
	Asbestos gloves	Heat radiation
	Acid and Alkali proof rubber gloves	Burns due to chemical handling
	Electrical resistance gloves	Electric shock
	Canvas gloves	Contact with oil, grease etc.
Leg	Leg guards	Welding sparks
	Leather safety boots	Striking by objects, fall of objects and stepping on sharp or hot objects.
	Asbestos safety boots	Eat radiation, stepping on hot or sharp objects, striking by stationary or moving objects
	Gum boots	Liquid splashing, in submerged and chemically hazardous area

**Other Occupational Health Risks Envisaged
Common¹**

- **Electrical hazards:** Thermal power plants are used to generate electricity therefore they utilize various types of machines and electrical equipment's that are used to process a large amount of electricity which poses a significant threat to the workers.
- **Heat stress and Fire hazards:** Workers are exposed to high temperatures, especially those working in boiler rooms and turbine sections. Fire safety in thermal power plants is another important focus. Various pieces of equipment use flames and sparks to do their jobs and that opens up the risk of a fire occurring in the plant.
- **Fall:** Many thermal power plants have large pieces of equipment spread across multiple stories. When employees work on these, they often do so on a ladder or some other type of elevation tool, which opens them up to the potential of falling and sustaining injury.
- **Exposure to chemicals:** Power plant workers are also routinely exposed to materials and chemicals that can be dangerous to come into contact with. Handling of chemicals used in water treatment and maintenance processes can lead to skin and respiratory issues.
- **Dust and particulate matters:** Coal dust and fly ash can cause respiratory problems like pneumoconiosis and chronic obstructive pulmonary disease (COPD). During maintenance and handling of ash, workers can be exposed to silica dust, increasing the risk of silicosis.
- **Noise exposure:** High noise levels from turbines, generators, and other machinery can lead to hearing loss.

¹ Safety, S., & Safety, S. (2022, May 3). *Safety 101: Power Plant Safety Measures*. Salvation Safety. <https://salvationsafety.com/safety-101-power-plant-safety-measures/>

Specific²

- Apart from the above-mentioned occupational hazards, the following hazards also exist specifically for the power plant under discussion:
 - **Ergonomic Hazards:** For saving costs and due to availability of cheap labour the power plant employs manual laborers. Manual handling of heavy equipment can lead to musculoskeletal disorders.
 - **Lack of expertise:** The power plant being located in an educationally backward region, the laborers tend to pay little heed to the safety standards and precautions thus exposing themselves to dangers.

7.6.3 OCCUPATIONAL HEALTH MONITORING, AWARENESS AND TRAINING

The work environment will be monitored for occupational accidents, diseases and dangerous occurrences. A proper record of the same will be maintained. The aspects that will be adopted to ensure good health condition of employees are (i) Pre- employment check-up; (ii) Awareness programme; (iii) Routine check-up and (iv) Periodic vaccination programme etc.

Occupational Health Monitoring for Workers: Engagement of contractual workers will be done only after proper health check-up and fitness certificate by approved medical practitioner through contractor. Periodic Medical Examination (PME), as required under the Factories Act shall be undertaken. However, the investigations performed under the PME should be relevant to the job exposures. Since coal/ash handling workers are prone to dust exposure-related diseases, due attention is required to those workers. In case of need, the frequency of PME may be scheduled, based on observation of the health check-up information. Providing PPE and relocating of job for those workers may also be considered.

Awareness programmes and training: Periodic awareness programmes regarding the health and safety with active involvement of the workers will be organized, covering each individual with the minimum annual average duration of 8 hours per worker. Regular community level awareness programmes may be organized in the vicinity of the plant for the family members of the workers. First-aid training will be imparted to workers on regular basis to provide immediate relief to accident victim.

7.6.4 ASSESSMENT OF ENDEMIC DISEASES OF ENVIRONMENTAL ORIGIN

Endemic Diseases in the area: From data available, it is understood that malaria and dengue are endemic in the region which may be due to lack of hygiene and health facilities.

Diseases

- **Common³**
 - **Influenza (ARI):** Seasonal influenza is an acute respiratory infection (ARI) caused by influenza viruses common in Narsinghpur District.

² Economy | Welcome to Aurangabad Madhya Pradesh | India. (n.d.). <https://aurangabad.bih.nic.in/economy/>

³ <https://idsp.mohfw.gov.in/WriteReadData/1892s/1544826741465987503.pdf>

- **Noise:** High noise generation can result in hearing problems for the nearby residents as well.
- **Specific⁴**
 - **Vector borne diseases:** The region's economic and educational backwardness has led to non-adoption of cleanliness and disease-preventive environmental measures like proper waste disposal or non-open defecation leading to vector-borne diseases like Malaria and Dengue.
 - **Other issues:**
 - **Maternal Mortality:** Lack of proper healthcare infrastructure has led to the facing of serious problems by the women during pregnancy and childbirth.
 - **Sanitation:** This lack of healthcare facilities coupled with educational backwardness has also led to lack of proper sanitation facilities like toilets, waste disposal systems, etc.
 - **Environmental Hazards:** Deforestation and untreated disposal of wastes has also lead to silting of the riverbeds thus resulting in flash floods. Also the region lies between the Seismic Zones 3 thus having a potential earthquake threat.

Factors

- **Human (including social and political)**
 - The major human factors in this regard are the ones already discussed above such as –
 - **Lack of education**
 - **Lack of healthcare infrastructure**
 - **Lack of public infrastructure**
 - **Improper waste management**
 - **Improper Sanitation**
 - **Lack of Government vigilance**
 - **Social issues:** The issues of caste division have also lead to lack of access towards already limited public utilities for the oppressed classes and castes.
 - **Impact:** The local community, particularly those living near the plant, experience higher rates of respiratory and waterborne diseases. Surveys indicate a higher incidence of chronic respiratory conditions among residents compared to regions farther from the plant. Also they are in the crosshairs of impending natural hazards like floods and earthquakes and are also the victims of bad governance.
 - **Global Warming and Climate Change:** An increase in the global warming due to ozone depletion has led to the melting of glaciers as well as excessive heatwaves and the unchecked and unregulated power-generation activities is adding more to this heatwave. Also, the melting of glaciers has led to an increase in flows in the river-basins and the silting of riverbeds has led to an increase in the intensity of the flash floods.

The District Health Department serves as the nodal agency responsible for preventing the occurrence of diseases originating from environmental factors. Recognizing the critical importance of maintaining

⁴ https://mpsdma.mp.gov.in/uploads/media/Narsinghpur_DDMP_Final.pdf

public health, especially during construction projects, several proactive measures are being implemented to mitigate the risk of endemic diseases. These initiatives are part of a comprehensive strategy aimed at improving sanitation, hygiene, and overall health conditions in the affected areas. Below are the detailed actions being undertaken by NTPC to maintain and enhance sanitation and hygiene, with a commitment to strengthen these efforts during the proposed expansion.

1. Maintaining Hygiene and Sanitation in Plant and Township

- Regular cleaning and disinfection of all plant and township areas.
- Implementation of waste management systems to ensure proper disposal of waste materials.
- Routine inspections and monitoring to ensure compliance with hygiene standards.

2. Provision of Community Toilets and Sanitation Facilities

- Construction of community toilets in labour colonies to prevent wastewater stagnation.
- Ensuring the availability of clean and functional sanitation facilities to all workers.
- Regular maintenance and cleaning of these facilities to ensure a hygienic environment.

3. Providing Mosquito Nets for Villagers

- Distribution of mosquito nets to households in nearby villages to prevent mosquito-borne diseases such as malaria and dengue.
- Conducting awareness campaigns to educate villagers on the proper use and maintenance of mosquito nets.

4. Supply of Bleaching Powder for Sanitation

- Regular supply of bleaching powder to neighbouring villages to assist in maintaining sanitation and hygiene.
- Training and support for villagers on the effective use of bleaching powder for disinfection and cleaning purposes.

5. Construction of Community and School Toilets

- Building new community toilets and repairing existing ones in nearby villages.
- Constructing toilets in schools to ensure children have access to clean and safe sanitation facilities.
- Promoting the importance of sanitation and hygiene practices among school children through educational programs.

6. Medical Health Camps and Mobile Clinics

- Organizing regular medical health camps in villages to provide healthcare services to the community.
- Deployment of mobile clinics to reach remote areas and offer medical consultations, treatment, and health check-ups.
- Distribution of essential medicines and health supplies during these camps.

7. Construction and Repair of Village Roads and Drains

- Building and repairing village roads to ensure proper access and mobility.
- Constructing and maintaining drainage systems to prevent water stagnation and reduce the risk of water-borne diseases.

- Regular monitoring and cleaning of drains to ensure they are free from blockages and function effectively.

8. Enhanced Waste Management Practices

- Implementation of comprehensive waste management systems to handle solid and liquid waste generated during construction and operation.
- Training workers and community members on proper waste segregation, recycling, and disposal practices.
- Installation of waste collection points and bins to ensure proper waste handling and reduce environmental contamination.

9. Awareness and Education Programs

- Conducting awareness campaigns and educational programs to inform the community about the importance of hygiene and sanitation.
- Collaboration with local health departments and organizations to promote health education and disease prevention strategies.
- Distribution of informational materials such as pamphlets, posters, and flyers to raise awareness about endemic diseases and preventive measures.

By implementing these comprehensive measures, NTPC aims to create a healthier and safer environment for both workers and the surrounding communities. These efforts not only address immediate health concerns but also contribute to the long-term well-being and development of the region. The commitment to maintaining and enhancing sanitation and hygiene practices during the proposed expansion underscores NTPC's dedication to sustainable and responsible development.

7.7 NTPC SAFETY POLICY & PRACTICES

Overview:

Safety is part of NTPC's core values. NTPC is committed to provide a safe, healthy and hygienic work environment to all its employees and contract workers. NTPC is committed towards striving for zero incidents at work which is explicitly mentioned in its safety policy. NTPC recognizes all accidents are preventable; therefore, safety shall be at the forefront of all our activities.

Principles of Safety Policy of NTPC

The safety policy of NTPC is built around following six principles:

1. Our activities carry various hazards; however, all hazards can be identified.
2. Every job shall be done safely, no matter how important or urgent it is.
3. Putting people to work carries a specific responsibility and accountability for safety which shall be visibly demonstrated.
4. Right procedures and actions can bring the risks under control.

5. Trained and committed team can ensure incident free operations.
6. Compliance to all applicable safety regulations and other legal requirements is a must. To the extent possible, we should improve and make it better than minimum standard(s).

Our safety policy is the apex document that includes commitment of organisation towards safety along with organisation responsibilities. Safety framework, different safety rules, procedures, manuals, TC documents are developed by safety department to achieve the policy intent. The safety policy supported by these rules and procedures are applicable for all business activities carried out by NTPC.

7.8 NTPC SAFETY FRAMEWORK

NTPC safety framework is a guidance document to the various functions and roles. It contains a set of expectations that ensure that all efforts are aligned with the overall policy and objectives of NTPC. The expectations are expressed broadly in the form of components –

- Safety Policy & Objective,
- Safety Risk Management,
- Safety Assurance and
- Safety Promotion.

This Framework also covers functional implementation expectations: what the different functions & roles must do to implement a robust system and provides essential guidance and how it will be accomplished. To facilitate such guidance, where required, components are divided into smaller Elements and Processes, as mentioned in Exhibit-1.

These components are described in the following sections.

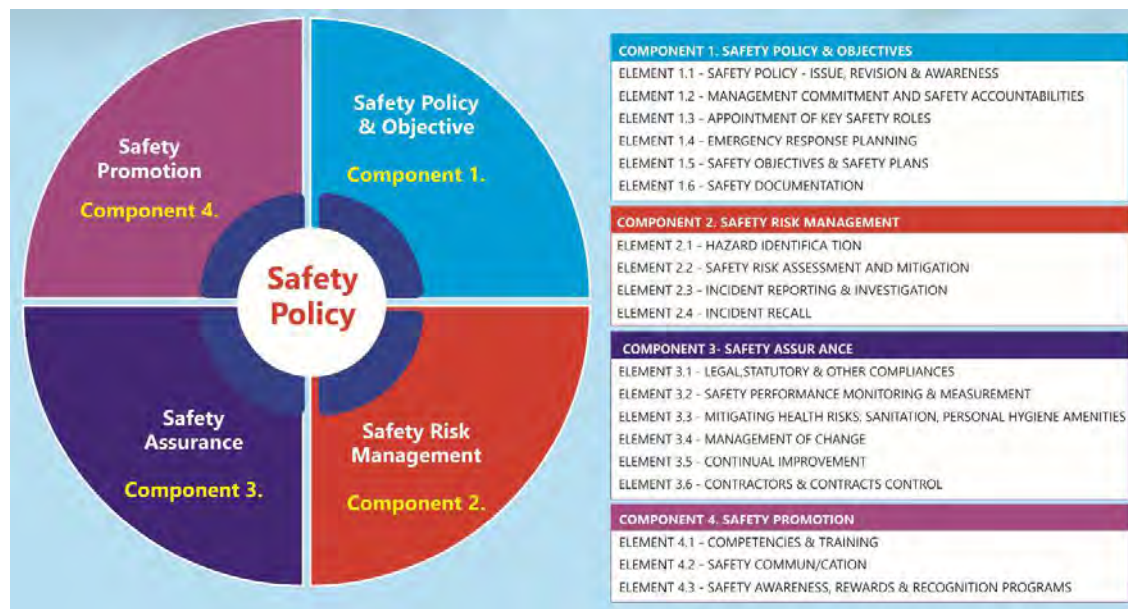


Exhibit-1: Over View of Safety Framework

7.9 Component 1. Safety Policy and Objectives

The Policy serves as the foundation for the NTPC Safety Framework, its Components and Elements. The Business unit, functional and individual employee goals and objectives are typically aligned to those of the overall organization.

Component 2. Safety Risk Management

The objective of safety risk management is to ensure that a formal system of hazard identification is in place so that the activity or, situation posing the risk may be avoided, accepted, reduced, shared, or transferred, depending on the facts and circumstances.

Component 3. Safety Assurance

Safety assurance ensures that all projects comply with safety policy, rules, procedures, legal requirements in achieving safety targets and objectives, ensure continual improvement and effectiveness of implementation of the safety framework; through regular inspections, audits and reviews, in order to provide assurance that procedures are followed, and appropriate controls are in place. Safety Assurance also includes Contractors and Contract Control to ensure Safety Policy objectives are achieved effectively.

Component 4. Safety Promotion

The objective of safety promotion is to promote Safety as a core value with practices that facilitate & support a sound safety culture. Elements of such promotion include communication, training & promotional activities.

SAP Integrated Safety Framework

NTPC has successfully completed full-fledged SAP INTEGRATION OF SAFETY FRAMEWORK in all NTPC stations. This ensures implementation of a uniform and evidence based safety management system across all stations. It triggers auto generated orders for uploading evidence of compliance (in central repository) for mandatory safety activities as per defined set of expectations for different roles and functions. It enables the executives with ease of tracking, monitoring and auditing the safety system of the plants in a seamless manner.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



7.10 Safety Training for Agency Workers: -

1. Induction training modules and 23 Job Specific Standard Training Module are developed in English and in Hindi. The standard modules of safety trainings include Induction Training, Caught In/ Caught By, Heavy Vehicle Safety, Working at Height, Electrical Safety, Working in Confined Spaces, Struck By, Safety in Using Hand Tools, Safety in Using Power Tools, Fire Prevention, Safety in Hot Works, Safety in Work On or Near Water, Work Permit System, Use of PPE, Manual Handling, Excavation Safety, Safety in Handling Hazardous Substances, Ergonomics, General Safety and Hygiene for Office, Safety in Demolition, Slips and Trips, Safety in Material Handling, Safety in Coal Handling Plant.
2. Language of Training modules are kept simple, personal and direct.
3. Guidance slides for trainers and prerequisite for training are available in training modules itself.
4. The identification of training needs (as per nature of work, potential exposure to hazards, working condition, personal capacity etc.) is to be done by EIC for each worker at the time of processing of gate pass. Thus, worker role competency matrix is to be prepared for all workers.
5. Safety Department of the station are required to conduct training on Induction, Fire and PPE Modules mandatorily for all workers.
6. Line managers (preferably trained trainers) are required to conduct training on other job specific safety training modules as identified during training need assessment.
7. The progress of training in form of identified Vis-a-vis Trained is to be captured on monthly basis by EIC to keep a track and completion of all identified trainings.

Safety in Overhauling Activity:

Overhauling of power plants is a specialised activity and many agencies involving high number of agency workers perform different works simultaneously. Safety provisions mentioned in 'Maintenance Management- Unit Overhauls' and 'Electrical & Mechanical- Safety Rules Handbook' are followed during unit overhauls.

From all the agencies involved in overhauling activities, nominations of Safety Officers/ Supervisors and qualified & trained electricians are obtained from each Agency. Safety Review Meeting with Contractors & Agencies' Safety Supervisors in presence of EICs and head of O&M before start of overhaul works shall be organized. In the meeting safety measures which are to be followed during overhauling works are discussed. Detailed guideline for maintaining safety in over hauling has been prepared and followed.

Safe Practices at Work:

For safety Practices at work NTPC has developed various guidance notes and directives on several topics like Hazard Identification and Risk Assessment, Implementation of Safety Rules (Electrical and Mechanical), Job Safety Analysis and Method Statements, First Aid Control and Monitoring, Safety Objectives and Plans, Safety Monitoring, Measurement & Improvement, Safety Awareness, Communication & Promotion, System for Reporting arrangements and Investigation of Accidents, Dangerous Occurrences and Major Incidents in a Power Station, Appointment of Key Safety Roles, Emergency Response Planning, Mitigating Occupational Health Risks - Stressors, Hygiene & Facilities, Periodic Safety Assessments (Internal to Station), Written Safe Work Procedures, General Safety Competencies and Training, Compliance with legal and other requirements, System for action on investigation reports etc.

Apart from above, various communications and circulars are issued from time to time by Corporate Safety regarding safe practices. Accident enquiry recommendations are also source of information regarding safe practice of work which are circulated and made readily accessible.

Safety Audits:

Audits are conducted to assess whether any deviation is existing from laid out procedure. Every year, internal safety audits are conducted by inter station team of Safety Officers and External safety audits are carried out by reputed organizations as per statutory requirement for each Project/ Station. Every TC document as mentioned above has a section on procedures to conduct audit for that particular document. This also clearly specifies documents to be verified and site samples to be taken. This process is followed for all internal audit purpose.

Apart from that, special audits are conducted from time to time to assess adherence to laid out procedures and rules. NTPC has developed a pool of Occupational Safety and Health (NOSA) certified auditors, certified lead / internal auditors as per ISO 45001 for ensuring quality audit.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



All audit observations are notified in Systems Applications and Products Enterprise Resource Planning (SAP ERP) system and compliance recorded along with evidence of compliance. Station safety department is required to monitor the progress of the closure of such notifications and present the status of the notifications to station management during review and other forums.

Incident Investigation:

There is a formal process for investigation of all accidents to examine each case in detail and in depth to find out the causes of accidents, the extent of losses caused, the circumstances / individuals responsible and to obtain considered recommendations for prevention of recurrences in similar or related nature of accidents.

There are specific guidelines and systems for handling the investigation report so that all recommendations of such investigations are taken up to a logical end and implemented. For all accident enquiry recommendations, action plan is prepared for compliance.

7.11 CORPORATE SOCIAL RESPONSIBILITY

NTPC is committed to develop the surrounding area in a well-coordinated and balanced manner while safeguarding the environmental and social aspects under its CSR programme. Wherever possible, Gadawara STPP shall provide infrastructure to help set up local schools, centres for primary learning and education, and repair/construction of primary schools in neighbouring villages. Gadawara STPP is committed to inclusive development and will further strengthen its activities for improvement in education, sanitation and health, livelihood, rural infrastructure and rural sports.

The details of work executed by Gadawara STPP under CSR-CD and CSR activities are given in **Annexure 8.1**. Total amount of Rs.4,322.12 Lakhs on CSR-CD activities and amount of Rs. 1,596.221 Lakhs has been incurred on CSR activities since inception till 2023-24. Year-wise CSR expenditures are given bellow in **Table 7.13**.

Table 7.13: Yearly CSR Expenditure

Sr. No.	Financial Year	Amount in Rs. Lakhs
1	FY 2019-20	435.075
2	FY 2020-21	273.617
3	FY 2021-22	238.453
4	FY 2022-23	157.376
5	FY 2023-24	491.700
	Total	1596.221

NTPC shall ensure that the following activities are taken up in the proposed CSR plan:

Education: Education must be given priority in CSR Schemes. Special attention is required for girls' education. Educational facilities provide to the handicapped should be free of cost. Activities related to athletics and games should be promoted to keep students healthy and fit. In order to create awareness

regarding education, educational society must be constituted which will look after related activities such as libraries providing magazine and newspaper to the villages/ hamlets. These societies should play important role in creating awareness among the community regarding importance of education.

Community health: Health awareness camp must be organized to aware the people regarding health, hygiene and rural sanitation. To improve health status more emphasis should be taken regarding safe drinking water & personal hygiene. People should be informed well in advance regarding health development activities being implemented by NTPC so that more & more people may get benefitted.

Rural infrastructure: Ensuring that the communities are not left behind due to poor infrastructure and focusing on strengthening community structures such as schools and institutions of higher learning, community halls, playground, Anganwadi centres, panchayat offices and villages information Centre, amongst other.

Plantation: Afforestation is an important method for ensuring environmental sustainability including mitigating the negative effects of climate change. Tree plantation in nearby villages or vacant land may be carried out under joint effort of Gadawara STPP, forest department & other government agency and the local community.

Skill development training: This major problem of unemployment can be eliminated up to certain level by conducting skill development programmes. The programme can be organized to familiarize the existing participant with the latest technology available in their area of operation, sensitize them for the adoption of new technology by educating them about the support available from the different organizations. An effort will be made to improve the managerial skill of these entrepreneurs by arranging lecture discussions and cases on different aspects of enterprise management.

Additional manpower will be required during the construction phase and operation phase for proposed expansion project. The skilled manpower will be in general sourced from the present pool of NTPC, while the semi-skilled and unskilled workers will be sourced locally as per qualification and skill. For this purpose, local youth from neighbouring villages will be identified through the Gram Panchayat and provided training in trades such as fitters, welders, electricians, and plumbing from the nearest ITI. As part of the CER activity, the ITI will be upgraded.

7.12 HYDROGEOLOGY STUDIES

- The study focuses on complying with environmental clearance conditions stipulated by MoEF&CC for the Gadawara Ultra Super Critical Thermal Power expansion project, Stage-II.
- Aims to understand groundwater flow dynamics, assess groundwater resources, and design a monitoring network.
- Detailed hydrogeological investigations within a 2 km radius of the Plant site to monitor the impact of ash disposal on groundwater.
- Study area in Narsinghpur District, Madhya Pradesh, features a subtropical climate with significant monsoon rainfall.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



- Landuse/land cover: 69.40% agricultural land, 1.89% built-up areas, 4.45% fallow land, 2.53% water bodies, 3.72% barren land, 0.5% plantation.
- Reconnaissance survey conducted to gather preliminary data and understand general geological and hydrogeological conditions.
- Geological and hydrogeological setup established, with alluvial plains having significant sand and clay deposits forming principal aquifers.
- Field investigations in pre-monsoon 2024 included groundwater level measurements, infiltration tests, and aquifer parameter analysis.
- Groundwater depth ranged from 5-20 meters below ground level.
- Soil infiltration tests showed infiltration capacity of soils around the proposed ash disposal area ranging from 2.8 to 10.6 cm/hr.
- Technical issues prevented long duration pumping tests; transmissivity of the alluvial aquifer ranges from 57-400 m²/day while the hard rock aquifers have very low transmissivity of the order of 19 m²/day.
- Exploratory wells trapping multi aquifers system: The transmissivity of these confined to semi confined aquifers range from 23 to 2400 m²/day. Storability value ranges from 2.01x10⁻⁶ to 1.5x10⁻³ indicating confined to semi confined nature of deep aquifers.⁵
- Study area assessed as Semi-critical by CGWB in 2023.
- Available groundwater quality data indicated major ions and heavy metals within permissible limits.
- Tress may be planted around the pond shore in the general direction of the wind to reduce evaporation losses.
- Assessed potential impacts of coal ash deposits on water quality, identifying heavy metals as primary contaminants.
- It is recommended that piezometer may be develop at about 5-6 locations around the ash pond area for regular monitoring of the water level and water quality. **Annexure as 7.2**

A study has also been carried out by National Institute of Hydrology, (An ISO 9001:2015 Institute under DoWR, RD and GR, Ministry of Jal Shakti, Govt. of India), Roorkee (Uttarakhand) for review of hydrogeology to assess the impact of NTPC Gadarwara STPP on surface water and ground water. The study recommendations and action plan is given below:

⁵ District groundwater information booklet, Narsinghpur, MP

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S.N.	NIH Recommendation	NTPC Gadarwara Action Plan	Estimated Expenditure & Target Date
1)	Regular monitoring of the mentioned surface water bodies may be carried out (both for pre and post monsoon seasons)	a) Regular monitoring of surface water bodies surrounding NTPC Gadarwara is being done through NABL accredited laboratory, both for pre and post monsoon seasons). b) Contract for monitoring of Hydrogeology of the area has also been initiated in which the locations according to scientific methodology shall be covered for both pre and post monsoon seasons. Thus, pre-monsoon and post-monsoon monitoring shall be done annually.	▪ Rs.1.29 Lakhs for Surface and Groundwater monitoring ▪ Approx. Rs.26 lakhs for Hydrogeology Study and Rs.1.29 Lakhs for Surface and Groundwater monitoring
2)	To analyse the possible impact of the operation of STPP Gadarwara on the ground water quality of the study area, through long term changes in ground water quality, ground water quality may be regularly monitored both in pre and post monsoon seasons for the mentioned locations.	a) Regular monitoring of ground water quality of area surrounding NTPC Gadarwara is being done through NABL accredited laboratory, for both for pre and post monsoon seasons. b) Ground water impact assessment study covered in the scope of work of the hydrogeology study as mentioned at Sl. no 1(a).	▪ Covered in point no. 1
3)	In order to study the impact of the STPP Gadarwara on changes in ground water levels in the study area, ground water levels may be regularly monitored both in pre and post monsoon seasons for the various locations mentioned.	a) Monitoring of Ground water levels is being done around ash dyke area during pre and post-monsoon seasons through institute of repute during hydrogeology study of the area. b) Twelve (12) nos piezometers shall be installed around ash dyke, plant and township area to monitor the ground water level as well as quality around NTPC Gadarwara Plant premises.	▪ Approx. Rs.24 lakhs, Target for Completion by December 2025
4)	It is recommended that piezometers may be developed at about 5-6 locations around the ash pond areas for regular monitoring of the water levels	Actions have been initiated for procurement of 12 nos. of new piezometers out of which 06 nos. will be installed in the water contour path around the ash pond areas for	▪ Covered in Point no. 3

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



	and water quality, as has already been recommended in the study for the year 2022.	regular monitoring of the water levels and water quality by December 2025.	
5)	Restoration of Ponds in the study area	Restoration work in 4 degraded ponds (Chor-Baretha, Gangai, Chirriya, Sukri) according to recommended methodology of the study area of Watershed Development Study conducted by Guru Ghasidas Vishwavidyalaya in the 10 Km radius of NTPC Gadarwara shall be taken up.	- Approx. Rs.35 Lakhs - Target date of Completion – December-26
6)	A detailed study on rainwater harvesting needs to be carried out assessing not only the rainwater harvesting potential of the study area but also assessing the existing recharge and storing potential of the present recharge and storage structures present in the study area and their adequacy for recharging the whole rainwater harvesting potential. Additional rainwater harvesting structures, if needed, can be suggested only then.	a) Rainwater Harvesting Study has already been carried out and the rainwater harvesting scheme suggested in its report has been approved by CGWB. RWH study recommendations have been implemented by construction of 30 rainwater harvesting pits to recharge the rainwater directly. b) Scheme is being implemented to redirect the rainwater in the plant area to the raw water reservoir which can be reused in the Power Generation Cycle. c) Further study will be carried out at an interval of 5 years according to the changing landscape / catchment area, groundwater regime.	- Rs 3.4 Lakh for study of RWH - Rs 41 Lakh for construction & implementation of 30 nos RWH pits. - Rs. 50 Lakhs (approx.) contracts awarded for diversion of all the stormwater falling in the plant area Raw Water reservoir inside plant. - Target for completion- December 2025 - Rs 10 Lakh for future RWH studies.

7.13 WATER SHED DEVELOPMENT PLAN

• Watershed Map Analysis:

- The study area is divided into four different watersheds.
- Project site majorly falls under one watershed, which means that watershed 3 will collect and channel the precipitation in Sitarewa River outlet. A smaller part of the project lies in the watershed 2 which will channel the precipitation in Shakkar River outlet.

- It is anticipated that even during the monsoon period, the possibility of any contamination of the surface water bodies around the plant site due to ash pond is very limited since the drainage outlet from the ash pond is in the opposite direction to the major river body.
- Managing a macro watershed requires a large part of community help which in turn will increase the financial expenses. So, the macro-watershed is divided into sub-watersheds for better understanding and implementation of development plans.
- Sub-watersheds falling in the upstream from the ash dyke marked as 1, 2 and 3 will be studied and planning activities for developing the surrounding area.
- Erosion control and maintaining ground water quality around the ash dyke is of utmost importance. So, the development of watershed around the ash dykes has to be carried out.
- Sub-watershed map of the study area is generated and shown below, highlighting the areas of importance in and around the ash dyke. **Annexure 7.3**

7.13.1 Action Plan

- **Challenges in Watershed Development:**

- Water source conservation and water supply management
- Lack of vegetation and tree cover causing opening of the soil and high rate of erosion resulted in thin top soil layer and poor soil health
- Agricultural practices such as cropping pattern and choice of crops.
- Lack of Institutional mechanism

- **Assessment and Measures for Watershed Development:**

- **Water Resources:**

- Develop storage capacities of natural and constructed water bodies.
- Construct check dams with local materials and coordinate with district authorities for resources.
- Build runoff management structures to control water harvesting and gully reclamation.
- Runoff management structure usually consists of constructing soil bunds of suitable dimensions across the river to hold the maximum runoff water
- Rejuvenate existing water bodies, especially the river Shakkar and Sitarewa, for agricultural use.
- Construct farm ponds in suitable areas for water storage.

- **Soil Moisture Conservation:**

- Field bunding with vetiver grass to control soil erosion.
- Implement gully control measures to protect cropland.
- River bank protection using Dry Rubble Stone Masonry (DRSM) or crate wire, and tree plantation in riparian zones.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



- **Agro-climate Conditions & Land Productivity:**
 - Characterized by hot summer, cool winter, and annual rainfall of 1129.1 mm.
 - Moderate quality and productivity of agricultural land, threatened by soil erosion and low moisture.
 - Majority of the area is used for paddy, wheat, and pulses production, with groundwater as the main irrigation source.
 - Rejuvenate surrounding water bodies to reduce dependency on groundwater.
 - Develop cropping patterns to maximize productivity and water utilization.
- **Improvement in Social Status:**
 - Agriculture and animal husbandry are the main livelihoods.
 - Better water availability from watershed development will improve agricultural output and income.
 - Evaluate water demand and supply and assess rainwater harvesting potential at the household level.
 - Provide training and demonstrations on rainwater harvesting to raise awareness and coordinate efforts to eliminate water scarcity.

A Study for Preparation of Action Plan for Watershed Development within 10 km Radius of the Plant Boundary of NTPC Gadarwara, Madhya Pradesh was carried out by Department of Forestry, Wildlife & Environmental Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.). Final report has been submitted by the agency and following measures are suggested for implementation over a three-year period:

Table 7.14: Proposed plan for Watershed Management

Particulars	Village	Activity	Area in Ha.	Cost, Rs.	Implementation Period		
					1 st Year	2 nd Year	3 rd Year
Construction of Check dams and Nala bunds	Gangai	Additional Nala bunds for Sakkar River side	7.71	77100			
			3.34	33400			
			2.79	27900			
	Mehrakheda	Additional Nala bunds for Sitareva River Side	4.31	43100			
			6.86	68600			
			5.95	59500			
			3.28	32800			
			2.51	25100			
	Dongargaon	Additional Nala bunds for Sakkar River side	7	70000			
			5.19	51900			
			8.8	88000			
			5.41	54100			
Restoration and	Gangai	Times Deepening,	6.45	3425000			
	Chor Barheta		1.5				

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Particulars	Village	Activity	Area in Ha.	Cost, Rs.	Implementation Period		
					1 st Year	2 nd Year	3 rd Year
Development of ponds	Sukri	Removal of algal bloom & weeds, lining and Desiltation Rs. 1000 per 100sq km	7.16				
	Chirriya		17.42				
Total, Rs.				40,56,500			

The successful implementation of this action plan hinges on a multi-stakeholder approach, fostering active community participation in planning and implementation. Regular monitoring and maintenance of the implemented structures are crucial to ensure their long-term sustainability and achieve the desired outcomes, including enhanced water availability, improved groundwater recharge, and a healthier watershed ecosystem.

7.14 BIODIVERSITY CONSERVATION PLAN & WILDLIFE MANAGEMENT PLAN

The project site does not fall in the Critically Polluted Area (CPA), where MoEF & CC has imposed moratorium on grant of environmental clearance vide its OM dated 13th January 2010. There are no eco sensitive areas like National Park, Wildlife Sanctuary, Elephant/ Tiger Reserves or Wildlife Corridors and/or breeding or nesting grounds and Eco-sensitive Zones or Biosphere Reserves or Ramsar Wetlands either within the Core Zone (project site) or within the zone of influence (ZoI) say Buffer Zone i.e. within 10 km radius of the project boundaries. The aim of wildlife conservation is to aimed at preserving and managing biological diversity, which includes the variety of species, ecosystems, and genetic resources within a given area. The plan outlines specific goals and actions to protect and restore habitats, prevent species extinction, and ensure sustainable use of natural resources. The ultimate aim of a biodiversity conservation plan is to maintain the resilience of ecosystems and the services they provide, ensuring both environmental and human well-being.

The Thermal Power Plant falls in the Narsinghpur district of the state of Madhya Pradesh and the 10 km radius around it is called the study area for this report. A major river Shakkar river (0.60 km, NE) and Sitarewa River (0.90 km, W) flow near from the project site.

Primary surveys were undertaken to understand the actual baseline and analyse the impacts of the proposed project on ecological baseline. 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.

In the study region, dry tropical vegetation is seen. Within the study area are trees such as *Tectona grandis*, *Butea monosperma*, *Acacia catechu*, *Dalbergia latifolia*, *Bauhinia purpurea*, *Azadiracta indica*, *Mangifera indica*, *Albizia lbbeck* and others are found. In the research region, shrubs were

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



found like *Targestes erecta*, *Lantana camara*, *Nerium oleander*, *Calotropis gigantea*, *Hibiscus rosa-sinensis*.

Inside the project site some common bird species, squirrel, chameleon etc were recorded. From the buffer zone, 11 Species of mammals, 19 species of birds, 6 species of reptiles and amphibians were recorded. 2 reptilian Schedule 1 species (*Naja naja* and *Python molurus*); 3 avian Schedule 1 species (*Bubo bubo*, *Tachy spizabadia* & *Pavo cristatus*) and 3 Schedule 1 mammalian species (*Antelope cervicarpa*, *Canis aureus* and *Herpestes edwardsii*) were recorded from the study area.

Comprehensive conservation measures for *Antelope cervicarpa*, *Canis aureus*, *Herpestes edwardsii*, *Python molurus*, *Naja naja*, *Bubo bubo*, *Tachy spizabadia* and *Pavo cristatus* have been provided in the Wildlife Conservation Plan. A thermal power plant can affect vegetation communities by eliminating them or altering one or more of these factors, potentially weakening the communities (e.g., through shading or redirecting runoff, leading to reduced water availability).

The cost of implementation for Wildlife Conservation & Management Plan for the proposed expansion of Gadarwara Super Thermal Power Plant is estimated considering different project specific activities as well as management wildlife actions through agencies. The overall cost estimated for implementation of wildlife management plan (WLMP) to be implemented over a period of 5 years is approximately **252.509 Lakhs INR**. Detailed plan for Wildlife and Biodiversity Conservation is given as **Annexure as 7.6**.

A study on Biodiversity Assessment has also been carried out by **Biodiversity and Wildlife Conservation Laboratory, Department of Zoology, University of Lucknow, Lucknow, Uttar Pradesh**.

Table 7.15: Action plan for Biodiversity Assessment study

Sr. No.	Potential Location/Selection of location for activity	Action Plan	Estimated Cost (In Rs.)	Implementation Timeline
Activity: Development of a Biodiversity Park				
1	Large Spaces/areas in the vicinity of the thermal plant, which are not used for any plant activity but are part of the plant area.	1. Cleaning of the projected area. Preparation of the land (area) according to the need. 2. After settlement prepare it for digging for major constructions, such as pathways, ponds, pond outer lining, etc. 3. Last stage cleaning for final establishments. 4. Planting of endangered plant species.	60,00,000/-	1-2 years

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sr. No.	Potential Location/Selection of location for activity	Action Plan	Estimated Cost (In Rs.)	Implementation Timeline
		5. Creating ponds and development of pathways. 6. Establishment of Information boards, maps, etc. 7. Establishments of path lightings, related wirings, and connections and Final cleaning		
Activity: Development of a Butterfly Garden				
2	In any degraded part of plant, an area with high invasive plants, in the residential campus as well as in the gardens of working plant	1. Cleaning of the projected area. Preparation of the land (area) 2. Plantation of host and nectar plants such as curry tree, lemon, oleander, tropical milkweed, Mussaenda, Ixora, Oxalis etc. 3. Preparing an area for mud puddling, shade, and moist areas/small ponds. 4. Continuous maintenance and sustenance of the garden area	2,00,000/-	1-3 years
Activity: Survey and protect heritage trees in the area				
3	The area around temples, in sacred groves in the 10km radius of the plant area.	1. Surveying the area to find the heritage tree. (Heritage Trees are trees that the City Council has formally recognized for their unique size, age, historical or horticultural significance, and Eligibility criteria). The main criteria for considering a tree as a heritage tree are its size, form, shape, age (more than 100 years old trees), color, and rarity 2. Identification of the trees and documenting the details of heritage trees in the area. 3. Providing interventions such as metal fencing of the Tree and, an information board (with details of the importance of the tree) for protection of the heritage trees.	40,000/- per tree (cost will be based on the number of trees)	1-3 years
Activity: Restoration of wetlands of selected villages in a radius of 10km of the thermal plant				

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sr. No.	Potential Location/Selection of location for activity	Action Plan	Estimated Cost (In Rs.)	Implementation Timeline
4	4 (a). Chirriya Talaab and 4 (b). Bada Talaab near Raja ka Mahal	1. Restoration of the wetland by removal of water Hyacinth and planting native aquatic plants. 2. Stopping drainage openings in wetlands, 3. Beautification (putting information boards, seating bench) for tourism.	10,000,00/-	2-5 Years

The study concludes that the implementing this action plan requires collaboration between the thermal power plant operators, environmental authorities, local communities, and conservation organizations. By adopting these strategies, the power plant can reduce its negative environmental impact, conserve biodiversity, and contribute to the well-being of the local ecosystem. **Annexure as 7.7**

The proposed projects will have only minimal impact on the nearby area. The location where Power Plant is proposed has no habitat for any critical species. The biodiversity indices shows good diversity in and around area. Low species reported in some groups during survey may be due to off season variability, which can be higher during peak season.

7.15 STUDY ON WATER INTAKE FROM OF NARMADA RIVER FOR GADARWARA STPP

To full-fill the demand of water NTPC Gadawara STPP for meeting the power demand of Western Region with present production capacity of 3200 Mega Watt. For operation of the plant, water is sourced from river Narmada with present demand of approx. 4675 m³/h for stage-I and for proposed to be 2000m³/h. Realizing the importance of maintaining desired flow in the river Narmada, as per the requirements of NTPC, Gadawara, a study was conducted by ICAR- Central Inland Fisheries Research Institute, Barrackpore, during pre-monsoon, monsoon and post-monsoon seasons covering the aspects of selecting sampling sites with habitat description, water and sediment quality assessment including metal contaminations, presence of microbial community, presence and season wise dominance of plankton and benthic organisms, fish biodiversity and existing fisheries, record of plants (weeds/macrophytes), etc. Additionally, the ICAR-CIFRI team recorded the existing water intake and distribution system, its utilization up to the level of generation of effluents.

- The river Narmada has a steady water flow even in the non-monsoon months. The riverbed is sandy with boulders and rocks. Water is abstracted for agricultural use and power generation.
- It was recorded that river Narmada is maintaining a steady flow of water after withdrawal of water at the level of approx. 6000 m³/hr at Kakraghat (S1) even in the peak pre-monsoon (summer) months. The water intake points of BLA power plant located at Tuiyapani (S3) also reported about its no issue associated with availability and flow of water in the river. It is thus, inferred that the aquatic community of river Narmada is not facing any stress due to present level of water withdrawal by NTPC Gadawara STPP.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



- No discharge was recorded to enter into the designated effluent discharge site of river Sitareva, no associated risk is anticipated.
- Considering all the aspects and information generated out of the study, it is recommended that though presently there is no adverse impact on the aquatic ecology of River Narmada due to withdrawal of water by NTPC, Gadawara, but a quick survey may be made at least in every two years, preferably during pre-monsoon months as a monitoring measure to mitigate unwanted effects, if any. Enclosed as **Annexure 7.8**.

8. PROJECT BENEFITS

8.1 INTRODUCTION

The proposed expansion of Gadarwara Super Thermal Power Project, by adding 1600 (2x800 MW) will benefit local and regional economy. It will bring improvement in the standard of living of the local population by providing employment opportunities and improved infrastructure. The project will also attract the high-income groups to invest in the region and thus bring about economic growth of the region in terms of following:

- Infrastructure development.
- Direct & Indirect employment opportunity
- Revenue generation to central & state government.
- Enhancement in Corporate Social Responsibility-Community Development (CSR/CD) activities.
- Trickle-down effect of enhanced profitability to the local populace
- Skill development and capacity building like vocational training, income generation programmes and entrepreneurship development program
- Awareness programme and community activities, like health camps, medical aides, family welfare camps, sanitization/ cleanliness awareness programme, immunization camp, sports & cultural activities, plantation, etc.
- Awareness about water borne diseases and pandemic diseases etc. will be done to local villagers.

8.2 IMPROVEMENT IN PHYSICAL INFRASTRUCTURE & COMMUNITY DEVELOPMENT

Establishment of large developmental projects improve the availability of the physical infrastructure (like approach roads, drainage, communication and transportation facilities etc.) and social infrastructures (like education and health care system). These will also benefit the local population. In addition to the plants & equipment for generation of power the following facilities shall be provided in this station:

- Construction offices and stores
- Time and security offices
- First Aid and fire-fighting station with appropriate equipment
- Canteen and welfare centre
- Toilets and change/rest rooms
- Parking facility – 2 & 4 wheelers
- Safety Training centre
- Development of additional residential facilities in existing township to provide accommodation for staff.

Office space shall be provided as per good practice including canteens, toilets and restrooms according to norms laid down in relevant factories act. The above facilities shall also be adequately furnished and equipped.

The proposed expansion of Gadarwara STPP will improve the power supply position in the state as well as in India, which is vital for economic growth as well as improving the quality of life. The power generated from this plant will benefit to a large extent leading to industrial/ commercial development in the state of Madhya Pradesh and also in the country.

The enhanced power supply will decrease the reliance of the general public and commercial establishments on DG Sets, thus lowering both noise and air pollution at the local level.

The construction and operation of the power plant is likely to attract influx of persons in the area in the form of equipment suppliers, material suppliers, maintenance technicians, etc. For their accommodation, the infrastructural facilities like lodging, eateries and transport facilities on the outskirts or at nearby villages up to the plant area is expected to improve significantly. These will also benefit the local population.

The proposed project will induce the development of ancillary and small-scale industries in the area to meet the requirement of the project. The people residing in the nearby areas will be benefited indirectly. The construction and operation of the proposed power plant are expected to bring benefits to the local community in two distinct phases.

8.3 IMPROVEMENT IN SOCIAL INFRASTRUCTURE

Social infrastructure is a component of the broader infrastructure sector, encompassing assets designed to support social services. Implementing the proposed project is expected to have a favourable impact on existing infrastructure, creating conditions conducive to urban development in the region. Company will employ additional workers, supervisors and engineers available locally to the extent possible. Necessary medical facility will upgrade under CSR activities/ programs which will be beneficial to locals residing in the study area as per Companies Act.

People coming from outside are expected to be educated and skilled. In addition, some secondary developments like opening of new shops may take place in view of the increased family population due to the proposed employment. These factors will be beneficial to locals residing in the study area.

8.4 EMPLOYMENT POTENTIAL

Direct Employment: Power projects have mechanized and automated plants. Hence, the employment prospects during the operational phase are constrained. The approx. number of NTPC employees during construction phase are 96 and contractual employees approx.2000 and operation phases are 186 and 1500 respectively. The direct employment opportunities with NTPC are extremely limited and the opportunities would exist mainly with the contractors and sub-contractors. The number of workforces employed during construction phase by the EPC contractors would be much

higher (about 2000-2500 during peak deployment). Providing jobs to local persons on a preferential basis wherever feasible would be facilitated through these agencies. The skilled manpower requirements for the operational phase of the power project shall come from outside the study area. Need of unskilled people would be satisfied from local population, depending on availability & feasibility.

In addition to the direct employment opportunities mentioned above, there will be indirect employment opportunities of local people by utilizing their expertise in different areas like horticulture, travel services, housekeeping and painting etc. Additionally, the advancement of the study area is expected to create new job opportunities.

Indirect employment: During operation phase, there will be employment opportunities, mainly in service sector, although its magnitude will be limited. Unskilled people and limited skilled people (depending on availability) may be hired by contractors from local population.

In addition, some secondary developments like opening of new shops may take place in view of the increased family population due to the proposed employment. These factors will be beneficial to locals residing in the study area. The local people may have opportunity to be engaged, under different agencies, as per their qualification & skill set, during the project expansion activities of Gadarwara STPP.

8.5 CORPORATE ENVIRONMENT RESPONSIBILITY

The Ministry of Environment, Forests & Climate Change issued the National Environment Policy (NEP) in the year 2006, as a “response to our national commitment to a clean environment as mandated in the Constitution in Articles 48A and 51A (g) and strengthened by judicial interpretation of Article 21.” The NEP is intended to mainstream environmental concerns in all development activities. The dominant theme of the policy is that “while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation than from degradation of the resource.” Whereas Corporate Social Responsibility (CSR) is mandatory as per Companies Act 2013, Corporate Environmental Responsibility (CER) gives specific stress on environment as per NEP. To meet the needs of NEP, MoEF&CC, w.e.f 01.05.2018, has issued an OM on CER. Another OM was issued in supersession of this OM by MoEF&CC dated 30th September, 2020 as revision of CER, Corporate Environment Responsibility.

Hence, additional fund shall be allocated towards CER activities (as per Ministry’s OM dated 01.05.2018) after addressing issues raised during Public Consultation.

The details of work executed by Gadarwara STPP under CSR-CD work are given in mentioned below in **Table 8.1**. Total amount of Rs. 4322.12 Lakhs on CD work activities and amount of Rs. 1596.221 Lakhs has been incurred on CSR activities since 2019 to till 2023-24. Photographs for the same is

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



given in **Figure 8.1 to 8.3**. Year-wise CSR expenditures are given below in **Table 8.2 & Annexure 8.1**.

Furthermore, proposed STPP activities for Stage-II has been envisaged and mentioned in **Table 8.3**.

Table 8-1: CSR-CD Activities undertaken by Gadarwara STPP (From 2014-15 to 2023-24)

Activities	Expenditure (in Lakhs)
Education	376.66
Health	323.21
Infrastructure	3454
Welfare	22.3
Sports and culture	17.36
Implementation measures	82.71
Other welfare	14.28
Others	31.6
TOTAL	4322.12

Table 8-2: Yearly CSR Expenditure

Gadarwara STPP Yearly CSR Expenditure		
Sr. No.	Financial Year	Amount in Rs. Lakhs
1	FY 2019-20	435.075
2	FY 2020-21	273.617
3	FY 2021-22	238.453
4	FY 2022-23	157.376
5	FY 2023-24	491.700
	Total	1596.221

Table 8-3: Proposed CSR/CER Budget (in lakhs) for Gadarwara

S. No.	Proposed recurring works under CSR/CER	RE 2025-26	BE 2026-27	Remarks
		Estimated Cost (In Lakhs Rs)	Estimated Cost (In Lakhs Rs)	
1	Education infrastructure, improvement in the level of education etc.	60.00	72.00	Every Year
2	Promoting Preventive HealthCare, Health Camps etc.	80.00	90.00	Every Year
3	Water & Sanitation infrastructure, expansion of drinking water facilities etc.	85.00	85.00	Every Year
4	Infrastructure development	50.00	30.00	Every Year
5	Road construction	80.00	90.00	Every Year
6	Renewable Energy	30.00	50.00	Every Year
7	Promotion of rural sports	5.00	5.00	Every Year
8	Vocational Trainings Empowering / Handholding of Self-Help Groups	31.96	51.96	Every Year
9	Physically Challenged Persons	15.00	10.00	Every Year

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Proposed recurring works under CSR/CER	RE 2025-26	BE 2026-27	Remarks
		Estimated Cost (In Lakhs Rs)	Estimated Cost (In Lakhs Rs)	
10	Miscellaneous/ Communication	53.00	55.00	Every Year
11	Strategic Planning	00	80.00	-
TOTAL		489.96	618.96	

**CSR/CER activities cover in line with MoEF&CC OM dated 1-5-2018 and OM dated 30-9-2020*

**The amount and year-wise phasing is tentative which shall be finalized after consultation with stakeholders and District Administration*



Figure 8-1 CD Activities at Village Dongargaon

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 8-2 Girl Empowerment Mission

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 8-3 CSR-CD Activities in nearby villages

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Solar High Mast Street Lights installed in Dongargaon, Gangai



**Social Welfare activities, Ambulance provide to
govt. Hospital, Gadarwara**



**Social Welfare activities, Community Hall
at Chichli, Gangai**

Figure 8-4 CSR-CD Activities in nearby villages

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Sports Activities at Chichli



Sanitary napkin machine



Self-Employment



Promoting Education

Figure 8-5 CSR-CD Activities in nearby villages

9. COST BENEFIT ANALYSIS

9.1 INTRODUCTION

Environmental Cost-Benefit Analysis (CBA) involves evaluating the economic impacts of policies and projects designed to enhance environmental services or those that may influence the environment, sometimes negatively. Originating from welfare economics, CBA addresses how different outcomes compare in terms of societal benefits. Welfare economics, grounded in eighteenth-century Utilitarian philosophy, aims to maximize benefits for the largest number of people. This approach focuses on assessing outcomes based on their overall utility to the population. The environmental costs and benefits of a development project are best understood when expressed both qualitatively and quantitatively (in monetary terms), and then compared to determine their relative value.

9.2 STAGES OF COST-BENEFIT ANALYSIS

- Defining the Project
- Identifying Impacts of the Project
- Valuing Impacts
- Valuing Benefits
- Cost Benefit analysis ratio
- Inference

The existing Gadarwara STPP has an installed capacity of 2x800 MW. All the units of Stage-I are under commercial operation.

In recent years, coal-based power generation has risen by 16.1% compared to previous years. According to the Central Electricity Authority (CEA), the installed capacity for coal and lignite power generation is projected to reach 266 GW by the end of 2029-30 to satisfy growing power demands, requiring an additional 34 GW from new coal and lignite projects. Given the current trend of retiring older, less efficient sub-critical units in line with emission standards set on 07.12.2015 and government policies on upgrading older units, the present proposal to establish a 1600 MW (2 X 800) ultra-supercritical unit will help in fulfilling the energy requirements of the country. This new unit will generate the electricity with reduced greenhouse gas emissions and lesser water requirement by utilizing more advanced, efficient technologies.

9.3 IDENTIFYING IMPACTS OF THE PROJECT

The impacts of construction and operational phases of the proposed expansion project comprise various activities each of which may have an impact on some or other environmental parameters. Various impacts during the construction and operation phase on the environment have been studied to estimate the impacts on the environmental attributes and are discussed in the subsequent sections. Impacts of the project activates are given in **Table no 9.1**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 9-1: Impacts of the Proposed Stage – II project during construction & operation phase

S. No.	Sector	Probable Impact
1.	Air Environment	➤ Stack emissions (PM, SO ₂ and NO _x).
2.	Water Environment	➤ Effluent generation from project site and township.
3.	Noise Environment	➤ Generation of noise due to plant.
4.	Solid Waste Environment	➤ Generation of Solid waste from plant and township.
5.	Ecology & Biodiversity Environment	➤ Change in land use for the requirement of proposed units.
6.	Socio-economic Environment	➤ Impact due to noise and air pollution. ➤ Pressure on public facilities like road due to proposed expansion project.
7.	Land Environment	➤ Change in land use pattern

9.4 EVALUATION OF ENVIRONMENTAL COSTS/IMPACTS

The study focuses on analyzing and evaluating the environmental and socioeconomic impacts including air and water pollution, deforestation, job creation, displacement, health risks, and changes in local community in terms of qualitative and quantitative. Evaluation of the impact during construction and operation is showing in **Table 9.2**.

Table 9-2: Environmental Costs/Impacts

S. No.	Sector	Impact	Amount in Rs. (Crores)																
1.	Air Environment (The cost for assessment of environmental damage may be guided by the MoEF&CC OM. No. 19-125/2019-IA.III dated 05.03.2020)	Impact Cost; per kg of emission; PM ₁₀ – Rs. 340/Kg Emission SO _x – Rs. 165/Kg Emission NO _x – Rs. 96/Kg Emission Total Emission/ Year based on Air Quality Modelling considering 24 hrs. operation for 85% PLF for proposed project <table border="1"> <tr> <th>Pollutant</th><th>Emission rate (gm/sec) Chapter 4</th><th>Total emission/ year (Kg)</th><th>Impact cost in Rs (Crores)</th></tr> <tr> <td>PM₁₀</td><td>47.11</td><td>1262758</td><td>42.93</td></tr> <tr> <td>SO₂</td><td>177.96</td><td>4770324</td><td>78.71</td></tr> <tr> <td>NO_x</td><td>471.08</td><td>12627582</td><td>121.32</td></tr> </table>	Pollutant	Emission rate (gm/sec) Chapter 4	Total emission/ year (Kg)	Impact cost in Rs (Crores)	PM ₁₀	47.11	1262758	42.93	SO ₂	177.96	4770324	78.71	NO _x	471.08	12627582	121.32	6071.70
Pollutant	Emission rate (gm/sec) Chapter 4	Total emission/ year (Kg)	Impact cost in Rs (Crores)																
PM ₁₀	47.11	1262758	42.93																
SO ₂	177.96	4770324	78.71																
NO _x	471.08	12627582	121.32																
2.	Water Environment	ETP & STP with ZLD system has been installed at Stage-I and proposed to be installed to Stage-II. Hence, no impact on water environment envisaged.	Nil																
3.	Noise Environment	Proper Equipment's design, and PPE kit will be provided, no major impact envisaged.	Nil																

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Sector	Impact	Amount in Rs. (Crores)
4.	Solid Waste Environment	Gadarwara STPP has facility for management and disposal of solid waste, no adverse impact due to solid waste is envisaged.	Nil
5.	Ecology & Biodiversity Environment	Loss of vegetation	Nil
6.	Social Environment	Cost of human re-settlement	Nil
		Loss of Public facilities and administrative infrastructures (roads, buildings, schools, dispensaries, electric lines, railways etc.)	Nil
		Suffering of Oustees	Nil
		Quantitative assessment of people effected due to noise and air emission is rather not feasible. It is to mention that Gadawara STPP has implemented several CSR & CER activities in the study area to mitigate the impact. It has also implemented special social schemes including medical facility for the project affected families.	
7	Land Environment	On Existing land	NA
8	Capital Investment	Total Project Cost	20,445.69
9	Cost of EMP	Recurring cost of EMP	38.01
	Total Impact/ Cost Value		26,555.40

9.5 EVALUATION OF BENEFITS

The commissioning of the proposed Gadawara STPP Stage-II (2x800 MW) project is expected to significantly enhance the power supply in various Indian states, which is crucial for both economic development and improving living standards. This upgraded power infrastructure will lessen the reliance of the public and businesses on diesel generators, thereby decreasing local noise and air pollution.

As part of its corporate social responsibility, the project will initiate several activities, including support for disadvantaged and physically challenged individuals, capacity-building programs, sports events, assistance to government schools, and scholarships. A key advantage of this expansion will be the creation of numerous temporary jobs during both the construction and operational phases.

Additionally, community development initiatives such as education, healthcare, water, and sanitation improvements will be implemented in nearby villages affected by the project. Gadawara STPP will also invest in essential infrastructure, including water supply, sewage systems, and medical facilities.

Table 9.3 Evaluation of benefits from the proposed Stage – II Project

S. No.	Parameters	Remarks	Monetary Equivalent
1.	Increase in Productivity	Quantified & expressed in monetary terms (Profit after Tax over the design life of 25 yrs.)	Rs.21,441.28 Cr

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Parameters	Remarks	Monetary Equivalent
	attributable to the specific project		
2.	Benefits to economy due to the specific project	The incremental economic benefit in monetary terms due the activities attributed to the specific project (Total cash flow during construction and operation of the project)	Rs.29,484.71 Cr
		Direct and indirect employment due to the project a) During construction (5 yrs) No. of temp. employment: 2500 nos. Man-days in 05 years=4562500 Considering Rs.600/man-day =Rs.273.75 Crores No. of permanent employment=96 Mandys in 05 years=175200 Considering Rs.5000/ per employee/ day = Rs.87.60 Crores b) During operation phase: No. of temporary employment=1000 Man-days in 25 years=9125000 Considering Rs.800/man-day =Rs.730.00 Crores No. of permanent employee 186 Man-days in 25 years =1697250 Considering average value @ Rs.6000 per employee/day = Rs.1018.35 Crores	Rs.2,109.7 Cr
3.	Physical Environment	Increased power generation will promote the reduction of DG dependency in the social and industrial sectors. This could cut the million tons of pollution emitted by the DG set far greater than the emission generation from the thermal power plant. Because a quantitative investigation to detect the reduction of DG reliance is not achievable, a qualitative statement has been considered.	--

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Parameters	Remarks	Monetary Equivalent
4.	Ecology and Biological Environment (MoEF&CC OM. No. 19-125/2019-IA.III dated 05.03.2020)	Green Belt, Afforestation & Landscaping undertaken by the project in the past 10 years. Benefit of Green belt plantation, Nos- 83,139 @1500/- Carbon sink plantation, Nos- 4,50,000 @ 1000/- Budget for cost towards wildlife conservation plan (for a period of 5 years)	57.47 Cr./ annum 1.93 Cr.
5	Social Environment (MoEF&CC OM. No. 19-125/2019-IA.III dated 05.03.2020)	No. of population benefited from the specific project (Considering energy consumption of 1255 units per capita per year (2021-22 consumption rate) total no. of Benefitted people is total units generated/ 1255 and multiply with the lifetime of the plant i.e., 25 years) 2x800=1600 MW At 85% capacity: 1600x0.85=1360 MW 1360x24=32640 MWh 32640x365= 1,19,13,600 MWh= 11,913,600,000 kWh 1 kWh=1 unit Annual power generation = 11.91 BU Total no. of Benefitted people = 11,913,600,000/1255=94,92,908.36 people/annum	Approx. 94,92,908 people/annum
	Total		53,095.09

9.6 COST BENEFIT ANALYSIS RATIO

The cost benefit analysis ratio based on above calculations is as under:

Impact Evaluation: **Rs.26,555.40 Crores**

Benefits Evaluation: **Rs. 53,095.09 Crores**

Environmental Cost Benefit Analysis ratio = Value of Impact: Value of Benefits

Environmental Cost Benefit Analysis ratio = **1:1.99**

Hence, the project benefits are 1.99 times is higher than the impacts evaluated.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



9.7 INFERENCE

The cost benefit analysis for the proposed Gadarwara, Stage-II (2x800 MW) indicates in favour of the project. The financial expenditure incurred in preventing, containing, mitigation or removing environmental contaminations occurring as a result of the proposed project activity will further add to the environmental benefit.

10. ENVIRONMENT MANAGEMENT PLAN

10.1 EMP IMPLEMENTATION, INSPECTION AND MONITORING

Environmental Management Plan (EMP) is proposed for its implementation during development of the project so objective of environmental protection can be achieved as per MoEF&CC norms & guidelines. If there is any adverse impact on the environment, it shall be identified and suitable mitigation measures along with the monitoring mechanism shall be prepared to control the adverse impact of the operation. This covers description of the administrative aspects of ensuring that mitigative measures are implemented and their effectiveness monitored, after approval of the EIA/EMP report and grant of Environment Clearance (EC).

In order to manage environmental issues, appropriate institutional arrangements with suitable organizational structure need to be in place, with clear definition of a range of required activities, powers and responsibilities. The assessment of environmental impacts and mitigation measures have been identified for effective operation of environmental management activities in the pre-construction, construction, commissioning and operation & maintenance (O&M) activities. These have to be operated with necessary resources i.e manpower, hardware and software to establish and monitor appropriate indicators for suitable remedial measures. NTPC is having well defined organization structure at corporate and site level to ensure proper implementation of NTPC Environment Policy as given in **Annexure 10.1**.

10.1.1 COMPONENTS OF EMP

Environment Management Plan (EMP) comprises of the components: (i) Institutional Arrangements; (ii) Monitoring Programme/plan; and (iii) Environmental Enhancement Measures.

10.1.2 INSTITUTIONAL ARRANGEMENTS

The construction and operation of a thermal power station entail significant environmental considerations. Since Gadawara STPP Stage-I is an operative project, Environmental Management Group (EMG) is already functional and led by Additional General Manager (EMG and AU) and supported by DGM (EMG) and qualified executive and contractual staff. The EMG group would be maintained for the proposed Gadawara Stage-II project. However, Gadawara STPP draws technical support from Environmental Engineering Group, Environmental Management Group (EMG) and Rehabilitation & Resettlement (R&R) Groups at Corporate Centre. The head of site EMG is directly reporting to the Head of the Project/Plant who would be accountable for implementation of environmental regulations and social impact improvement/mitigation measures. The general responsibilities associated with each of these functional domains are enclosed as **Annexure 10.2**.

Operation Guidance Note (OGN) on the 'Control of Environment Pollution' has been issued with the approval of the competent authority for maintaining/corrective action on the applicable Environment/Forest norms at the station level.

In addition to the above-mentioned OGN, other applicable OGNs on Environment have been issued with the approval of Director (Operations) which acts as SOP. As mentioned in the EIA Report

necessary institutional arrangement are in place to address the issues related to deviation or violation of the environmental or forest norms.

Further, a Risk Management Committee comprises of members from senior functionaries of management as per provisions of Companies Act 2013 and subsequent amendments has been constituted to establish system for reporting environment related parameters, deviations, and constraints to management. Environmental risks perceived shall be reviewed through risk management mechanism for appropriate action.

Concerned group shall oversee compliance assurance of operating stations through reviews and appraisals.

Training and awareness programs will be conducted from time to time on environmental conservation, environmental monitoring like AAQMS, CEMS, EQMS, ambient air & water quality assessments, municipal & hazardous waste management, noise reduction measures etc.

To ensure operational efficiency, pollution control equipment will be equipped with spare parts and maintenance facilities. Competent manpower will ensure efficient operation and maintenance of Electrostatic Precipitators (ESP), Flue Gas Desulphurisation System, ETP, STP and other pollution control systems optimally.

10.2 Environmental Monitoring Programme

A robust environmental monitoring program is essential to gather scientifically valid data for assessing the environmental quality around the power station and ensuring critical pollutants remain within acceptable limits. This initiative provides an early alert system for detecting unacceptable environmental conditions, enabling prompt implementation of control measures. Furthermore, it facilitates timely detection of changes in local environmental conditions.

The program specifies the monitoring locations, duration, and frequency of parameters to be observed. Monitoring during both construction and operation phases is integral to environmental mitigation efforts. Regular monitoring is vital for evaluating the effectiveness and performance of pollution control equipment. Regular monitoring is being carried out for existing Gadarwara STPP which covers monitoring activity for air quality, water quality, soil quality and noise levels and the data is submitted to Madhya Pradesh State Pollution Control Board (MPPCB) at regular intervals. The same would be augmented/strengthened encompassing proposed Gadarwara STPP Stage-II (2x800 MW).

Environment Monitoring Plan is described in **Chapter 6**. Monitoring during construction phase is given in **Table 6.1**. The environmental monitoring program including number and location of monitoring stations, frequency of sampling and parameters to be covered have been summarized and presented in **Table 6.2**.

10.3 Laboratory

The monitoring will be done by an external NABL/ MoEF&CC approved laboratory and in-house laboratory.

10.4 Flue Gas Desulphurization System (FGD)

Wet limestone-based flue gas desulphurization (FGD) system shall be installed at the tail end of the steam generator downstream of the ESP to reduce SO₂ emission to the applicable value of 100

mg/Nm³. The FGD shall be provided with limestone slurry preparation system which shall grind limestone to desired fineness and prepare the limestone slurry. The FGD shall have a scrubber as the main reaction vessel in which SO₂ gas shall be captured in limestone slurry to produce gypsum. The scrubber shall be provided with bypass system. Necessary auxiliary equipment and systems like mills, cyclones, vacuum filters, belt conveyors, pumps, storage vessels, piping and fittings etc., shall complete the FGD plant.

10.5 Zero Liquid Discharge (ZLD)

An effluent management scheme would be implemented with the objective of optimization of various water systems to reduce intake water requirement which would result in zero wastewater discharge. The effluent management scheme would essentially involve collection, treatment, and recirculation/disposal of various effluents. Adequate treatment facilities would be provided to all the waste streams emanating from the power plant to control water pollution.

10.6 Solid waste Management

Solid waste generated during construction will be managed as per Construction and Demolition Waste Management Rules, 2016.

Ash and Gypsum shall be the major solid waste likely to be generated from the project. Ash shall be generated due to combustion of coal. About 80% of the ash shall be generated as Fly Ash while 20% of the ash shall be generated as bottom ash.

The ash management scheme involves dry collection of fly ash through silos and bottom ash collection through dewatering bins, supply of ash to entrepreneurs for utilization, promoting ash utilization and safe disposal of unused ash (if any) to ash dyke in case of emergency. NTPC shall make maximum efforts to utilize the ash for various purposes. Unused fly ash and bottom ash shall be disposed-off in the ash dyke. A blanket of water shall be maintained over the entire ash dyke to control fugitive dust emission. After the ash dyke is abandoned, it shall be reclaimed through green vegetation as per prevailing norms. Gypsum generated from FGD system shall also be utilized/disposed-off in an environmentally suitable manner. Estimated Limestone requirement for the proposed Gadawara Stage-II plant would be approx. 200 TPD and estimated Gypsum generation from the proposed Gadawara Stage-II plant would be approx. 350 TPD.

10.7 ASH DYKE

The ash dyke area for Stage-II is located adjacent to existing Stage-I ash dyke. Earlier, total proposed area for the ash pond was about 135 Ha, which is now reduced to 99 Ha for use of partial area in green belt. Accordingly, Fly ash (FA) from Stage-II is now proposed to be disposed-off in existing Stage-I HCSD lagoon through a high concentration slurry disposal (HCSD) system and bottom ash (BA) is proposed to be disposed-off in new ash pond of Stage-II through lean slurry (LCSD). In this project, about 30 lakhs cum per annum of coal-ash is expected to be produced. However, as per MOEF&CC latest notification, 100 percent fly ash utilization is to be achieved progressively within 3 years of plant commissioning. As per the MOEF&CC notification dtd. 30.12.2022, 0.1 hectares per MW for Ash Dyke is allowed for new thermal power plants or expansion of existing thermal power

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



plants. However, due to area optimization for Stage-II, only 99 Ha of land is to be considered for new ash pond adjacent to the existing Stage-I ash dyke.

Based on experience of Stage-I ash dyke and pending topographical survey & geotechnical investigations, for estimating the storage capacity in proposed new ash dyke area, starter dyke of varying height is considered. Based on the same, two ash storage lagoons and one common Overflow lagoon will be accommodated in 99 Ha. Approx. 15% of ash pond area is occupied by dyke embankment, ash slurry pipeline corridor in dyke area, peripheral road for maintenance all along the periphery of the dyke, peripheral drain, AWRS & SWPH system facilities etc. for safe operation of dykes.

Considering the disposal requirement of Stage-II of approximately 30 lakhs cum per annum, the storage capacity of the proposed Stage-II ash pond is sufficient for stage-II operation of about 2 years (with Nil ash utilization) by constructing one starter dyke (7.5m) and one raising (effective height 3m). HDPE lining system is envisaged in overflow lagoon (OFL) and Bentonite blended lining in all ash storage lagoons.

Table 10.1: Details of Existing Ash Dykes

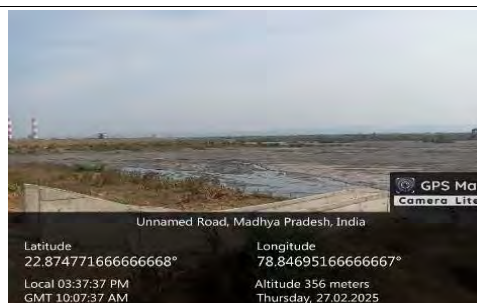
Details of Existing Ash Dykes	
Lining	HCSD Lagoon: HCSD lining BA Lagoon-II: HCSD lining BA Lagoon-III: Clay & Bentonite OFL: Clay & Bentonite
Height of the dyke	Avg. Height – 10.0 meter
Stability	Stability study conducted through IIT-Hyderabad in December 2021 and the observations have been addressed.
Ash Water Recirculation System	Ash Water Recirculation System (AWRS) has been provided to recycle back the decanted water from decanted ash water tank at ash dyke to plant for reuse. Further, the decanted water is also used for Dust Suppression in Dyke area. AWRS and Dust Suppression water pumps have been provided in the AWRS pump house with the following details: • Ash water recirculation Pumps: Two nos. (01 in Service and 01 as Standby), Capacity-1200 M³/Hr with 35 MWC head. • Decanted ash water tank capacity: 600 M³ • Dust Suppression water pumps: 03 nos. (02 in Service and 01 as Standby) of capacity 200 M³, 125 MWC head each   AWRS Pump House AWRS Pipeline

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Photographs of the Ash Pond



Life of the ash pond with calculation

Calculations of Life of Ash Pond			
Ash Dyke Particulars	Lagoon-1	Lagoon-2	Lagoon-3
	Fly Ash Lagoon (HCSO)	Bottom Ash Lagoon	Bottom Ash Lagoon
Storage Capacity (In LCM)	31.87	21.48	25.39
Residual Capacity (In LCM) as on date	8.22	17.14	23.82
Residual Capacity in terms of Days*	147 Days	2926 Days (~ 8 Years)	
* Considering 20400 MT of coal @85% PLF and 36% ash content. (7000 MT of ash /day) Fly ash is 80% of the total ash generated.			

Legacy Ash details (Cumulative unutilized ash available till 2024-25: 6,65,238 MT)

Year	Ash Generation, MT	Ash Utilization, MT	Cumulative ash in Dyke, MT	Ash Utilization, %
2022-23	19,58,865	14,31,092	5,27,773	73.06
2023-24	21,32,894	23,82,289	2,78,378	111.69
2024-25	21,72,114	17,85,254	6,65,238	82.19

Latest Ash Compliance Report (2023-24)

ACR of 2023-24 is enclosed as **Annexure-10.3**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 10.2: Details of Proposed Ash Dykes

Details of Proposed Ash Dykes	
Lining	HDPE lining system is envisaged in OFL and Bentonite blended lining in ash storage lagoons
Height of the dyke	7.5m (Starter dyke) + 3m (effective height of 1 Raising)
Stability	Adequate measures for safety and stability of the Ash dyke has been considered from design stage.
Ash Water Recirculation System	In case of non-utilisation in Dry Form, Bottom ash shall be disposed to Dyke for utilisation at dyke end, where in water shall be recovered through Ash Water Recirculation System (AWRS).
Photographs of the Ash Pond	 Proposed Ash Dyke Site Photographs
Life of the ash pond with calculations	Approx. 2 Years Storage Volume of Ash Pond 6.2 Million M ³ , Ash Generation estimated: 30 Lakh M ³ per annum

10.7.1 Ash Utilisation Plan

Fly ash will be collected in dry form in silos for subsequent utilization or transportation via rail wagons or bulk trucks to nearby cement plants. Moving forward, all ash will be fully utilized in cement manufacturing, reclamation of abandoned mines/quarries, brick production, road construction, and as an aggregate replacement in concrete, in compliance with the Fly Ash Notification of December 31, 2021. For any unutilized ash, provisions will be in place to dispose of it in high-concentration slurry form to the ash dyke. Ash Generation and Utilization Data of Stage-I from 2019-20 to 2024-25 are given in **Table 10.3**.

Table 10.3: Ash Utilization Report from 2019-20 up to 2024-2025

Fin Year	Ash Production (LMT)	Total AU (LMT)	Total AU (%)
FY 2019-20	2.88	0.02	0.69
FY 2020-21	9.44	0.78	8.26
FY 2021-22	16.85	6.35	37.66
FY 2022-23	19.59	14.30	73.00
FY 2023-24	21.10	23.03	111.69
FY 2024-25	21.72	17.85	82.19

A Detail Ash Utilization Plan has been prepared from FY 2024-25 to FY 2032-33:

- ❖ As per MoEF&CC Fly Ash Notification on dated 31.12.2021, starting w.e.f. April 2022, all TPPs to utilise 100% current ash (fly ash and bottom ash) generated during that year with

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



minimum utilization of 80% every year in 03-year cycle while achieving average 100% AU in each 03-year cycle. However, there is relaxation of two years for Plants with Ash utilization below 60 % in FY 2021-22.

- ❖ Since Ash utilization in Financial Year 2021-22 was 37.66 %, 03-year cycle shall start from April 2024. So accordingly, Ash Utilization Plan For MOEF&CC 3-Compliance Cycle (from FY 2023-24 to FY 2032-33) is given below.
- ❖ Non-compliance of same shall attract Environmental Compensation @ Rs. 1000 per metric ton on unutilized ash.
- ❖ MoU for Ash utilization is enclosed as **Annexure 10.3**.

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT MANAGEMENT PLAN FOR GADARWARA SUPER THERMAL POWER PROJECT, STAGE-II (2X800 MW)
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 10.4: Ash Utilization Plan from FY 2024-25 to FY 2032-33

MoEF&CC Compliance Cycle	Year	Ash Generation (LMT)	Area Development (LMT)	Outside Bricks (in MT)	Own Brick plant (LMT)	Cement & Other Industries (LMT)	Roads Construction (LMT)	Ash based Product / Others (LMT)	Mines Filling (LMT)	Total Ash Utilized (LMT)	Ash Utilization (%)
	Operation from existing 2x800 MW(St-1)										
First	FY 2022-23 (Actual)	19.59	0.04	0.15	0.00	0.45	13.42	0.00	0.00	14.89	76.06
	FY 2023-24 (Actual)	21.33	0.00	0.31	0.00	0.09	23.43	0.00	0.00	23.82	111.69
	FY 2024-25 (Actual)	21.72	0.00	0.00	0.00	0.62	17.23	0.00	0.00	17.85	82.19
	FY 2025-26	27.50	0.05	3.00	0.00	6.00	22.25	0.00	0.00	31.30	113.82
	FY 2026-27	27.50	0.05	3.00	0.00	6.00	22.25	0.00	0.00	31.30	113.82
Second	FY 2027-28	27.50	0.05	3.00	0.20	8.00	16.25	0.18	0.00	27.68	100.66
	FY 2028-29	27.50	0.05	3.00	0.25	10.00	14.25	0.23	0.00	27.78	101.00
	With Commissioning of St-2 1st Unit & Operation from 2x800 MW(St-1) + 1x800(St-2)										
	FY 2029-30	41.25	0.05	4.50	0.27	15.00	21.38	0.25	0.00	41.45	100.48
	With Commissioning of St-2 2nd Unit & Operation from 2x800 MW(St-1) + 2x800(St-2)										
Third	FY 2030-31	55.00	0.05	6.00	0.30	20.00	28.50	0.27	0.00	55.12	100.22
	FY 2031-32	55.00	0.04	7.20	0.33	24.00	24.23	0.30	0.00	56.10	102.00
	FY 2032-33	55.00	0.04	8.64	0.36	28.80	18.17	0.33	0.00	56.35	102.45

The above data is tentative and the actual ash generation as well as utilization, shall depend upon a number of factors such as PLF, ash content of coal, demand of ash, etc.

Bottom Ash System:

- ❖ Bottom ash is collected in dry bottom ash hoppers. Economizer and air preheater ash (including duct hopper ash if applicable) are conveyed in dry form to an intermediate bottom ash silo, through mechanical conveying systems (for bottom ash) and pneumatic conveying system (for other coarse ash). The collected ash in the intermediate silo is then transported to main bottom ash silos for dry ash utilization near the plant boundary. In case of non-utilization, it is converted to lean slurry and disposed to the ash dyke in wet form. A dry bottom ash conveyor system, utilizing troughed conveyors, is used to transport ash from the intermediate silo to the main silo.

Fly Ash System:

- ❖ Fly ash from the Main Fly Ash cum HCSD silos will be mixed with water in an agitator tank to achieve the required high concentration slurry.
- ❖ This slurry will be pumped to the designated ash disposal area.
- ❖ There will be operational HCSD (High Concentration Slurry Disposal) silos and fly ash silos of adequate capacity.
- ❖ Each HCSD stream will have its own HCSD pump.
- ❖ Each pumping stream will be equipped with its own dedicated disposal pipes.
- ❖ All HCSD pumps and HCSD silo aeration blowers will be housed in the HCSD pump house.

Ash Water System:

- ❖ An ash water re-circulation system is proposed to comply with environmental regulations.
- ❖ Decanted water from the ash pond will be pumped back to the plant using ash water recirculation pumps.
- ❖ This recycled water will be conveyed through pipes from the ash dyke to the plant area for use in the ash handling system.
- ❖ A blowdown process will be implemented to maintain a scale-free system.
- ❖ The normal makeup water for the ash system will be raw water and wastewaters like DM Plant effluent & Aux. cooling water (CW) blowdown water.
- ❖ Provision will be made to operate the ash water system in a “Once Through” mode when recycled ash water is unavailable.

Ash Pond:

- ❖ Ash Dyke provision is envisaged with adequate liners and an Ash water recovery system.
- ❖ Fugitive dust suppression system will be installed in the ash dyke area to control dust emissions.

Mill Reject System:

- ❖ To handle the Mill Rejects on a continuous basis, a mechanical type Mill Reject system shall be provided.

10.8 Environment Enhancement Measures

10.8.1 Power Harnessing

For harnessing solar power, solar street lights will be provided. Daylighting can be especially helpful in industrial environments where natural light is often non-existent, presenting a prime opportunity for implementation.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



The Solar Photo Voltaic (PV) installation on Rooftop of various buildings of the Power Plant shall be carried out preferably on shadow free area in such a way that the generation is maximized on each building suitable for installation of Solar PV power plants. Solar PV rooftop system will be installed on the buildings under proposed plant is estimated to be of 1125kWp.

Technical Requirements for Rooftop Solar Power Plant shall be as below:

- Shadow free flat roof top area having proper drainage
- Total distributed load of the roof top PV due to panels, supporting structures, equipment's and concrete blocks etc. and imposed load will not be more than 100 kg/m²
- Proper approach to the roof top through lift / staircase.
- Availability of water for panel washing

Implementation Schedule

- Implementation schedule for "Roof Top Solar PV Plant" will be approximately 6 months from the Award of solar package by EPC contractor subject to availability of roofs identified in the tender documents. It will be commissioned before commercial operation of the last unit of the thermal project.

In addition to the above, NTPC has pinpointed rooftop locations within the existing township and plant area for harnessing solar energy and it is planned to be installed at the earliest. The specific locations for solar rooftops on various buildings are detailed in Table 10.3.

Table 10.5: Solar Rooftop on various buildings of Under Stage-1

Narmada Vihar Township				
S. No	Building	Latitude (N)	Longitude (E)	Capacity (kWp)
1.	Taran tal	22.863787	78.874292	19.08
2.	B Type building	22.862611	78.880914	381.6
3.	C Type building	22.863986	78.879552	314.82
4.	Avni mahila mandal Nr. Shopping complex	22.865051	78.878971	38.16
5.	Tapti 1	22.864479	78.878023	98.58
6.	MSB or Alaknanda Building	22.866707	78.876494	67.84
7.	CISF Building	22.866789	78.874521	23.85
8.	Divya Jyoti Building	22.864470	78.875166	107.06
9.	D Block	22.862028	78.876751	400.68
10.	Admin Building (Prerna)	22.866202	78.873116	171.72
11.	Tarang	22.864498	78.875161	
12.	Mandakani	22.864479	78.878023	20.14
TOTAL CAPACITY				1643.53

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Inside Plant				
S. No	Building	Latitude (N)	Longitude (E)	Capacity (kWp)
1.	O&M Workshop	22.865368	78.869617	283.02
2.	Rawat Building	22.912049	78.864627	22.26
3.	MCC 1C	22.866235	78.859795	28.62
4.	Coal Bhawan	22.864409	78.858793	28.62
5.	Labour Rest room	22.864508	78.858793	23.85
6.	ESP -1	22.863058	78.866869	62.01
7.	CW Pump House	22°51'49.93"	78°52'4.80"	25.44
8.	CT -1 Switchgear	--	--	33.92
9.	Compressor house (Shed type roof)	--	--	90.1
TOTAL CAPACITY				597.84

10.8.1.1 Windows and Skylights

Incorporating windows and skylights is the most popular option for introducing natural light into a building.

To ensure the effectiveness of windows and skylights, correct placement is essential. The selection and placement of windows and skylights should be determined by the amount of light needed, regional climate, security requirements and the design of the building. This will be done during detailed engineering stage.

10.8.1.2 Tubular Daylight Devices (TDDs)

Tubular daylighting devices are a versatile alternative to traditional skylights because they can be used to provide light to areas that are not in a direct line of sight with the sun. Tubular daylighting devices (TDDs) utilize a rooftop dome to harness sunlight, which is then directed through a reflective tube. TDDs are more effective than traditional skylights or windows because of the reflective tubing, delivering maximum daylight with minimal heat transfer.

10.8.2 Training

The education and training of employees in good safety practices will be the responsibility of management. Employees will be instructed for the proper use of all equipment operation, safe lifting practices, location and handling of fire extinguishers, and the use of personal protective equipments.

Experienced O&M staff will be placed at an early stage to introduce the best system and operational management and practices. O&M staff will be assisted by a group of experienced technical personnel, to carry out the operation of the plant.

O&M staff will be associated with the plant commissioning stage itself to get them fully familiar with the plant. A suitable training schedule will be developed for this purpose.

10.8.3 Welfare Activities & Facilities for Employees

Permanent employees required for 2x800MW Units O&M are estimated to be around 186 nos. excluding contract labour. In addition to the plants & equipment for the generation of power the following facilities shall be provided in this station:

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



- ❖ Construction offices and stores
- ❖ Time and security offices
- ❖ First Aid and fire-fighting station
- ❖ Canteen and welfare centre, Toilets and change rooms.
- ❖ Car parks and cycle/ scooter stands
- ❖ Training & Development centre

Office space shall be provided as per good practice and canteens, toilets and restrooms according to norms laid down in the relevant Factories Act. The above facilities shall also be adequately furnished and equipped.

The main health hazards due to working in coal handling areas, ash handling areas, acid and alkali using areas, oil storage areas etc. are skin diseases and chemical burns. The workers will be encouraged to wash frequently and good sanitary and washing facilities shall be provided. A separate lunch room will be provided outside the work area. This will help to reduce dermatitis among the employees due to contact with acids, caustic chemicals, solvents, oils, as well as coal ash and fuel oil residues. The ambient air quality will be monitored for PM, SO₂, NO_x etc. to avoid excessive exposure.

10.8.4 Greenbelt

The green belt will be composed of indigenous and rapidly growing tree species. Additional trees will be strategically planted around the coal stockpile and ash disposal areas to reduce fugitive dust pollution.

It is preferable to cultivate a diverse mix of tree species rather than relying on monocultures. Line and rows of green belt will be break with the resistant tree species. This practise will help in improving the life of green belt by improving the disease resistance. The treated sewage water will be used for developing the green belt area. The survival rate of trees & plantation should be more than 90%, and it can be achieved by proper administration and good technical skill.

NTPC Gadawara has carried out plantation on 7.740 Ha inside the main plant premises and 58.628 Ha adjacent to the main plant and periphery. Approx. 83,639 trees have been planted under Gadawara STPP Stage-I. Further, 90.412 Ha of greenbelt is proposed adjacent to the main plant boundary and periphery. Total green belt area of 156.780 Ha has been identified within main plant premises out of which 66.368 ha. green belt development has been completed and green belt on 90.412 Ha. is proposed under Stage-II. The greenbelt shall have 3-tier plantation as per the CPCB guidelines with re-densification & strengthening of existing greenbelt.

Afforestation efforts have been undertaken around the plant site. NTPC Gadawara has carried out plantation on 181.17 Ha outside the plant premises in consultation with State Forest Department. Approx. 4,50,000 trees have been planted under Gadawara STPP Stage-I. Additional afforestation initiatives will continue to be implemented across all feasible areas surrounding the project site in consultation with Madhya Pradesh Rajya Van Vikas Nigam Limited (MPRVNL). This includes the identification and utilization of any available spaces for planting trees and promoting green cover to enhance environmental sustainability and biodiversity in the region

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Details of tree plantation in Stage-I is given in **Table 10.6** and a green belt development plan for Stage-II is given **Table-10.7**

Table 10.6: Tree Plantation from 2014-15 up to 2024-2025

Financial Year	Plantation Inside Plant Premises, Nos.
2015-16	100
2016-17	20070
2017-18	-
2018-19	25156
2019-20	1300
2020-21	120
2021-22	18000
2022-23	9870
2023-24	2450
Township area (2015-2023)	6073
2024-25	500
Total	83,639



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Figure 10.1: Plantation of saplings

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 10.7: Green Belt Area Details

S. No.	Location of Plantation	Plantation Completed, Ha.	Plantation proposed, Ha.	Total Area, Ha.
1.	Green belt along west wall in township	0.49	0.00	0.49
2.	South west boundary wall	0.00	4.62	4.62
3.	Green belt along south boundary wall Laydown and pre assembly	0.00	7.04	7.04
4.	Landscape area west of steel storage yard	0.00	0.86	0.86
5.	Green belt along South East boundary wall opposite to steel yard	1.91	0.00	1.91
6.	Along East boundary wall beside construction office	0.79	0.00	0.79
7.	Along East boundary wall beside BHEL laydown	0.84	0.00	0.84
8.	All along North boundary wall	3.00	1.65	4.65
9.	Green belt towards north of railway lines and loco shed	14.58	0.00	14.58
10.	Land South east corner towards south	0.16	0.00	0.16
11.	East of makeup water	0.00	0.29	0.29
12.	West of makeup water	0.00	1.64	1.64
13.	Inside Township at various locations- Area outside plant boundary, Park Areas, Plantation along roads	12.43	6.18	18.61
14.	Along toe line of ash dyke between RCC drain and toe drain of dyke	0.81	0.00	0.81
15.	Area between ash dyke approach road and plant's outside peripheral road (arch portion)	1.21	0.00	1.21
16.	Area between acquisition	0.00	0.81	0.81

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



S. No.	Location of Plantation	Plantation Completed, Ha.	Plantation proposed, Ha.	Total Area, Ha.
	line and RCC road north west of ash dyke			
17.	Road side plantation inside plant covering both sides of 14km road(approx)	4.28	0.00	4.28
18.	Area in Stage II ash Dyke along Road from Helipad to Sudras	13.38	0.00	13.38
19.	Area in front of Police station, towards Ash Dyke IA	4.86	0.00	4.86
20.	Area along Road from Chor-Barheta to Station Building upto underpass	0.00	2.12	2.12
21.	Area Along Track both side upto Baranjh in Railway siding corridor	0.00	14.06	14.06
22.	Green belt towards north of railway lines near S & T Hut	5.08	0.00	5.08
23.	BHEL Yard	0.00	7.65	7.65
24.	Ash Dyke stage II Portion	0.00	33.54	33.54
25.	Ash Dyke to Gadarwara Road	2.55	0.00	2.55
26.	Green belt in plant Railway siding	0.00	0.96	0.96
27.	In Stage-II Plant Area	0.00	1.24	1.24
28.	In Stage-I Plant Area	0.00	6.50	6.50
29.	Construction Office Area	0.00	1.25	1.25
	TOTAL	66.368	90.412	156.780

Out of total project area of 910.706 Ha., an area of 56.146 Ha has not been acquired but the land is under Right of Use (ROU) or for makeup water pipeline. Hence, 854.6 Ha area has been considered as total project area.

As mentioned in the Environmental Clearance for Gadarwara STPP Stage-I, 60.70 Ha area was to be developed against which 66.368 Ha. greenbelt has been completed. Further, 90.412 Ha area has been identified to be developed as Greenbelt under proposed Stage-II. Hence, total greenbelt under proposed project is 156.780 Ha. which is approximately 33% of the main plant area (473.570 Ha) earmarked for Main Plant and Ash Dyke areas under Existing Stage-I and proposed Gadarwara STPP Stage-II (2x800MW).

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 10.8: Green Belt Development Plan from 2025-26 up to 2031-2032

Period	Plantation area (Ha)	No. of Plantation	Amount (Rs. Lakhs)
FY 2025-26	3.42	8550	9.40
FY 2026-27	10.23	25575	28.13
FY 2027-28	14.06	35150	38.67
FY 2028-29	9.15	22875	25.16
FY 2029-30	5.86	14650	16.12
FY 2030-31	33.54	83850	92.24
FY 2031-32	14.15	35375	38.91
Total	90.41	226025	248.63

Green Belt development is a key element in environment conservation and protection. The establishment of a vegetation covering land in and around the proposed thermal power plant will result in many direct and indirect benefits as:

- ❖ Plants can absorb a wide variety of atmospheric pollutants emitted from thermal power plant and attenuates the noise levels.
- ❖ Plants will be able to control the build-up of atmospheric greenhouse gases (e.g., CO₂) that are emitted during power generation and thereby will postpone global warming.
- ❖ Afforestation will help restore the eco dynamics around the plant. It checks soil erosion and increases soil fertility.
- ❖ A green belt acts as a buffer zone and increases the aesthetic value of the surrounding area by adding to the greenery and providing a visual filter.
- ❖ A green belt will also compensate the vegetation loss during the construction phase and will help in reclamation of land used for ash disposal.

An appropriate greenbelt plantation programme is envisaged for expansion which will help in establishing the harmony with the environment of the proposed power plant and surrounding environment. The above tree plantation program would consider the following:

- ❖ Native plant species would be preferred for green belt development. Introduction of monocultures and alien plant species would be avoided.
- ❖ Heterogeneous native tree species will be selected and planted considering soil and climate adaptability, flowering, growth characteristics, canopy structure and resistance to pollution load.

A nursery will be maintained at site or sapling may be taken from local forest nursery to develop good planting stock to meet the plantation requirements.

Extensive green plantation within plant premises and surrounding areas of the plant focusing on water reservoir, school, hospital, other institutional area and over & above the green belt, as carbon sink, additional plantation shall be carried out on the identifying blocks of degraded forests, in close consultation with the District Forests Department. Additional plantation plan in the vicinity is being explored in consultation with state forest department is enclosed as **Annexure 10.5**.

[illegible]Page
10-18

10.8.4.1 Plantation under Ek ped Maa ke Naam Campaign

About 2 lakhs plant has been planted at Lakhnadon by NTPC Gadarwara through MPRVVNL with a total expenditure of ₹ 1,98,36,765 which includes 5 years maintenance cost. 500 nos. trees planted inside NTPC Premises on World Environment Day. Tree plantation program was held on September 23, 2024, in NTPC Gadarwara (Narmada Vihar Township) whereby total of 500 trees were planted in the township.

Furthermore, action plan for future NTPC “Ek Ped Maa ke Naam Campaign” (attached as **Annexure 10.4**) in its endeavour towards sustainability has resolved to plant 2000 trees in the FY 25-26. Each tree will be planted by a worker in his name who is toiling day and night inside and outside the plant to keep the electricity generation running and in good condition which indirectly ensures that the power in our homes keeps running.

Total budget estimated for plantation of 2000 trees is Rs. 2,00,000 along with 5 years maintenance. Estimated on the basis of 2 Lakh plantation cost at Lakhnadon.

10.8.5 Rainwater Harvesting

Summary of rainfall of last 30 years as per IMD climatological normal is given in Table 3.13 of Chapter 3. The effective area available for the rainwater harvesting is tabulated in the **Table 10.7**. The effective area is considered on the basis of rainwater harvesting comes in contact with other possible contaminants. The average annual rainfall is taken as 1192.1mm¹

Rainwater harvesting is crucial in capturing rainfall and runoff for local use. Hard surfaces such as roofs, pavements, and roads reduce groundwater recharge and generate significant runoff. This runoff should be directed into storage tanks for later extraction through service wells. Rainwater harvesting provides a practical, short-term solution to improve water availability. Structures designed for this purpose will be based on average annual rainfall, its intensity, the recharge capacity of the first aquifer (as determined by recharge tests), and runoff generated from various catchment areas.

Estimation of Recharge Potential in the Project Area:

For an effective rainwater harvesting design, the following factors are considered:

- Optimal location with a suitable ground slope.
- Adequate subsurface permeability of the aquifer to ensure maximum recharge through the injection well.
- The filtration rate must exceed the average rainfall intensity.
- Regular cleaning of the filtration media to prevent clogging.
- Measures to prevent groundwater pollution.

¹ Ground Water Management Plan of Narsinghpur District Madhya Pradesh, 2018

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Rooftop Rainwater Harvesting:

Table 10.9: Recharge potential of the Project Area

Peizo-metric Surface before slug injection (in mbgl)	Developed head after injection of slug (in mbgl)	Water released in bore hole (in Liter)	Time taken for initial water level in minute	Water intake in Liter	Water intake in minute	Water intake per hour	Water intake per day	Cubic meter/ day	During Rainy Season (Considering 45 rainy days for recharge)
1	2	3	4	5	6	7	8	9	10
					3/4	6x60	7x24	8/1000	8x45
23.15	7.03	1000	7.0	1000	142.85	8571.42	205714.3	205.7	9257.14

So, each proposed structure is capable of accommodating is 9257 m³ of water.

1. Proposed roof top rain water harvesting in all building through tube wells = $(37536.43+97190.75)/9257 = 14.55 \cong 15$ nos.

Proposed rain water harvesting structure in Open Area Rain water through recharge shaft and drilling one tube well in each shaft. The runoff will be diverted into the shaft then through tube well into the ground = $(171729.20+15449.62)/9257 = 20.22 \cong 20$ nos.

Proposed rain water recharge through all structures = 15 + 20 = 35 No.

Total rainy days in the year = 45 Days.

Total rain hour in one year = 45 x 24 hours/ Day = 1080 Hours.

Total Recharge from one structure in a year = $2.38 \times 3600 \times 1080 / 1000$ per year = 9253.44 Cum.

Expected recharge from 35 structures = $9253.44 \times 35 = 3,23,870.40$ m³

Total storage of storm water on surface / Raw Water Reservoir during Rainy Days in plant area = $360466.1 + 737316.9 = 1097783$ m³

Deduct evaporation loss 10% = 988004.7 m³

Total storage of storm water in percolation tank during Rainy Days in township area = $26844.48 + 69501.37 = 96345.85$ m³

Deduct evaporation loss 10% = 86711.27 m³

Recharge by gabion structures in Peripheral/ Diversion drain around plant and township area of 2.0 km length with average 1.0 m height and 3.0 m width = 4500.0 m³/yr

Total recharge from surface water storage = $988004.7 + 86711.27 + 4500.0 = 1079216$ m³

Total Recharge from all rain water harvesting structures = $1079216 + 3,23,870.40 = 14,03,086.365$ cum.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Proposed recharge potential to be created by the project premises would improve ground water regime of the project area and would contribute to positive water environment.

Detailed rain water harvesting plan, number of RW harvesting structure and their intake capacity
Design basis for storm water drainage system:

Run off discharge

$Q = CIA$

Where,

Q = run off (discharge) in cubic meters per hour

C = Co-efficient / Impermeability factor of the surface

I = Intensity of Rainfall

Taking 20 mm/hr or 0.020 m/hr

A = Total drainage area in Ha.

Terraces, Hard Paved Surface	0.70 - 0.95
Paved Surface, Roads	0.70 – 0.80
Gravel Path, Loosely paved walk, rocky surface	0.50 - 0.60
Brick Paved, Compact Turf	0.75
General Ground	0.50-0.60
Natural Ground, Sloping Ground	0.20-0.50

The Technicality Involved

There are both direct and indirect methods for artificial recharge and water conservation. Direct surface techniques include methods like flooding, recharge through ditches and furrows, spreading, and over-irrigation. Direct subsurface techniques involve injection wells, recharge pits and shafts, dug well recharge, etc. A combination of surface and subsurface methods includes percolation tanks with pit shafts, trenches, or wells. Indirect methods for groundwater conservation include subsurface dykes or groundwater dams.

Rainwater harvesting and groundwater recharge methods can be further classified based on their suitability for urban and rural areas:

- Urban techniques: Roof-top rainwater harvesting or runoff harvesting through recharge pits, trenches, tube wells, and dug wells.
- Rural techniques: Gully plugs, contour bunds, gabion structures, percolation tanks, check dams/cement plugs, recharge shafts, dug well recharge, and groundwater dams/dykes.

Structures like contour bunding, trenches, and terraces, designed to prevent soil erosion, also play a secondary role in groundwater recharge. Designing a rainwater harvesting system requires scientific

and technical expertise since it involves enhancing nature's natural recharge process. Poorly designed systems without adequate technical support can lead to groundwater pollution, collapse of structures, or ineffective systems.

Recommendation For Rainwater Harvesting

On the basis of the analysis of the data generated from the systematic and comprehensive Hydrogeological survey, the Geophysical resistivity survey and lateral profiling, the lineament fabric studies of the area, thoroughly understanding the aquifer geometry and its disposition at depth, Hydro meteorological studies (rainfall, intensity etc.) the location and types suitable rainwater harvesting structures are finalized to impound as well as research groundwater.

Rooftop Rainwater Harvesting Structure:

To accommodate the runoff from rooftops roof top rainwater harvesting is proposed rain water harvesting structures in all buildings through tube wells. In the area where the shallow aquifer has dried up and existing tube wells are tapping deeper aquifer, roof top rain water harvesting through vertical shaft/ tube wells can be adopted to recharge the deeper aquifer.

Rainwater from roof will be taken to filtration chambers located on ground. These chambers are provided with a tube well. Slotted casing is provided below filter media to facilitate the filtered water to enter into tube well. The filtration chamber is backfilled with graded material, boulders at the bottom, gravel in the middle and sand on the top with varying thickness and may be separated by screen. The top 1.0 m of the chamber is left empty to accumulate unfiltered water drained from roof.

Rainwater Harvesting Potential and Plan

Total recharge potential of the Area (Plant +Township) according to the study: 13,69,167.0 m³/annum

Expected recharge from 30 structures= 2,77,603 m³/annum

Storage of stormwater on surface/Raw water reservoir during rainy days = 8,72,075 m³

Evaporation loss 10%= 87,207.5

Final Storm water storage= 7,84,867.5 m³

Recharge by Gabion structures in peripheral/diversion drain around plant and township- 4,500 m³/year

Total capacity after both facilities is operational= 10,66,970 m³/annum

Approx 78% of the total Recharge potential.

Rainwater Harvesting Scheme for Gadarwara STPP

A detailed study carried out for assessment of Rainwater Harvesting Potential and development of scheme for rainwater conservation. The scheme has been approved by Central Ground Water Board. The study recommendation and present implementation status is given below:

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 10.10: Rainwater harvesting action plan

S. N.	Recommendation	Action Taken/ Status
1	Roof top Rainwater Harvesting in 20 buildings through tubewells	21 Nos Recharge shafts have been constructed in Township (8 Nos) and Plant (13 Nos). Total Recharge potential is 1,94,397 Cum.
2	Rainwater harvesting Structure in Open area rainwater through recharge shaft - 10 Nos	09 Nos Recharge shafts have been constructed in Plant. Total Recharge potential is 83313 Cum.
3	Open area Recharge Pit	Additional 28 Nos. Recharge shafts locations have been identified in Township Area. Proposal has been prepared and the work is expected to be completed by Dec-25.
4	Recharge by Gabion Structure	Gabion structures have been constructed from plant to near Weigh Bridge (Ash Dyke). 3 nos. recharge pits have been completed along the diversion drain.
5	Recharge by Storm water	A scheme is being developed to reroute storm water into reservoir. Work is expected to be completed by June 2025.

Water Saving:

- ❖ To the possible extent water is saved at each point of use by taking proper care in maintenance of drain pipe, tap etc. from leakage. There should be display board for optimum use of water in washroom, toilet or at other appropriate locations.
- ❖ Use of recycled water, if possible, in cleaning of toilets or gardening after proper treatment and testing for its intended use.
- ❖ Use of sprinkler or drip irrigation method in garden irrigation.
- ❖ Adoption of machinery– equipment, methods, if possible and economic viable, for manufacturing.
- ❖ Appropriate plantation to reduce evaporation.

Maintenance of the recharging system: Periodic maintenance required for reliable and higher quality water supply. During raining season, the entire system to be checked before and after rains and cleaned after every dry period. Before first shower storage tanks should be cleaned and flushed of all sediments and debris. Also, the roof top will be cleaned before monsoon and coarse mesh is used to prevent the debris on the entrance of the water at roof. The first shower should be flushed so that any sediment can be washed away.

10.9 COST OF ENVIRONMENT MANAGEMENT MEASURES

A capital cost provision of **Rs. 2015.44 Cr** towards environmental protection measures/EMP and the recurring cost of **Rs. 40.16 Cr per annum** have been earmarked. The break of EMP cost is mentioned below in **Table 10.11**.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Table 10.11: Cost Provisions for Environment Pollution Control Measures

S. No.	Item Description	Capital Cost, Rs. in Crores	Recurring Cost, Rs. in Crores
1.	Electrostatic Precipitator	356.67	7.13
2.	Chimney	224.15	4.48
3.	Aux. Cooling Towers incl. Civil Works	26.92	0.53
4.	Ash Handling incl. AWRS	702.12	14.04
5.	Ash Dyke	100	2.0
6.	Dust extraction & suppression System	6.1	0.12
7.	DM plant, Waste treatment systems	5.0	0.1
8.	Sewerage collection, treatment & disposal	2.0	0.04
9.	Rainwater Harvesting	1.0	0.02
10.	Green Belt, Afforestation & Landscaping	10.0	0.2
11.	Flue Gas Desulfurization (FGD)	566.25	11.32
12.	Solar Power harnessing	4.59	0.09
13.	Environmental Lab Equipment	0.50	0.01
14.	Environmental Monitoring Systems	4.30	0.08
15.	Provision for Implementation of study recommendation		
a.	Wildlife Conservation through Forest Dept.	2.52	--
b.	Watershed Development and River conservation	0.70	--
c.	Biodiversity Analysis Report Recommendation	0.72	--
d.	Hydrogeology Study Report Recommendation	1.90	--
	TOTAL	2015.44	40.16

**The works proposed in the EMP shall be completed simultaneously along with construction work for Stage II in 60 months for Unit I and 69 months for Unit II as per project timeline.*

10.9.1 PROVISION FOR ADDRESSING ISSUES RAISED DURING PUBLIC HEARING

In line with MoEF&CC OM dated 30.9.2020, the costs of the activities proposed to address issues raised in Public Hearing are additional to the Environmental Protection and Conservation measures and shall be restricted to the affected area around the project. Activities like supply of drinking water, health and sanitation, construction and repair of infrastructure for schools/roads/drains, plantation etc. have been proposed which are in compliance to MoEF&CC office memorandum. Other activities like pollution control measures, Water Conservation, Rainwater harvesting, Solar PV etc. have been covered in EMP budget. Details of public hearing incorporated in chapter 7 section 7.2, Table 7.2, 7.3 and 7.4. Budget provision of Rs.11.50 Cr has been caped for addressing the issues raised during public hearing.

10.10 EXISTING ENVIRONMENT MANAGEMENT MEASURES

Various environmental measures have been implemented in Gadarwara STPP Stage-I. Photographs of environmental facilities are given in **Figure 10.3**.



Electrostatic Precipitators (ESPs)



Dust Suppression



Recycling of treated water, ETP, CSSP & STP



Roof top Solar

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



Storm water diversion



Rain water harvesting structures



Water Sprinklers at Ash Silo



Dust Suppression during Wagon Tippler for Coal



Latitude: 22.86509
Longitude: 78.86469
Elevation: 354.0±21 m
Accuracy: ±1 m
GPSTime: 16 August 2024 Friday 11:16:44 pm
Time zone: India Standard Time
Address: Unnamed Road, NTPC Gadawara, Chhor Barhata, Madhya Pradesh 487441, India
Note: NTPC GADARWARA

EQMS
Powered by NTPC



Latitude: 22.86555
Longitude: 78.86555
Elevation: 372.8±17 m
Accuracy: ±2 m
GPSTime: 16 August 2024 Friday 12:17:41 pm
Time zone: India Standard Time
Address: NTPC Gadawara, Chhor Barhata, Madhya Pradesh 487441, India
Note: NTPC GADARWARA

CEMS
Powered by NTPC

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 10
ENVIRONMENT
MONITORING PLAN**

**Page
10-26**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



CAAQMS



**Dust Extraction & Suppression at Coal
Crusher House**

Figure 10.3: Environment Management System

10.11 Measures for Prevention and Control of Air Pollution at NTPC Gadarwara STPP

a) Provision of Electrostatic Precipitator (ESP) for Particulate Matter (PM) Control



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



b) Installation of Flue Gas Desulphurization (FGD) for SO₂ Control



c) Dust Suppression at Railway Siding and Coal Handling Plant



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



d) Dust Control Measures at Ash Dyke and Ash Transportation



Covering of all Ash Transporting Vehicles



**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



e) Installation of Monitoring Equipment

❖ AAQMS Station



11. SUMMARY AND CONCLUSION

11.1 INTRODUCTION

NTPC Limited, a Government of India enterprise, stands as India's largest power generating company, established in November 1975 with the aim of coordinating and advancing thermal power development nationwide. Recognized as a "Navratna" by the Government of India in 1997 and subsequently as a "Maharatna" in 2010, NTPC has evolved into a diversified entity venturing into hydro, solar, coal mining, power trading, equipment manufacturing, power distribution, and renewable energy. The company is also exploring nuclear power development.

Presently, NTPC Group operates coal, gas, solar, hydro and wind projects, boasting an installed capacity of 77,393.18 MW, making it the leading power generator in India. Additionally, NTPC Group has around various projects under construction across various locations in the country, along with expanding ventures into coal mining, power equipment manufacturing and trading, positioning itself as an Integrated Power Major in the evolving power sector.

Environmental Clearance for Gadawara STPP Stage-I (2x800 MW) was accorded by MOEF&CC vide letter no. J-13012/125/2009-IA.II(T) dated 22nd March, 2013. Gadawara STPP Stage-I (2x800 MW) has been established and both the units have been commissioned on 01.06.2019 & 01.03.2021 respectively and are under commercial operation.

THE PROJECT

The Ministry of Power identified the Gadawara STPP Stage-II as a candidate project for thermal capacity addition, aiming to establish it as a baseload power station to meet the growing electricity requirement.

Location: Near Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon etc., Tehsil Gadawara, in Narsinghpur district of Madhya Pradesh.

Elevation & Topography: Site elevation 354-380 m. The topography of ash dyke area is undulating terrain due to ravines however main plant area is plain.

Plant Capacity: Existing 1600 MW (Stage-I), Proposed 1600 MW (Stage-II), Total 3200 MW

Technology: Super Critical (existing), Ultra Super Critical (proposed)

Land Area: 910.706 Ha

Main Fuel/Coal Consumption: 13.66 MTPA (Existing + Proposed)

Water Requirement: 1,60,200 KLD (Existing + Proposed) from Narmada River for which adequate water allocation given by WRD, Govt of Madhya Pradesh.

11.2 THE PROJECT PROPONENT

NTPC Limited, established in 1975, is an integrated power major involved in various energy sectors. It operates multiple power projects with a capacity of 77,393.18 MW and various project under

construction. NTPC is proposing to expand the Gadarwara STPP by adding two units of 800 MW under Stage-II.

11.3 LOCATION OF THE PROJECT

The Gadarwara STPP is situated approximately 18.4 km from bank of the Narmada River near village Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon, etc., Tehsil Gadarwara, in Narsinghpur district of Madhya Pradesh.

11.4 DEMAND JUSTIFICATION

Electricity is vital for economic growth. The Gadarwara STPP Stage-II aims to meet the power demand of the Central Region as well as other regions of the country. As of December 2024, India's installed capacity is 4,62,065.16 MW, with significant contributions from both fossil fuels and renewables. Projections for 2029-30 estimate a capacity of 8,17,254 MW, with growth in solar and wind energy. Programs like Saubhagya have been crucial in expanding electricity access.

11.5 PURPOSE OF THE REPORT

The Environmental Impact Assessment (EIA) report is required for Category A Thermal Power projects over 500 MW. An application for Environmental Clearance (EC) was submitted, and the Ministry of Environment, Forests, and Climate Change (MoEF&CC) provided Terms of Reference (ToR). This report assesses the environmental impacts of the proposed project.

11.6 SCOPE OF THE STUDY

NTPC appointed M/s. Greencindia Consulting Private Limited to prepare the EIA report. The study includes literature review, environmental monitoring, pollution source identification, impact prediction, and mitigation plans. Parameters for the baseline study and their frequency are outlined.

11.7 PROCESS OF OBTAINING ENVIRONMENTAL CLEARANCE

Projects are classified into Category A or B based on potential impacts. Category A projects, like this one, require clearance from the Expert Appraisal Committee, MoEF&CC. The clearance process involves four stages: Screening (for Category B), Scoping, Public Consultation, and Appraisal.

This comprehensive summary outlines the background, project details, demand justification, purpose of the report, study scope, and environmental clearance process for the proposed Gadarwara STPP Stage-II expansion project.

11.8 PROJECT DESCRIPTION

The Ministry of Power, through an Office Memorandum dated October 25, 2023, discussed in a meeting chaired by the Honourable Minister of Power and New & Renewable Energy on September 27, 2023, to review the capacity addition up to 2031-32. During this review, Gadarwara STPP Stage-II (2x800 MW) ultra-super critical project as candidate thermal power project (in planning likely to be commissioned by FY 2031-32) under brownfield project category of NTPC.

NTPC Gadarwara is planning to expand the Gadarwara Super Thermal Power Plant by adding 1600 MW (2x800 MW) of Ultra Super Critical Technology to the existing 1600 MW (2x800 MW) capacity within the current plant boundary in Village Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



etc., Tehsil: Gadarwara Dist. Narsinghpur in Madhya Pradesh. Details of the project features and related information are summarised below:

Capacity & Unit Configurations: Proposed expansion for Stage II- 1600 MW (2 X 800 MW) Ultra Super Critical Technology.

Land Requirement and Availability: A total of 910.706 hectares of land is available with NTPC Gadarwara out of which 56.146 Ha has not been acquired but the land is under Right of Use (ROU) or for makeup water pipeline. Approximately 621.474 hectares of this land has been utilized for Stage-I. The remaining 289.232 hectares of land will be allocated for Stage-II Units, Ancillary Facilities and Ash Disposal Area.

Fuel Requirement: The annual coal requirement for Stage-I is estimated at 7.56 MTPA. The estimated coal requirement for Stage-II is approximately 6.10 MTPA.

Support Fuel: Light Diesel Oil (LDO) will be used for initial startup and as secondary fuel.

Fuel Transportation: Coal transportation from mines to the power plant will be managed by Indian Railways. To accommodate additional rakes for Stage-II, the current railway siding will need augmentation.

The secondary fuel shall be sourced from the refineries located nearer to the project by railway wagons.

Coal Handling System: Coal handling facility, which comprises receipt of coal through Rail, with on-line crushing and stacking by stacker-cum-reclaimer in the coal yard and finally feeding the bunker level conveyors.

Ash Disposal system: The ash produced by the project comprises 80% fly ash and 20% bottom ash. High Concentration Slurry Disposal (HCSD) System is proposed for Fly Ash Disposal System.

Water Requirement: The water requirement for Stage-I of the project is approximately 1,12,200 KLD (4,675m³/hour). It is based on Water Cooled Condenser (WCC).

For the Gadarwara-II (2x800 MW) project, the water requirement is expected to be around 48,000 KLD (2,000m³/hour). It is proposed to be based on Air Cooled condenser (ACC) system.

Source of Water: The Water Resource Department (WRD), Govt. of Madhya Pradesh granted water commitment of 56 MCM and additional allocation of 11 MCM from River Narmada to the Gadarwara project.

Power Generating Unit: The plan includes building and operating two units, each with a capacity of 800 MW (2 X 800 MW).

Power Evacuation: The Stage-II generation switchyard shall be interconnected to Stage-I through 400 kV line for drawl of start-up power and additional flexibility in power evacuation through Stage-I lines. Presently, provision of Two nos. of 765 kV outgoing line bays has been kept in the new 765kV generation switchyard along with interconnection between the Two phases. The above-mentioned

Power evacuation provisions are tentative and shall be reviewed based on the finalized ATS of the project.

Project Time Frame: Commercial Operation Date (COD) of first 800 MW unit of Gadarwara STPP Stage II will be in 60 months from the investment approval and subsequent units after an interval of 9 months thereafter.

Project Cost

The estimated Cost of the proposed Expansion Project is Rs.20,445.69 Crores. The specific project cost appears to be Rs.12.78 Crores per MW based on the estimated Project Cost.

Technology and Process Description

In a coal-based thermal power plant, electricity generation involves the following series of steps-

1. **Coal Preparation and Combustion:** Coal is transported to bunkers and pulverized into a fine powder mixed with air. This coal-air mixture is burned in the boiler to release thermal energy.
2. **Steam Generation and Turbine Rotation:** Boiler feed water is heated by combustion heat to produce high-pressure steam. The high-pressure steam drives turbines by expanding through nozzles, generating mechanical energy. Turbines are connected to generators which convert mechanical energy into electrical energy.
3. **Ash Handling:** During combustion, non-combustible ash forms (bottom ash 20% & fly ash 80%). Bottom ash is collected, quenched, ground and disposed of or sold. Fly ash is carried with flue gas and removed using electrostatic precipitators (ESPs).
4. **Flue Gas Treatment and Ash Collection:** Flue gas undergoes further treatment in a Flue Gas Desulphurisation (FGD) system before release. Ash collected in ESPs is stored in dry ash silos for disposal or industrial use.
5. **Steam Condensation and Reuse:** Steam exiting turbines is condensed back into water in air-cooled condensers. Condensed water is reused as boiler feed water, enhancing efficiency.
6. **Accessories and Support Systems (Air Cooled Condenser (ACC):**
 - i. **Fin Tube Bundles:** Increase surface area for air cooling, enhancing heat transfer.
 - ii. **Steam Distribution Manifold:** Efficiently directs steam to condenser tubes.
 - iii. **Condensate Collection Headers:** Collect condensed water for storage.
 - iv. **Condensate and Non-condensable Removal Piping:** Removes water and gases to maintain performance.
 - v. **Hot Well (Condensate Collection Tank):** Collects and separates gases from condensed water
 - vi. **Supporting structure:** Ensures stability of ACC components.
 - vii. **Steam Duct and Expansion Joints:** Allow steam flow and accommodate thermal changes.
 - viii. **Anchors and Hangers:** Stabilize ducting system to prevent stress.
 - ix. **HP-LP Bypass Steam Dumping Device:** Provides operational flexibility.
 - x. **Fans, Gearboxes, Couplings:** Drive air movement for cooling efficiency.

- xi. **Vibration Monitoring System (VMS):** Detects anomalies for maintenance.
- xii. **Motors and Associated Controls:** Regulate fan and component operation.
- xiii. **Maintenance Platforms and Access Stairways:** Facilitate safe maintenance access.
- xiv. **Cleaning/ Washing System:** Maintains heat transfer surface efficiency.

Turbine and its Auxiliaries:

For each 800 MW TG unit encompass a comprehensive array of systems designed to ensure efficient and reliable operation-

1. **Steam Turbine (TG):** Tandem compound, single reheat, regenerative, condensing design. Designed for base load operation with flexibility for varying operational modes. Features optimized HRH temperature and safeguards against water induction.
2. **Condenser:** Utilizes dry cooling with direct air-cooled condenser. Includes inclined roof-like finned cooling tubes made of carbon steel for cost efficiency. Hot well stores condensate sufficient for 5 minutes of turbine operation.
3. **Air Extraction System:** Includes vacuum pumps for condenser air evacuation. Features startup air evacuation system with pumps and accessories.
4. **Lube Oil System:** Comprehensive system meeting turbine bearings' lubrication needs. Provides for turbine turning gear and emergency jacking oil requirements. Utilizes main oil pump (MOP), auxiliary oil pumps (AOP), and emergency oil pump (EOP).
5. **Turbine Control Fluid System:** Self-contained system using fire-resistant fluid for turbine control. Includes reservoir, AC motor-driven pumps, and coolers for fluid circulation and cooling.
6. **Gland Steam Sealing System:** Ensures effective sealing of turbine shaft glands to prevent steam and air leakage. Utilizes seal steam from auxiliary steam header with provisions for various load conditions.
7. **Governing / Regulation System:** Features throttle or nozzle-controlled governing for precise speed control. Includes electrohydraulic governor with backup for stability and safety.
8. **HP/LP Bypass:** Enables quick startup and operation during load changes. Designed for specific steam flow capacities to match turbine conditions.
9. **Regenerative Feed Heating Cycle:** Handles condensate flow through LP heaters to deaerator and boiler feed pumps. Utilizes turbine extraction steam for heating before entering boiler.
10. **HP & LP Heaters:** Includes LP heaters, drain coolers, deaerator, and HP heaters optimized for feed heating. Compliant with standards for heat exchanger design and material use.
11. **Deaerator:** Features Spray-cum-tray deaerator with integral direct contact vent condenser. Ensures effective deaeration of incoming condensate and HP heater drains.
12. **Boiler Feed Pumps (BFP):** Includes turbine-driven and motor-driven pumps with booster pumps on common shaft. Designed for efficient and reliable feed water delivery to steam generator.
13. **Condensate Extraction Pumps:** Three motor-driven pumps for condensate extraction, handling various operational conditions.

14. **Turbine Hall EOT Cranes:** Electric overhead travelling cranes for installation and maintenance of turbogenerators and equipment.
15. **On-Line Integrated Blade Vibration Monitoring System:** Monitors blade health of critical turbine stages using non-contact sensors.
16. **Deaerator Level Control Station:** Manages condensate flow with control valves and variable frequency drive system.

Plant Water System

Gadarwara STPP Stage-II proposes an Air-Cooled Condenser (ACC) System, which significantly reduces the water demand. The estimated water requirement for Gadawara-II, an expansion project generating 2x800 MW, 48,000 KLD (2,000m³/hour) with AWRS. It is proposed to be based on Air Cooled condenser (ACC) system.

- **Make-up Water System:** The make-up water requirement for this project would be about 2,000 M³/hr., with ash water recirculation system, in once through operation of ash water system considering bottom ash disposal in lean slurry form and HCSD system for fly ash disposal.
- **Equipment Cooling Water (ECW) System & Aux. Cooling System:** Closed circuit type ECW system shall be provided with demineralized (DM) water in the primary circuit. The recirculating type ACW system with Auxiliary Cooling Tower (Aux. CT) shall be provided in the secondary circuit for cooling of primary (DM) water. ECW system shall cater to the cooling water requirements of TG, SG & its auxiliaries including station auxiliaries. TG and SG primary cooling circuits shall be independent. The secondary cooling water circuit shall, however, be common for both the primary cooling systems.
- **Auxiliary Water Systems:** The plant will feature a comprehensive water distribution system for potable and service water needs. Potable water will be distributed via a dedicated pipe network from overhead storage tanks, with sufficient pumps to meet plant demand. For cleaning purposes, a separate pipe network covering the entire plant area will be established, utilizing service water drawn from designated tanks through service water pumps.

Water Treatment Systems

The project's water treatment system includes several components consisting the following-

- **Water Pretreatment Plant:** The pretreatment plant would be designed to remove suspended/colloidal matter in the raw water. Separate pre-treatment plant shall be provided for meeting the requirement of ACW system and Demineralization (DM) Plant. A common chemical house shall be provided to store chemicals such as lime, alum, coagulant aid, etc., and respective lime, alum, coagulant, etc., dosing equipment such as tanks, pumps etc., for all the PT systems. Independent chemical preparation tanks and chemical dosing pumps shall be provided for each PT system.
- **Water Demineralization Plant:** The Demineralization (DM) Plant will cater to the water needs of the steam cycle, closed circuit auxiliary systems, and stator water cooling. It can

operate on either Ion-Exchange technology or a combination of Ultrafiltration (UF), Reverse Osmosis (RO), and Mixed Bed (MB) processes. Regeneration of cation and anion resins will use hydrochloric acid and sodium hydroxide respectively, with facilities for bulk chemical storage, preparation, and dosing. The plant will feature three DM water storage tanks and interconnections between Stage-I and Stage-II tanks.

- **Chlorine Dioxide Plant:** Two Chlorine Dioxide (ClO_2) plants will be installed for the ACW system and the pretreatment plant. Each system will include generators, chemical storage tanks, unloading systems, and safety features like leak sensors. The ACW- ClO_2 system will have two generators, while the PT- ClO_2 system will include one generator and one sodium chlorate generator.
- **Condensate Polishing Plant:** The project will integrate a Condensate Polishing Plant downstream of condensate extraction pumps to maintain feed water purity. Each turbine-generator unit will feature vessels with Cation and Mixed Bed resins, along with pre-filters for condensate polishing. External regeneration systems and neutralization facilities will support resin reuse and wastewater management.
- **ACW Treatment System:** A comprehensive chemical treatment program will manage the water chemistry in the Auxiliary Cooling Water (ACW) system. Acid dosing, scale inhibitors, and corrosion inhibitors will be employed, supported by acid and chemical storage tanks, dosing pumps, and neutralization pits for safe operation.
- **Liquid Effluent Treatment System:** Effluents will be managed to achieve zero liquid discharge and environmental compliance. Recycled backwash water from the PT Plant, ash handling system integration for clarifier sludge, and wastewater treatment for FGD (Flue Gas Desulfurization) and coal handling systems will ensure efficient water use and treatment across the plant.

Fire Protection System

The power station will be equipped with a comprehensive fire detection and protection system based on the guidelines of TAC (India), IS: 3034, NFPA-850, or equivalent standards.

Fuel Handling System

- **Coal Handling System:** The proposed design incorporates a coal handling plant with a rated capacity of 2,400 MTPH, featuring parallel double-stream belt conveyors (one operational and one standby) to manage receiving, unloading, crushing, and conveying of coal to boiler bunkers. Additionally, it includes facilities for stacking and reclaiming coal from the crushed coal stockyard. The coal stockyard management will utilize three rail-mounted, bucket wheel type, unidirectional travelling stacker-reclaimers.
- **Fuel Oil Handling System:** The following civil works are to be provided for fuel oil handling system as mentioned below:
 - a. Two (2) numbers of 2,500 KL LDO tank has been envisaged in-line with Stage-I. Connection from existing unloading pump discharge header up to new LDO tank to be provided.
 - b. Oil-water separator pit shall be provided.

- **Biomass Handling System:** Biomass will arrive in the form of biomass pellets via road transport. Upon arrival, biomass will be unloaded using a truck tippler and biomass receiving unit (BRU). After unloading, the biomass will be stored in storage silos or bins using a bucket elevator. From the storage silo or bin, the biomass will be blended with coal and conveyed together via coal conveyors to the bunkers for further processing and utilization.

Limestone & Gypsum Handling System

- **Limestone Handling System:** A separate standard limestone handling system proposed earlier as an alternative to interconnection with existing system is deleted from scope to optimize the project cost. As of now only interconnection with existing silo to day silo(s) is proposed. While using the Stage I Limestone Handling System for Stage II also, the storage capacity for limestone would be slightly more than 4 days (including capacity of day silos) usages of both the stages. Estimated Limestone requirement for the proposed Gadawara Stage-II plant would be approx. 200 TPD.
- **Gypsum Handling System:** Gypsum produced by the FGD system is removed by conveyers (capacity 150 TPH) to a covered storage shed (7 days storage capacity) and shall be transported by road through trucks. While providing interconnection from existing 7 days storage silos, the diversion of exiting road required. This aspect to be taken care of by layout. Estimated Gypsum generation from the proposed Gadawara Stage-II plant would be approx. 350 TPD.

Ash Handling System

The bottom ash and economizer ash shall be extracted and disposed of either in wet form as lean slurry or in dry form. The fly ash shall be conveyed in dry form from electrostatic precipitator hoppers. This dry ash is taken to buffer hoppers or intermediate silos for its onward transportation in dry form to storage silos near plant boundary for utilization. Facility of fine ash collection and classifier & bagging of ash also envisaged.

In case of non-utilization of fly ash, fly ash is conveyed to HCSD silos for onward disposal through HCSD (High Concentration Slurry Disposal). The HCSD slurry further disposed off to existing ash dyke. Ash collected from Air pre-heater, Duct Hopper shall be conveyed either in wet form up to the Ash slurry sump through intermediate tanks for further transportation to the Ash dyke with bottom ash or in dry form pneumatically up to BA IM silo for further transportation to Bottom Ash silo. In case of non-utilization of ash in dry form, it shall be further disposed in lean slurry into ash dyke.

Pollution Control System

- **Air Pollution Control System:** Electrostatic Precipitators (ESP): High-efficiency ESPs will limit particulate emissions to 30 mg/Nm³. Chimneys with appropriate height will disperse emissions effectively.
 - **Dust Suppression:** Systems for coal dust extraction and suppression in critical areas like Coal Handling Plant (CHP) and ash handling facilities.

- **Flue Gas Desulphurization (FGD) System:** Wet limestone-based FGD system to capture SO₂ emissions, producing gypsum includes bypass system.
- **NO_x Control:** Combines low NO_x burners (LNB) and combustion staging techniques to minimize NO_x emissions.
- **Water Pollution Control System:**
 - **Air-Cooled Condensers:** Reduce raw water consumption.
 - **Effluent Management:** Comprehensive system for treatment, recycling of effluents from various plant processes, ensuring zero liquid discharge (ZLD).
- **Noise Pollution:** Acoustic enclosures and personal protective equipment for personnel working in high-noise areas to keep noise levels below 90 dB(A).
- **Solid Waste Management:** Ash Management: Dry collection of fly ash and dewatering-based collection of bottom ash. Emphasis on ash utilization; surplus disposed in ash dyke with dust control measures.
- **Afforestation and Green Belt Development:** Plantation and Afforestation activities to enhance green cover and biodiversity within and around the project site.
- **Sustainable Development Mechanism (SDM):** Intent to leverage SDM or Article 6.2/6.4 mechanisms of the Paris Agreement for emission reductions and revenue generation once operational. Alignment of project activities with SDG goals ensuring sustainable development.
- **Post Operational Monitoring Programme:** Continuous monitoring of air and water quality parameters, expansion of monitoring program for new units. Data submitted to Madhya Pradesh Pollution Control Board.
- **Institutional Set-Up:** Environmental Management Group (EMG): Existing EMG oversees monitoring activities, collaborates with regulatory bodies for compliance.

11.9 BASELINE ENVIRONMENT

Baseline environment data forms a part of the Environmental Impact Assessment study and helps to evaluate the predicted impacts on various environmental attributes and also required in preparing Environmental Management Plan (EMP) outlining the measures for improving the environment quality and scope of future expansions for environmentally sustainable development.

Study Area and Period: An area of 10km radius (aerial distance) from the boundary of the project area is the study area for the EIA Study. The study period for baseline data collection was March, 2024 to May, 2024.

Methodology Adopted: Baseline data was generated for various environmental parameters including air, water (surface and groundwater), land and soil, ecology and socio-economic status to determine quality of the prevailing environmental settings. Sampling of soil and water, monitoring of air quality and noise level and other field data collection were carried out by the team operating from this field station.

Regional and Locational Setting: The project site is connected to State Highway No. 44 at project site (NW direction) at a distance of 8.60 km. The State Highway No. 22 meets State Highway No. 44

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



at Kareli at a distance of approximately 18.7 km in NE direction. The 10 km radius buffer zone falls in Narsinghpur District of Madhya Pradesh.

Connectivity: The nearest Railway station is Gadarwara Railway station at a 9.0 km distance in the North-West and the nearest Airport is the Jabalpur Airport which is around 115 km from the proposed site.

Land use/ Land Cover Details: The land used of the study area shows that majority of the land in the study area i.e., buffer zone of the mine lease area is majorly agricultural of 35621.40 Ha., 69.40% of total study area. The forest land 1114.69 Ha. (2.17%), land with and without Scrub is 6716.94 (13.09%), barren land is 1911.41 (3.72%), fallow land is 2283.38 ha (4.45%), road 1.65% and plantation 257.17 Ha. (0.50%) are also crucial land use characters of the study area. About 2.53% of the study area is covered by the water body which covers primarily rivers, channels, ponds and reservoirs. Built up area (972.39 Ha) of the study area is which is 1.89% of the total study area.

Physical Environment

- **Topography:** The elevation in the study area is observed to range from 255 m to 423 m above mean sea level with a general slope from south east to North West direction. Project site falls under area having elevation between 354-380 m.
- **Drainage:** Two perennial River flowing from study area one river Shakkar is passing through the study area in SE to NW direction and it is located 0.60 km in north east direction from project site, another river Sitarewa River flows S to SW direction and further it joins Shakkar river in north. Apart from this Sukha nala flows south to north and in north it merges into Sitarewa. In the north direction Sitarewa River merge into Shakkar River and Shakkar river is tributary of Narmada River. Drainage pattern of the area is in dendritic pattern.
- **Geology:** The Gadarwara Super Thermal Power Project shall be located on alluvium & soil cap comprising clays, sand, gravels etc.
- **Hydrogeology:** Groundwater is the principal source of irrigation in the district and all the alluvial deposits of Narmada valley in the district forms very potential aquifers.

Vulnerability of Study Area:

- **Earthquake:** The district Narsinghpur has fall under Zone III: Moderate Damage Risk Zone. The project site falls in moderate damage risk zone.
- **Wind:** The project site falls in Moderate Damage Risk Zone -B($V = 39$ m/s) of Wind Hazard zones.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)

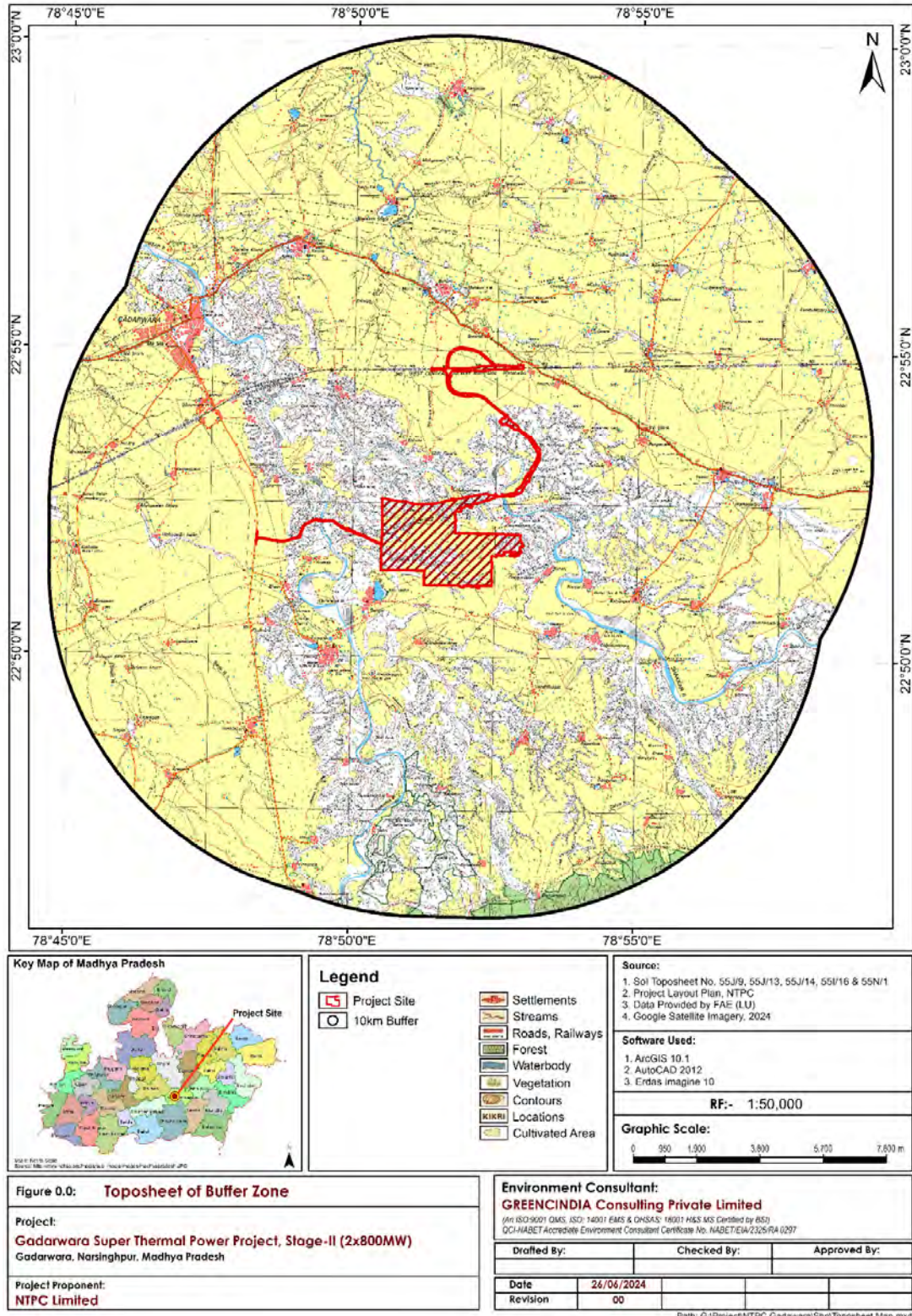


Figure 11-1 Study Area Map

Soil Quality:

- **pH:** The pH value recorded in the study area varies from “Neutral to Slightly Alkaline” as per ICAR report.
- **Electrical Conductivity (EC):** In the study area soil conductivity varies between 520 $\mu\text{mhos/cm}$ at S9 to 880 $\mu\text{mhos/cm}$ at S4
- **Soil Texture:** According to the study of soil texture, the soil of the study area varies from 20% clay, 70% sandy loam and 10% silt.
- **Bulk Density:** Bulk density of the study area ranges between 1.0 gm/cm^3 at S5 to 1.8 gm/cm^3 at S4.
- **Moisture:** The field moisture of all the samples from the study area ranges between 4.85% at S10 to 8.41% at S3. The moisture of the study area remains lower than the wilting point.
- **Soil nutrients:**
 - **Phosphorus:** Available Phosphorus ranges between 100.8 kg/ha at S1 site to 165.76 kg/ha at S7. As per ICAR classification the phosphorus in the study area present is classified as “more than sufficient”.
 - **Potassium:** Potassium content in the study area ranges between 397 kg/ha at S6 to 513.9 kg/ha at S2. As per ICAR classification the potassium in the study area present is classified as “more than sufficient”.
 - **Nitrogen:** Nitrogen content in the surface soil of the study area varies between 235.2 kg/ha at S1 to 761.6 kg/ha at S6. As per ICAR classification the nitrogen in the study area present as “better” to “sufficient” in the study area.
 - **Organic Matter:** In the study area organic matter varies between 0.98% to 1.46%. As per ICAR classification, the organic matter found in the study area is “more than sufficient”.

Climatology and Meteorology:

- **Temperature:** Temperature of the study area is generally high during April to June. The maximum temperature was recorded in the month of May (42.6°C) & minimum temperature is recorded in the month of January (9.0°C).
- **Rainfall:** The annual rainfall is 1192.1mm. It rains 12 months and the intensity varies from 25.2 mm to 230.4 mm per month. The maximum annual rainfall is received during the months from June to September.
- **Relative Humidity:** The humidity is highest in July to December with average relative humidity of 77%.
- **Wind Pattern:** The wind rose shows that the dominant directions of the wind flow throughout the year is North-West and during the pre-monsoon the pre-dominant wind direction is from WNW.

Air Environment:

- o **PM₁₀:** The 98th percentile value of PM₁₀ varies between 53.34 µg/m³ at AAQ4 to 89.92 µg/m³ at AAQ1.
- o **PM_{2.5}:** The 98th percentile value of PM_{2.5} varies between 23.99 µg/m³ at AAQ4 to 31.92 µg/m³ at AAQ6.
- o **SO₂:** The 98th percentile value of SO₂ in the study area ranges from 9.58 µg/m³ in AAQ4 to 12.74 µg/m³ in AAQ6.
- o **NO₂:** In the study area, the 98th percentile of NO₂ varies between 13.80 µg/m³ at AAQ4 to 18.37 µg/m³ at AAQ6.
- o **CO:** CO in the study area varies from 0.20 mg/m³ at AAQ10 to 1.10 mg/m³ at AAQ1.
- o **Ammonia, Lead, Nikel and Mercury** was below detection limit at all locations.

Noise Environment:

- o **Day Time:** The day time noise levels showed minimum 50.0 dB(A) at Badgaon PF n/v Baghakudi to maximum 54.6 dB(A) at Dongargaon village. In the study area during day time all locations observed noise level under prescribed limit is 55 dB (A) for rural/residential areas and 75 dB (A) for industrial zones.
- o **Night Time:** The night time noise levels showed minimum 41.7 dB(A) at Badgaon PF n/v Baghakudi to maximum 44.8 dB(A) Dongargaon village. In study area during night time all locations observed noise value under prescribed limits for residential zones. As per CPCB prescribed limit during night time is 45 dB (A) for rural/residential areas and 70 dB (A) for industrial zones.

Water Environment:

- **Surface Water Quality**
- o **pH:** pH of the study area varied from 6.99 (SW6) in month of May to 7.66 (SW5) in the month of March which is slightly alkaline in nature
- o **TDS:** TDS was observed in the range of 234.53 mg/l at SW4 in the month of May to max. 339.76 mg/l at SW1 in the month of March.
- o **TSS:** Value of Total suspended solids range from 1.0 mg/l to 2.6 mg/l.
- o **Conductivity:** Conductivity of water samples indicated non saline in nature it was varied between 378.28 µS/cm at SW4 in May to 548 µS/cm at SW1 in March.
- o **Nitrate & Fluoride:** Both Nitrate and Fluoride were under limit in pre-monsoon season.
- o **DO:** Dissolved oxygen was recorded sufficient in the study area i.e min 5.20 mg/l (SW2) in March month to max. 5.80 mg/l (SW3, SW4, SW5 and SW6) in May for SW3 and rest in April month.
- o **BOD:** BOD in surface water found high which is varied between 5 mg/l in SW2, SW4 and SW5 to 8.0 mg/l in SW1 & SW3 during March month.
- o **Alkalinity:** The maximum alkalinity of water bodies samples was found to range between 124.6 mg/l to 234.26 mg/l in the study area.
- o **Chloride:** The minimum chloride concentration (14.62 mg/l) was found at SW1 during March month and the maximum (26.42 mg/l) was recorded at SW6 during march and April.

- o **Fluoride:** The level of fluoride ranged between 0.22 mg/l at SW1 in April to 0.35 mg/l at SW4 in April and were found to be within the tolerance limit of surface water.
- o **Nitrate:** The nitrate in surface water ranged between 4.6 mg/l at SW2 in March to 8.96 mg/l at SW1 in May and were found to be within the tolerance limit of surface water.
- **Ground Water Quality:**
 - o **pH:** The pH value of ground water samples varied from 7.1 to 7.84.
 - o **Electrical Conductivity (EC):** Electrical conductivity of ground water ranged between 485 µS/cm to 710 µS/cm during March.
 - o **TDS:** All the samples are within the permissible limits.
 - o **TH:** The maximum total hardness of ground water was found to be minimum was observed as 184.9 mg/l in the sample at GW3 in May month and maximum 276.2 mg/l in sample at GW4 in April month.
 - o **Calcium and Magnesium:** The range of Ca²⁺ and Mg²⁺ are also remaining within the acceptable limits 39.67 mg/l to 70.6 mg/l and 6.16 mg/l (GW5) during April to 24.4 mg/l (GW2) during March respectively.
 - o **Alkalinity:** The alkalinity for ground water was found to be minimum was observed as 224.08 mg/l at GW5 in April and maximum 351.25 mg/l at GW4 in April.
 - o **Chloride:** The maximum chloride concentration the minimum 10.4 mg/l was recorded at GW1 in March and 24.15 mg/l was found at GW1 in May. The samples were compared with the BIS standard and all the samples were within the acceptable limit of 250 mg/l.
 - o **Fluoride:** The minimum level of fluoride (0.22 mg/l) was found in GW1 in March and the maximum value (0.38 mg/l) was found at GW4 in April. All samples were within permissible limits of 1.5 mg/l.
 - o **Nitrate:** The concentration of nitrate in ground water samples ranged from 7.40 mg/l at GW1 during March to 16.21 mg/l at GW5 in April. All the samples were compared with the BIS standard and found within the acceptable limit of 45 mg/l.
 - o **Heavy Metals:** Zinc concentration in the ground water samples were within the acceptable limit of 5 mg/l prescribed by BIS. Other heavy metals like arsenic, cadmium, chromium, copper, lead and selenium were recorded below detection limit.

Traffic Scenario: The results of the survey, the existing PCU of each location were compared with the capacity of each type of road as suggested by Indian Road Congress thus determining the existing Level of Service (LoS) for each location. The existing conditions shows A Level of service at T1, T2 and LoS B for T3 which implies a zone of stable flow.

Terrestrial Ecological Survey and Biodiversity Study:

- **Forest type:** As per the Champion and Seth classification (1968) Narsinghpur lies in the Tropical Dry Deciduous Forest and Tropical Moist Deciduous Forest.
- **Floral Study:** In the study region, dry tropical vegetation is seen. Within the study area are trees such as *Tectona grandis*, *Butea monosperma*, *Acacia catechu*, *Dalbergia latifolia*, *Bauhinia purpurea*, *Azadiracta indica*, *Mangifera indica*, *Albizia lbbbeck* and others are found. In the research region, shrubs were found like *Targestes erecta*, *Lantana camara*, *Nerium*

oleander, Calotropis gigantea, Hibiscus rosa-sinensis to name a few. The common species of the grassland observed during field survey are congress grass, kans, munher, sevai grass etc.

- **Faunal Study:** Inside the project site some common bird species, squirrel, chameleon etc were recorded. From the buffer zone, 11 Species of mammals, 19 species of birds, 6 species of reptiles and amphibians were recorded. 2 reptilian Schedule 1 species (*Naja naja* and *Python molurus*); 3 avian Schedule 1 species (*Bubo bubo*, *Tachy spizabadia* & *Pavo cristatus*) and 3 Schedule 1 mammalian species (*Antelope cervicarpa*, *Canis aureus* and *Herpestes edwardsii*) were recorded from the study area.
- **Aquatic Ecology:** The aquatic ecology of Gadarwara, Narsinghpur, is characterized by its river systems, especially the Shakkar River and Sitarewa River.

11.10 SOCIAL ENVIRONMENT:

There are 125 villages in the study area. These villages have total population of 1,09,427 (in 2001) & 1,43,280 (in 2011). The average household size in the study area was found to have reduced from 5.4 in 2001 to 4.52 in 2011. According to the survey, gender ratio of study area was 897 in 2001 and 910 in 2011.

- **Vulnerable Group:** the study area encompasses a scheduled caste population of approximately 17.8% and a scheduled tribe population of 10.4%.
- **Literacy Rate:** The female literacy rate of the study area has decreased with time (58% in 2001 & 56% in 2011) whereas the male literacy rate has increased, which was 76% in 2001 and 78% in 2011.
- **Occupational Structure:** In the villages around the study area, people mainly earn from agriculture and animal rearing. The percentage of non-workers is high (56%) in the study area as compared to the total workers.

11.11 INFRASTRUCTURE

- **Educational Facilities:** There is a total of 122 Primary Schools, 56 Middle Schools, 23 Secondary School and 9 Senior Secondary Schools in the study area as per Census 2011. It can be seen that there has been a substantial increase in the number of middle and secondary schools over the 10 years in the study area. This is a very healthy sign which is reflected in the increase of literacy rate of the area.
- **Banking and Post Office Facilities:** Number of banking infrastructures like commercial and cooperative banks have increased whereas infrastructure like Post offices have decreased from 25 in 2001 to 16 in 2011 and Agricultural credit society from 13 in 2001 to 6 in 2011.
- **Drinking water facilities:** One of the most important factors responsible for the emergence of a settlement is availability of water. Many water sources such as wells, hand pumps, tanks, etc. are available in rural areas. In the villages under study, the main source of water is tap water, well, followed by hand pump and service reservoirs.
 - **Health Facility:** The healthcare facilities present in the study area did not have any significant improvement except for addition in number of primary health sub-centers and TB Clinics.

11.12 IMPACTS ASSESSMENT & MITIGATION MEASURES

Possible environmental impacts on various features such as air quality, noise level, water use and quality, land-use, ecological status, soil quality and socioeconomic factors are evaluated and appropriate mitigation measures are proposed both for construction phase and operation phase.

Ambient Air: During construction site preparation, transportation and storage of construction material/ equipment, civil construction activities, mechanical and electrical erection activities and transportation and disposal of construction debris will have an adverse impact on ambient air quality of the area. The same for the operation phase are caused by plant operation, unloading and storage of coal, coal combustion, water withdrawal and treatment and ash handling. For mitigation of the impacts necessary dust suppression measures like water sprinkling using road tanker will be deployed, suitable surface treatment to the roads and regular sprinkling of water shall be provided, proper periodical tuning and maintenance of vehicles are recommended.

Water Resources: Impact on water resources during construction phase will be caused during site preparation, influx of labour and construction of temporary houses and transportation and disposal of construction debris. Whereas water quality will be affected due to transportation and storage of construction material/equipment, civil construction activities, mechanical and electrical erection activities, and transportation and disposal of debris. During operation phase, water quality will be affected by plant operation, unloading and storage of coal, water withdrawal and treatment, ash handling and disposal and storage of Gypsum. The mitigation measures suggested includes directing wash offs to a sedimentation basin before discharge, storage of fuel oil, lubricants, grease etc in closed containers and proper drainage and disposal of wastewater.

Ambient Noise: During construction site preparation, transportation and storage of construction material and equipment, civil construction activity, mechanical and electrical erection activities and transportation and disposal of construction debris will disturb the ambient noise environment. During operation phase unloading and storing of raw material will disturb the noise environment. For mitigating the impacts any machinery or equipment generating excessive noise levels will be taken out for maintenance, use of proper personal protective equipment will be encouraged, well-tuned vehicles will be used and loud noise will be checked every day, D.G set to be used during construction phase shall be provided with acoustic enclosure to reduce noise disturbances.

Soil Quality: Transportation related activities during construction phase including raw materials and construction debris and during operation phase coal combustion, ash handling and disposal and storage of Gypsum will adversely impact the soil quality. To mitigate the impacts it is recommended that the truck movement shall be carried out through existing roads, trucks shall be covered with tarpaulin and overloading shall be avoided and appropriate soil conservation measures associated with improved construction techniques should be implemented.

Ecology: Fugitive dust deposition during construction may lead to temporary reduction of photosynthesis in nearby flora. The runoff from construction area may lead to a short-term increase in suspended solids and decrease in DO near the discharge point in receiving waterbody. For mitigation

of those impacts measures like sprinkling water in dust-generating areas, green belt development and channelizing stormwater runoff through sedimentation basin are to be implemented.

Traffic: After the proposed expansion, there will be increase in number of vehicles. It is considered that 100% of the additional traffic shall travel through the selected locations. In that scenario the level of service will change from B to C for the station T3 SH22, Gadarwara and rest of the connectivity links will have the same level of services.

11.13 ANALYSIS OF ALTERNATIVE TECHNOLOGIES

Site Alternative: Since the proposed project is envisaged to be established within the premises of existing Gadarwara STPP, which is having all the infrastructure facilities already developed, no alternative site is explored for this expansion.

Technology Alternative

Summary of Advantages of Ultra Super Critical Thermal Power Plant:

- Improve thermal efficiency attainable.
- Reduce fuel cost.
- Reduction of CO₂ emission by as much as 15% per unit of electricity generated compared to typical sub-critical units. This may help in meeting country's GHG Reduction target.
- Very good part load efficiency.
- Very low emissions of NO_x, SO₂ and PM achievable using modern flue gas clean-up equipment.
- Initial investment requirement marginally higher than super critical technology and less than other clean coal technology. This, however, depends on the unit size considered.

11.14 ENVIRONMENTAL MONITORING PROGRAMME

The monitoring program is designed to verify the implementation of environmental measures and confirm their effectiveness in delivering the intended benefits to the target population. The primary aims are to monitor impacts of the surrounding environment and the effectiveness of mitigation measures during the construction and operation phases, to ensure that environmental control systems are installed and operating satisfactorily and to suggest ongoing improvements in mitigation measures, if required for subsequent effective monitoring.

Environment Monitoring Program during Construction Phase: The formulated monitoring programme includes multiple parameters for five different aspects Metrological (wind speed & direction, temperature, rainfall and humidity), Ambient Air Quality (PM₁₀, PM_{2.5}, SO₂, and NO_x), Noise (Equivalent noise pressure level), Ground water quality (Physical, chemical and biological parameters including heavy metals) and Surface water quality (Physical, chemical and biological parameters including heavy metals) at different frequency and different locations.

Environment Monitoring Program during Operation Phase: Monitoring programme during operation phase includes nine aspects of Metrology (Wind speed & direction, temperature, rainfall and Humidity), Work zone air quality (PM₁₀, PM_{2.5}, SO₂, NO₂, CO), Ambient Air Quality (PM₁₀, PM_{2.5}, SO₂, NO₂, CO within and outside the plant area at least at four locations) and Process stack (PM₁₀,

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



PM_{2.5}, SO₂, NO₂, CO the project proponent shall install a 24x7 continuous emission monitoring system at main process stack emission concerning standards prescribed in Environmental Protection Rules 1986 and connected to MPPCB and CPCB online servers), Noise, Surface Water Quality (Physical, Chemical and biological parameters including heavy metals), Ground Water Quality (Physical, chemical and biological parameters including heavy metals.), Soil (Physical and chemical parameters with organic content) and Ecology (Visible damage to crops density and diversity of local fauna).

Wastewater Quality Monitoring: the wastewater monitoring programme consist of wastewater parameters monitoring monthly prior to reuse, recycle and recirculation, Surface water and ground water quality monitoring will also be covered. The monitoring should be done for the waste water sources of Boiler blow down (temperature suspended solids, oil & grease, dissolved solids, copper, iron etc to be examined), Water treatment plant effluent (pH, suspended solids, COD, BOD, dissolved solids to be monitored) and Ash Pond effluent (pH, suspended solids, oil & grease, dissolved solid, heavy metals like chromium, zinc, iron, manganese, aluminium, nickel, phosphate etc. to be monitored).

Data Analysis and Reporting Schedule: Data generated from monitoring and analysis of the sample will be compared with the prescribed/ stipulated limits. If any parameter is not found within the prescribed/stipulated limit appropriate control measures will be taken to satisfy the limit.

Regular monitoring and data analysis shall be followed through proper documentation and reporting system. Provision will be made for online monitoring of emission and effluent data is already available for the existing unit and same arrangements shall be made for the upcoming expansion units and the data shall be uploaded to MPPCB/CPCB server to make them available on real-time basis as public disclosure.

Emergency Procedures: Emergency procedures including drills shall be employed viz, Emergency Evacuation Plan, Disaster Management Plan and Industrial Safety plan to meet the requirement in case of failure of any pollution control equipment.

Environmental Monitoring Cost: Total environmental monitoring cost during construction phase (recurring) estimated cost is 6,86,000 Lakhs and the same during operation phase (capital) estimated cost is 32,06,000 Lakhs and 1,20,000 Lakhs (recurring cost).

11.15 ADDITIONAL STUDIES

NTPC, Gadarwara is carrying out additional studies of Public Consultation, Risk Assessment, watershed plan, biodiversity conservation plan, wildlife conservation plan and hydrogeological study as suggested in EIA Notification 2006.

Public Hearing & Consultation: As per the condition of the TOR issued by MoEF&CC dated; 30.09.2024 and the EIA Notification 2006, Public Hearing for the expansion project was conducted on Monday, December 30, 2024, from 11:00 AM at the Police Station Dongargaon, village Mehrakheda, NTPC Station Bhawan, near Gadarwara, Narsinghpur (MP) under the chairmanship of the Sub District Magistrate, Gadarwara organized by Madhya Pradesh Pollution Control Board (MPPCB), Jabalpur. Local villagers, citizens of Gadarwara, and representatives of non-governmental organizations also participated.

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



The major issues raised during public hearing were regarding employment to local people, skill development, women empowerment, renovation of school building, village Road construction, bridge on Shakkar and Sitarewa river, check dam, plantation in villages and pollution from ash and coal dust pollution.

An amount of action plan budget for issues raised during Public Hearing has been 1150 & CSR/CER activities recurring cost for year 2025-26 is 489.56 Lakhs and 2026-2027 is 618.96 Lakhs for various sectors like Education infrastructure, Health Care, Water & Sanitation infrastructure, Infrastructure development, Vocational Trainings, sports and culture, Renewable Energy, Miscellaneous/Communication and more under CSR/CER.

Corporate Environment Responsibility: NTPC has been pioneers in implementing Environmental & Social Responsibility/Corporate Environmental Responsibility and made significant contribution to improve quality of people's life and Environment in all the regions they are operating in, around the nearby villages, Gadarwara STPP have started key initiative in support of sustainable development.

Based on the need assessment for villages surrounding the NTPC Gadarwara project, a village-wise plan for implementing initiatives which focuses on key areas like education, healthcare, infrastructure, employment, and community development based on the specific needs of the villages.

Risk Assessment: Risks present in a thermal power plant operation mostly arises due to involvement of hazards like High pressure super-heater, re-heaters, economizer units exchanging heat with the hot flue gases, Turbines utilizing HP steam, Fuel oil storage and handling units, Coal handling units, Hydrogen as coolant in turbo generators drawn from hydrogen cylinders, water treatment chemical and Switchyard including transformers, isolators etc.

Hazard Identification: Hazard identification includes **Component-1:** Identification of contaminants being released which are hazardous. Estimation of probability of an expected event and its consequences form the basis of quantification of risk in terms of damage to property, environment, or personal. Therefore, the type, quantity, location, and conditions of release of a toxic or flammable substance have to be identified in order to estimate its damaging effects, the area involved, and the possible precautionary measures required to be taken.; **Component-2:** Estimation of the amounts of contaminants released from all sources or the source of concern. Fuel oils (LDO) will be used in small quantity for initial start-up. Chlorine dioxide and other chemicals are used in the makeup water treatment & DM Plant. The hazards associated with the use of these materials would be taken careful consideration and due precaution would be taken for its safe handling at various stages of usage.; **Component-3:** Estimation of the concentration of contaminants through Preliminary Hazard Analysis considering spillage of chemicals while handling.

Mitigation Measures of Fire & Explosion Hazards: Fire prevention and relevant code enforcement is one of the major responsibilities of project proponent. The fire service facility shall be equipped with- Smoke and fire detection alarm system, Water supply, Fire hydrant and nozzle installation, Foam system, Water fog and sprinkler system and First aid appliances. Apart from the general mitigation measures site specific mitigation measures are also suggested for LDO Storage.

Disaster Management Plan: Gadarwara STPP has already implemented a Disaster Management Plan for existing unit. New units shall also be included in the same plan. Emergency preparedness planning is divided in two subsections:

- **Onsite Disaster Management Plan:** The Onsite Disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operation in this same order of priorities. The important elements in the DMP suggested for emergency planning are- Reliable and early detection of an emergency and careful planning, Command, co-ordination, and response organisation structure along with efficient trained personnel, availability of resource for handling emergencies, appropriate emergency response actions, effective notification and communication facilities, regular review and updating of the EMP and proper training of the concern personnel.

The management plan will include a sequence of action in order to handle disaster/emergency situations, with organizational chart entrusting responsibility to various plant personnel with their specific roles. Infrastructures & operational systems should be provided to meet emergencies. Assembly points, evacuation path should be marked. Different types of alarms to differentiate types of emergencies should be provided along with warning system and control, emergency services and fire protection systems.

- **Off-site Disaster Management Plan:** Under the Environmental Protection Act 1986, the responsibility of preparation of Off-site Emergency Plan lies with the State Government. The Collector/ Deputy Collector are ordinarily nominated by State Government to prepare Off-site Emergency Plan.

Natural Disasters: Madhya Pradesh State Disaster Management Authority is a nodal agency for preparation of disaster management plan of natural disaster of Madhya Pradesh. The plant and surrounding area fall in a moderate damage risk zone as per the recent earthquake categorization zone and subsequently general precautions and safety measures are recommended to be taken by the people before and after the earthquake.

Occupational Health and Safety Management Plan: Large industries, and power plants in particular where multi-functional activities are involved during construction, erection, testing, commissioning, operation and maintenance, occupational health needs attention during all phases. The work environment will be monitored for occupational accidents, diseases and dangerous occurrences. A proper record of the same will be maintained. The aspects will be adopted to ensure good health condition of employees are (i) Pre- employment check-up; (ii) Awareness programme; (iii) Routine check-up and (iv) Periodic vaccination programme etc.

Corporate Social Responsibility: NTPC is committed to develop the surrounding area in a well-coordinated and balanced manner while safeguarding the environmental and social aspects under its CSR programme. Wherever possible, Gadarwara STPP shall provide infrastructure to help set up local schools, centres for primary learning and education, and repair/construction of primary schools in neighbouring villages. Gadarwara STPP is committed to inclusive development and will further

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)



strengthen its activities for improvement in education, sanitation and health, livelihood, rural infrastructure and rural sports. A budget of 2025-26 is 489.56 Lakhs and 2026-2027 is 618.96 Lakhs has been proposed for the development of social and physical infrastructure in the surrounding villages, reflecting our commitment to community development.

Project Benefits

The proposed expansion of Gadawara Ultra Super Critical Thermal Power Plant will benefit local and regional economy along improving the standard of living of the local by providing employment opportunities and improved physical and social infrastructure. The project benefits include-

- Infrastructure development.
- Direct & indirect employment opportunity
- Revenue generation to central & state government.
- Allocation towards the CSR activities.
- Trickle-down effect of enhance profitability to the local populace
- Skill development and capacity building like vocational training, income generation programmes and entrepreneurship development program
- Awareness programme and community activities, like health camps, medical aides, family welfare camps, sanitization/ cleanliness awareness programme, immunization camp, sports & cultural activities, plantation, etc.

Employment potential: Power projects have mechanized and automated plants. Hence, the employment prospects during the operational phase are constrained. The approx. number of NTPC employees during construction phase are 96 and contractual employees approx. 2000 and operation phases are 186 and 1500 respectively. The direct employment opportunities with NTPC are extremely limited and the opportunities would exist mainly with the contractors and sub-contractors. The number of workforces employed during construction phase by the EPC contractors would be much higher (about 2000-2500 during peak deployment). Providing jobs to local persons on a preferential basis wherever feasible would be facilitated through these agencies.

11.16 COST BENEFIT ANALYSIS

The impact of the project was evaluated as per the current values in monetary terms. Most of the impacts were on the Air environment, as per MoEF&CC OM. No. 19-125/2019-Ia.III dated 05.03.2020 the monetary equivalence of the emissions including capital investment was evaluated to be 26,555.40 Crores.

Evaluating the benefits of the project including ecological benefit of the green belt, benefit to social environment through generation of electricity, benefit to economy through employment was a total of 53,094.09 Cr.

The cost benefit ratio for the project was evaluated to be 1:1.99. The analysis for the proposed NTPC Gadawara, Stage-II (2x800 MW) indicates in favour of the project. The financial expenditure incurred in preventing, containing, mitigation or removing environmental contaminations occurring as a result of the proposed project activity will further add to the environmental benefit.

11.17 ENVIRONMENT MONITORING PLAN

EMP Implementation, Inspection and Monitoring: The assessment of environmental impacts and mitigation measures have been identified for effective operation of environmental management activities in the pre-construction, construction, commissioning and operation & maintenance (O&M) activities.

Components of EMP: Environmental Management Plan comprises of the components of i) Institutional Arrangements; ii) Monitoring Programme/ plan; iii) Environmental Enhancement Measures; and iv) Social Enhancement Measures.

Institutional Arrangements: The construction and operation of the thermal power station will be managed by a comprehensive Environmental Management Group/ Cell (EMG). The EMG will be staffed by a team of environmental engineers/ officers/ specialists. Training programs will be conducted to educate staff on environmental monitoring, stack emission monitoring, AAQMS, CEMS, EQMS, ambient air and water quality assessments, municipal and hazardous waste management, noise reduction measures etc.

Operation and Maintenance Group: NTPC Gadawara has Operation & Maintenance Group Management Organization headed by a GM (O&M) and is assisted by a team of managers & engineer. This O&M Group Organization will take up additional responsibility of operations and monitoring of pollution control equipment/ system related to proposed thermal power plant.

Laboratory: The monitoring will be done by an external NABL/MoEF&CC approved laboratory and in-house laboratory.

Ash Utilisation Plan: 100% Ash will be utilised in Cement Industries, reclamation of abandoned mines and quarries, manufacturing of bricks, road construction, aggregate replacement in concrete, etc.

Environment Enhancement Measures:

- **Solar Power Harnessing:** For harnessing solar power, roof top solar PV, solar street lights will be provided.
- **Greenbelt:** The green belt will be composed of indigenous and rapidly growing tree species. Additional trees will be strategically planted around the coal stockpile and ash disposal areas to reduce fugitive dust pollution.
- **Rainwater Harvesting:** Provision is made for rainwater harvesting to collect stormwater from roof top, road/paved areas, greenbelt and open areas.

12. DISCLOSURE OF CONSULTANT

12.1 INTRODUCTION TO THE TEAM

Greencindia Consulting Private Limited (GCPL) is an environmental consultancy organization, manned by a highly qualified, experienced and multidisciplinary team of scientists and engineers. The company has received accreditation from Quality Council of India (NABET-QCI) as an EIA Consultancy organization. The validity of NABET accreditation is up to 22.02.2026. The company has MOU with EEPL NABL Laboratory.

The primary aim of GCPL is to sensitize policy planner and local people about their development needs through capacity building process. The company facilitates managerial and technical expertise to people and associations for development of areas and regions.

GCPL has undertaken more than 150 EIA and other associated studies and clearances for township & area development projects, mining projects, thermal power projects; airports, road and highways; special economic zones (SEZs); urban infrastructure projects, etc.

GCPL has been appointed by the Project proponent to carry out Environment Impact Assessment Studies for the proposed project.

The main objects of the Company are as follows;

- To carry on the business of providing all types of consultancy services related to Social And Environmental Impact Assessment, Environment Action Plan, Tribal Development Plan, Resettlement and Rehabilitation Action Plan, Project Information Report, Detailed Project Report, Need Assessment Report, Corporate Social Responsibility Plan, Forest Diversion Plan, Wildlife Conservation Plan, Drainage Plan and Hydrogeology Environment, Social & Land related legal services and any other consultancy services and studies related to urban development, rural development, environment, forest and legal aspects.
- To provide consultancy services in environment monitoring, sample collection of air, water, soil, meteorological data and publish testing results for the collected samples
- To undertake research study in the field of environment, social, legal, agriculture, urban planning, rural planning, alternate sources of energy etc. and provide consultancy/advisory/training services in these field to government, quasi-government, non-government and private institutions.
- EPFI (Equator Principle & Financial Institution) reporting, environmental and social impact assessment according to IFC (International Finance Corporation) guidelines and equator principles.

12.2 PROJECT AREAS OF EXPERTISE

- Environmental Impact Assessment
- Environmental Management Plan
- Disaster Management Plan
- Risk Assessment
- Rehabilitation & Resettlement Plan
- Pre-Feasibility Report
- Detailed Project Report
- Geo-Technical Investigation
- National, Regional and Urban Plans
- Management Information System and Geographic Information system
- Urban Infrastructure Development including Water Supply and Solid Waste Management
- Environmental Monitoring and Assessments
- Impact Assessment Formulate Policies & Mitigation Measures R&R
- Natural Resource Management
- Terminal Planning and Design
- Institutional Strengthening
- Development, Functional and Strategic Planning and Design
- Preparation of Manuals
- Training Programmes.

12.3 ACHIEVEMENT OF THE COMPANY

Greencindia Consulting Private Limited (GCPL) is an ISO 9001:2008-QMS, 14001:2004-EM and 18001:2004-OHSAS certified company. The company is accredited with QCI-NABET since 2010. We are accredited for following sectors: -

- Townships & Area development projects.
- Thermal Power Plants.
- Mining Project-Open Cast & Underground Mining.
- Coal Washery.
- River Valley Projects.
- Metallurgical Industries (Ferrous and Non-Ferrous).

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

**PROJECT PROPONENT: NTPC Ltd. (A Government of India
Enterprise)**



- Industrial Estate/Parks/Complexes/areas, export processing zones, special economic zones, biotech parks, leather complexes.
- Highways.
- Cement Plants.
- Oil & gas transportation pipelines.
- Common Municipal Solid Waste Management Facility.
- Airports.
- Buildings and construction projects.

12.4 TEAM INVOLVED

GCPL comprises of group of professionals drawn from development related fields. The core members of GCPL team hold experiences in Developmental Planning, Pollution Control, Economic Analysis, Social Work and Information Technologies. In addition, there is a panel of senior associates and young voluntaries facilitating the various programmes. The brief resume of the Environment Coordinator and Functional Area experts (Core Functional Areas & Significant Functional Area) involved in this project are discussed below:

Sl. No.	Name of Expert	Years of Experience	Area of Specialization	Involvement (Period & Task)
1	Nandini Choudhury	22	EC	<u>FEBRUARY 2024 TO TILL DATE</u> Selecting the team to be involved in the EIA report. ▪ Visiting the site for appropriate duration for the selection of sampling locations and deciding the type of samples in consultation with the FAEs. ▪ Reviewing the process write-up ▪ Developing the EIA report and circulating the same amongst EIA team members for final feedback and ensuring coverage of the respective functional areas FA in the EIA.
CORE FUNCTIONAL AREAS				
2	Dr. Subinoy Mondal	10	Water Pollution-WP	<u>FEBRUARY 2024 TO TILL DATE</u> Selection of Monitoring location for ground water and surface water ▪ Assessment of Impact associated with the project operation activities

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE
LIMITED**
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

**CHAPTER – 12
DISCLOSURE OF
CONSULTANT**

**Page
12-3**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

**PROJECT PROPONENT: NTPC Ltd. (A Government of India
Enterprise)**



Sl. No.	Name of Expert	Years of Experience	Area of Specialization	Involvement (Period & Task)
				- Preparing cost estimate for treatment of waste water. - Development of Water Management Plan.
3	Nandini Choudhury	22	Socio-economy-SE	<u>FEBRUARY 2024 TO TILL DATE</u> - Assessment of impact associated with the project. - Interpretation of primary and secondary data to derive socio-economic status of PAFs/PAPs and related stakeholders. - Assessment of social changes arising out of the project. - Suggesting measures to enhance the socio-economic status of the people living in and around the project.
4	Dr. Sangeeta Verma	6	Ecology & Biodiversity-EB	<u>FEBRUARY 2024 TO TILL DATE</u> - Survey of existing flora & fauna in the study area - Assessment of impact associated with project - Selection of species for greenery development. - Preparation of conservation plan for scheduled species - Assistance during development of project management plan.
SIGNIFICANT FUNCTIONAL AREAS				
5	Nandini Choudhury	22	Land-use	<u>FEBRUARY 2024 TO TILL DATE</u> - Development of Land-use Map - Impact of project on surrounding land use - Assistance during development of project management plan. - Suggestion of mitigation measures due to change in land uses by the project.
	& Dr. Sangeeta Verma		Soil Conservation-SC	<u>FEBRUARY 2024 TO TILL DATE</u> Baseline data generation for soil sampling analysis and characterization of soil.

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE
LIMITED**
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)

**CHAPTER – 12
DISCLOSURE OF
CONSULTANT**

**Page
12-4**

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

**PROJECT PROPONENT: NTPC Ltd. (A Government of India
Enterprise)**



Sl. No.	Name of Expert	Years of Experience	Area of Specialization	Involvement (Period & Task)
				- Assessment of fertility/productivity of soil. - Suggesting soil conservation measures.
6	G.C. Patnaik	40	Air Pollution-AP	<u>FEBRUARY 2024 TO TILL DATE</u> Identification of sources of air pollution and most suitable control device and mechanism.
	Shyam Sunder	30		<u>JULY 2024 TO TILL DATE</u> - Assessment of impact associated with the project operation activities - Assessment of impact associated with vehicle movement operation - Development of management plan to control the air pollution & its mitigation.
7.	G.C. Patnaik	40	Risk & hazard-RH	<u>FEBRUARY 2024 TO TILL DATE</u> - Assessment of risk likely to be generated from the project activities. - Preparation of emergency preparedness plan. - Development of disaster management plan for the project.
8	Dr. Subinoy Mondal	10	Air quality modeling-AQ	<u>FEBRUARY 2024 TO TILL DATE</u> Study of wind pattern & wind conditions.
	Shyam Sunder	30		<u>JULY 2024 TO TILL DATE</u> - Developing micro-meteorological data for use in modeling. - Quantitative assessment of project impact associated with project activities using AERMOD.
9	Nirzar Ajay Lakhia	18	Geology-Geo	<u>FEBRUARY 2024 TO TILL DATE</u> Study of geological and rock structure of the study area based on secondary data and literature survey.

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENT MANAGEMENT PLAN FOR GADARWARA SUPER THERMAL POWER PROJECT, STAGE-II (2X800 MW)	
PROJECT PROPONENT: NTPC Ltd. (A Government of India Enterprise)	

Sl. No.	Name of Expert	Years of Experience	Area of Specialization	Involvement (Period & Task)
			Hydrogeology-HG	<u>FEBRUARY 2024 TO TILL DATE</u> - Study of hydrogeological study of the study area. - Study rainwater harvesting and groundwater fluctuation in the study area.
10.	Rahul Singh	20	Noise & Vibration-NV	<u>FEBRUARY 2024 TO TILL DATE</u> - Assessment of noise and vibration likely to be generated from the project activities. - Assessment of impact associated with project. - Assistance during development of project management plan.
11.	Shyam Sunder	30	Solid & Hazardous Waste-SHW	<u>JULY 2024 TO TILL DATE</u> - Identifying source of waste generation. - Quantitative assessment of hazardous and industrial solid waste likely to be generated.
				- Development of management, handling and disposal techniques. - Suggesting measures for minimization of waste generation.

GCPL is accredited under QCI-NABET scheme for accreditation of EIA consultants organizations vide certificate number: NABET/EIA/2326/RA 0297 for and Mining Projects (open cast and underground), River Valley projects, Thermal Power Plants projects, Coal washeries, Metallurgical Industries (Ferrous only)-both primary & secondary, Petroleum refining industries, Petro chemical complexes, Airports, Industrial Estate Planning, TSDFs, Highways, CETPs, Building and construction projects and Townships & Area Development Projects. Validity of the accreditation is extended till 22nd February, 2026 vide certificate no. NABET/EIA/2326/RA 0297. (enclosed as **Annexure-12.1**).

12.5 ACCREDITED LABORATORY

The analytical tests for GCPL are conducted by M/s EEPL, Kolkata which was accredited by MOEF&CC. GCPL has signed MoU with M/s EEPL for specialized testing and analysis of samples from their laboratory enclosed as **Annexure-12.2**).

ENVIRONMENT CONSULTANT GREENCINDIA CONSULTING PRIVATE LIMITED NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)	CHAPTER – 12 DISCLOSURE OF CONSULTANT	Page 12-6

**FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)**

**PROJECT PROPONENT: NTPC Ltd. (A Government of India
Enterprise)**





**QUALITY COUNCIL
OF INDIA**
Creating an Ecosystem for Quality



**National Accreditation Board
for Education and Training**



Certificate of Accreditation

Greencindia Consulting Private Limited, Ghaziabad

605-611, Level-5, Sector-5, Shopprix Mall, Vaishali, Ghaziabad-201010

*The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –*

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1.	Mining of minerals including opencast and underground mining both	1	1 (a) (i)	A
2.	River Valley projects	3	1 (c)	A
3.	Thermal power plants	4	1 (d)	A
4.	Coal washeries	6	2 (a)	A
5.	Metallurgical industries (ferrous & non-ferrous)	8	3 (a)	A
6.	Petroleum refining industry	10	4 (a)	A
7.	Petro-chemical complexes	18	5 (c)	A
8.	Petrochemical based processing	20	5 (e)	A
9.	Air ports	29	7 (a)	A
10.	Industrial estates/ parks/ complexes/areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes	31	7 (c)	A
11.	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	32	7 (d)	B
12.	Highways	34	7 (f)	A
13.	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
14.	Building and construction projects	38	8 (a)	B
15.	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated July 18, 2023 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no QCI/NABET/ENV/ACO/23/2862 dated Aug 25, 2023. The accreditation needs to be renewed before the expiry date by Greencindia Consulting Private Limited, Ghaziabad following due process of assessment.


Sr. Director, NABET
Dated: Aug 25, 2023

Certificate No.
NABET/EIA/2326/RA 0297

Valid up to
Feb 22, 2026

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to the QCI-NABET website.

NABET Certificate

**ENVIRONMENT CONSULTANT
GREENCINDIA CONSULTING PRIVATE
LIMITED
NCR, GHAZIABAD (QCI-NABET Certificate No. NABET/EIA/RA 0297)**

**CHAPTER – 12
DISCLOSURE OF
CONSULTANT**

**Page
12-7**

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENT MANAGEMENT PLAN FOR
GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-II (2X800 MW)

PROJECT PROPONENT: NTPC Ltd. (A Government of India
Enterprise)



  National Accreditation Board for
Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

**LABORATORY DIVISION, ENVIROTECH EAST PRIVATE
LIMITED**

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

**"General Requirements for the Competence of Testing &
Calibration Laboratories"**

for its facilities at

100, KALIKAPUR, KOLKATA, WEST BENGAL, INDIA

in the field of

TESTING

Certificate Number: TC-12649

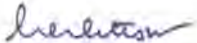
Issue Date: 24/11/2023 Valid Until: 23/11/2025

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued
satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity: Envirotech East Private Limited

Signed for and on behalf of NABL




N. Venkateswaran
Chief Executive Officer

NABL Certificate