

# ADDENDUM REPORT

ENVIRONMENTAL CLEARANCE (EC)  
UNDER 7(ii) CLAUSE

FOR

INSTALLATION OF ULTRA CLEAN COAL GASIFICATION SYSTEM FOR  
REPLACING FURNACE OIL IN CAST HOUSES OF ALUMINIUM SMELTER  
PLANT LOCATED IN HIRAKUD OF SAMBALPUR DISTRICT, ODISHA  
(EC Ref : Letter no J-11011/400/2006-IA.II(I) dated 6<sup>th</sup> February, 2008)

*Submitted to*

Ministry of Environment, Forest & Climate Change (MoEF&CC)  
New Delhi

*Submitted by*



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April, 2020



## **1.0 Introduction**

Hindalco Industries Ltd (HIL) is located in Hirakud town of Sambalpur district in Odisha. It was established in the year 1959. The present capacity of Hirakud smelter is 2,16,000 TPA. The power is sourced from the coal based 467.5 MW captive power plant (CPP).

The existing plant had obtained EC for capacity expansion of smelter from 100,000 TPA to 360,000 TPA and captive power plant from 267.5 MW to 967.5 MW vide Letter no J-11011/400/2006-IA.II(I) dated 6<sup>th</sup> February 2008. However the project has been implemented for smelter capacity of 2,16,000 TPA and power plant of 467.5 MW.

Hindalco, Hirakud uses furnace oil in their 5 cast houses for melting & holding the aluminium received from smelter & Flat Rolling Product (FRP). Daily Furnace Oil (FO) consumption for Hirakud plant is approximately 47 KL per day.

Hindalco explored alternate fuel options such as use of Bio Furnace Fuel (BFF- made from cashew nut shell etc), Petro-polymer fuel (PPF) made from end of life plastic/rubber waste and use of coal gas. Based on techno-economical feasibility, availability and quality of the fuel, coal gas is most suitable alternate fuel to replace FO, 30,000 Nm<sup>3</sup>/hr (Phase-I: 10,000 Nm<sup>3</sup>/hr & Phase-II 20,000 Nm<sup>3</sup>/hr) coal gas is required, which will be implemented in 2 phases. Existing facility of FO will be retained and will be kept as standby operation in case coal gasification plant is not in operation stage.

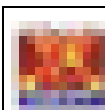
Total water requirement for this project is 83.4 KLD which will be accommodated within existing 34,252 KLD (14 cusec) water sanction from Hirakud reservoir. Total project cost is Rs. 60 crores, including land procurement, site preparation, plant and equipment setup, greenbelt development etc. Total land requirement for this proposed project is 21.69 acres (8.77 ha) to set-up the complete plant, coal transportation & storage system, ash handing & disposal, pipeline and green belt development etc. The total budget allocated for environmental pollution control measures is Rs. 5.5 crores.

Hindalco is also proposing for the replacement of start-up fuel LDO (Light Diesel Oil, GCV- 10,000 Kcal/KG, Sulphur-4%) which is used for boiler litup (approx. 4-5 KL/startup/boiler) with an green alternate fuel i.e. Petro Polymer Fuel (GCV- 10,480 Kcal/KG, Sulphur- 0.45%) which is made from plastic waste.

## **2.0 Brief Description and Nature of the Project**

Hindalco Hirakud plant uses furnace oil in their 5 cast houses for melting & holding the aluminium received from Smelter & FRP. Present daily FO consumption for Hirakud plant is approximately 47 KL per day.

Analyzing the current situation and environment requirement, HIL explored alternate fuel options such as use of Bio Furnace Fuel (BFF- made from cashew nut shell), Petro-polymer fuel (PPF) made from end of life plastic/rubber waste and use of coal gas.



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Based on techno-economical feasibility, availability and quality of the fuel, coal gas is most suitable alternate fuel to replace furnace oil.

### 3.0 Purpose of Submission

The proposal is for amendment in environmental clearance J.11011/400/2006-IA II(I) dated 6<sup>th</sup> February, 2008 under 7(ii) clause. The present proposal includes installation of 3 coal gasification units with capacity of 10,000 Nm<sup>3</sup>/hr each in cast houses of aluminium smelter plant for replacing furnace oil use.

The operating project has environmental clearance for utilization of furnace oil in cast houses. HIL intends to replace the furnace oil with coal gas, which is a better fuel from environmental considerations. Hence, an amendment is being sought to the environmental clearance.

### 4.0 Project Justification

India is one of the world's fastest growing economies and its demand for energy is ever increasing. The security of India's energy supply is the foremost challenge. Besides energy security, there is also need to develop and harness environmentally-friendly clean energy resources in line with the global trend. Energy security for India pertains to the availability and security of all fuel sources. The fast paced growth of Indian economy, the third largest in terms of GDP based on purchasing power parity, has resulted in a surging demand for energy which is projected to grow at the rate of 3 percent over next three decades (2010-2040).


In this view, HIL proposes for set-up of coal gasification unit for the cast houses of the aluminium smelter plant.

### 5.0 Statutory Clearances

As per Environmental Impact Assessment (EIA) Notification dated 14<sup>th</sup> September, 2006, the proposed project falls under category 'A' of project activity 3(a) and requires prior Environmental Clearance (EC) to be obtained from MoEF&CC before the commencement of project activity. The list of statutory clearances for existing units in the smelter complex is given in **Table-1**.

**TABLE-1**  
**LIST OF STATUTORY CLEARANCES**

Sr. No	Name of the Unit	Issuing Authority	Letter No	Date	Remarks
A					
1	Expansion of smelter plant from 1,00,000 TPA to 3,60,000 TPA and captive power plant from 267.5 MW to 967.5 MW at Hirkud, Sambalpur, Orissa	MOEF&CC	J-11011/400/2006-IA II(I)	06.02.2008	<b>Annexure-I(A)</b>
2	Expansion of smelter plant (1,00,000 to 3,60,000 TPA) and captive power plant	MOEF&CC	J-11011/144/2006-IA II(I)	19.10.2009	<b>Annexure-I (B)</b>

	<b>Addendum Report For Installation of Ultra Clean Coal Gasification System For Replacing Furnace Oil in the Cast Houses of Aluminum Smelter Located in Hirakud Village of Sambalpur District, Odisha</b>
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Sr. No	Name of the Unit	Issuing Authority	Letter No	Date	Remarks
	(267.5 MW to 967.5 MW) at Hirakud, Sambalpur, Orissa- [Amendment]				
3	Consent to Establish for M/s. Hindalco Industries Limited	SPCB, Odisha	No.4768/Ind.II-NOC.4655	16.03.2013	<b>Annexure-I (C)</b>
4	Consent to discharge of sewage and trade effluent	SPCB, Odisha	3982/IND-I-CON-1411	31.03.2018	<b>Annexure-I (D)</b>
5	EC Compliance (Latest 6 monthly report )	MOEF&CC		26.11.2018	<b>Annexure-I (E)</b>
6	Certified EC Compliance	MOEF&CC	101-266/10/EPE/633	04.11.2019	<b>Annexure-I (F)</b>

Source: HIL

## 6.0 Resource Requirement

### ➤ Raw Material Requirement

Raw material consumption of the gas station is given in **Table-2**. Coal will be procured through E-auction coal. Coal will be transported from tarpaulin covered trucks/rail. Coal will be stacked in the separate stack yard adjacent to coal gasification unit.

**TABLE-2**  
**PROPOSED RAW MATERIAL CONSUMPTION OF THE GAS STATION**

Description	Qty per hour (Kg)	Qty per day (Metric Tonnes)	Qty per Year (Metric Tonnes)
Coal	12,875	309	108,150

Note: 350 operating days considered for the year

Sulphur balance is given below in **Figure-1**.



**FIGURE-1**  
**SULPHUR BALANCE**

➤ Water Requirement

Existing water requirement for the facilities at Hirakud smelter complex is 24,465.75 KLD (10 cusec). The break-up of water requirement is given in **Table-3**.

**TABLE-3  
EXISTING WATER REQUIREMENT**

Sr.No	Description	Quantity (KLD)	Remarks
1	CPP	21,585	In process
2	Smelter	960	In process
3	Flat Rolling Product (FRP)	240.75	In process
4	Drinking	1,680	To 3 colonies and plants requirement.
	<b>Total</b>	<b>24,465.75</b>	

Source: HIL

Total water requirement for proposed coal gasification unit will be 83.4 KLD (0.034 cusec) which will be accommodated within the existing 34,252 KLD (14 cusec) water sanction for Hirakud reservoir. The proposed break-up of water requirement for coal gasification plant is given in **Table-4**. The water balance diagram is given in **Figure-2**.

**TABLE-4  
BREAK-UP OF WATER REQUIREMENT**

Sr. No	Description	Quantity (KLD)	Remarks
1	To CT make up water	32.40	Evaporation losses-25.8 KLD + Blow down-6.6 KLD
2	To vapour drum	45.00	This is consumed in gasification process & converted into H <sub>2</sub> , tar and phenol water (14.4 KLD)
3	To boiler	6.00	
	<b>Total Consumption</b>	<b>83.40</b>	

Source: HIL



**FIGURE-2**  
**WATER BALANCE DIAGRAM**

➤ Power Requirement

Total power required for the proposed coal gasification plant is 0.946 MW and will be sourced from the coal based 467.5 MW captive power plant (CPP).

The existing power generation from CPP is 350 MW. Out of which, 9.5 % is utilised in CPP as auxiliary power requirement. Existing power requirement for smelter, FRP & CPP is given in **Table-5**.

**TABLE-5  
POWER REQUIREMENT**

Sr. No	Description	Power Requirement
1	Smelter	306 MW
2	FRP	10 MW
3	Existing CPP	34 MW
4	Proposed coal gasification unit	0.946 MW

Source: HIL

➤ Land Requirement

Total land requirement is about 21.69 acres (8.77 ha) to set-up the complete coal gasification plant, coal transportation & storage system, ash handling & disposal, pipeline, maintenance shed, goods storage shed and green belt development etc. Out of 21.69 acres, Government lease land is 7.31 acres and private land acquisition under progress is 14.38 acres.

## 7.0 Description of Environment

Baseline environment monitoring was carried out by M/s.Visiontek Consultancy Services for a period of one month i.e 1<sup>st</sup> November 2019 to 30<sup>th</sup> November 2019.

➤ **Meteorology**

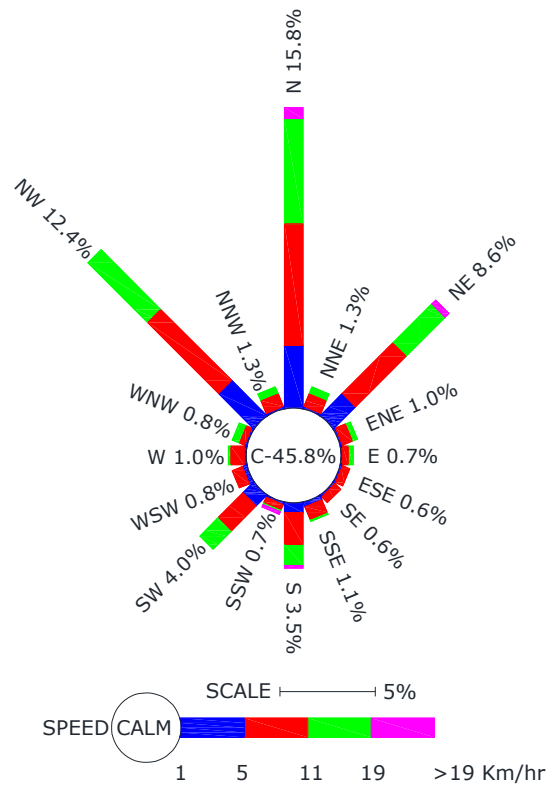
On-site monitoring was undertaken for various meteorological variables in order to generate the site-specific data. Data was collected every hour continuously from 1<sup>st</sup> November 2019 to 30<sup>th</sup> November 2019. The meteorological parameters were recorded on hourly basis during the study period and comprises of wind speed, temperature, relative humidity and rainfall. The meteorological parameters are presented in **Table-6**.

**TABLE-6  
SUMMARY OF THE METEOROLOGICAL DATA GENERATED AT SITE**

Month	Temperature (°C)		Relative Humidity (%)		Wind Speed (m/s)	Rainfall (mm)
	Min	Max	Min	Max		
November 2019	15.0	35.1	65	75	1.8	12.7

*Site Specific Wind Rose*

The wind rose for the study period during the month November, 2019 is shown in **Figure-3**. A review of the wind rose diagram shows that predominant winds are mostly from N followed by NW. Calm conditions prevailed for about 45.8 % of the total time.



**FIGURE-3**  
**SITE-SPECIFIC WIND ROSE**



### Geomorphology

Sambalpur district has three common geomorphological features comprising of denudational hills, pediments and pediplains and can be divided broadly in three units as; i) Northern hilly terrain of Bamra and Kuchinda, ii) South eastern plateau and ridges of Rairakhol and iii) South eastern valley and plains of Sambalpur Sadar sub-division. Average elevation of major parts of the district ranges from 100-300 m above mean sea level with isolated hill peaks having height up to 600 m above mean sea level.

### Topography of the Project Site

The area is characterized by plain topography. The average elevation of the site is about 160-180 m above mean sea level.

### Drainage

Most parts of the district are drained by Mahanadi (with Harihar Jore, Surbali Jore, Karandi Jore and Jhul jore as tributaries), Ib (along with Bhedan as tributaries) and Bramhani (with Tikara and tributary). Famous Hirakund reservoir constructed by damming Mahanadi River occupies about 250 km<sup>2</sup> of area in Sambalpur district. Other important rivulets of the district are Maltijor, Harrad, Kulsara, and Phuljiharana.

### Drainage of the Project Site

Khajoor nallah passes through the existing plant premises. The nallah is not a perennial river and joins river Mahanadi after traveling about 3 km from the plant. During monsoon time, the storm water is drained out into nearby Khajoor nallah.

### Geology and Mineral Wealth

The trend of gneissosity in the eastern ghat belt swerves from north-easterly in the western part to north-westerly in the eastern part of the district. Granite gneiss, migmatite and augen gneiss form the most conspicuous country rocks in the district, stretching from Panikhimal in the south to as far as Govindpur in the north. It is essentially biotite granite, with composition ranging from granodiorite to occasional alkali granite. Bonai Group is represented by meta-volcanics and sericite quartzite in stratigraphically lower horizons and shale, phyllite, mica schist, quartz sericite schist in the upper horizons. They are mostly found in the north-eastern part of the district. Metabasic bodies are occasionally found as intrusives within the meta-sedimentaries of Bonai Group. A very thin strip of sedimentary rocks belonging to Gangpur Group are found near the northern tip of the district. The rock types are basal conglomerate, quartzite, phyllite and mica schist. An isolated outcrop of Chattisgarh Super group of rocks occurs west of Mahanadi river. It runs in a N-S direction. A cluster of nepheline syenite bodies are intruded into the Eastern Ghat Super group of rocks near Rairakhol which is responsible for the formation of gemstones in the region. The swarm of NW-SE trending dolerite dykes traverse the gneisses near Badarama Reserve Forest.



Rocks of Gondwana Super group are hosted in the fault bounded basins occupying the central portion of the district with a NW-SE trend. They are represented by Talchir Formation, Barakar Formation and Mahadeva Formation. Coal bearing horizons are yet to be reported from the Barakars, present in the district. Quaternary sediments are sporadically distributed district. They occur as soil/alluvium in the pediplains and flood plains. Cenozoic laterites occur as small cappings over the altered bedrocks.

### Hydrogeology

The hydrogeological features of the region and the study area are discussed below

- Nature of Occurrence of Ground Water

Ground water systems are a result of the complex combination of different lithological and structural types within an area that together constitute an aquifer within which ground water accumulates and moves. Rather than describing individual lithologies and their tendencies to form aquifers or otherwise, it is useful to describe the ground water as one continuous across various lithological types (Kulkarni and Deolankar, 1995).

Sambalpur district can divide into two major hydrogeological units, viz; (1) Consolidated formations comprising of hard rocks of Precambrian age occupying 85% of the area and (2) Semi consolidated rocks of Gondwana Super Group occurring in pockets in northern and southern eastern parts. Consolidated formations include Granite Gneisses, Khondalites, Charnockites, Schistose rocks and Epidorites. Secondary porosity forms the conduits for movement of groundwater and also act as reservoir of groundwater. Groundwater occurs under pheratic conditions in upper weathered residium of rock masses at shallower depths. At deeper levels in fractured and joined rocks it occurs under semi confined to confined conditions.

- Depth to Water Levels

Ground water regime conditions of the district are monitored through 46 National hydrograph stations for quantity and quality during January, April, August and November months.

Depth to water levels during pre-monsoon period (April-2011) range from 5 m to 10 m below ground levels in most parts of the districts. Whereas in limited western canal irrigated parts shallow depth to water levels of the order of 2 m to 5 m below ground levels are also observed.

A deeper water level of the order of more than 10 m bgl is observed in the south-western part of the district.

During the post monsoon period (November-2011) most parts of the district have depth to water levels in the range of 2 m to 5 m below ground levels with shallow depth to water levels of the order of 0 to 2 m below ground levels in the same



period in some limited isolated pockets in western parts having canal irrigation network.

Long term water levels trend over the last ten years from 2001 to 2011 do not show any perceptible significant changes, as deciphered by the ground water regime monitoring through hydrograph stations.

There are 7 dug wells in Baijamunda, Remerha, Christianpara, Jugipali, Hirakud, Jamadarpali and Golgunda and on bore well Dhankauda under CGWB water level monitoring network in the study area. Of these 8 wells, dug well in Baijamunda was initiated in 2016, Remerha was initiated in 2005, Golgunda was initiated in 2013 and monitoring on the bore well in Dhankauda was initiated in 2012 and other 4 dug wells in Christianpara, Jugipali, Hirakud and Jamadarpali was initiated in 1995. Water levels at these wells have been monitored four times in a year – monsoon, post monsoon rabi, post monsoon kharif and pre monsoon. A review of this monitoring data indicates that the average monsoon, post monsoon rabi, post monsoon kharif and pre monsoon water levels at these locations are 1.13 m, 3.84 m, 2.51 m and 5.02 m bgl respectively with an average fluctuation of 2.37 m.

➤ **Ground Water Resources**

➤ Ground Water Recharge

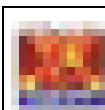
The main source of ground water recharge is by the rainfall by direct percolation to the zone of saturation. A significant part of the rainfall is lost as runoff from area while a limited percentage of rainfall therefore reaches zone of saturation and becomes the part of ground water storage after meeting the evaporation and evapo-transpiration losses. There is also ground water recharge from the return flow of irrigation water from dug wells and tube wells operated by the cultivators and from canals.

The dynamic groundwater resources of Sambalpur district of Odisha has been estimated jointly by CGWB and State Ground Water Department. Govt of Odisha, following the norms laid down by revised GEC-2015 methodology and projected as on March 2017. The ground water resources of the district of Sambalpur is given in **Table-7**.

**TABLE-7  
THE DYNAMIC GROUNDWATER RESOURCES**

Sr.No.	Particulars	Quantity (HAM)
		Sambalpur
1	Total annual ground water recharge	65715.23
2	Total natural discharge	4913.32
3	Annual extractable ground water resources	60801.91
4	Total current annual ground water extraction	16080.88
5	Annual GW allocation for domestic use as on 2020	3313.07
6	Net ground water availability for future use	44431.32
7	Stage of ground water extraction (%)	26.45% <b>(Safe)</b>

Source: Dynamic Ground Water Resources of India-2017



➤ **Land Use Pattern based on Remote Sensing Data**

Remote sensing satellite imageries were collected and interpreted for the 10 km radius study area for analyzing the land use pattern of the study area. Based on the satellite data land use/land cover maps have been prepared.

*Land Use/Land Cover Classification System*

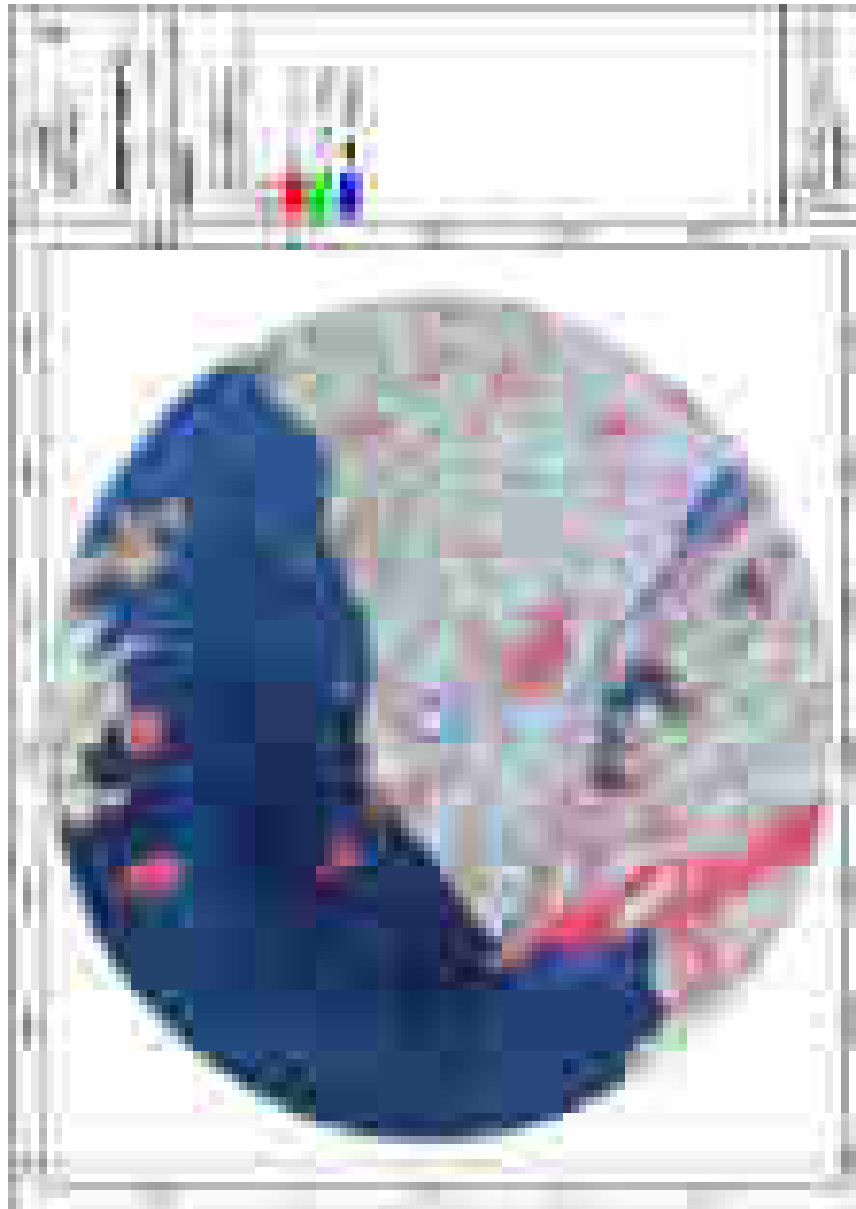
The present land use/land cover maps were prepared based on the classification system of national standards. For explanation for each of the land use category the details as given in **Table-8** were considered. IRS RS-2 LISS IV FX data acquired for 10<sup>th</sup> January 2020 and was used for the mapping and interpretation.

**TABLE-8**  
**LAND USE/LAND COVER CLASSIFICATION SYSTEM**

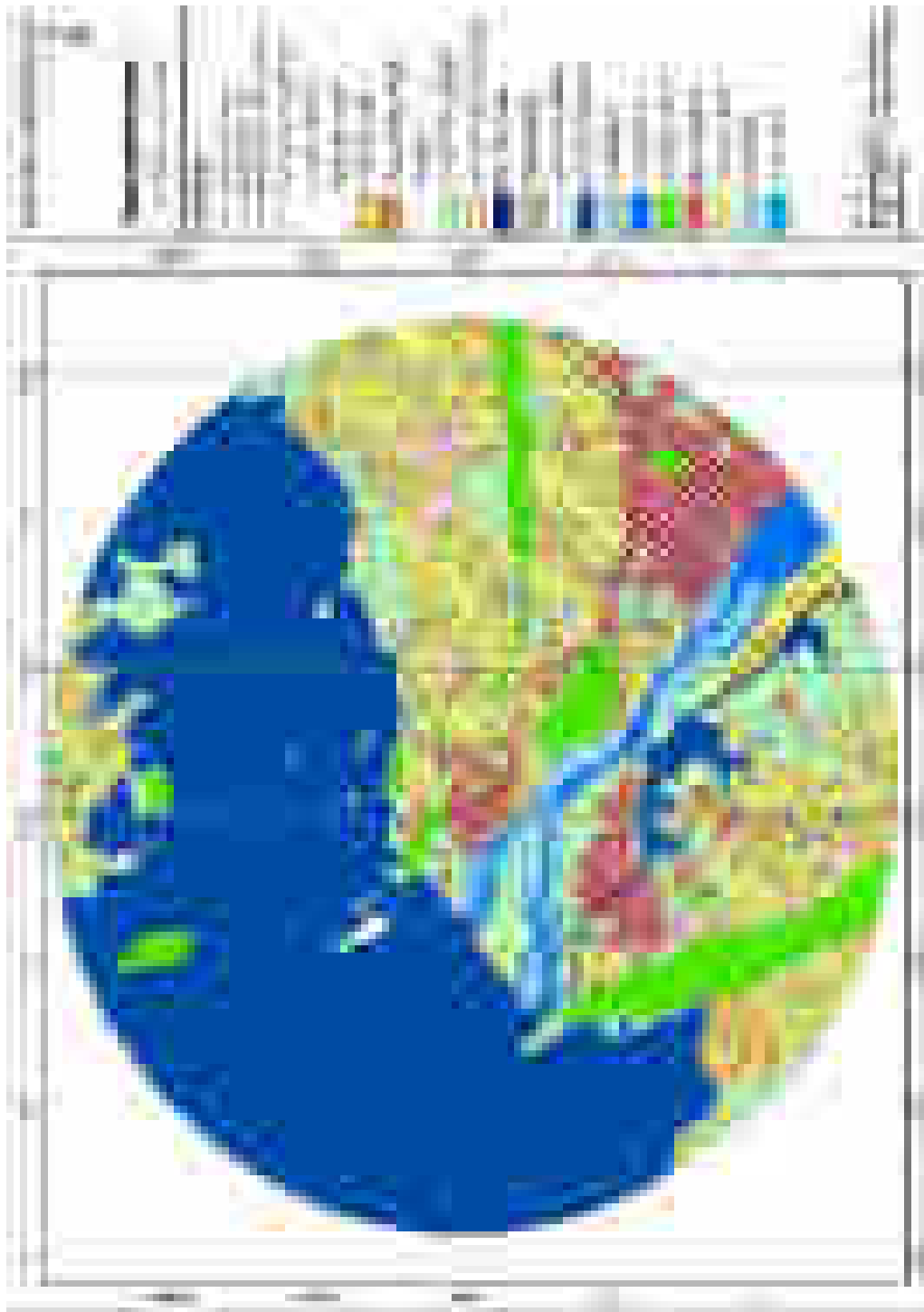
Sr. No.	Level-1	Level-2
1	Built-up land	Town/cities
		Villages
		Institution/industry/godown etc
		Plotted area/layout
2	Agriculture land	Crop land
		Plantations
		Fallow
3	Forest	Evergreen/Semi evergreen
		Deciduous
		Forest plantation
4	Wastelands	Rocky/stony waste
		Land with /without scrubs
		Saline/sandy & marshy/swampy
5	Water bodies	River/stream
		Lake/reservoir/tanks
6	Others	Orchard/Other plantation
		Shifting cultivation
		Salt pans, snow covered/glacial
		Barren/vacant land

*Observations*

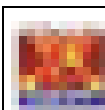
The following are the main interpreted land use/land cover classes of the study area and their respective areas are given in hectares in **Table-9** for the year 2020. The thematic map and land use pattern of 10 km radius based on IRS RS-2A LISS IV FX for 10<sup>th</sup> January 2020 are shown in **Figure-4(A)** and **Figure-4(B)**.



**FIGURE-4 (A)**  
**THEMATIC MAP OF STUDY AREA IRS RS- 2A LISS IV FX SATELLITE IMAGERY**



**FIGURE-4 (B)**  
**LAND USE PATTERN BASED ON SATELLITE DATA**



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**TABLE-9**  
**LANDUSE BREAK-UP BASED ON IRS RS-2 LISS IV FX DATA – 10<sup>th</sup> JANUARY 2020**

Sr.No.	Land Use	Area (sq.km)	Area (ha)	Percentage (%)
<b>Built-up Land/Other Development</b>				
A	Settlement	23.298	2329.8	6.6
B	Industrial area	4.236	423.6	1.2
	<b>Sub-total</b>	<b>27.534</b>	<b>2753.4</b>	<b>7.8</b>
<b>Water Bodies</b>				
C	Tank / river/reservoir etc.	<b>175.794</b>	<b>17579.4</b>	<b>49.8</b>
<b>Forest</b>				
D	Scrub forest	<b>21.886</b>	<b>2188.6</b>	<b>6.2</b>
<b>Crop Land</b>				
E	Single crop	<b>71.306</b>	<b>7130.6</b>	<b>20.2</b>
<b>Waste Lands</b>				
F	Land with scrub	25.416	2541.6	7.2
G	Land without scrub	12.002	1200.2	3.4
H	Mining area	7.766	776.6	2.2
I	Gulled land	11.296	1129.6	3.2
	<b>Sub-total</b>	<b>56.48</b>	<b>5648</b>	<b>16.0</b>
	<b>Total</b>	<b>353</b>	<b>35300</b>	<b>100</b>

Source: IRS RS-2A LISS IV FX Data – 10<sup>th</sup> January, 2020

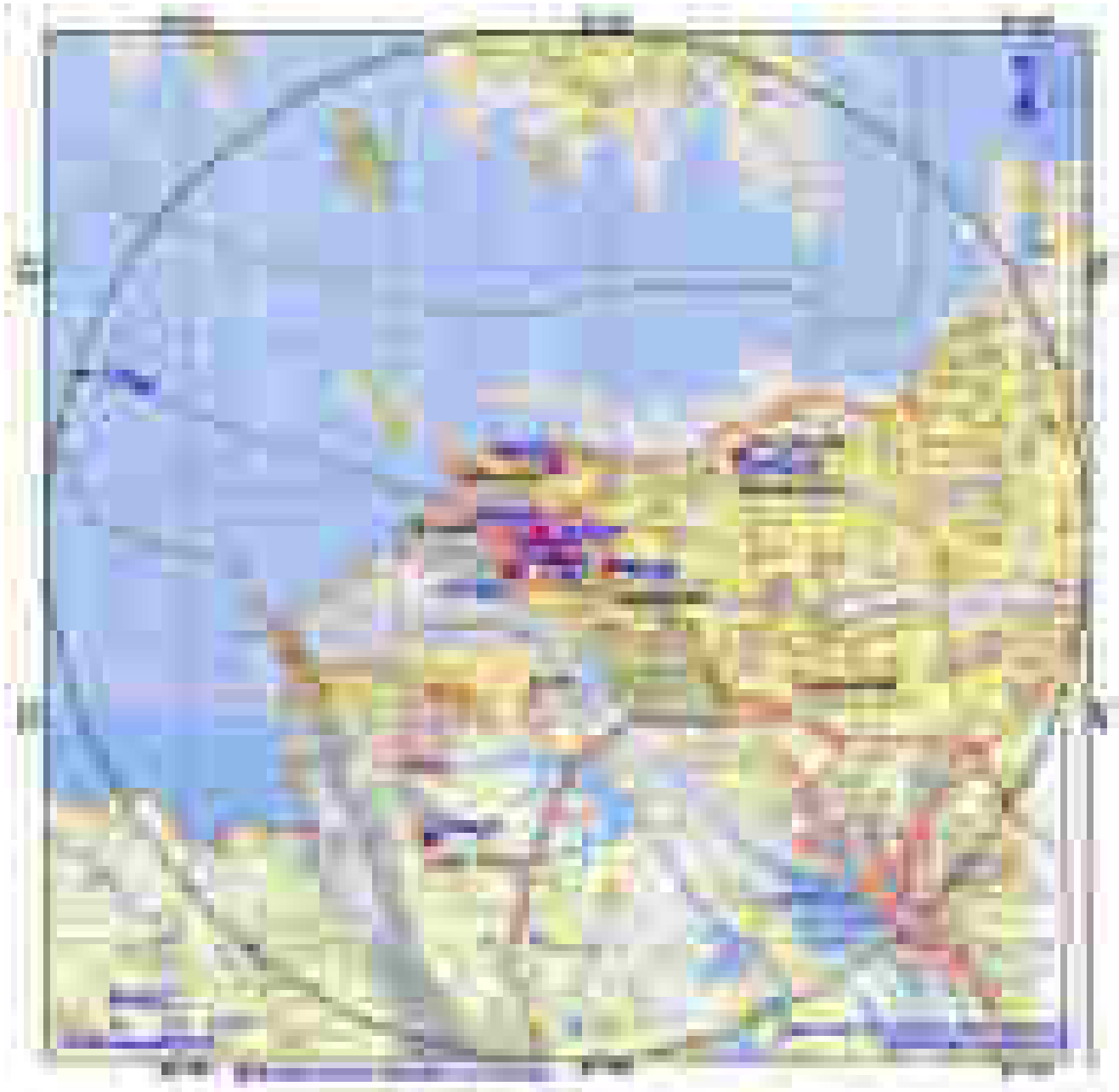
As per satellite imagery, the built-up land is 7.8 %, forest land occupies 6.2 %, agricultural land is about 20.2 %, water body is 49.8 % and remaining land is either area available for cultivation or cultivable waste land.

➤ **Ambient Air Quality**

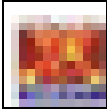
The ambient air quality monitoring is carried out for study period 1<sup>st</sup> November 2019 to 30<sup>th</sup> November 2019. Ambient air quality monitoring (AAQM) stations were set-up at **ten** locations. The details of environmental setting around each monitoring station is given in **Table-10**. The location of the selected stations with reference to the plant area boundary is given in the below table and shown in **Figure-5**. The summary of ambient air quality results are given in **Table-11**.

**TABLE-10**  
**DETAILS OF AMBIENT AIR QUALITY MONITORING LOCATIONS**

Station Code	Name of the Station	Distance from the Plant Boundary (km)	Direction w.r.t Boundary	Zone
AAQ1	CHP control room	1.4	Near to S-W boundary of project site	Core
AAQ2	Admin building	0.1	Near to S-W boundary of project site	Core
AAQ3	Ash silo	0.3	Near to S-W boundary of project site	Core
AAQ4	R & D building	0.1	Near to NNW Boundary of project site	Core
AAQ5	Project office	0.2	Near to S-W boundary of project site	Core
AAQ6	Rajapada	0.7	Near to S boundary of project site	Buffer
AAQ7	Hindalco club	0.8	Near to S-W boundary of project site	Buffer
AAQ8	Jyoti Vihar	5.9	Near to S-W boundary of project site	Buffer
AAQ9	Ash mound road	1.4	Near to N-W boundary of project site	Buffer
AAQ10	Ash mound	3.7	Near to E side boundary of project site	Buffer



**FIGURE-5**  
**AMBIENT AIR QUALITY MONITORING LOCATIONS**



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**TABLE-11  
SUMMARY OF AMBIENT AIR QUALITY RESULTS**

Code	Location	PM <sub>10</sub> (µg/m <sup>3</sup> )				PM <sub>2.5</sub> (µg/m <sup>3</sup> )				SO <sub>2</sub> (µg/m <sup>3</sup> )				NO <sub>2</sub> (µg/m <sup>3</sup> )			
		Min	Max	Avg	98%	Min	Max	Avg	98%	Min	Max	Avg	98%	Min	Max	Avg	98%
AAQ1	CHP control room	62.0	75.0	69.1	74.6	31.4	37.0	35.1	36.9	13.5	15.7	14.6	15.6	11.1	12.6	12.0	12.6
AAQ2	Admin building	57.0	68.0	62.1	67.6	28.7	35.2	31.6	34.9	11.3	13.4	12.4	13.4	15.4	16.6	16.0	16.6
AAQ3	Ash silo	66.0	77.0	71.1	76.7	33.7	39.2	36.3	39.1	15.8	17.7	16.9	17.6	19.2	22.0	20.7	21.9
AAQ4	R & D building	53.0	62.0	57.1	61.6	27.2	32.3	29.5	32.1	7.7	9.2	8.4	9.2	13.3	15.6	14.4	15.5
AAQ5	Project office	57.0	67.0	62.3	67.0	29.4	34.8	32.1	34.7	11.2	12.6	12.0	12.6	13.4	15.7	14.8	15.7
AAQ6	Rajapada	53.0	66.0	59.1	65.4	26.7	32.7	30.0	32.6	11.6	13.1	12.4	13.0	14.7	17.0	15.9	16.9
AAQ7	Hindalco club	52.0	61.0	56.4	60.7	26.3	31.3	28.6	31.1	5.9	6.8	6.4	6.8	13.3	14.7	14.0	14.7
AAQ8	Jyoti Vihar	56.0	68.0	61.9	67.9	27.4	34.6	31.2	34.5	11.6	13.1	12.4	13.0	14.7	17.0	15.9	16.9
AAQ9	Ash mound road	66.0	78.0	70.6	77.3	33.6	39.4	36.0	39.2	13.2	15.1	14.3	15.0	17.5	20.2	18.5	20.1
AAQ10	Ash mound	62.0	73.0	67.1	72.6	32.5	37.7	34.6	37.5	13.5	15.3	14.4	15.3	16.7	19.3	18.1	19.2
<b>Range</b>		<b>52.0-78.0</b>				<b>26.3-39.4</b>				<b>5.9-17.7</b>				<b>11.1-22.0</b>			
<b>NAAQ Standards</b>		<b>100</b>				<b>60</b>				<b>80</b>				<b>80</b>			

Code	Location	CO (µg/m <sup>3</sup> )				O <sub>3</sub> (µg/m <sup>3</sup> )				Ammonia (µg/m <sup>3</sup> )	Benzene (µg/m <sup>3</sup> )
		Min	Max	Avg	98%	Min	Max	Avg	98%		
AAQ1	CHP control room	120	170	150	170	5.6	6.7	6.1	6.7	<20	<0.001
AAQ2	Admin building	150	210	180	210	5.7	6.6	6.1	6.6	<20	<0.001
AAQ3	Ash silo	130	190	160	190	5.8	7.0	6.3	7.0	<20	<0.001
AAQ4	R & D building	110	170	140	170	4.5	5.3	4.9	5.3	<20	<0.001
AAQ5	Project office	150	200	180	200	5.7	6.5	6.1	6.5	<20	<0.001
AAQ6	Rajapada	130	190	160	190	4.6	5.5	5.0	5.5	<20	<0.001
AAQ7	Hindalco club	115	178	146	143	3.6	6.5	4.5	6.2	<20	<0.001
AAQ8	Jyoti Vihar	120	180	150	180	5.1	6.1	5.5	6.0	<20	<0.001
AAQ9	Ash mound road	130	190	160	190	5.6	6.5	6.0	6.5	<20	<0.001
AAQ10	Ash mound	140	210	170	210	5.9	7.2	6.5	7.1	<20	<0.001
<b>Range</b>		<b>115-210</b>				<b>3.6-7.2</b>				<b>&lt;20</b>	<b>&lt;0.001</b>
<b>NAAQ Standards</b>		<b>2.0</b>				<b>100</b>				<b>400</b>	<b>5</b>

Code	Location	B(a)P (ng/m <sup>3</sup> )	As (ng/m <sup>3</sup> )	Pb (µg/m <sup>3</sup> )	Ni (ng/m <sup>3</sup> )
AAQ1	CHP control room	<0.002	< 0.001	<0.001	<0.01
AAQ2	Admin building	<0.002	< 0.001	<0.001	<0.01
AAQ3	Ash silo	<0.002	< 0.001	<0.001	<0.01
AAQ4	R & D building	<0.002	< 0.001	<0.001	<0.01
AAQ5	Project office	<0.002	< 0.001	<0.001	<0.01
AAQ6	Rajapada	<0.002	< 0.001	<0.001	<0.01
AAQ7	Hindalco club	<0.002	< 0.001	<0.001	<0.01
AAQ8	Jyoti Vihar	<0.002	< 0.001	<0.001	<0.01
AAQ9	Ash mound road	<0.002	< 0.001	<0.001	<0.01
AAQ10	Ash mound	<0.002	< 0.001	<0.001	<0.01
<b>Range</b>		<b>&lt;0.002</b>	<b>&lt; 0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.01</b>
<b>NAAQ Standards</b>		<b>1</b>	<b>6</b>	<b>1.0</b>	<b>20</b>



*Observations of AAQ Data*

The minimum and maximum concentrations for PM<sub>10</sub> were recorded as 52.0 µg/m<sup>3</sup> and 78.0 µg/m<sup>3</sup> respectively. The minimum and maximum concentration was recorded at Hindalco club (AAQ7) and ash mound road (AAQ8) respectively.

The minimum and maximum concentrations for PM<sub>2.5</sub> were recorded as 26.3 µg/m<sup>3</sup> and 39.4 µg/m<sup>3</sup> respectively. The minimum and maximum concentration was recorded at Hindalco club (AAQ7) and ash mound road (AAQ8) respectively.

The minimum and maximum SO<sub>2</sub> concentrations were recorded as 5.9 µg/m<sup>3</sup> and 17.7 µg/m<sup>3</sup>. The minimum and maximum concentration was recorded at Hindalco club (AAQ7) and ash silo (AAQ3) respectively.

The minimum and maximum NO<sub>2</sub> concentrations were recorded as 11.1 µg/m<sup>3</sup> and 22.0 µg/m<sup>3</sup>. The minimum and maximum concentration was recorded at CHP control room (AAQ1) and ash silo (AAQ3) respectively.

The minimum and maximum CO concentrations were recorded as 115 µg/m<sup>3</sup> and 210 µg/m<sup>3</sup>. The minimum and maximum concentration was recorded at Hindalco club (AAQ7) and administration building (AAQ2) respectively. The minimum and maximum O<sub>3</sub> concentrations were recorded as 3.6 µg/m<sup>3</sup> and 7.2 µg/m<sup>3</sup>. The minimum and maximum concentration was recorded at Hindalco club (AAQ7) and ash mound (AAQ10) respectively.

The concentrations of PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub>, O<sub>3</sub>, CO, NH<sub>3</sub>, Pb, BaP, As, Ni and C<sub>6</sub>H<sub>6</sub> are observed to be well within the NAAQ standards prescribed by Central Pollution Control Board (CPCB) for industrial and rural / residential zone.

➤ Water Quality

In the study area, five surface and five ground water samples were collected during the study period. The water sampling locations are listed below in **Table-12** and are depicted in **Figure-6**. The analytical results of water samples for surface and ground water samples are given in **Table-13 (A)** and **Table-13 (B)**.

**TABLE-12**  
**WATER SAMPLING LOCATIONS**

Station Code	Location	Distance (km)	Direction
<b>Surface Water Locations</b>			
SW1	Khajur nalla	-	Adjecent To the E side boundary line
SW2	Solpali	0.9	Near to NE side boundary of project site
SW3	Gadmunda	0.7	Near to SSE side boundary of project site
SW4	Rajapada	0.4	Near to S side boundary of project site
SW5	Pond near mosque	0.5	Near to SSW side boundary of project site
<b>Ground Water Locations</b>			
GW1	U#4 Canteen	0.1	Near to S side boundary of project site
GW2	Muhammadpur	1.6	Near to E side boundary of project site
GW3	Sahajpur	2.5	Near to SE side boundary of project site
GW4	Rajapada	2.1	Near to SE side boundary of project site
GW5	Silipathar	1.4	Near to E side boundary of project site



**FIGURE-6**  
**WATER SAMPLING LOCATIONS**



**TABLE-13 (A)  
SURFACE WATER QUALITY**

Sr.No	Parameters	Unit	SW1	SW2	SW3	SW4	SW5	Range
1	pH	-	7.30	6.9	7.8	7.4	6.9	6.9-7.8
2	Colour	Hazen	6	7	4	6	8	4-8
3	Conductivity	µS/cm	680	560	490	448	512	448-680
4	TDS	mg/l	419.4	345.9	301.3	280.0	319.5	280-419.4
5	DO	mg/l	6.1	5.4	5.2	5.4	5.7	5.2-6.1
6	BOD	mg/l	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
7	COD	mg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
8	Turbidity	NTU	6	8	8	11	14	6-14
9	Total Hardness as CaCO <sub>3</sub>	mg/l	112.6	119.0	113.6	85.2	99.2	85.2-119
10	Total Alkalinity as CaCO <sub>3</sub>	mg/l	112.6	96.5	79.6	64.8	76.8	64.8-112.6
11	Calcium as Ca	mg/l	22.8	20.6	21.4	18.6	20.9	18.6-22.8
12	Magnesium as Mg	mg/l	13.5	16.4	14.6	9.4	11.4	9.4-16.4
13	Chlorides as Cl	mg/l	136.4	112.5	102.5	98.6	102.5	98.6-136.4
14	Residual free chlorine	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
15	Phosphates as PO <sub>4</sub>	mg/l	0.02	0.04	0.03	0.05	0.02	0.02-0.05
16	Sulphates as SO <sub>4</sub>	mg/l	26.4	22.9	18.6	21.2	31.8	18.6-31.8
17	Fluorides as F	mg/l	0.3	0.4	0.5	0.3	0.4	0.3-0.5
18	Nitrates as NO <sub>3</sub>	mg/l	1.80	1.60	2.60	2.20	2.70	1.6-2.7
19	Sodium as Na	mg/l	103.2	73.4	59.1	63.1	71.9	59.1-103.2
20	Potassium as K	mg/l	2.4	1.6	2.4	1.8	1.1	1.1-2.4
21	Total Boron as B	mg/l	0.19	0.21	0.24	0.26	0.32	0.19-0.32
22	Phenolic Compounds	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
23	Cyanides	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
24	Oil & grease	mg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
25	Cadmium as Cd	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Arsenic as As	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
27	Copper as Cu	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Lead as Pb	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
29	Iron as Fe	mg/l	0.06	0.14	0.12	0.08	0.09	0.06-0.14
30	Chromium as Cr <sup>+6</sup>	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
31	Selenium as Se	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Zinc as Zn	mg/l	0.06	0.04	0.08	0.04	0.07	0.04-0.07
33	Aluminum as Al	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
34	Mercury as Hg	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
35	SAR	-	4.2	2.9	2.4	3.0	3.1	2.9-4.2
36	Insecticides	mg/l	Absent	Absent	Absent	Absent	Absent	Absent
37	Anionic detergents as MBAS	mg/l	Absent	Absent	Absent	Absent	Absent	Absent
38	Total Coliforms	MPN/100	1120	590	720	680	540	540-1120

➤ **Surface Water Quality**

- The results of surface water sample analysis indicate that the pH value was observed to be in the range of 6.9 to 7.8.
- Electrical conductivity of surface water samples was observed to be in the range of 448 µS/cm to 680 µS/cm.
- The dissolved oxygen was observed in the range of 5.2 to 6.1 mg/l.
- Biochemical oxygen demand (BOD) was found in the range of <3.0 mg/l.
- Chemical oxygen demand was found <5.0 mg/l.
- The total hardness was found to be in the range of 85.2 mg/l to 119 mg/l.
- The chloride concentration was observed in the range of 98.6 mg/l to 136.4 mg/l.



**Addendum Report For Installation of Ultra Clean Coal Gasification System For Replacing Furnace Oil in the Cast Houses of Aluminum Smelter Located in Hirakud Village of Sambalpur District, Odisha**

- Sulphates were found to be in the range of 18.6 mg/l to 31.8 mg/l.
- Fluoride content was found to be in the range of 0.3 mg/l to 0.5 mg/l.
- Bacteriological studies revealed that the total coliform count is measured 540 -1120 MPN/100 ml.

The surface water quality in the study area does not indicate any industrial contamination.

**TABLE-13 (B)  
GROUNDWATER QUALITY**

Sr. No	Parameters	Unit	IS: 10500 Limits	GW1	GW2	GW3	GW4	GW5	Range
1	PH	-	6.5 – 8.5(NR)	7.40	7.60	7.2	7.1	7.20	7.1-7.6
2	Colour	Hazen	5(15)	2	3	2	2	4	2-4
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Conductivity	µS/cm	§	625.5	460	520	496	560	460-625.5
6	Turbidity	NTU	1(5)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
7	TDS	mg/l	500(2000)	383.8	279.7	317.9	302.3	342.4	279.7-383.8
8	Total Hardness as CaCO <sub>3</sub>	mg/l	200(600)	139.0	118.3	118.6	117.8	148.3	117.8-148.3
9	Total Alkalinity	mg/l	200(600)	92.6	68.5	78.9	66.8	74.5	66.8-92.6
10	Calcium as Ca	mg/l	75(200)	28.6	24.6	26.2	25.4	27.4	24.6-28.6
11	Magnesium as Mg	mg/l	30(100)	16.4	13.8	12.9	13.2	19.4	12.9-19.4
12	Residual Chlorine	mg/l	0.2(1.0)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
13	Boron as B	mg/l	0.5(1.0)	0.21	0.33	0.42	0.29	0.21	0.21-0.42
14	Chlorides as Cl	mg/l	250(1000)	132.8	94.2	104.2	112.8	118.6	94.2-132.8
15	Sulphates as SO <sub>4</sub>	mg/l	200(400)	31.2	22.4	26.8	19.8	34.6	19.8-34.6
16	Fluorides as F	mg/l	1.0(1.5)	0.4	0.6	0.5	0.6	0.5	0.4-0.6
17	Nitrates as NO <sub>3</sub>	mg/l	45(NR)	1.20	2.60	1.80	2.40	3.20	1.2-3.2
18	Sodium as Na	mg/l	§	79.4	49.6	62.4	57.6	58.4	49.6-79.4
19	Potassium as K	mg/l	§	1.2	3.4	4.2	3.7	5.8	1.2-5.8
20	Phenolic Compounds	mg/l	0.001(0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
21	Cyanides as CN	mg/l	0.05 (NR)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
22	Anionic Detergents	mg/l	0.2 (1.0)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
23	Mineral Oil	mg/l	0.5(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
24	Cadmium as Cd	mg/l	0.003 (NR)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
25	Arsenic as As	mg/l	0.01(0.05)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Copper as Cu	mg/l	0.05 (1.5)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
27	Lead as Pb	mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Manganese as Mn	mg/l	0.1 (0.3)	0.01	0.02	0.01	0.01	0.02	0.01-0.02
29	Iron as Fe	mg/l	0.3(NR)	0.11	0.08	0.06	0.02	0.04	0.02-0.11
30	Total Chromium as Cr	mg/l	0.05(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Selenium as Se	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Zinc as Zn	mg/l	5(15)	0.08	0.06	0.04	0.11	0.08	0.04-0.11
33	Aluminum as Al	mg/l	0.03(0.2)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
34	Mercury as Hg	mg/l	0.001(NR)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
35	Pesticides	mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent
36	E.Coli	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent
	Total Suspended Solids	mg/l	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
37	Total Coliforms	MPN/100	10	Absent	Absent	Absent	Absent	Absent	Absent



➤ *Ground Water Quality*

- The analysis results of ground water samples showed the pH in range of 7.1-7.6 which are with the specified standard limits of 6.5 to 8.5.
- Turbidity of the samples are found <1.0 NTU respectively.
- Electrical conductivity of the samples ranged from 460 -625.5  $\mu\text{S}/\text{cm}$ .
- The total hardness of the samples ranged from 117.8-148.3 mg/l which indicates that hardness concentration in all the ground water samples is well within the desirable limit 200 mg/l.
- Calcium concentration ranged from 24.6 -28.6 mg/l which indicates that calcium concentration in all the ground water samples is well within the desirable limit 75 mg/l.
- Magnesium concentrations ranged from 12.9-19.4 mg/l where the acceptable limit is 30 mg/l.
- The total dissolved solids of the samples ranged from 279.7-383.8 mg/l where the acceptable limit is 500 mg/l.
- Range of chlorides concentration is found to be 94.2-34.6 mg/l where the desirable limit is 250 mg/l.
- Range of sulphates concentration is found to be 7.6-9.5 mg/l where the desirable limit is 200 mg/l.
- Fluoride concentration ranged from 0.11-0.15 mg/l where the desirable limit is 1.0 mg/l.
- Similarly, nitrates are also found to be ranging in between BDL-0.14 mg/l where the desirable limit is 45 mg/l
- Iron concentration in ground water varied from 0.13 -0.16 mg/l where the desirable limit is 0.3 mg/l.
- Zinc levels varied from 0.2 to 0.27 mg/l respectively where the desirable limit is 5 mg/l. The zinc concentration is found to be well with in the standards.
- The total coliform counts are <1.1 in all the samples against the standard limit of 10 MPN/100 ml.

Based on the above results, it is evident that all of the parameters in ground water fairly meet the desirable standard limits of IS: 10500. The ground water quality in the study area does not indicate any industrial contamination.



➤ **Soil Characteristics**

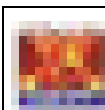
Five locations in and around the proposed expansion of project were selected for soil sampling. The details of the sampling locations are given in **Table-14** and are shown in **Figure-7**. The soil analysis results are given in **Table-15 (A)**. The standard soil classification is given in **Table-15 (B)**.

**TABLE-14  
DETAILS OF SOIL SAMPLING LOCATIONS**

Station Code	Name of the Station	Distance (km)	Direction
S1	Near CGP	0.3	Near to SSE boundary side
S2	Muhammadpur	0.8	Near to N boundary side
S3	Silipathar	2.2	Near to S boundary side
S4	Sahajpur	2.6	Near to S boundary side
S5	Rajapada	1.4	Near to S boundary side

**TABLE-15 (A)  
SOIL ANALYSIS RESULTS**

S.No	Parameters	Unit	S1	S2	S3	S4	S5	Range
1	Texture	-						
a	Sand	%	39	35	32	37	34	32-39
b	Silt	%	15	12	13	14	15	12-15
c	Clay	%	46	53	55	49	51	46-55
2	Textural Class		Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	-
3	Bulk Density	g/cc	1.36	1.28	1.21	1.26	1.19	1.19-1.36
4	pH (1:5 Aq.Extraction)	-	7.2	7.03	6.93	6.85	7.12	6.85-7.2
5	Conductivity (1:5 Aq.Extraction)	µS/cm	143	215.6	119.4	198	162	119.4-215.6
6	Exchangeable Calcium as Ca	mg/kg	2341.0	2716.1	2944.6	2393.2	1659.9	1659.9-2944.6
7	Exchangeable Magnesium as Mg	mg/kg	905.5	634.2	552.7	468.2	359.3	359.3-905.5
8	Exchangeable Sodium as Na	mg/kg	1263.3	1356.1	1018.0	914.3	980.0	914.3-1356.1
9	Sodium Absorption Ratio (SAR)	-	5.62	6.09	4.51	4.47	5.68	4.47-6.09
10	Available Nitrogen as N	Kg/ha	92.6	108.5	124.6	152.8	89.6	89.6-152.8
11	Available Phosphorous as P	Kg/ha	166.5	175.4	156.5	143.2	162.9	143.2-175.4
12	Available Potassium as K	Kg/ha	541.0	429.3	245.4	176.9	111.4	111.4-541.0
13	Organic Carbon	%	1.85	1.4	1.3	1.2	1.1	1.1-1.85
14	Organic Matter	%	3.19	2.41	2.24	2.07	1.90	1.9-3.19
15	Water Soluble Chlorides as Cl	mg/kg	190	164	151	211	141	141-211
16	Water Soluble Sulphates as SO4	mg/kg	107.9	150.2	236.5	129.6	132.8	107.9-236.5
17	Aluminum	%	2.44	3.06	1.86	2.49	3.55	1.86-3.55
18	Total Iron	%	3.86	4.15	3.22	5.26	4.92	3.22-5.26
19	Manganese	mg/kg	236	315	324	289	264	236-324
20	Boron	mg/kg	32.6	21.4	29.6	22.5	24.8	21.4-32.6
21	Zinc	mg/kg	16.4	14.3	15.1	15.6	16.2	14.3-16.4
22	Total Chromium as Cr	mg/kg	5.6	6.8	4.8	5.5	3.9	3.9-6.8
23	Lead as Pb	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
24	Nickel as Ni	mg/kg	14.2	16.8	14.8	10.8	13.4	10.8-16.8
25	Arsenic as As	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
26	Mercury as Hg	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Cadmium as Cd	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
28	Exchangeable Sodium	meq/100g	6.26	7.14	5.67	4.89	5.55	4.89-7.14
29	Exchangeable Potassium	meq/100g	1.02	0.86	0.52	0.36	0.24	0.24-1.02
30	Exchangeable Calcium	meq/100g	11.6	14.3	16.4	12.8	9.4	9.4-16.4
31	Exchangeable Magnesium	meq/100g	8.6	6.4	5.9	4.8	3.9	3.9-8.6
32	Cation Exchange Capacity	meq/100g	27.48	28.70	28.49	22.85	19.09	19.09-28.7



**TABLE-15 (B)**  
**STANDARD SOIL CLASSIFICATION**

Sr. No.	Soil Test	Classification
1	pH	<4.5 extremely acidic 4.51- 5.50 very strongly acidic 5.51-6.00 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
2	Salinity electrical conductivity ( $\mu\text{mhos/cm}$ ) (1 ppm = 640 $\mu\text{mho/cm}$ )	Up to 1.00 average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops (sensitive to salts)
3	Organic carbon (%)	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
4	Nitrogen (Kg/ha)	Up to 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	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
6	Potash (Kg/ha)	0 -120 very less 120-180 less 181-240 medium 241-300 average 301-360 better >360 more than sufficient

Source: Hand Book of Agriculture, Indian Council of Agricultural Research

➤ **Baseline Soil Status**

- It has been observed that the pH of the soil in the study area ranged from 6.85 to 7.2.
- The electrical conductivity was observed to be in the range of 119.4  $\mu\text{mhos/cm}$  to 215.6  $\mu\text{mhos/cm}$ .
- The nitrogen values range between 89.6 to 152.8 kg/ha. The maximum value was observed at Sahajpur (S4) and the minimum value was observed at Rajapada (S5). The nitrogen content in the study area is less to good category.
- The phosphorus values range between 143.2 to 175.4 kg/ha, with maximum value at Muhammadpur (S2) and Sahajpur (S4) indicating that the phosphorus content in the study area is more than sufficient category



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- The potassium values range between 111.4–541.0 kg/ha. The maximum value was found in Sahajpur (S1) and minimum at Rajapada (S5). The potassium content in the study area very less to more than sufficient category.
- The chlorides were found to be in the range of 141–211 mg/kg of soil. The maximum value was found in Sahajpur (S4) and minimum at Rajapada (S5).



**FIGURE-7**  
**SOIL MONITORING LOCATIONS**

➤ **Noise Level Survey**

The noise monitoring has been conducted for determination of ambient noise levels at five locations in the study area. The details of noise monitoring locations are given in **Table-16**. The noise levels in the study area is given in **Table-17**. The noise monitoring locations are given in **Figure-8**.

**TABLE-16**  
**DETAILS OF NOISE MONITORING LOCATIONS**

Location Code	Noise Sampling Location	Distance (km)	Direction	Zone
N1	Near CGP area (Gate No. 8)	0.3	Near to NE boundary side	Industrial
N2	Near unit-5, Boiler-12 side Road	-	Adjecent To the E side boundary line	Industrial
N3	Near ash silo gate	-	Adjecent to the E side boundary line	Industrial
N4	Nuajamunda village	0.9	Near to E boundary side	Residential
N5	Rajapada	1.1	Near to SE boundary side	Residential

**TABLE-17**  
**NOISE LEVELS [dB (A)] IN THE STUDY AREA**

Station Code	Location	Zone	Limit in dB(A) Leq		L10	L50	L90	Leq	Lday	Lnight	Ldn
			Day	Night							
N1	Near CGP area (Gate No. 8)	Industrial	75	70	68.6	64.9	61.3	65.8	66.4	63.2	70.2
N2	Near unit-5, Boiler-12 side road	Industrial	75	70	60.5	56.6	52.8	57.6	58.5	54.9	62.0
N3	Near ash silo gate	Industrial	75	70	72.3	68.5	65.0	69.4	70.0	67.0	74.0
N4	Nuajamunda village	Rural /Residential	55	45	49.3	45.7	42.0	46.6	47.1	44.1	51.1
N5	Rajapada	Rural /Residential	55	45	51.3	47.4	43.6	48.4	49.4	45.5	52.7

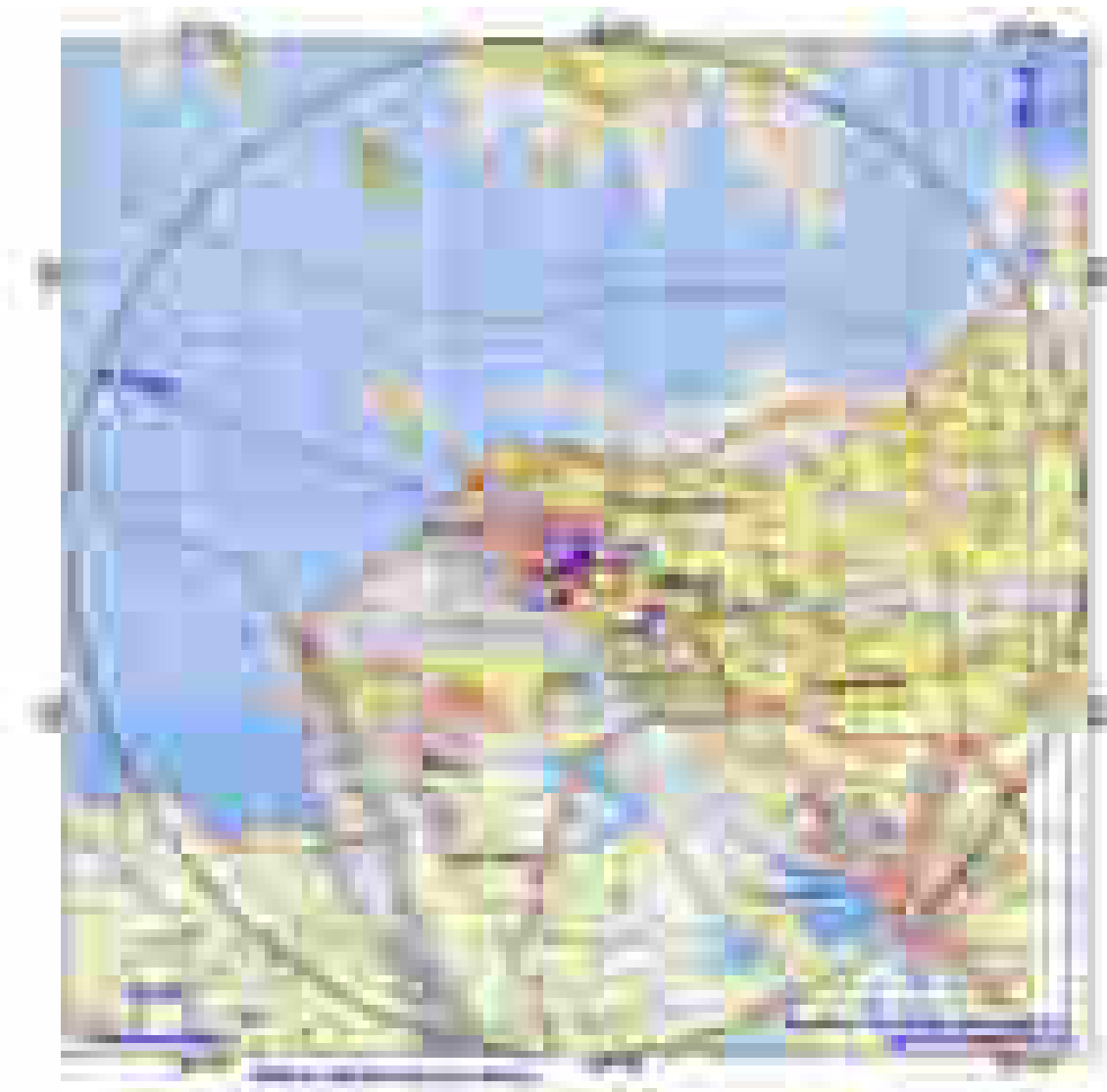
Observations

Day time Noise Levels ( $L_{day}$ )

The day time noise levels at all the locations were ranged in between 47.1 to 70.0 dB(A). The minimum value (47.1 dB (A)) was recorded near Nuajamunda village (N5) and the maximum value (70.0 dB (A)) was recorded at near ash silo gate (N3).

Night time Noise Levels ( $L_{night}$ )

The night time noise levels were ranged in between 44.1 to 67.0 dB (A). The minimum value (44.1 dB (A)) was recorded near Nuajamunda village (N5) and the maximum value (67.0 dB (A)) was recorded at near ash silo gate (N3).



**FIGURE-8**  
**NOISE MONITORING LOCATIONS**



➤ Ecology and Biodiversity

The ultra clean coal gasification plant is going to become an integral part of the existing HIL and it is not located in any forest area and there are no eco-sensitive areas such as the Wildlife Sanctuaries or Biosphere Reserves or National Parks within the project site or its buffer zone of 10 Km radius. But there are reserve forests in the 10 km buffer zone and elephant reserve at 10.5 km and Wildlife sanctuaries within 15 km from the core area as given in **Table-18**.

**TABLE-18**  
**LIST OF RESERVE FORESTS, WILDLIFE SANCTUARIES AND WATER BODIES FOUND WITHIN THE 15 KM BUFFER ZONE OF THE PROJECT EXCEPT BADRAMA WLS, WHICH IS 30 KM FROM THE CORE AREA**

<b>Name of the Reserve Forest (RF)</b>	<b>Direction</b>	<b>Distance (km)</b>
R.F near Tankipara	N	Adjacent
Jamarha R.F	N	1.2
Lakshmi Dungri R.F	SE	1.2
Chandli Dungri R.F	WSW	5.4
Desar R.F	NNW	7.3
Burharaja R.F	SE	8.0
R.F near Butiparha	SE	9.8
Junan R.F	ENE	11.8
Lambai Dungri R.F	SSE	12.3
Lohara R.F	W	13.1
Tabla R.F	W	13.8
Maulabhanja R.F	NE	14.6
Baighara R.F	NE	14.8
<b>Wildlife Sanctuaries (WLS)</b>		
Sambalpur Elephant Reserves	ESE	10.5
Debrigarh WLS	W	13.1
Badrama WLS (Ushakothi)	E	30.0
<b>Water bodies</b>		
Khajjor nala	Passing through site	-
Mahanadi river	W	0.8
Hirakud Reservoir	N	1.4
Rapta nala	W	3.0
Harad nadi	ESE	10.9

As per the working plans of Sambalpur division, the RFs in the area come under 5B/C2 (Northern Tropical Dry Deciduous Forest), as per Champion & Seth (1968). Species such as Shorea robusta (Sal), Neem (Azadirachta indica), Terminalia crenulata (Saja), Madhuca latifolia (Mahuwa), Cleistanthus collinus (Karada), Anogeissus latifolia (Dhaura), Lannea coromandelica (moyen), Cassia siamea (Bada chakunda), Tectona grandis (Teak), Lagerstroemia parviflora (Sidha) etc constitute the ecologically dominant species. Representation of Sal in this type of forest is less, which constitute rarely up to 10% of the total flora. A list of trees, shrubs and perennial climbers found in the buffer zone is given in **Table-19**. A list of herbs and weeds found in the study area including the Hindalco Industries Ltd (HIL) is given in **Table-20**. It may be stated that none of the species listed under the Threatened plants of India by the Botanical Survey of India is found in the study area.



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**TABLE-19  
LIST OF TREES, SHRUBS AND PERENNIAL CLIMBERS FOUND IN THE  
BUFFER ZONE OF THE PROJECT SITE (THE LIST INCLUDES BOTH THE WILD  
AND CULTIVATED PLANTS)**

Scientific Name	Common / Local Name	Family	Habit
<i>Abrus precatorius</i>	Gunja / Runjo	Mimosaceae	Climber
<i>Acacia auriculiformis</i>	Australian Wattle	Mimosaceae	Tree
<i>Acacia caesia</i>	Gurar	Mimosaceae	Climber
<i>Acacia catechu</i>	Khair	Mimosaceae	Tree
<i>Acacia concinna</i>	Sigakai (Chilli)	Mimosaceae	Climber
<i>Acacia ferruginea</i>	Safed Khair	Mimosaceae	Tree
<i>Acacia leucophloea</i>	Reunja / Gohira	Mimosaceae	Tree
<i>Acacia mangium</i>	Mangium	Mimosaceae	Tree
<i>Acacia nilotica</i>	Babul / Bamur	Mimosaceae	Tree
<i>Acacia pennata</i>	Dumtari (Chilli-roal)	Mimosaceae	Climber
<i>Adhatoda zeylanica</i>	Adusa	Acanthaceae	Shrub
<i>Aegle marmelos</i>	Bel / Bela	Rutaceae	Tree
<i>Agave americana</i>	Murga	Agavaceae	Shrub
<i>Agave sisalana</i>	Sisal hemp	Agavaceae	Shrub
<i>Ailanthus excelsa</i>	Mahalimba	Simarubaceae	Tree
<i>Alangium lamarckii</i>	Ankula	Cornaceae	Shrub
<i>Alangium salviifolium</i>	Akol	Cornaceae	Shrub
<i>Albizia lebbek</i>	Siris	Mimosaceae	Tree
<i>Albizia odoratissima</i>	Chichwa	Mimosaceae	Tree
<i>Albizia procera</i>	Garkhair	Mimosaceae	Tree
<i>Albizia stipuluta</i>	Barangi	Mimosaceae	Tree
<i>Alstonia scholaris</i>	Chhatian	Apocynaceae	Tree
<i>Amorphophallus paeonifolius</i>	Oluo	Araceae	Shrub
<i>Anacardium occidentale</i>	Cashew Nut	Anacardiaceae	Tree
<i>Annona reticulata</i>	Ramphal	Annonaceae	Shrub
<i>Annona squamosa</i>	Seethaphal	Annonaceae	Shrub
<i>Anogeissus acuminata</i>	Phasi	Combretaceae	Tree
<i>Anogeissus latifolia</i>	Dhaora / Dhaura	Combretaceae	Tree
<i>Anogeissus pendula</i>	Kardhai	Combretaceae	Tree
<i>Anona squamosa</i>	Sitaphal	Annonaceae	Shrub
<i>Anthocephalus cadamba</i>	Cadam	Rubiaceae	Tree
<i>Antidesma diandrum</i>	Khatua / Jamarla	Euphorbiaceae	Shrub
<i>Antidesma ghaesembilla</i>	Jondharli	Euphorbiaceae	Shrub
<i>Ardisia solenasea</i>	Bat guri	Myrsinaceae	Shrub
<i>Aristolochia indica</i>	Birthwort	Aristolochiaceae	Climber
<i>Artocarpus heterophyllus</i>	Jackfruit	Moraceae	Tree
<i>Artocarpus integrifolia</i>	Panas	Moraceae	Tree
<i>Asparagus racemosus</i>	Satavar / Iswar-jata	Asparagaceae	Climber
<i>Asteracantha longifolia</i>	Koilalakha	Acanthaceae	Shrub
<i>Atylosia volubilis</i>	Ban-kandul	Fabaceae	Shrub
<i>Azadirachta indica</i>	Neem / Nim	Meliaceae	Tree
<i>Bambusa arundinacea</i>	Kanta bans	Poaceae	Bamboo
<i>Bassia latifolia</i>	Mahua / Mahul	Sapotaceae	Tree
<i>Bauhinia malabarica</i>	Amta	Caesalpiniaceae	Tree
<i>Bauhinia purpurea</i>	Keolar	Caesalpiniaceae	Tree
<i>Bauhinia racemosa</i>	Asta	Caesalpiniaceae	Tree
<i>Bauhinia retusa</i>	Sehra / Amthi	Caesalpiniaceae	Tree
<i>Bauhinia vahlii</i>	Mahul / Siali	Caesalpiniaceae	Climber
<i>Bauhinia variegata</i>	Kachnar	Caesalpiniaceae	Tree
<i>Bixa orellana</i>	Japhra	Bixaceae	Small Tree
<i>Bombax malabaricum</i>	Semal	Bombacaceae	Tree
<i>Borassus flabellifer</i>	Taad / Tal	Arecaceae	Tree
<i>Boswellia serrata</i>	Salai / Sarai	Burseraceae	Tree
<i>Bridelia retusa</i>	Kasai / Kasi	Euphorbiaceae	Tree



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Scientific Name	Common / Local Name	Family	Habit
Buchanania latifolia	Achar / Chara	Anacardiaceae	Tree
Bursera serrata	Andiri	Burseraceae	Tree
Butea monosperma	Palas	Fabaceae	Tree
Butea superba	Palasbel / Laipalas	Fabaceae	Climber
Caesalpinia bonducella	Sagargoti	Caesalpinaceae	Climber
Cajanus scarabaeoides	Showy Pigeon pea	Fabaceae	Climber
Callicarpa lanata	Boro	Lamiaceae	Small Tree
Calotropis gigantea	Aak	Asclepiadaceae	Shrub
Calotropis procera	Arakh	Asclepiadaceae	Shrub
Calycopteris floribunda	Kukaranj	Combretaceae	Climber
Canthium glabrum	Canthium	Rubiaceae	Small tree
Careya arborea	Kumbhi	Myrtaceae	Tree
Carissa spinarum	Karonda / Ankhukolt	Apocynaceae	Shrub
Caryota urens	Salap	Arecaceae	Tree
Cascabela thevetia	Yellow oleander	Apocynaceae	Shrub
Casearia graveolens	Gilchi	Samydaceae	Tree
Casearia tomentosa	Tondri / Benimonj	Samydaceae	Tree
Cassia auriculata	Tarwar	Caesalpinaceae	Shrub
Cassia fistula	Amaltas / Sunari	Samydaceae	Tree
Cassia siamea	Siamese Cassia	Caesalpinaceae	Tree
Cedrela toona	Toon	Meliaceae	Tree
Celastrus paniculata	Malkangni / Pengu-mal	Celastraceae	Climber
Cephalostachyum purgracile	Bans(Topi)	Poaceae	Poaceae
Chloroxylon swietenia	Bhirra / Bheru	Meliaceae	Tree
Chromolaena odorata	Tivra Gandha	Asteraceae	Shrub
Cipadessa fucosa	Nalbali	Meliaceae	Tree
Cissampelos pareira	Akunabindh	Menispermaceae	Climber
Cleistanthus collinus	Garari / Karada	Euphorbiaceae	Tree
Clerodendron infortunatum	Bhant / Bhanta	Verbenaceae	Shrub
Clerodendron phlomidis	Inni	Verbenaceae	Shrub
Clerodendrum inerme	Glory Bower	Verbenaceae	Shrub
Cochlospermum gossypium	Galgal / Gonairi	Bixaceae	Tree
Colebrookea oppositifolia	Kalabansa	Labiatae	Shrub
Colocasia esculenta	Saru (Bono)	Araceae	Shrub
Combretum decandrum	Pivarbel / Atundi	Combretaceae	Climber
Combretum ovalifolium	Hathisandan	Combretaceae	Climber
Combretum roxburghii	Paibal / Punk	Combretaceae	Climber
Cordia myxa	Lasora	Boraginaceae	Tree
Crateva religiosa	Barna / Baruna	Capparidaceae	Tree
Cryptolepis buchanani	Nagbel / Dudhi-mal	Asclepiadaceae	Climber
Cuscuta reflexa	Amarbel	Convolvulaceae	Climber
Dalbergia latifolia	Shisham	Fabaceae	Tree
Dalbergia paniculata	Dhobin / Barbakulia	Fabaceae	Tree
Dalbergia sissoo	Sissoo	Fabaceae	Tree
Dendrocalamus strictus	Bans (Dongor)	Poaceae	Bamboo
Derris scandens	Tupbel	Fabaceae	Climber
Desmodium pulchellum	Chipti	Fabaceae	Shrub
Dichrostachys cinerea	Velati	Mimosaceae	Tree
Dillenia aurea	Chhota Rai	Dilleniaceae	Tree
Dillenia indica	Chalta	Dilleniaceae	Tree
Dillenia pentagyna	Kalla / Rai	Dilleniaceae	Tree
Dioscorea bulbifera	Kuhia kanda	Dioscoreaceae	Climber
Dioscorea dremona	Baichandi	Dioscoreaceae	Climber
Dioscorea pentaphylla	Pita alu	Dioscoreaceae	Climber
Diospyros cordifolia	Bhaktendu	Ebenaceae	Tree
Diospyros embryopteris	Makadkendu	Ebenaceae	Tree
Diospyros melanoxylon	Tendu / Kendu	Ebenaceae	Tree
Diospyros montana	Bistendu	Ebenaceae	Tree
Dodonaea viscosa	Kharenta	Sapindaceae	Shrub
Dolichandrone falcata	Medhsingh	Bignoniaceae	Tree



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Scientific Name	Common / Local Name	Family	Habit
Ehretia laevis	Datranga	Boraginaceae	Tree
Embelia robusta	Baibirang	Myrsinaceae	Shrub
Entada scandens	Gila	Fabaceae	Climber
Erioglossum rubiginosum	Dogwood	Sapindaceae	Tree
Eriolaena hookeriana	Bhoti / Paldhua	Sterculiaceae	Shrub
Erythrina suberosa	Pangra	Fabaceae	Tree
Eucalyptus tereticornis	Eucalyptus	Myrtaceae	Tree
Eugenia heyneana	Kath Jamun	Myrtaceae	Shrub
Eugenia jambolana	Jamun	Myrtaceae	Tree
Eugenia operculata	Poi-gam	Myrtaceae	Tree
Euphorbia neriifolia	Thuar	Euphorbiaceae	Shrub
Euphorbia nivulia	Sehund	Euphorbiaceae	Tree
Euphorbia royaleana	Siju	Euphorbiaceae	Small Tree
Euphorbia tirucalli	Niwarang	Euphorbiaceae	Tree
Feronia elephantum	Kaith / Khaita	Rutaceae	Tree
Ficus bengalensis	Bar / Bara	Moraceae	Tree
Ficus cunia	Purhei (Padeikoli)	Moraceae	Tree
Ficus glomerata	Dimiri	Moraceae	Tree
Ficus religiosa	Pipal	Moraceae	Tree
Flacourtia indica	Kakai	Flacourtiaceae	Tree
Flacourtia sepiaria	Bainchu	Flacourtiaceae	Tree
Flemingia chappar	Rani-kathi	Fabaceae	Tree
Gardenia latifolia	Papra / Dara kurudu	Rubiaceae	Tree
Gardenia lucida	Dikamali	Rubiaceae	Tree
Gardenia resinifera	Dikamali / Gurudu	Rubiaceae	Tree
Gardenia turgida	Phetra / Khurdu	Rubiaceae	Tree
Garuga pinnata	Kekad	Burseraceae	Tree
Glochidion lanceolarium	Glochidium	Phyllanthaceae	Small Tree
Gmelina arborea	Gamari / Gambhari	Verbenaceae	Tree
Grewia hirsuta	Gursakri / Suna-ragoda	Tiliaceae	Shrub
Grewia tiliaefolia	Dhaman	Tiliaceae	Tree
Gymnema sylvestre	Gudmar	Asclepiadaceae	Climber
Gymnosporia montana	Baikal	Celastraceae	Shrub
Haldinia cordifolia	Haldu / Kurum	Rubiaceae	Tree
Helicteres isora	Marorphali / Mur-muri	Sterculiaceae	Shrub
Hemidesmus indicus	Ananta-mul	Apocynaceae	Climber
Hiptage bengalensis	Mali (bura)	Malpighiaceae	Climber
Holarrhena antidysenterica	Kurchi	Apocynaceae	Shrub
Holoptelea integrifolia	Chirol / Dhauranjan	Ulmaceae	Tree
Hygrophila spinosa	Talmakhana	Acanthaceae	Shrub
Hymenodictyon excelsum	Kansa (Budhimahul)	Rubiaceae	Tree
Ichnocarpus frutescens	Dhimarbel / Sugandhi-mal	Apocynaceae	Climber
Indigofera pulchella	Neel / Girli	Fabaceae	Shrub
Ipomoea carnea	Bush morning glory	Convolvulaceae	Shrub
Ipomoea reptans	Kalami sag	Rubiaceae	Shrub
Ixora parviflora	Lokhandi / Telkuran	Rubiaceae	Shrub
Jasminun humile	Kundo-phul	Oleaceae	Climber
Kydia calycina	Pula / Ban capasia	Malvaceae	Tree
Lagerstroemia indica	Pride of India	Lythraceae	Tree
Lagerstroemia parviflora	Seja	Lythraceae	Tree
Lannea coromandelica	Moi	Anacardiaceae	Tree
Lantana camara	Raimunia	Verbenaceae	Shrub
Largerstroemia parviflora	Sena (Sidha)	Lythraceae	
Leea macrophylla	Hathikand / Had kinkali	Vitaceae	Shrub
Limonia acidissima	Bilsena / Behenta	Rutaceae	Tree
Litsea macrophylla	Gad panas	Lauraceae	Tree
Litsea sebifera	Maidalakri	Lauraceae	Tree
Loranthus longiflorus	Bandha	Loranthaceae	Parasite
Loranthus parasiticus	Madang	Loranthaceae	Parasite



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Scientific Name	Common / Local Name	Family	Habit
Madhuca longifolia	Mahua	Sapotaceae	Tree
Mallotus philippinensis	Roli / kamalgundi	Euphorbiaceae	Tree
Mangifera indica	Aam / Amba	Anacardiaceae	Tree
Marsdenia tenacissima.	Chikti	Asclepiadaceae	Climber
Millettia auriculata	Gauj	Fabaceae	Climber
Milium velutina	Gandh palas / Patruasu	Annonaceae	Tree
Millettia auriculata	Arkala	Fabaceae	Tree
Mimusops hexandra	Khirmi	Sapotaceae	Tree
Mitragyna parvifolia	Kaim / Mundi	Rubiaceae	Tree
Morinda tinctoria	Aal / Anchu	Rubiaceae	Tree
Mucuna pruriens	Kewanch / Baidhanka	Fabaceae	Climber
Murraya exotica	Madhukamini / Hinjala	Rutaceae	Tree
Murraya koenigii	Mithinim / Bhersinga	Rutaceae	Tree
Musa superba	Bankndeli	Musaceae	Shrub
Nyctanthes arbortristis	Harsingar / Gutikbadiku	Verbenaceae	Shrub
Odina wodier	Jhingan	Anacardiaceae	Tree
Opuntia dillenii	Nagphani	Cactaceae	Shrub
Oroxylon indicum	Papuni	Bignoniaceae	Tree
Ougeinia oojenensis	Tinsa / Bandhan	Fabaceae	Tree
Oxytenanthera albociliata	Bans (Pani)	Poaceae	Bamboo
Oxytenanthera monostigma	Bans(Patsi)	Poaceae	Bamboo
Petalidium barlerioides	Indrajata	Acanthaceae	Shrub
Phoenix acaulis	Dwarf Khajur / Ban khnjuri	Arecaceae	Palms
Phoenix sylvestris	Khajur	Arecaceae	Palms
Phyllanthus emblica	Aonla	Phyllanthaceae	Tree
Pogostemon plectranthoides	Kora	Labiatae	Shrub
Pongamia pinnata	Karanj / Karanjo	Fabaceae	Tree
Prosopis cineraria	Chenkur	Mimosaceae	Tree
Prosopis juliflora	Khejra	Mimosaceae	Tree
Pterocarpus marsupium	Bijasal / Bija	Fabaceae	Tree
Pterospermum heyneianum	Giringa	Malvaceae	Tree
Randia dumetorum	Mainphal / Mohana	Rubiaceae	Tree
Randia uliginosa	Katul / Theika	Rubiaceae	Tree
Saccharum spontaneum	Tandi(Kasatandi)	Poaceae	Tall grass
Salmalia malabarica	Simul	Bombacaceae	Tree
Salvadora oleoides	Pilu	Salvadoraceae	Tree
Sapindus laurifolius	Ritha	Sapindaceae	Tree
Schleichera trijuga	Kusum	Oleaceae	Tree
Schrebera swietenoides	Mokha	Oleaceae	Tree
Semecarpus anacardium	Bhilma / Bhalia	Anacardiaceae	Tree
Shorea robusta	Sal	Dipterocarpaceae	Tree
Smilax macrophylla	Mut-uri / Ramdaton	Smilacaceae	Climber
Soymida febrifuga	Rohan / Rohini	Meliaceae	Tree
Spatholobus roxburghii	Nasbel / Mardha-mal	Fabaceae	Climber
Spondias mangifera	Amra / Amda	Anacardiaceae	Tree
Stephegyne parvifolia	Kaim	Rubiaceae	Tree
Sterculia urens	Kulu / Genduli	Sterculiaceae	Tree
Sterculia villosa	Kodali	Sterculiaceae	Tree
Stereopermum angustifolium	Chhai putoli	Bignoniaceae	Tree
Stereospermum suaveolens	Padhel	Bignoniaceae	Tree
Streblus asper	Majni / Sahada	Moraceae	Tree
Strobilanthes callosus	Maruadona	Acanthaceae	Shrub
Strychnos nux-vomica	Jahar / Kochila	Loganiaceae	Tree
Strychnos potatorum	Katak	Loganiaceae	Tree
Syzygium cumini	Jamu	Myrtaceae	Tree
Tamarindus indica	Imli / Tnetuli	Caesalpiniaceae	Tree
Tectona grandis	Sagon / Sagan	Verbenaceae	Tree
Terminalia arjuna	Arjun	Combretaceae	Tree
Terminalia belerica	Bahera / Baheda	Combretaceae	Tree
Terminalia chebula	Harra / Harida	Combretaceae	Tree



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Scientific Name	Common / Local Name	Family	Habit
Terminalia crenulata	Asan	Combretaceae	Tree
Terminalia tomentosa	Saj	Combretaceae	Tree
Thysanolaena agrostis	Phul badhuni	Poaceae	Tall grass
Tinospora cordifolia	Giloy	Menispermaceae	Climber
Urena lobota	Jatjoti	Malvaceae	Shrub
Vallisneria spiralis	Dudhbel	Apocynaceae	Climber
Ventilago calyculata	Keoti	Rhamnaceae	Climber
Ventilago madaraspatana	Petchurimal	Rhamnaceae	Climber
Vetiveria zizanioides	Khus-khus (Bena)	Poaceae	Tall grass
Vitex negundo	Nirgundi	Verbenaceae	Shrub
Vitex peduncularis	Chadel gudi	Verbenaceae	Shrub
Waltheria indica	Halduli	Sterculiaceae	Shrub
Wendlandia exserta	Tilwan	Rubiaceae	Tree
Wendlandia tinctoria	Tilai	Rubiaceae	Tree
Woodfordia floribunda	Dhawai	Lythraceae	Shrub
Woodfordia fruticosa	Dhatki	Lythraceae	Shrub
Wrightia tinctoria	Dudhi	Apocynaceae	Tree
Wrightia tomentosa	Kalidudhi / Bod-kurhein	Apocynaceae	Tree
Xanthoxylon rhetsa	Raj simal	Rutaceae	Tree
Xylia xylocarpa	Tangini	Mimosaceae	Tree
Ziziphus oenopia	Kantoikoli	Rhamnaceae	Climber
Zizyphus jujuba	Ber	Rhamnaceae	Tree
Zizyphus rotundifolia	Jharberi	Rhamnaceae	Shrub
Zizyphus rugosa	Churna	Rhamnaceae	Shrub
Zizyphus xylopyra	Ghonto	Rhamnaceae	Tree

**TABLE-20**  
**LIST OF HERBS AND WEEDS FOUND IN THE STUDY AREA INCLUDING THE HINDALCO INDUSTRIES LTD**

Scientific Name	Family
Cucumis melo L.	Cucurbitaceae
Acanthospermum hispidum DC.	Asteraceae
Aerva lanata (L.) Juss. ex. Schult.	Amaranthaceae
Aeschynomene indica L.	Fabaceae
Ageratum conyzoides L.	Asteraceae
Alternanthera philoxeroides (Mart.) Griseb.	Amaranthaceae
Alternanthera pungens Kunth	Amaranthaceae
Alternanthera sessilis (Linn) DC.	Amaranthaceae
Amaranthus spinosus L.	Amaranthaceae
Argemone mexicana L.	Papaveraceae
Bidens pilosa L.	Asteraceae
Blainvillea acmella (L.) Philipson	Asteraceae
Blumea lacera (Burm.f.) DC.	Asteraceae
Cardamine scutata L.	Brassicaceae
Cardiospermum halicacabum L.	Sapindaceae
Cassia obtusifolia L.	Caesalpiniaceae
Cassia occidentalis L.	Caesalpiniaceae
Cassia tora L.	Caesalpiniaceae
Catharanthus pusillus (Murr.) G. Don.	Apocynaceae
Celosia argentea L.	Amaranthaceae
Chenopodium album L.	Chenopodiaceae
Chloris barbata Sw.	Poaceae
Chrozophora rottleri (Geisel.) Juss.	Euphorbiaceae
Cleome gynandra L.	Capparaceae
Cleome monophylla L.	Capparaceae
Cleome rutidosperma DC	Capparaceae
Cleome viscosa L.	Capparaceae
Convolvulus nervosus Burm.f.	Convolvulaceae



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<b>Scientific Name</b>	<b>Family</b>
Corchorus aestuans L.	Tiliaceae
Crotalaria pallida Ait	Fabaceae
Crotalaria retusa L.	Fabaceae
Croton bonplandianum Baill.	Euphorbiaceae
Cuscuta reflexa Roxb.	Cuscutaceae
Cynodon dactylon (L.) Pers.	Poaceae
Cyperus difformis L.	Cyperaceae
Cyperus iria L.	Cyperaceae
Echinochloa colona (L.) Link	Poaceae
Echinochloa crus-galli Beauv.	Poaceae
Eclipta prostrata L.	Asteraceae
Eichhornia crassipes (Mart.) Solm.	Pontederiaceae
Emilia sonchifolia (L.) DC.	Asteraceae
Euphorbia heterophylla auct. Non L.	Euphorbiaceae
Euphorbia hirta L.	Euphorbiaceae
Euphorbia thymifolia L.	Euphorbiaceae
Evolvulus nummularius L.	Convolvulaceae
Gnaphalium polycaulon Pers.	Asteraceae
Gomphrena celosioides Mart.	Amaranthaceae
Gomphrena globosa L.	Amaranthaceae
Grangea maderaspatana L.	Asteraceae
Heliotropium indicum L.	Boraginaceae
Hyptis suaveolens (L.) Poit.	Lamiaceae
Impatiens balsamina L.	Balsaminaceae
Indigofera linnaei Ali	Fabaceae
Ipomoea hederifolia L.	Convolvulaceae
Ipomoea obscura (L.) Ker-Gaw	Convolvulaceae
Ipomoea pes-tigridis L.	Convolvulaceae
Ipomoea quamoclit L.	Convolvulaceae
Leonotis nepetifolia (L.) R.Br.	Lamiaceae
Malvastrum coromandelianum (L.) Garcke	Malvaceae
Melochia corchorifolia L.	Sterculiaceae
Merremia vitifolia (Burm.f.) Hall.f.	Convolvulaceae
Mimosa pudica L.	Mimosaceae
Ocimum canum Sims	Lamiaceae
Oxalis corniculata L.	Oxalidaceae
Parthenium hysterophorus L.	Asteraceae
Pedalium murex L.	Pedaliaceae
Peperomia pellucida (L.) Kunth	Piperaceae
Peristrophe bicalyculata (Retz.) Nees.	Acanthaceae
Phyla nodiflora (L.) Greene	Verbenaceae
Physalis angulata L.	Solanaceae
Physalis minima L.	Solanaceae
Portulaca oleracea L.	Portulacaceae
Portulaca quadrifida L.	Portulacaceae
Rhoeo discolor Hance.	Commelinaceae
Richardia scabra L.	Rubiaceae
Ruellia tuberosa L.	Acanthaceae
Saccharum spontaneum L.	Poaceae
Scoparia dulcis L.	Scrophulariaceae
Sida acuta Burm.f.	Malvaceae
Solanum nigrum L.	Solanaceae
Sonchus asper (L.) Hill	Asteraceae
Spermacoce articularis L.	Rubiaceae
Sphaeranthus indicus L.	Asteraceae
Spilanthes acmella (L.) L.	Asteraceae
Spinacia oleracea L.	Chenopodiaceae
Stachytarpheta jamaicensis (L.) Vahl.	Verbenaceae
Stylosanthes hamata L.	Fabaceae
Synedrella nodiflora (L.) Gaertn.	Asteraceae



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Scientific Name	Family
Tagetes erecta L.	Asteraceae
Tagetes patula L.	Asteraceae
Tribulus terrestris L.	Zygophyllaceae
Tridax procumbens L.	Asteraceae
Triumfetta pentandra A.Rich.	Tiliaceae
Turnera ulmifolia L.	Turneraceae
Urena lobata L.	Malvaceae
Vernonia cinerea L.	Asteraceae
Waltheria indica L.	Sterculiaceae
Xanthium indicum L.	Asteraceae
Xanthium strumarium L.	Asteraceae

### Terrestrial Fauna of the Study Area

The study area comes under the territorial jurisdiction of the Hirakud Wildlife Division. It was created in 2003 by the Sambalpur forest division (vide Government Resolution NO.1F(A)-100/2003/13228/ F&E dt.8.8.2003). Thus, the Hirakud Wildlife Division was not there when the HIL was established in 1959. The boundary of the Sambalpur Elephant Reserve is about 10.5 km towards the East Southeast of the HIL. The Debrigarh WLS is about 13.1 km from core area. Though there are no eco-sensitive areas with the 10 km radius for the core area, there is an elephant reserve and a wildlife Sanctuary between 10.5 to 13.1 km from the core zone respectively.

Herbivores such as Spotted deer, Sambhar, Four horned Antelope, Nilgai, and Carnivores such as Leopard and other animals such as Indian Gaur, Bear, Wild Boar, Civet, Porcupine, Hanuman Langur etc. are noticed. Among birds Peafowls are seen in plenty. Other birds such as Eagle, Owl, Parrot, Flycatcher, Sunbird, Hornbill, Crow, Pigeon, Nightjar etc. are seen. Python, Cobra and other snakes are rarely seen. There are 19 numbers of elephants in this sanctuary and captive one named Kharshel. Wildlife including leopards are very often sighted. Bison and Sambhar are endemic to this region in the Odisha State. Nilgai is a rare species which is occasionally sighted. However, according the site inspection and survey carried out by the forest department of Sambalpur division under the supervision of the D.F.O, in connection with the diversion of 9.44 ha of Lamdungri R.F for spillway, there were no RET species in the area under consideration.

As the core area is secured from its surroundings by a compounding wall and hence it is isolated from the surrounding areas but there are no barriers for movement of flying animals like bats, birds; arboreals like primates and squirrels and certain species of reptiles between the core area and the buffer zone. There are chances of sharing the core area and the buffer zone by the same animal species at different times. As the animals are capable of moving from place to place either for food or shelter or mate, there is no justification for listing them separately for different areas. Hence, common lists are prepared based both on primary data and the available secondary data. Primary data is based on the direct observation, indirect or circumstantial evidence such as foot prints, feathers, skin, hair, hooves etc. The area of survey and study extends up to a radius of 10 km in case of terrestrial fauna. Though there are dense forests adjacent to the existing plant, no major wild animal was spotted at any time in the core area, according the workers deployed in the plant operations. As the Project site is subjected to extensive anthropogenic and biotic disturbances, the chances of



occurrence of any rare or endangered wildlife is remote as far as the core area is concerned. But the reserve forests (RF) found in the buffer zone are a source of biodiversity. There are no reports or records of occurrence of any rare or endangered or threatened (RET) animals such as the Asian Elephant in the reserved forests within the 10 km radius of the project site. A list of mammals either spotted or reported from the study area is given in **Table-21**. A list of reptiles and amphibians either spotted or reported from the study area is given in **Table-22**. Many terrestrial birds such as Indian Ring dove, Minnows, Finches, Crows, Sparrows, Parrots, Mynas, Swifts, Doves, Pigeons, Egrets, Weavers, Crows, Woodpeckers, Kingfishers etc were common. None of the species other than Peacock (*Pavo cristatus*) is listed in Schedule I of the Indian Wildlife (Protection) Act was found in the study area. Though Peacock is Schedule-I, it does not belong to the RET category of the IUCN. If allowed to domesticate, it is easy to multiply them. Further, they are not threatened by poaching since it attracts severe punishment. Hence, no specific action plan for its conservation is required. A list of butterflies and other insects found during the survey are listed in **Table-23**.

**TABLE-21**  
**LIST OF MAMMALS EITHER SPOTTED OR REPORTED**  
**FROM THE STUDY AREA**

VU means vulnerable; NT means near threatened; EN means endangered and LC means least concern			
Scientific Name	Common Name	Local Name	IUCN /WPA
<i>Axix axis</i>	Spotted Deer	Cheetal	LC / III
<i>Bandicoota bengalensis</i>	Lesser bandicoot	Chota chuhah	LC / V
<i>Bandicota indica</i>	Greater Bandicoot	Bada Chuhah	LC / V
<i>Boselaphus tragocamelus</i>	Blue buck	Nilgai	LC / III
<i>Canis aureus</i>	Jackal	Geedad	LC / II
<i>Cynopterus sphinx</i>	Short nosed Fruit Bat	Chamgad	LC / IV
<i>Felis chaus</i>	Jungle cat	Jungly billii	LC / III
<i>Funambulus palmarum</i>	Three striped Squirrel	Squirrel	LC / V
<i>Hystrix indica</i>	Indian porcupine	Shahi	LC / IV
<i>Lepus nigricollis</i>	Common Indian Hare	Khargosh	LC / IV
<i>Macaca mulatta</i>	Rhesus macaque	Bander	LC / II
<i>Presbytis entellus</i>	Common langur	Langoor	LC / II
<i>Rattus rattus</i>	Rat	House rat	LC / V
<i>Rusa unicolor</i>	Sambar	Sambar deer	VU / III
<i>Suncus murinus</i>	Asian musk shrew	Chuchunder	LC / V
<i>Sus scrofa</i>	Wild pig	Jungly Suvar	LC / III
<i>Vulpes bengalensis</i>	Indian fox	Lomdi	LC / II

**TABLE-22**  
**LIST OF REPTILES AND AMPHIBIANS EITHER SPOTTED**  
**OR REPORTED FROM THE STUDY AREA**

NT means Near Threatened and LC means Least concern.			
Scientific Name	Common Name	Local Name	IUCN /WPA
<b>Reptiles</b>			
<i>Ahaetulla nasuta</i>	Green vine snake	Harshara	LC / II
<i>Amphiesma stolatum</i>	Buff striped keelback	Buff striped keelback	LC / II
<i>Bungarus caeruleus</i>	Common Indian Krait	Karait	LC / II
<i>Calotes versicolor</i>	Garden lizard	Chipaakali	LC / IV
<i>Chameleon zeylanicus</i>	Chameleon	Giragit	LC / II
<i>Cnemaspis indica</i>	Indian Day Gecko	Chhipaakali	LC / IV
<i>Dendrelaphis tristis</i>	Tree Snake	Tree snake	LC / II
<i>Echis carinatus</i>	Saw scaled viper	Fursa	LC / II



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NT means Near Threatened and LC means Least concern.

Scientific Name	Common Name	Local Name	IUCN /WPA
Eryx johnii	Sand boa	Red sand boa	LC / IV
Eutropis carinata	Indain grass Skink	Skink	LC / IV
Eutropis multifasciata	Common skink	Skink	LC / II
Geochelone elegans	Indian star tortoise	Star tortoise	LC / IV
Hemidactylus flaviviridis	Indian wall lizard	House Gecko	LC / IV
Hemidactylus leschenaultii	Marbled tree gecko	Lizard	LC / IV
Lycodon aulicus	Wolf snake	Wolf snake	LC / II
Melanochelys trijuga	Indian black turtle	Kacchawa	LC / II
Naja naja	Indian cobra	Nag	LC / II
Ptyas mucosus	Rat snake	Dhaman	LC / II
Python molurus	Python	Python	NT / I
Testudo elegans	Star Tortoise	Kacchawa	LC / II
Typhlops diardii	Giant Blind Snake	Blind snake	LC / II
Typhlops porrectus	Slender Blind Snake	Blind snake	LC / II
Varanus bengalensis	Common Indian Monitor	Chhipkali / Goh	LC / I
Vipera russelli	Russell's viper	Viper	LC / II
<b>Amphibians</b>			
Bufo melonosticatus	Common Indian Toad	Bhek	LC / IV
Hoplobatrachus tigerinus (Rana tigerina)	Tiger Frog	Bull Frog	LC / IV
Hyla arborea	Tree Frog	Tree frog	LC / IV
Rana hexadactyla.	Green Pond Frog	Green Frog	LC / IV

**TABLE-23**  
**LIST OF BIRDS EITHER SPOTTED OR REPORTED FROM THE STUDY AREA.**

IUCN status for rare or endangered or threatened species is shown in parenthesis.

Scientific Name	Common or Local Name	ICCN /WPA Schedule
Acridotheres tristis	Common myna	LC / IV
Aegithinia tiphia	Common Iora	LC / IV
Alcedo atthis	Small blue kingfisher	LC / IV
Andeolv grayii	Pond heron	LC / IV
Apus nipalensis	House swifts	LC / IV
Bubo bengalensis	Great horned Owl	LC / IV
Bubo virginianus	Great horned owl	LC / IV
Bubulcus ibis	Cattle Egret	LC / IV
Caprimulgus asiaticus	Indian Nightjar	LC / IV
Ceryle rudis	Lesser pied Kingfisher	LC / IV
Columba livia	Blue rock pigeon / Kabotar	LC / IV
Coracias benghalensis	Nilkanth / Indian Roller	LC / IV
Corvus splendens	House crow	LC / V
Dendrocitta vagabunda	Indian tree pie	LC / IV
Dendrocopus marhatensis	Maratha Woodpecker	LC / IV
Dicrurus macrocercus	Black drongo	LC / IV
Egretta garzetta	Little egret	LC / IV
Eudyanamys sclopacea	Koel	LC / IV
Francolinus Pictus	Painted partridge / Teetar	LC / IV
Francolinus pondicerianus	Grey partridge / Safed Teetar	LC / IV
Gallus gallus	Red jungle fowl / Murgi jungli	LC / IV
Gallus sonneratii	Grey jungli fowl / Murgi jungli	LC / IV
Halcyon smyrnensis	White-Breasted King fisher	LC / IV
Hierococcyx varius	Common hawk-cuckoo	LC / IV
Merops orientalis	Little Green Bee Eater	LC / IV
Milvus migrans	Common pariah Kite / Cheel	LC / IV
Motacilla alba	White wagtail	LC / IV
Oriolus oriolus	Golden Oriole	LC / IV
Passer domesticus	House sparrow	LC / IV



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IUCN status for rare or endangered or threatened species is shown in parenthesis.

Scientific Name	Common or Local Name	ICCN /WPA Schedule
<i>Pavo cristatus</i>	Pea fowl / Mayur	LC / I
<i>Perdicula asiatica</i>	Bush quail / Bater	LC / IV
<i>Phalacrocorax carbo</i>	Large Cormorant	LC / IV
<i>Phalacrocorax niger</i>	Little cormorant	LC / IV
<i>Ploceus philippinus</i>	Weaver bird	LC / IV
<i>Psittacula cyanocephala</i>	Blossom headed Parakeet	LC / IV
<i>Psittacula krameri</i>	Rose-Ringed Parakeet	LC / IV
<i>Pycnonotus barbatus</i>	Common Bulbul	LC / IV
<i>Pycnonotus cafer</i>	Red-vented bulbul	LC / IV
<i>Pycnonotus jocosus</i>	Red whiskered Bulbul	LC / IV
<i>Saxicolodides fucicata</i>	Indian robin	LC / IV
<i>Sterptopelia chinensis</i>	Spotted Dove / Chitta fakata	LC / IV
<i>Streptopelia chinensis</i>	Spotted dove	LC / IV
<i>Sturnus contra</i>	Pied myna	LC / IV
<i>Sturnus pagodrum</i>	Brahminy myna	LC / IV
<i>Taccocua leschenaur</i>	Parrot / Jungly Tota	LC / IV
<i>Treron phoenicoptera</i>	Green pigeon / Harial	LC / IV
<i>Turdoides caudatus</i>	Common babbler	LC / IV
<i>Tyto alba</i>	Barn owl	LC / IV
<i>Upupa epops</i>	Common hoopoe	LC / IV

**TABLE-24  
LIST OF BUTTERFLIES AND INSECTS SPOTTED IN THE STUDY AREA  
BY SURVEY TEAM**

Latin Name	Common Name	WPA Schedule
<i>Pseudocoladenia dan dan</i>	Fulvous pied flat	IV
<i>Precis lemonias lemonias</i>	Lemon pansy	IV
<i>Precis hierta hierta</i>	Yellow Pansy	IV
<i>Tros aristolochiae</i>	Common rose	IV
<i>Araca violae</i>	Tawny costar	IV
<i>Tirumala limniace</i>	Blue Tiger	IV
<i>Euploea corecor</i>	Common Crow	IV
<i>Danusus aglea</i>	Glassy Blue Tiger	IV
<i>Precis orithya</i>	Blue pansy	IV
<i>Hypolimnas misippus</i>	Danaid egg fly	IV
<i>Neptis hylas</i>	Common sailor	IV
<i>Papilio demoleus</i>	Lime butterfly	IV
<i>Catopsilia crocale</i>	Common emigrant	IV
<i>Danais chrysippus</i>	Plain tiger	IV
Other insects		
<i>Brachytron pratense</i>	Hairy Dragonfly	Not listed
<i>Anax imperator</i>	Emperor Dragonfly	Not listed
<i>Tettigonia viridissima</i>	Grasshopper	Not listed
<i>Hieroglyphus banian</i>	Rice grasshopper	Not listed
<i>Nephotettix apicalis</i>	Paddy Jassids	Not listed
<i>Hyblea pura</i>	Skeletonizer	Not listed
<i>Hepalia mauritia</i>	Defoliators	Not listed
<i>Spodoptera mauritia</i>	Swarming caterpillar	Not listed

List of important wild animals reported from the Sambalpur elephant reserves and Debrigarh Wildlife Sanctuary located at a distance of 10.5 to 13.1 km from the core area is given in **Table-25**.



**TABLE-25**  
**LIST OF IMPORTANT MAMMALS, BIRDS AND REPTILES REPORTED FROM THE SAMBALPUR ELEPHANT RESERVE AND THE DEBRIGARH WILDLIFE SANCTUARY, LOCATED BEYOND THE 10 KM BUFFER ZONE BUT WITHIN 15 KM FROM THE CORE ZONE**

Scientific Name	Common Name	Group	IUCN / WPA
<i>Axis axis</i>	Spotted deer / Chital	Mammal	LC / III
<i>Bos gaurus</i>	Indian Gaur/ Bison	Mammal	VU / I
<i>Boselaphus tragocamelus</i>	Nilgai / Blue bull	Mammal	LC / III
<i>Elephas maximus indicus</i>	Elephant	Mammal	EN / I
<i>Hystrix indica</i>	Porcupine	Mammal	LC / IV
<i>Melursus ursinus</i>	Sloth Bear	Mammal	VU / I
<i>Panthera pardus fusca</i>	Leopard	Mammal	VU / I
<i>Paradoxurus hermaphroditus</i>	Asian Palm Civet	Mammal	LC / III
<i>Rusa unicolor</i>	Sambar Deer	Mammal	LC / III
<i>Semnopithecus entellus</i>	Hanuman Langur	Mammal	LC / II
<i>Sus scrofa</i>	Wild Boar	Mammal	LC / III
<i>Tetracerus quadricornis</i>	Four horned Antelope	Mammal	VU / I
<i>Clanga hastata</i>	Indian spotted Eagle	Bird	LC / IV
<i>Ocyrceros birostris</i>	Indian Grey Hornbill	Bird	LC / IV
<i>Pavo cristata</i>	Peacock	Bird	LC / I
<i>Python molurus</i>	Python	Reptile	NT / I
<i>Varanus bengalensis</i>	Bengal monitor	Reptile	LC / I

As many as 8 Schedule-I species are reported from the Elephant Reserve and the WLS located outside the buffer zone. Except Elephant (EN category of the IUCN), others belong to lower risk categories of LC (least concern), NT (near threaten) and VU (vulnerable) categories of the IUCN. Since the Schedule-I species are reported from the Elephant Reserve and the WLS, no additional conservation plan is required.

**Aquatic Flora and Fauna**

Some of the stagnant water bodies were fully choked with Water Hyacinth (*Eichhornia crassipes*), *Ceratophyllum demersum*, *Ipomoea aquatica*, *Nelumbo nucifera*, *Nymphaea nouchali*, *Nymphaea pubescens*, *Nymphaea rubra*, *Nymphaea stellate*, *Nymphoides cristatum*, *Ottelia alismoides*, *Pistia stratiotes*, *Eichhornia crassipes* and others. the flows from North to South in the western part of the buffer zone. There are many seasonal streams and a few tanks but there are no perennial water bodies. A list of aquatic and semi-aquatic macrophytes found in the buffer zone is given in **Table-26**. A list of fishes either caught by fisherman or reported from the river is given in **Table-27**.

**TABLE-26**  
**LIST OF AQUATIC /SEMI-AQUATIC MACROPHYTES FOUND IN THE LOTIC AND LENTIC WETLANDS OF THE STUDY AREA**

Scientific Name	Family	Habit
<i>Aeschynomene aspara</i>	Fabaceae	Rooted emergent
<i>Aeschynomene indica</i>	Fabaceae	Rooted emergent
<i>Alternanthera philoxeroides</i>	Amaranthaceae	Rooted emergent
<i>Alternanthera sessilis</i>	Amaranthaceae	Rooted emergent
<i>Ammania baccifera</i>	Lythraceae	Emergent anchored



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<b>Scientific Name</b>	<b>Family</b>	<b>Habit</b>
Aponogeton crispum	Aponogetonaceae	Floating
Aponogeton natans	Aponogetonaceae	Floating
Azolla pinnata	Azollaceae	Floating
Ceratophyllum demersum	Ceratophyllaceae	Floating
Cynodon dactylon	Poaceae	Emergent anchored
Cyperus rotundus	Cyperaceae	Emergent anchored
Echinochloa colona	Poaceae	Emergent anchored
Eclipta alba	Asteraceae	Emergent anchored
Eclipta procera	Asteraceae	Semiaquatic
Eichhornia crassipes	Pontederiaceae	Floating
Eleocharis dulcis	Cyperaceae	Rooted emergent
Fimbristylis tetragona	Cyperaceae	Rooted emergent
Hydrilla verticillata	Hydrocharitaceae	Submerged anchored
Imperata cylindrica	Poaceae	Wetlands
Ipomoea aquatica	Convolvulaceae	Floating
Ipomoea carnea	Convolvulaceae	Emergent anchored
Kyllinga bulbosa	Cyperaceae	Emergent anchored
Lemna gibba	Lemnaceae	Floating
Limnophyton obtusifolium	Alismataceae	Emergent anchored
Lippia geminata	Verbenaceae	Wetlands
Ludwigia adscendens	Onagraceae	Emergent anchored
Ludwigia perennis	Onagraceae	Emergent anchored
Lythrum salicaria	Lythraceae	Wetlands
Malvestrum tricuspidatum	Malvaceae	Wetlands
Marsilea minuta	Marsileaceae	Emergent anchored
Monochoria hastata	Pontederiaceae	Emergent anchored
Najas graminea	Najadaceae	Submerged anchored
Nelumbo nucifera	Nymphaeaceae	Floating leaved anchored
Neptunia prostrata	Mimosaceae	Floating
Nymphaea nouchali	Nymphaeaceae	Floating leaved anchored
Nymphaea pubescens	Nymphaeaceae	Floating leaved anchored
Nymphaea rubra	Nymphaeaceae	Floating leaved anchored
Nymphaea stellata	Nymphaeaceae	Floating leaved anchored
Nymphoides cristatum	Menianthaceae	Floating leaved anchored
Ottelia alismoides	Hydrocharitaceae	Submerged anchored
Oxalis corniculata	Oxalidaceae	Semiaquatic
Pistia stratiotes	Aponogetonaceae	Floating
Polygonum hydropiper	Polygonaceae	Emergent anchored
Potamogeton crispus	Potamogetonaceae	Submerged
Potamogeton pectinatus	Potamogetonaceae	Submerged
Rotala rotundifolia	Lythraceae	Emergent
Saccharum spontaneum	Poaceae	Wetlands
Sagittaria sagittifolia	Alismataceae	Emergent
Scirpus articulatus	Cyperaceae	Emergent anchored
Typha angustifolia	Typhaceae	Emergent anchored
Vallisneria spiralis	Hydrocharitaceae	Submerged anchored



**TABLE-27**  
**LIST OF FISHES RECORDED FROM THE HIRAKUD RESERVOIR**

Scientific Name	Common Name	Family	IUCN
<i>Ailia coila</i>	Gangetic ailia	Ailiidae	NT
<i>Amblyceps mangois</i>	Indian Torrent Catfish	Amblycepidae	LC
<i>Amblypharyngodon mola</i>	Mola Carplet	Cyprinidae	LC
<i>Anabas testudineus</i>	Climbing Perch	Anabantidae	DD
<i>Aspidoparia morar</i>	Morari	Cyprinidae	LC
<i>Badis badis</i>	Badis	Nandidae	LC
<i>Bagarius bagarius</i>	Goonch	Sisoridae	NT
<i>Barilius barila</i>	Barila	Cyprinidae	LC
<i>Barilius bendelesis</i>	Khoksa	Cyprinidae	LC
<i>Barilius vagra</i>	Vagra Baril	Cyprinidae	LC
<i>Catla catla</i>	Catla	Cyprinidae	LC
<i>Chanda nama</i>	Elongate glass-perchlet	Ambassidae	LC
<i>Chanda ranga</i>	Indian Glassy Fish	Ambassidae	LC
<i>Channa gachua</i>	Dwarf Snakehead	Channidae	LC
<i>Channa marulius</i>	Great Snakehead	Channidae	LC
<i>Channa orientalis</i>	Walking Snakehead	Channidae	NE
<i>Channa punctatus</i>	Spotted Snakehead	Channidae	LC
<i>Channa striatus</i>	Striped Snakehead	Channidae	LC
<i>Chitala chitala</i>	Clown Knifefish	Notopteridae	LC
<i>Cirrhinus reba</i>	Reba Carp	Cyprinidae	LC
<i>Cirrhinus mrigala</i>	Mrigal	Cyprinidae	LC
<i>Clarias batrachus</i>	Philippine Catfish	Claridae	LC
<i>Clarias gariepinus</i>	North African Catfish	Claridae	LC
<i>Clupisoma garua</i>	Garua	Schilbeidae	LC
<i>Ctenopharyngodon idella</i>	Grass Carp	Cyprinidae	NE
<i>Cyprinus carpio</i>	Common Carp	Cyprinidae	CR
<i>Danio rerio</i>	Zebra Danio	Cyprinidae	LC
<i>Danio aequipinnatus</i>	Giant Danio	Cyprinidae	DD
<i>Danio devario</i>	Sind Danio	Cyprinidae	LC
<i>Esomus danricus</i>	Flying Barb	Cyprinidae	LC
<i>Eutropiichthys vacha</i>	Batchwa Vacha	Schilbeidae	LC
<i>Gagata cenia</i>	Indian Gagata	Sisoridae	LC
<i>Gagata gagata</i>	Gangetic gagata	Sisoridae	LC
<i>Garra annandalei</i>	Garra	Cyprinidae	LC
<i>Garra gotyla</i>	Sucker head	Cyprinidae	LC
<i>Garra mullya</i>	Sucker fish	Cyprinidae	LC
<i>Glossogobius giuris</i>	Tank Gobi	Gobiidae	LC
<i>Gonialosa manmina</i>	Ganges River Gizzard Shad	Clupeidae	LC
<i>Gudusia chapra</i>	Indian River Shad	Clupeidae	LC
<i>Heteropneustes fossilis</i>	Stinging Catfish	Heteropneustidae	LC
<i>Hypophthalmichthys molitrix</i>	Silver Carp	Cyprinidae	NT
<i>Hypophthalmichthys nobilis</i>	Bighead Carp	Cyprinidae	DD
<i>Labeo angra</i>	Angra Labeo	Cyprinidae	LC
<i>Labeo bata</i>	Bata	Cyprinidae	LC
<i>Labeo boga</i>	Boga labeo	Cyprinidae	LC
<i>Labeo boggut</i>	Boggut Labeo	Cyprinidae	LC
<i>Labeo calbasu</i>	Calbasu	Cyprinidae	LC
<i>Labeo fimbriatus</i>	Fringed Lipped Peninsular Carp	Cyprinidae	LC



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Scientific Name	Common Name	Family	IUCN
Labeo gonius	Kuria Labeo	Cyprinidae	LC
Labeo rohita	Rohu	Cyprinidae	LC
Laubuca laubuca	Indian Glass Barb	Cyprinidae	LC
Laubuca lubuca	Indian Glass barb	Cyprinidae	LC
Lepidocephalichthys guntea	Guntea Loach	Cobitidae	LC
Macrognathus aculeatus	Lesser Spiny Eel	Mastacembelidae	LC
Mastacembelus armatus	Zig -zag eel	Mastacembelidae	LC
Mastacembelus punctalus	Barred Spiny Eel	Mastacembelidae	LC
Mystus seenghala	Giant River Catfish	Bagridae	LC
Mystus bleekeri	Day's Mystus	Bagridae	LC
Mystus cavasius	Gangetic Mystus	Bagridae	LC
Mystus tengara	Tengara Catfish	Bagridae	LC
Mystus vitatus	Striped Dwarf Catfish	Bagridae	LC
Nandus nandus	Gangetic leaf fish	Nandiade	LC
Noemacheilus botia	Mottled Loach	Nemocheilidae	LC
Notopterus notopterus	Bronze Featherback	Notopteridae	LC
Ompok bimaculatus	Butter Catfish	Siluridae	LC
Ompok pabda	Pabda fish	Siluridae	LC
Opsarius barna	Barna	Cyprinidae	LC
Oreochromis mossambicus	Mozambique Tilapia	Cichlidae	LC
Oreochromis niloticus	Nile Tilapia	Cichlidae	LC
Osteobrama cotio	Cotio	Cyprinidae	LC
Osteobrama vigorsii	Godavari Osteobrama	Cyprinidae	LC
Pangasius pangasius	Pangas Catfish	Pangasiidae	LC
Parluciosoma daniconius	Slender Rasbora	Cyprinidae	LC
Puntius chola	Swamp Barb	Cyprinidae	LC
Puntius dorsalis	Long snouted Barb	Cyprinidae	LC
Puntius gelius	Golden Barb	Cyprinidae	LC
Puntius guganio	Glass Barb	Cyprinidae	LC
Puntius phutunio	Spotted Sail Barb	Cyprinidae	LC
Puntius sarana	Olive Barb	Cyprinidae	LC
Puntius sophore	Pool Barb	Cyprinidae	LC
Puntius ticto	Ticto Barb	Cyprinidae	LC
Rhinomugil corsula	Corsula	Mugilidae	LC
Rita rita	Rita Catfish	Bagridae	LC
Salmostoma bacaila	Large Razon-belly Minnow	Cyprinidae	LC
Salmostoma phulo	Fine-scale Razon-belly Minnow	Cyprinidae	LC
Schistura denisonii	Ray finned fish	Nemocheilidae	LC
Systemus sarana	Olive Barb	Cyprinidae	LC
Tetraodon cutcutia	Ocellated Puffer fish	Tetrodontidae	LC
Trichogaster fasciatus	Banded gourami	Anabantidae	LC
Wallago attu	River Catfish / Wallago	Siluridae	NT
Xenentodon cancila	Fresh water Garfish	Belonidae	LC

**Rare or Endangered or Threatened (RET) Flora and Fauna**

The status of the RET flora is evaluated based on the BSI list of threatened plant species. None of the threatened taxa of the BSI is found in the study area. Among the plants, Chloroxylon swietenia is the only plant that is listed under the Vulnerable (VU) category by the IUCN but it is not included in the BSI list of



threatened taxa. It is endemic to Peninsular India and Sri Lanka. It is highly resistant to forest fires and it has great coppicing ability. It is expanding and spreading towards north. There is no threat to this species in the area. Hence, no specific conservation measures are required.

The Sambalpur Elephant Reserve is a home for 19 elephants including one trained (domesticated) elephant. Debrigarh WLS is a home for a total of 8 schedule I species but none of them is in the RET category. They belong to the lower risk category. Peacock is the only schedule I species found in the study area. There is no threat to the peacock and hence it is included in the LC category by the IUCN. It may not be out of context to state that the Peacock has assumed the status of a pest in Sri Lanka. Peacock is the National Bird and the only beautiful large flying bird in India but there are no threats to this species. Hence, it is placed under the LC category by the IUCN. If allowed to domesticate, one can find them in every public in no time. With regard to the elephant, National Elephant Conservation Authority and the Wildlife Board are empowered to deal with their conservation in accordance with the established practices. Some rare species may be present in the Cattle island located in the Hirkud Reservoir and the Sambalpur Elephant Reserve but they are beyond the buffer zone and hence no primary survey was carried out. If any Schedule I species are found in the core area at any time, the EHS division will immediately alert the forest and wildlife department and assist them in rescue operations. Hence, the conservation of Schedule-I species is beyond the legal jurisdiction of the HIL. However, the company is ready to extend full support and cooperation to the wildlife authorities.

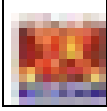
### **Conclusions**

There are no eco-sensitive areas such as National Parks or Wildlife Sanctuaries or Biosphere Reserves or Elephant or Tiger reserves within the 10 km buffer zone of the Hindalco Industries Limited (HIL). But there is an Elephant reserves (Sambalpur Elephant Reserve) and Debrigarh Wildlife Sanctuary at a distance of 10.5 km and beyond.

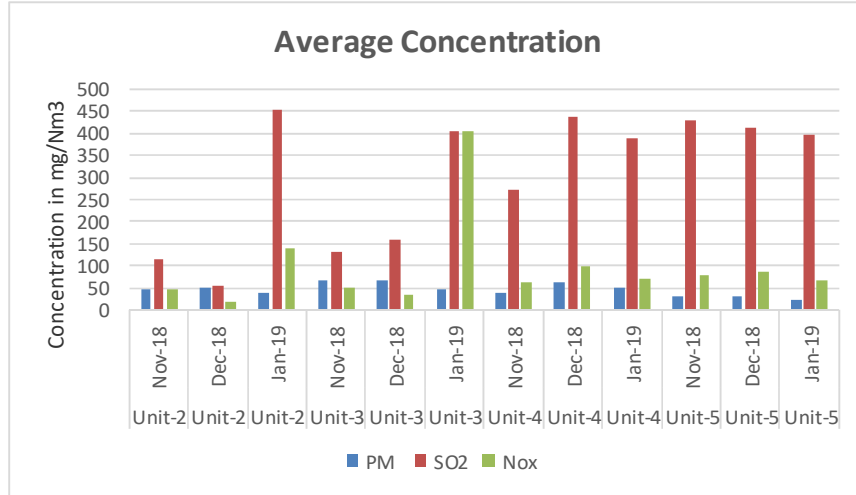
There are no Schedule-I or RET species within the 10 km study area. Schedule-I/RET species are reported only from the Elephant reserve and the WLS located beyond 10.5 km from the HIL. The proposed activity doesn't pose any direct or indirect, short-term or long-term adverse impacts on the flora and fauna of the Elephant reserve or the WLS. It is absolutely safe to the bio-diversity of the study area and there shall be no loss of any bio-diversity.

#### **➤ Real Time Monitoring**

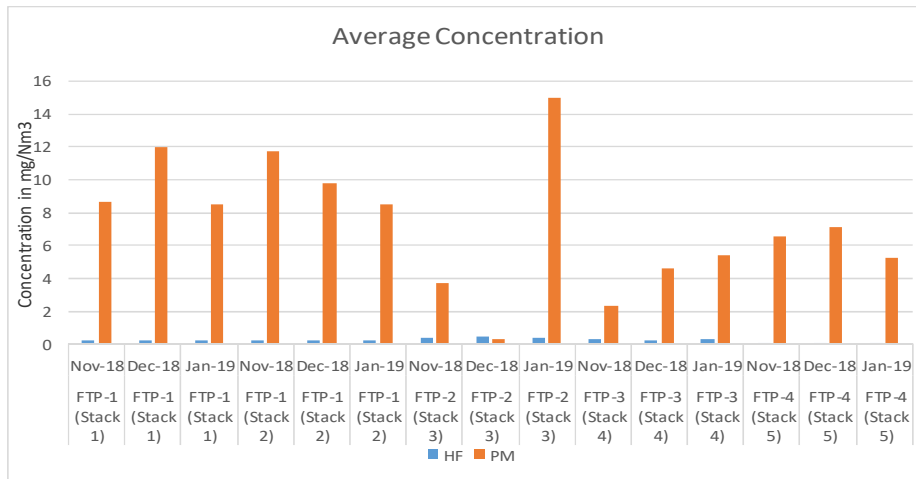
The real time monitoring by OSPCB & stack monitoring conducted by M/s. S. K Mitra & Biosphere Private Limited is attached as **Annexure-II**. The monthly average concentration ( $\text{mg}/\text{Nm}^3$ -real time monitoring) for PM,  $\text{SO}_2$  &  $\text{NO}_x$  of CPP is depicted in **Figure-9(A)**. The monthly average concentration for PM and HF of smelter plant is given in **Figure-9(B)**. The monthly average concentration of ambient air quality is given in **Figure-9(C)**.



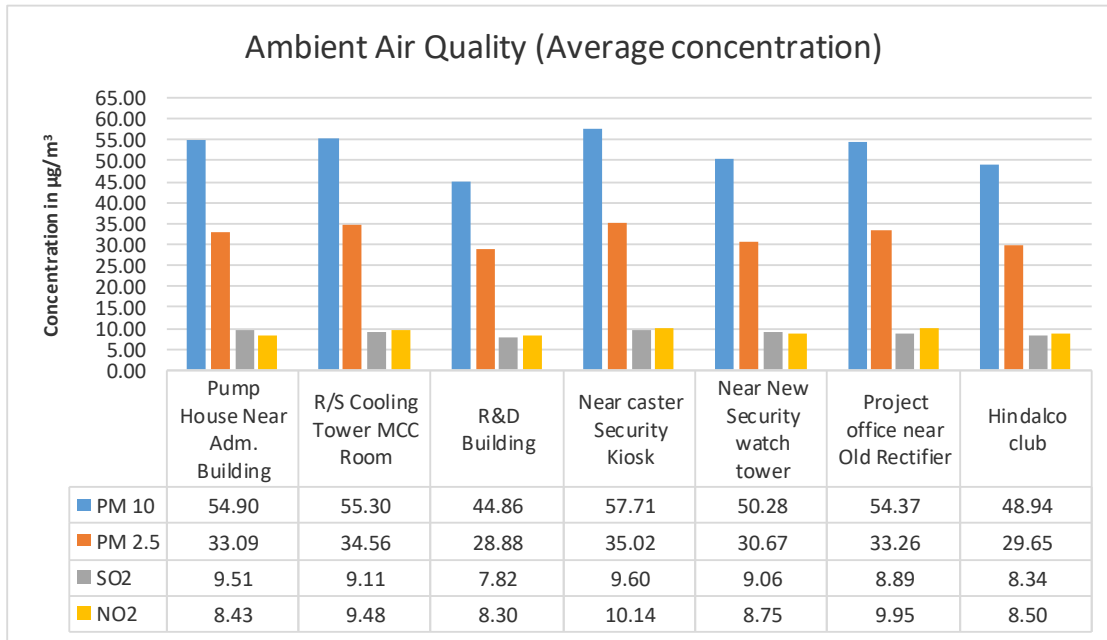
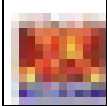
**Addendum Report For Installation of Ultra Clean Coal Gasification System For Replacing Furnace Oil in the Cast Houses of Aluminum Smelter Located in Hirakud Village of Sambalpur District, Odisha**



**FIGURE-9(A)**  
**REAL TIME MONITORING GRAPH FOR CPP STACKS**



**FIGURE-9(B)**  
**REAL TIME MONITORING GRAPH FOR SMELTER**



**FIGURE-9(C)  
AVERAGE CONCENTRATION OF AMBIENT AIR QUALITY (APRIL 2018-  
SEPTEMBER 2018)**

**8.0 Anticipated Environmental Impacts and Mitigation Measures**

The anticipated adverse environmental impacts and the mitigation measures for the proposed ultra clean coal gasification system are given below:

**8.1 Impacts on Soil Quality**

Most of the impacts of proposed project on soil are restricted to the construction phase, which will get stabilized during operational phase. The impact on the topsoil will be confined to the plant area. There will not be any demolition waste. The construction waste will be handled as per Construction & Demolition Waste Rules, 2016.

**Fugitive Emissions**

The air borne fugitive dust from the plant is likely to be deposited on the surface in the immediate vicinity of the plant boundary. However, the fugitive emissions are likely to be controlled to a great extent through proposed control measures like mist type water sprinklers and vaccum sweeping machines. The plantation of adequate width around the plant will help in arresting the fugitive emissions.



## 8.2 Impact on Topography and Drainage

The area is characterized by plain topography. The average elevation of the site is about 160-180 m above mean sea level.

The proposed project will involve minor site preparation and leveling work, which is likely to alter the drainage pattern of the site and surroundings. Khajoor nallah passes through the existing plant premises. The nalla is not a perennial river and joins river Mahanadi after traveling about 3 km from the plant. During monsoon time, the storm water is drained out into nearby Khajoor nalla.

The storm water drains of the plant premises are kept separate from wastewater drains. Wastewater generated from the smelter and power plant is being treated in RO based ETPs. The treated wastewater from smelter is reused inside the plant. Cooling tower blowdown from the power plant is being treated in RO plant and reutilised. The proposed activity is not likely to affect the nearby nallahs as it will work on zero discharge principle.

## 8.3 Impact on Air Quality

The impact on air quality is assessed based on emissions of the existing plants (Smelter-216 KTPA, captive power plant-467.5 MW) and proposed addition of coal gasification project.

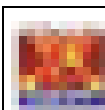
Particulate matter (PM), sulphur dioxide (SO<sub>2</sub>), Oxides of Nitrogen (NO<sub>x</sub>) and Fluoride (F) are the important pollutants emitting from the existing plants. The pollutants such as SO<sub>2</sub>, NO<sub>2</sub> and dust will be generated from coal gasification process. There will be no additional stacks due to installation of gasification plant. The gas generated from the coal gasification unit will be used in the cast houses in place of furnace oil.

### ➤ **Details of Mathematical Modelling**

For prediction of maximum Ground Level Concentrations (GLC's), the air dispersion modeling software (AERMOD version 7.1.0) was used. AERMOD is steady state advanced Gaussian plume model that simulates air quality and deposition fields upto 50 km radius. AERMOD is approved by USEPA and is widely used software. It is an advanced version of Industrial Source Complex (ISCST3) model, utilizes similar input and output structure to ISCST3 sharing many of the same features, as well as offering additional features. The model is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases and multiple sources including point, area, flare, line and volume sources.

### **Model Input Data**

The existing smelter is operating with furnace oil where it will be replaced by using coal gas in the present proposal. The furnace oil is being used in the cast houses. The coal requirement will be 10,000 TPD for coal gasification plant. The specifications of coal gas are given in **Table-28**. The isopleths showing incremental concentration are shown in **Figure-10**.



**TABLE-28  
COAL GAS CHARACTERISTICS**

Parameter	Concentration (%)
CO	23-28
H <sub>2</sub>	15-18
CnHm	3-4
CO <sub>2</sub>	<6
N <sub>2</sub>	40-50
O <sub>2</sub>	0.08
CV of Gas	>1450 Kcal/Nm <sub>3</sub>
H <sub>2</sub> S	30 mg/Nm <sup>3</sup>

Source: HIL

The pollutants considered for modelling include particulate matter, sulphur dioxide and nitrogen dioxide. The modelling tool has been executed considering two scenarios and details are given below in **Table-29**. The emission loads have been calculated for two scenarios the details of which are given below.

Scenario-1: By using Furnace Oil

Scenario-2: By using Coal Gas

The existing details of the stacks are given in **Table-29**.

**TABLE-29(A)  
STACK DETAILS OF SMELTER PLANT: SCENARIO-1 : FURNACE OIL**

Sr.No	Units	Stack Height	Dia	Temp	Vel	PM	SO <sub>2</sub>	Nox
	Smelter	m	m	°c	m <sup>3</sup> /sec	g/s	g/s	g/s
1	FTP-1 Stack-1	37	3.4	80	18	4.1	-	-
2	FTP-1 Stack-2	37	4.4	80	18	6.9	-	-
3	FTP-2 Stack3	37	5.6	80	18	11.2	-	-
4	FTP-3 Stack4	37	4.4	80	15	5.8	-	-
5	FTP-4 Stack5	65	5.3	110	15	7.7	-	-
					<b>Total</b>	<b>35.8</b>		
	Holding Furnace						-	-
6	Cast house-1 (2 furnaces)	10	0.6	250	6	-	-	-
7	Cast house-2 (2 furnaces)	20	0.55	250	6	-	-	-
8	Cast house-3 (2 furnaces)	35	1.2	250	7	3.1	4.8	1.2
9	Cast house-4 (4 furnaces)	50	1.2	200	7	9.3	14.2	0.4
					<b>Total</b>	<b>12.4</b>	<b>19.0</b>	<b>1.6</b>

**TABLE-29(B)  
STACK DETAILS OF SMELTER PLANT: SCENARIO-2 : COAL GAS**

Sr. No	Units	Stack Height	Dia	Temp	Vel	PM	SO <sub>2</sub>	Nox
	Smelter	m	m	°c	m <sup>3</sup> /sec	g/s	g/s	g/s
1	FTP-1 Stack-1	37	3.4	80	18	4.1	-	-
2	FTP-1 Stack-2	37	4.4	80	18	6.9	-	-
3	FTP-2 Stack3	37	5.6	80	18	11.2	-	-
4	FTP-3 Stack4	37	4.4	80	15	5.8	-	-
5	FTP-4 Stack5	65	5.3	110	15	7.7	-	-
					<b>Total</b>	<b>35.8</b>	-	-
	<b>Holding Furnace</b>							
6	Cast house-1(2 furnaces)	10	0.6	250	6	-	-	-



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Sr. No	Units	Stack Height	Dia	Temp	Vel	PM	SO <sub>2</sub>	Nox
7	Cast house-2(2 furnaces)	20	0.55	250	6	-	-	-
8	Cast house-3(2 furnaces)	35	1.2	250	7	0.6	0.02	0.07
9	Cast house-4(4 furnaces)	50	1.2	200	7	1.6	0.09	0.18
					<b>Total</b>	<b>2.2</b>	<b>0.11</b>	<b>0.25</b>

\*\* There are no additional stacks proposed for coal gasification unit

*Presentation of Results*

The incremental concentration considering scenario-1 & scenario-2 are given in **Table-30**. The isopleths showing incremental concentrations is shown in **Figure-10 (A) to Figure-10 (E)**.

**TABLE-30  
PREDICTED GROUND LEVEL CONCENTRATIONS**

Parameters	Predicted GLCs $\mu\text{g}/\text{m}^3$		Distance (km)/Direction
	Scenario-I Furnace Oil	Scenario-II Coal Gas	
PM <sub>10</sub>	2.21	0.38	0.5 km, S
SO <sub>2</sub>	2.80	0.01	0.5 km, S
NO <sub>2</sub>	0.23	0.03	0.5 km, S

The proposed incremental concentrations (baseline + incremental) after implementation of the project are tabulated below in **Table-30(A)**.

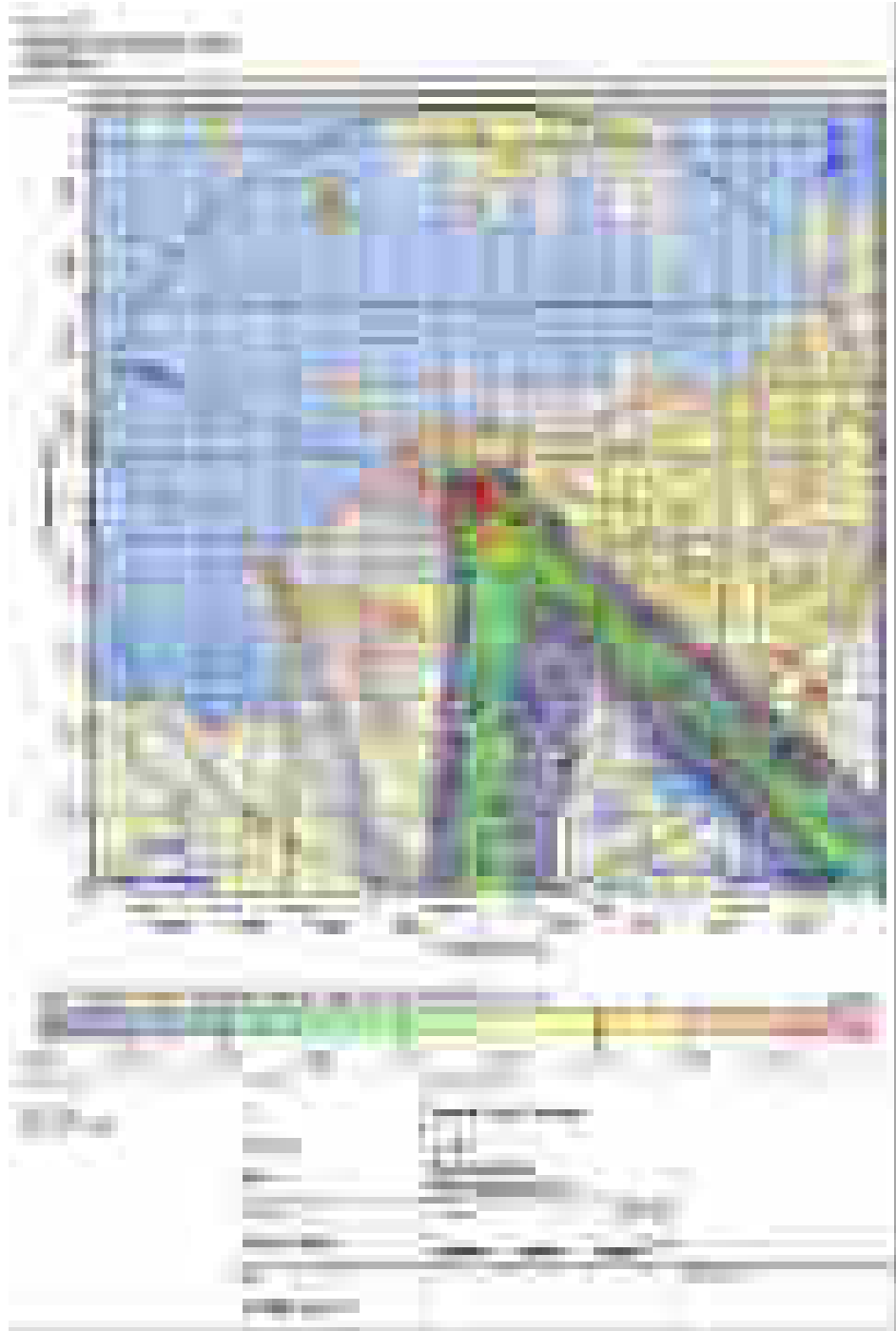
Assuming that the baseline concentrations captured the emissions of existing plant which is operating with furnace oil the coal gas predicted concentrations have been added to baseline deducting the emission load of plant with furnace oil. The details are given below in **Table-30(B) & Table-30(C)**.

**TABLE-30(A)  
BASELINE CONCENTRATION WITHOUT ADDITION OF  
EMISIONS DUE TO FURNACE OIL**

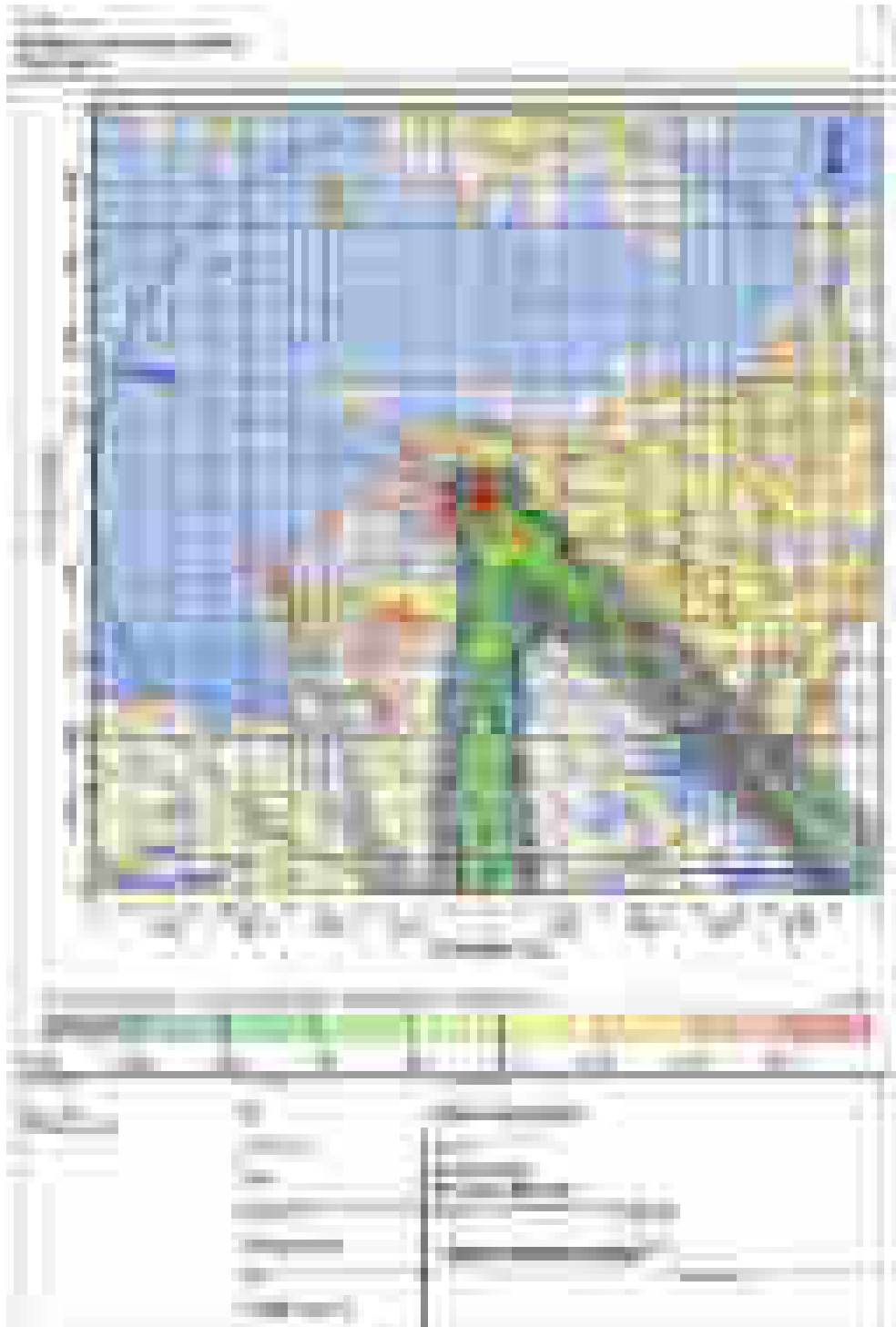
Pollutant	Baseline With FO ( $\mu\text{g}/\text{m}^3$ )	Incremental FO ( $\mu\text{g}/\text{m}^3$ )	Baseline without FO Emissions ( $\mu\text{g}/\text{m}^3$ )	Limits (Industrial/Residential) ( $\mu\text{g}/\text{m}^3$ )
	<b>A</b>	<b>B</b>	<b>A-B</b>	
PM <sub>10</sub>	78.0	2.21	75.8	100
SO <sub>2</sub>	17.7	2.80	14.9	80
NO <sub>2</sub>	22.0	0.23	21.8	80

**TABLE-30 (B)  
PROPOSED RESULTANT CONCENTRATIONS  
DUE TO INCREMENTAL GLC's WITH COAL GAS**

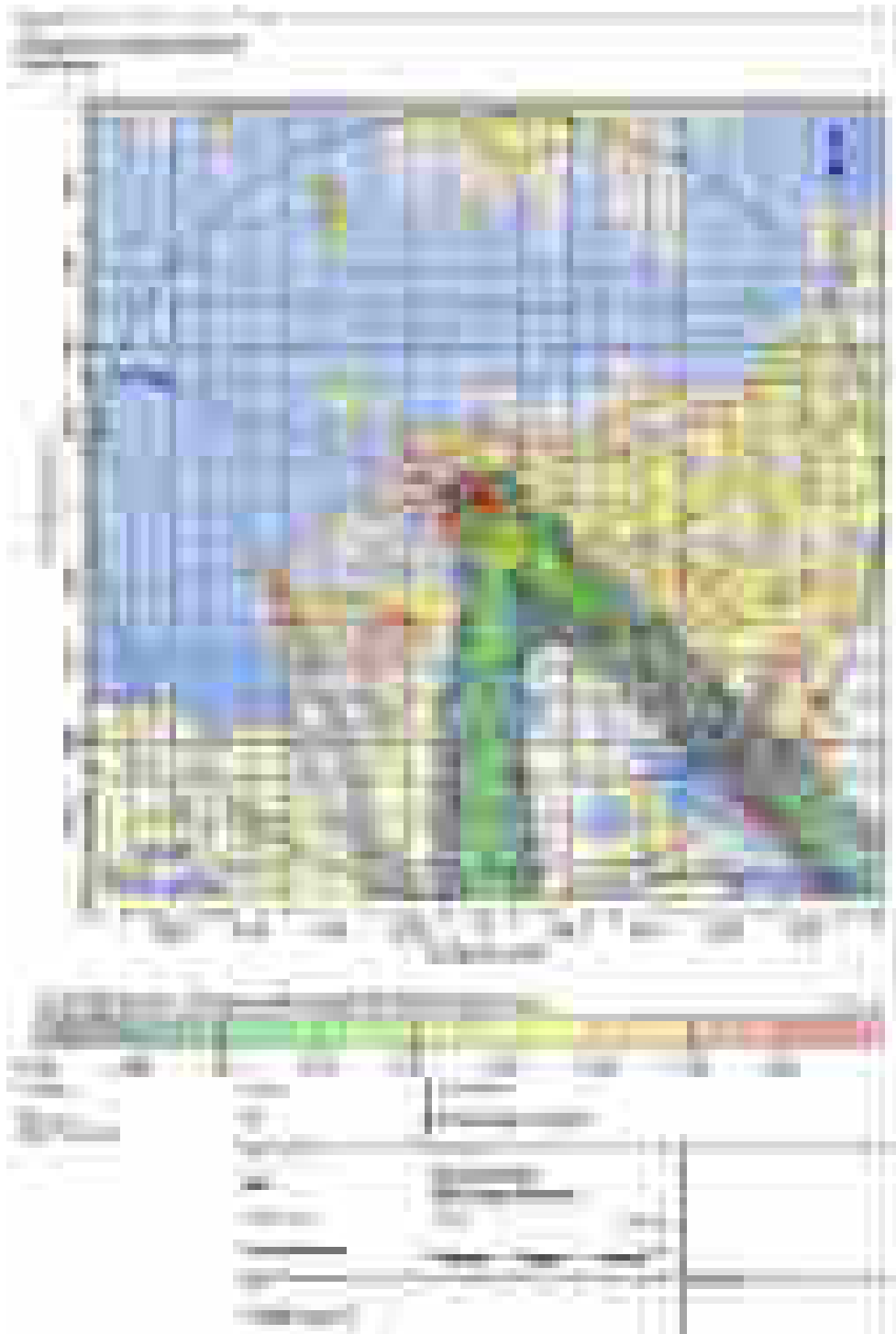
Pollutant	Baseline without FO Emissions ( $\mu\text{g}/\text{m}^3$ )	Incremental ( $\mu\text{g}/\text{m}^3$ )	Resultant Baseline with Coal Gas ( $\mu\text{g}/\text{m}^3$ )	Limits (Industrial/Residential) ( $\mu\text{g}/\text{m}^3$ )
	<b>A</b>	<b>B</b>	<b>A+B</b>	
PM <sub>10</sub>	75.8	0.39	76.2	100
SO <sub>2</sub>	14.9	0.01	14.9	80
NO <sub>2</sub>	21.8	0.03	21.8	80



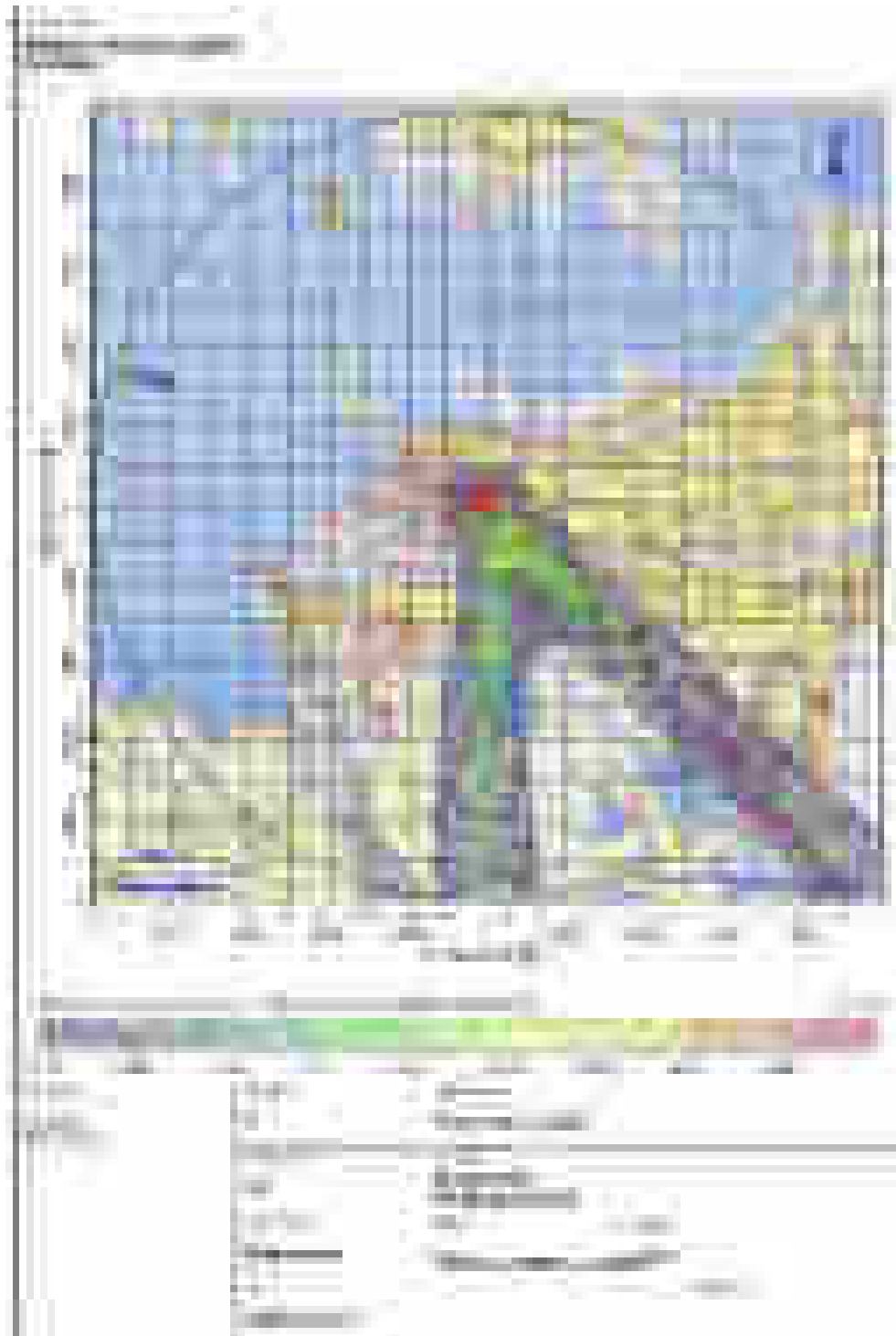
**FIGURE-10(A)**  
**ISOPLETH SHOWING INCREMENTAL CONCENTRATION FOR PM<sub>10</sub>**  
**SCENARIO-1 : FURNACE OIL**



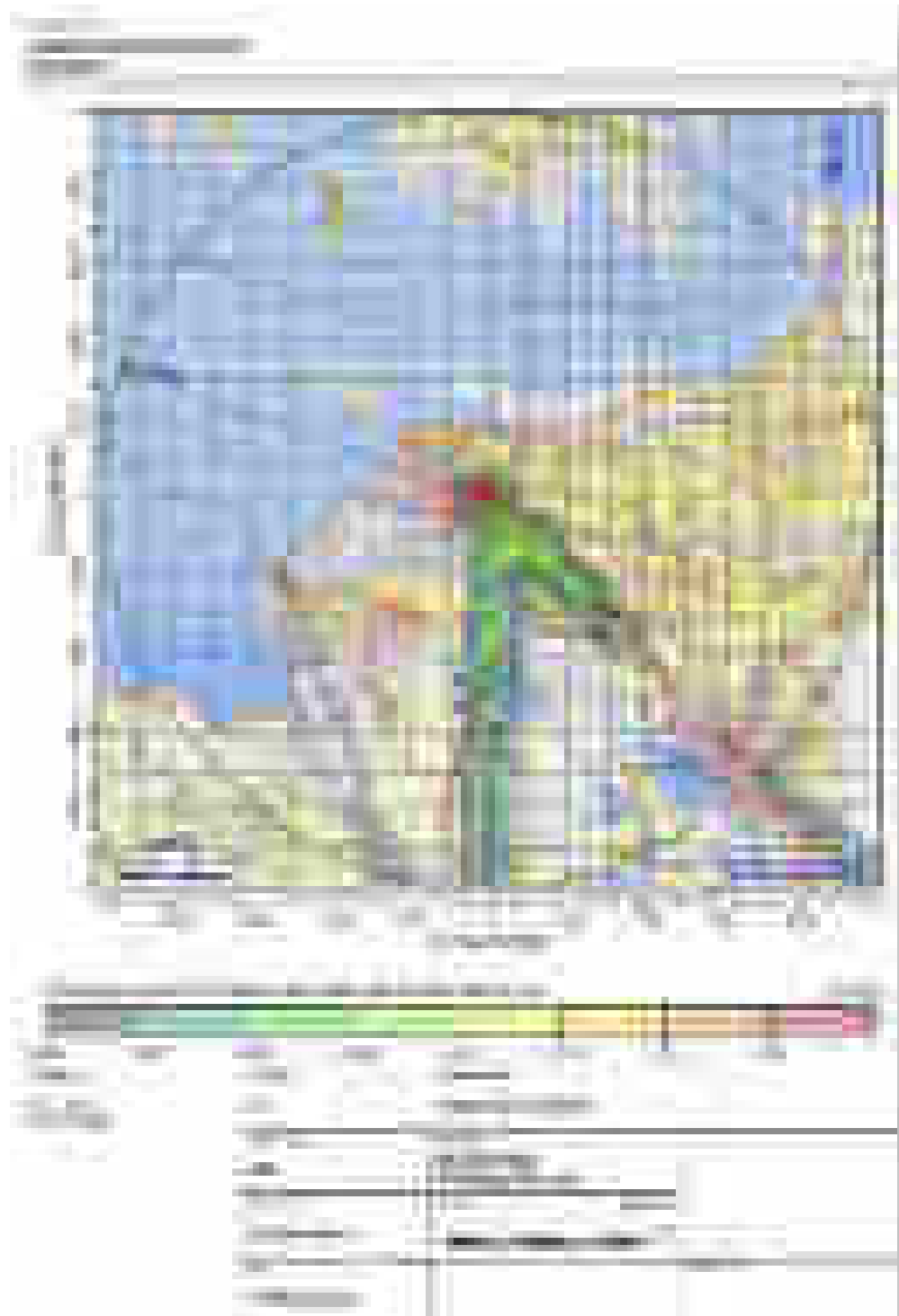
**FIGURE-10(B)**  
**ISOPLETH SHOWING INCREMENTAL CONCENTRATION FOR SO<sub>2</sub>**  
**SCENARIO-1 FURNACE OIL**



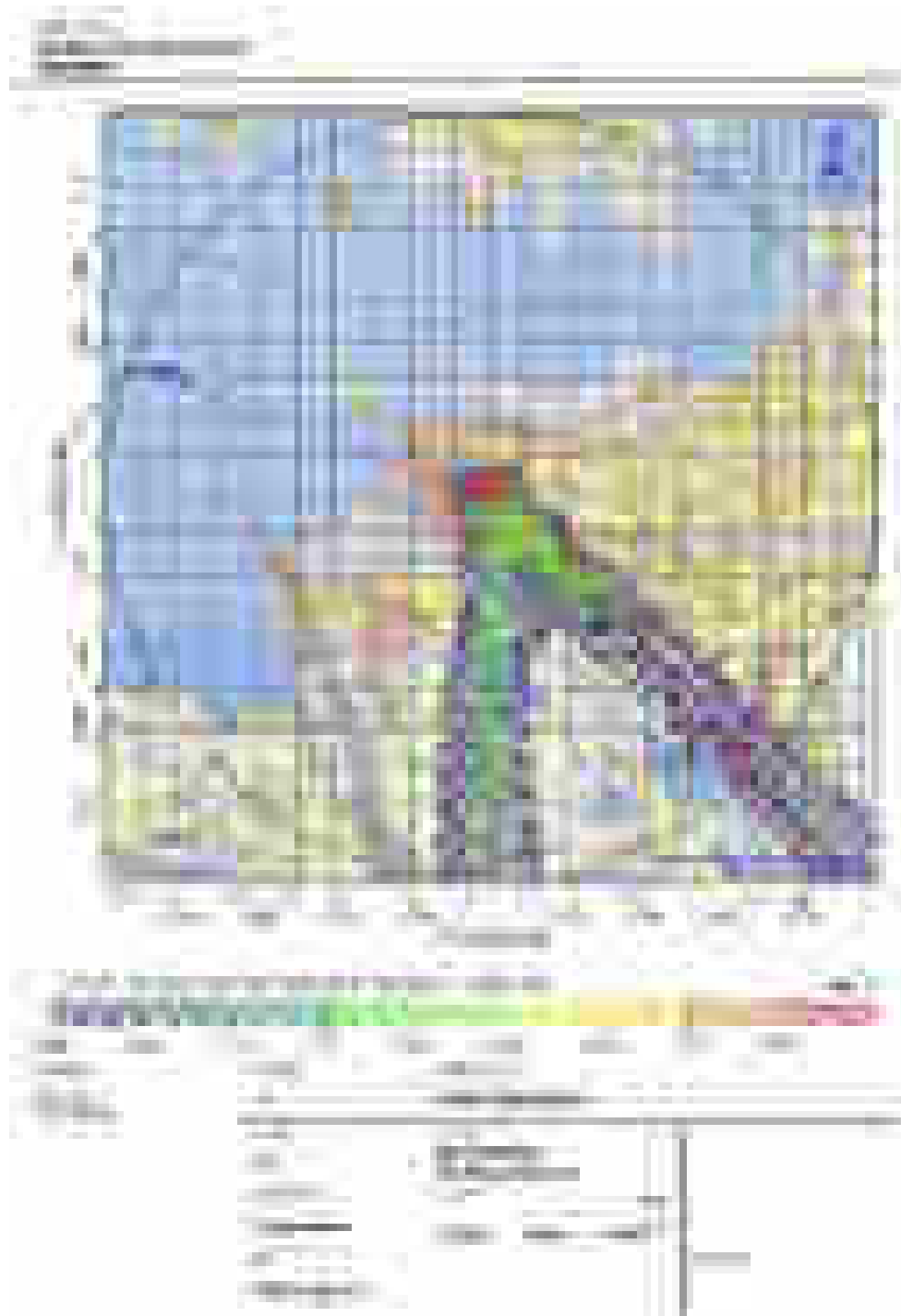
**FIGURE-10(C)**  
**ISOPLETH SHOWING INCREMENTAL CONCENTRATION FOR NO<sub>2</sub>**  
**SCENARIO-1**



**FIGURE-10(D)**  
**ISOPLETH SHOWING INCREMENTAL CONCENTRATION FOR PM**  
**SCENARIO-2 COAL GAS**



**FIGURE-10(E)**  
**ISOPLETH SHOWING INCREMENTAL CONCENTRATION FOR SO<sub>2</sub>**  
**SCENARIO-2 COAL GAS**



**FIGURE-10(F)**  
**ISOPLETH SHOWING INCREMENTAL CONCENTRATION FOR NO<sub>2</sub>**  
**SCENARIO-2 COAL GAS**



### **Mitigation Measures for Proposed Coal Gasification Plant**

#### ➤ *Proposed Coal Gasification Plant*

The pollutants such as SO<sub>2</sub>, NO<sub>2</sub> and dust will be generated from coal gasification process.

#### **Gas Purification Section**

The following control measures will be implemented in the coal gasification unit:

- Washing tower: Lowers the gas temperature;
- Electrostatic tar collector: Removing tar and making sure the gas is clean;
- Electrostatic precipitator: It is used for a removal of dust and light tar so that gas purification quality is guaranteed; and
- Sulphur generated from coal gasification unit will be treated in de - sulphurisation unit. The sulphur extracted will be sold to the local markets for pharmaceutical & agricultural purposes.

Coal shed of capacity of 1000 MT (3 day stock) will be provided which will consist of mist type sprinkler system to avoid fugitive dust emissions.

## 8.4 Impacts on Water Resources and Water Quality

### *Impact on Water Resources*

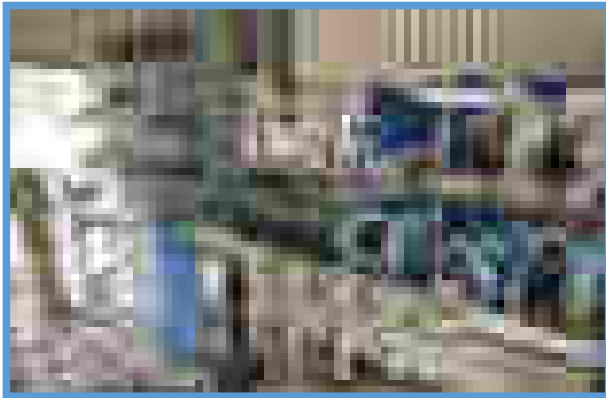
No ground water source will be tapped for meeting the water requirement during operation of existing plants and proposed coal gasification plant. The water requirement of the project will be met from the Hirakud reservoir. The water required will be met from the existing sanction only.

### *Impact on Water Quality*

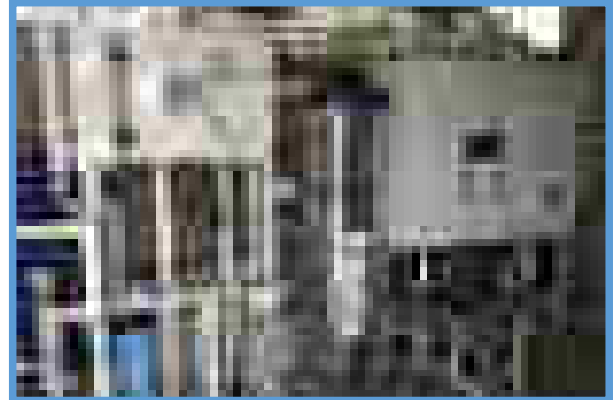
The total wastewater generation from the existing aluminium smelter plant & CPP is 1968 KLD. About 14.6 KLD (0.006 cusec) of wastewater is expected from the proposed coal gasification unit.

The phenol wastewater generated during gasification process will be alkaline in nature having pH around 8.5-9.0. To bring down the pH level, pH inhibitors are added in the pH correction tank to maintain the pH around 7.5-8.0. This is the only treatment of phenol water which is being carried out so that it can be used in the gasification process.

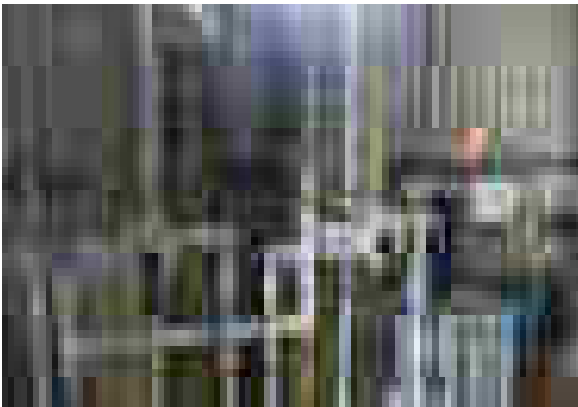
The present wastewater generated from smelter is being treated in three effluent treatment plants of capacity 250 KLD, 250 KLD & 50 KLD capacity. The domestic wastewater is treated in STPs of capacities 500 KLD, 400 KLD, 300 KLD & 100 KLD. The treated water is reused within the plant. In CPP, the cooling tower blow down water is being treated through RO plant for reuse in process. Other effluent is being treated to meet the standards after reuse in various inhouse activities and cooling towers. The photographs of ETP is given in **Figure-11**. The schematic diagram is given in **Figure-12**.



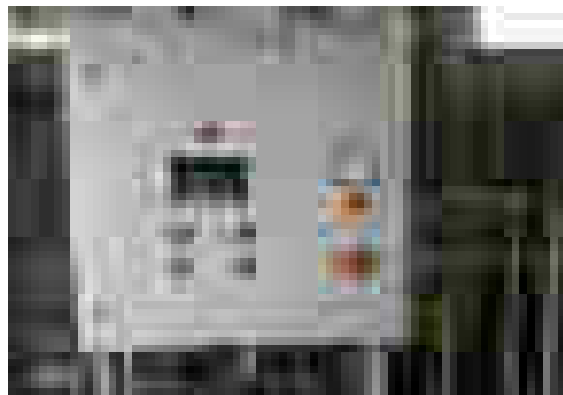
**New RO Membrane**



**New UF System**

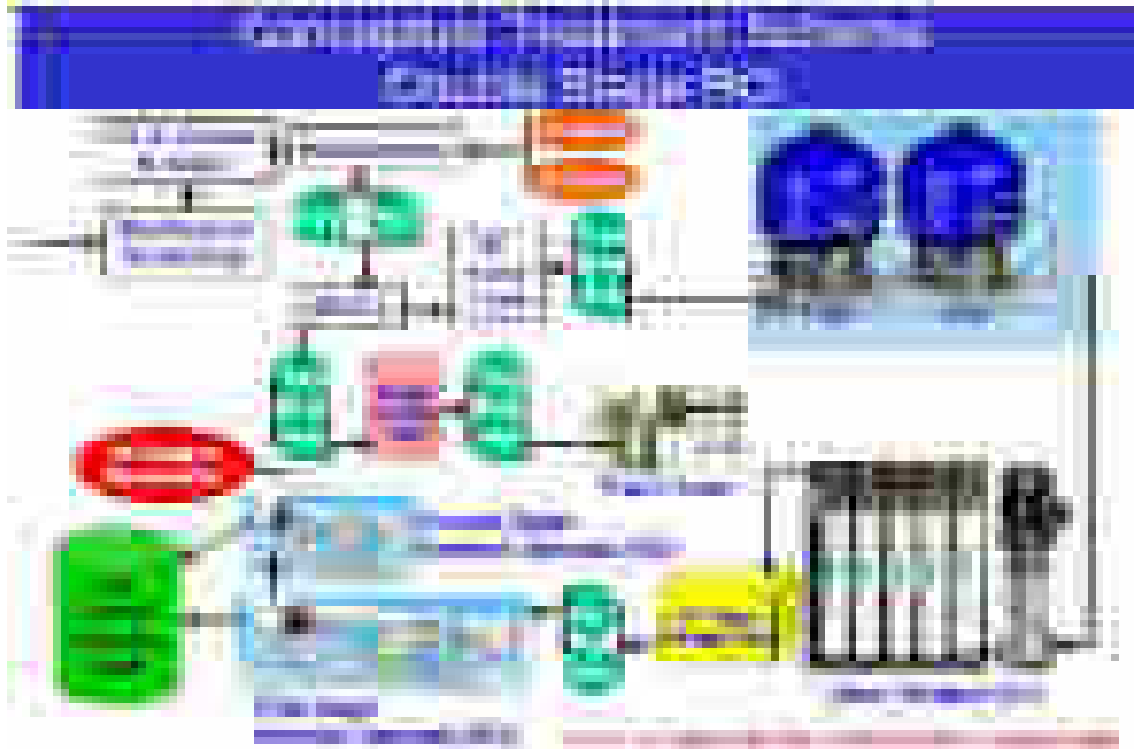


**New PSF & IRF Filter**

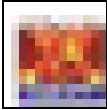


**PLC Panel**

**FIGURE-11**  
**ETP PHOTOGRAPHS**



**FIGURE-12**  
**SCHEMATIC DIAGRAM OF ETP**



## 8.5 Solid Waste / Hazardous Waste Management

The total solidwaste generation details from proposed coal gasification units are given in **Table-31**. The existing solid waste generation details are given in **Table-32**. The photographs showing captive brick plant is given in **Figure-13**.

**TABLE-31**  
**PROPOSED SOLID WASTE GENERATION**

Description	Qty per hour (Kg)	Qty per day (Metric Tonnes)	Qty per year (Metric Tonnes) (350 days)	Disposal Plan
Ash generation @22%	2835	67.98	23, 800	Ash will be used in the captive brick plant which has the capacity of 24,000 bricks per day and supplying ash to more than 160 brick plants which is around 35 % of the total ash generated in captive CPP.
Coal Tar generation- @3.5% of coal consumption	451	10.815	3790	Coal tar, it contains high calorific value and used in diffrenet areas i.e. road construction, ready mix, medicines and green anode making for aluminum smelting. Hence it will be sold to the authorized end users



**FIGURE-13**  
**CAPTIVE FLY ASH BRICK PLANTS**



**TABLE-32  
EXISTING SOLID WASTE GENERATION FROM SMELTER PLANT**

List of Hazardous Waste	Authorized Quantity Per Year	Total Quantity Per Year (2018-19)
Used oil	60 KL/A	11.408
Waste containg oil	3 T/A	0.011
Spent pot lining (cathode residues)	5000 T	4583.04
Aluminium dross	4000 T	3996
Tar containing wastes	60 KL/A	0
Aluminium dross(Recycling unit)	330 T/month	3139
Aluminium dross residue		2083
Pot duct cleaning waste	10 T	0
Rejected lining of furnace (Refractory)	20 T	0
Rejected refractory of furnace	30 T	2
Shot blasting dust(containing fluoride)	60 T	57
Laddele cleaning residue	50 T	21.74
Rejected filter bags (ftp)	30 T	19.2588
Asbestos waste	5 T	0
Rejected air bags	1 T	0.0229
Fluoride contaminated waste (spilled waste from potline)	100 T	40.25
Drain cleaning sludge	20 T	4.76
Floor sweeping & housekeeping waste	600 T	58.17
ETP sludge	20 T	3.156
Used anode butts	26400 T	20620.65
Discarded containers/liners used for hazardous chemical	2 T	0
Existing fly ash generation	MT	11,10,074

Source: Hindalco Industries Limited

#### 8.6 Greenbelt

33 % of total land area including solid waste disposal sites are covered with greenbelt / green cover. The plantation is being carried out in and around the plant premises. The existing plantation details are given in **Table-33**. The greenbelt / green cover photographs are shown in **Figure-14**.

**TABLE-33  
PLANTATION DETAILS**

Sr. No	Year	No. of Saplings Planted	Area Covered (Acres)	Species Planted
1	Up to 2006- 07	4,19,865	250.12	
2	2007-08	33,000	12.0	Chakunda, Gambhari, Sisam, Krushna Chuda, Radha Chuda, Jammun & Neem
3	2008-09	25,200	16.0	Chakunda, Gambhari, Sisam, Krushna Chuda, Radha Chuda, Jammun & Neem
4	2009-10	31,000	10.0	Chakunda, Gambhari, Sisam, Krushna Chuda, Radha Chuda, Jammun & Neem
5	2010-11	30,000	10.0	Chakunda, Gambhari, Sisam, Krushna Chuda, Radha Chuda, Jammun & Neem



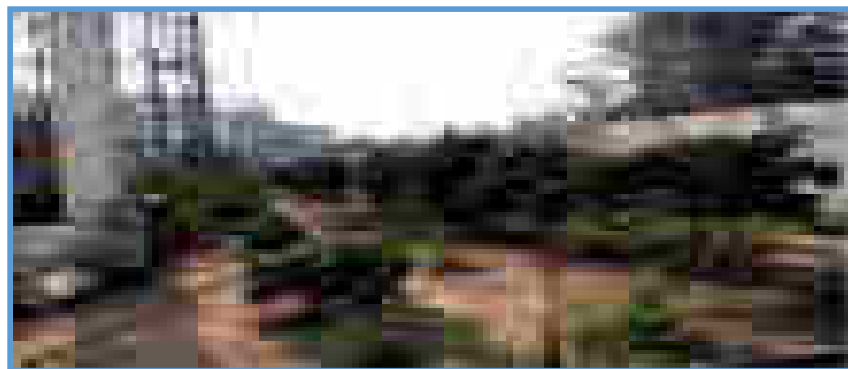
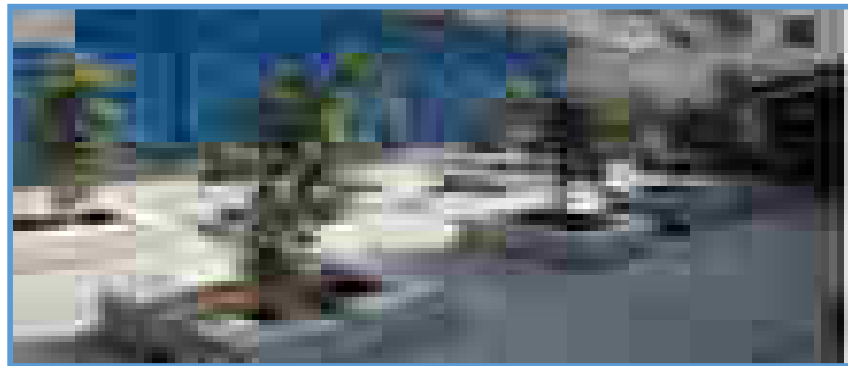
**Addendum Report For Installation of Ultra Clean Coal Gasification System For Replacing Furnace Oil in the Cast Houses of Aluminum Smelter Located in Hirakud Village of Sambalpur District, Odisha**

Sr. No	Year	No. of Saplings Planted	Area Covered (Acres)	Species Planted
6	2011-12	25,200	10.0	Chakunda, Gambhari, Sisam, Krushna Chuda, Radha Chuda, Jammun & Neem
7	2012-13	25,000	10.0	Neam, Karanja, Sisam, Krushna Chuda, Radha Chuda, Cassia Fistula, Alstonia & Kadamba
8	2013-14	30,000	13.0	Neem, Karanja, Sisam, Cassia Fistula, Alstonia, Kadamba, Mango, Jamun etc
9	2014-15	12,000	6.0	Neem, Karanja, Sisam, Cassia Fistula, Alstonia, Kadamba, Mango, Jamun etc
10	2015-16	10,000	5.0	Bamboo, Sisoo, Karanja, Alstonia, Chhatiana, Mango, Jamun etc
11	2016-17	21,175	10.6	Bamboo, Ficus, Alstonia, Champa, Plumeria Alva etc
12	2017-18	13,500	6.75	Krushnachuda, Radhachuda, Acassia, Ficus, Jamun, Arjun, Ashok etc
13	2018-19	10,500	5.25	Bamboo, Sisam, Cassia Fistula, Alstonia, Kadamba, Mango, Jamun
	<b>Total</b>	<b>6,86,440</b>	<b>364.72</b>	

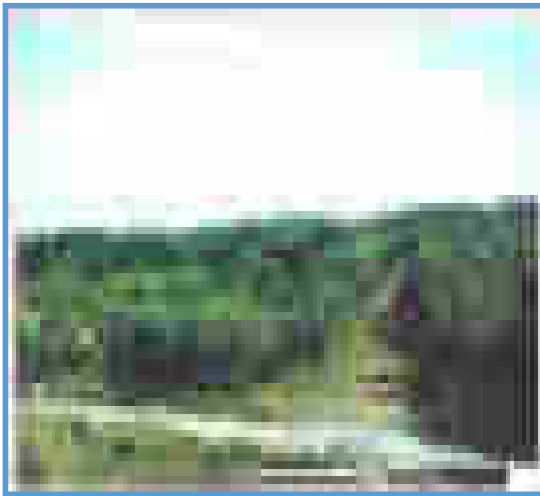
Source: Hindalco Industries Limited



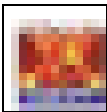
**FIGURE-14(A)**  
**GREEN BELT/GREEN COVER PHOTOGRAPHS**



**FIGURE-14(B)**  
**GREEN BELT/GREEN COVER PHOTOGRAPHS**



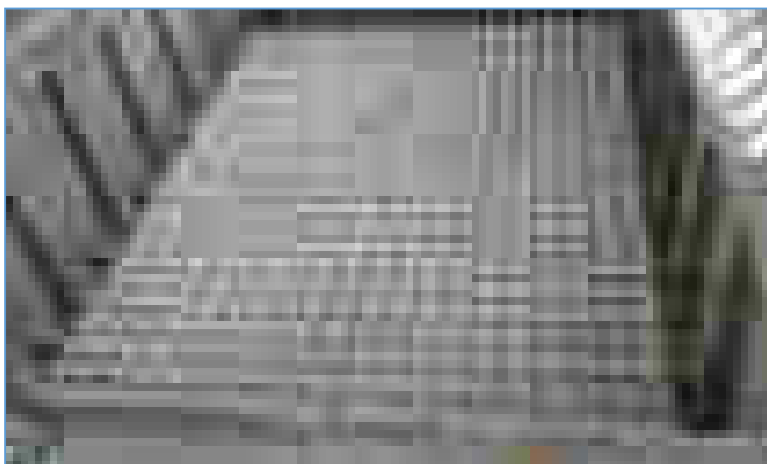
**FIGURE-14(C)**  
**GREEN COVER DEVELOPED ON ASH MOUND**



## 8.7 Environment Sustainability Measures

- *Aluminium Smelter Plant -Process Emissions*

For control of process fluoride emission from smelter plant is equipped with 4 FTPs with 5 connected stacks. To restrict the fluoride emission Hindalco replaced almost all the filter bags (around 28,200 no.s) of the FTPs with new one. All the FTPs of smelter plant are operating effectively for controlling the fluoride emissions.



**New Filter Bag Fitted In FTP**

- *Captive Power Plant*

The 13 Circulating Fluidised Bed Combustion (CFBC) boilers of all five units of CPP are attached with individual ESPs of more than 99.8 % efficiency. To achieve the new emission norm notified by MoEF&CC, the ESPs of all units (other than Unit - I which was established before Jan 2003 and is meeting the standard) have been provided with High Frequency Rectifier Transformers (HFTR) in their first fields. Installation of HFTRs has been planned in the second fields of the ESPs of the boilers. For control of SO<sub>2</sub> emission from CPP process, Hindalco is in process of installing automated lime stone feeding system to the boilers for which a CAPEX of Rs 30 crores has been approved. At FRP plant, all the three stacks have been fitted with Demisters to control the oil vapor from the process.

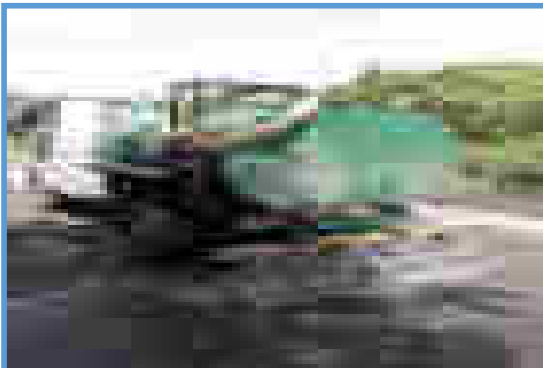
The following mitigation measures are adopted for aluminium smelter plant and Captive Power Plant (CPP) and the same will be practiced after the implementation of the project also:

- Only prebake anode technology is being adopted. All the soderberg pots have already been converted to prebake one;
- The emission/discharge confirm to the standards prescribed by OSPCB from time to time;



**Addendum Report For Installation of Ultra Clean Coal Gasification System For Replacing Furnace Oil in the Cast Houses of Aluminum Smelter Located in Hirakud Village of Sambalpur District, Odisha**

- Particulate matter and fluoride emissions from the smelter at FTP (Dry scrubbers) out let and fugitive fluoride from smelter pot rooms is being monitored regularly;
- Fume Treatment Plant (FTPs), dust collector and bag filters have been provided in smelter;
- Online real-time fluoride and dust monitoring analyzers are installed at all FTPs stack of smelter and the real time monitoring data connected to OSPCB server; and
- Online Forbes Marshall-Codel make Opacity Monitor (Model No: DCEM-2100) has already been installed and commissioned in stacks of Unit # 4 & 5 along with similar online monitoring facilities in all other units of CPP. Further, online Continuous Flue gas Analyzers of SO<sub>2</sub>, NO<sub>x</sub> (Model No: GCEM 4000 of Codel make) have also been installed in all the stacks. Real time stack data from the online monitors of smelter and power plant are connected to SPCB/CPCB server and data transmitted continuously.
- For control of fugitive emission in CPP, central dedusting system with suction hoods has been provided to the crusher houses of CHP. Dust suppression systems have also been provided in the railway siding, coal yard, ash silo area, ash transporting road and all other vulnerable areas of fugitive dust emission;

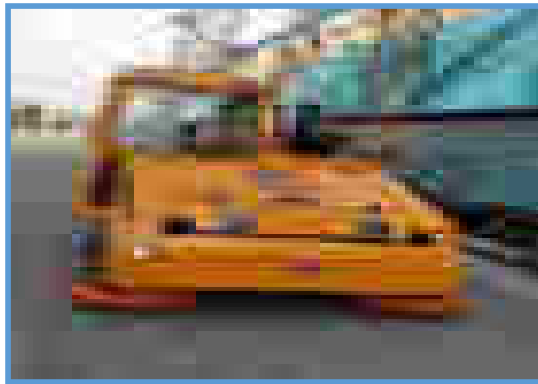


**Water Sprinkling through Tankers**

- In power plant, environment friendly CFBC boilers have been provided to each unit, which are low SO<sub>2</sub> & NO<sub>x</sub> producing in nature. ESPs, of efficiency 99.9 %, have been attached to each boiler of the CPP to maintain the particulate matter standard;
- Bag filter houses have been provided to crusher houses of CHP & ash silos. Ash is undloaded from the silos after moisturisation and frequent sprinkling is carried out on the ash and coal transportation road;



- Transportation of Raw Material: At Hirakud Smelter Hindalco procure 100% Alumina through BTAP Wagons. At Hirakud Power (CPP), to switch over the mode of transportation from road to railways Hindalco established and operating a temporary coal unloading platform to handle 1 lakh tonne coal per month by obtaining due permission from OSPCB. At present some of coal requirement at CPP is being met through road transportation by covered trucks. For control of fugitive emission on Remed - Hirakud road due to spillage of coal from these trucks, if any, 5 gangs of sweepers have been engaged along with regular water sprinkling.



**Vaccum Sweeping Machine**

8.7 Cost Provision Environment Management Measures

The total capital cost of the project is Rs 60 crores. It is proposed to invest about Rs. 5.5 crores as a capital cost on pollution control, treatment and monitoring systems. The break-up of implementation cost of EMP is given in **Table-34**.

**TABLE-34  
COST ESTIMATE FOR IMPLEMENTATION OF EMP**

Sr. No.	Particulars	Capital Investment (Rs in Crores )	Recurring Cost (Rs in Crores )
1	De-Suplhurisation System	4.50	0.23
2	Water mist sprinklers	0.20	-
3	Phenol Water Treatment System	0.50	0.10
4	CO smart monitors	0.30	-
	<b>Total</b>	<b>5.50</b>	<b>0.33</b>

Source: HIL

8.8 CSR Activities

The CSR budget allocated & utilized for the year 2018-19 is given in **Table-35**.

**TABLE-35  
CSR BUDGET**

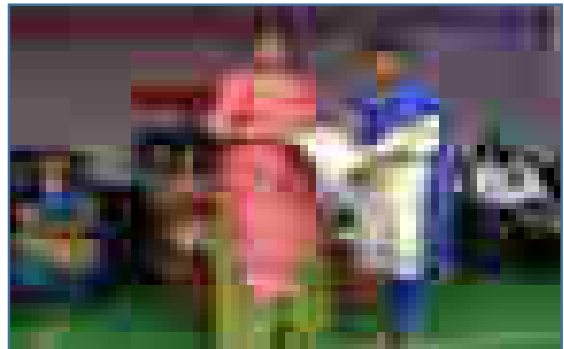
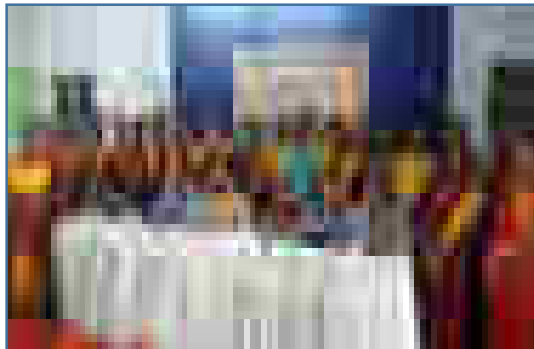
Area of Intervention	Beneficiary Coverage (Nos.)	Hindalco Fund (Amount in Rs.Lakhs)	Other Mobilisation (Amount in Rs.Lakhs)	Total (Amount in Rs.Lakhs)
Education	5196	15.53	4.80	20.33
Health care	43,975	9.02	53.70	62.72
Sustainable livelihood	1598	3.96	1.56	5.52
Infrastructure development	58,480	139.10	17.9	157
Social causes	10695	13.47	10.90	24.37
<b>Total</b>	<b>1,19,944</b>	<b>181.08</b>	<b>88.86</b>	<b>269.94</b>

Source: Hindalco Industries Limited

### Education

The following activities in the field of education development have been taken up:

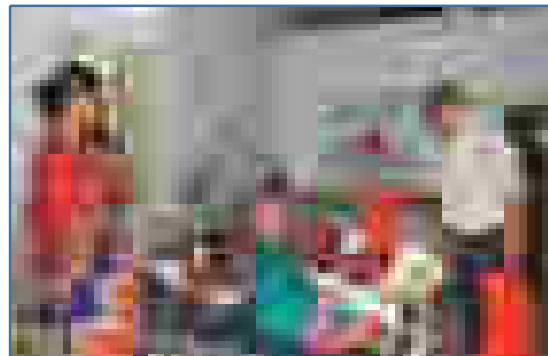
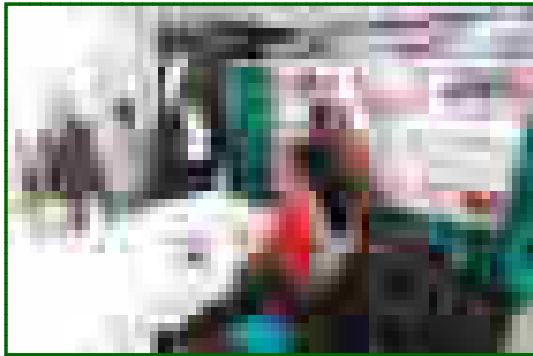
- Basic material support to 39 Anganwadis of 1080 students;
- Scholar ship to 10 meritious students of matriculate exam;
- Sponsoring science exhibition to develop educational activities;
- Desk bench support to 5 schools helped sitting arrangement of 400 students; and
- Infrastructure, sanitation, drinking water facility provided near by schools.



### Health

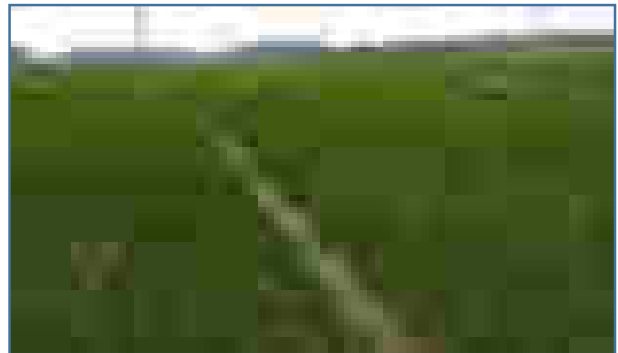
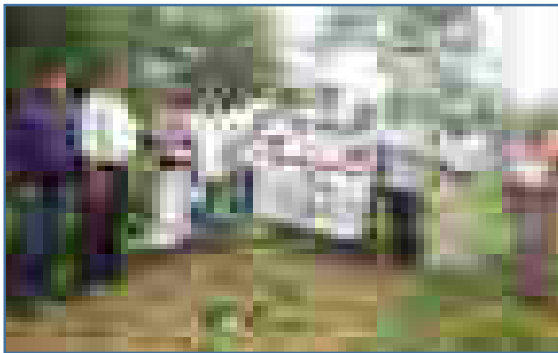
The following activities were taken up:

- Immunization coverage for 2561 babies;
- OPD facility for 1630 patients;
- Dental camp for 63 patients & support for family planning camps;
- Eye camp (Cataract Operation) for 138 poor people;
- First aid box distributed to near by schools; and
- Blood grouping of 783 students.



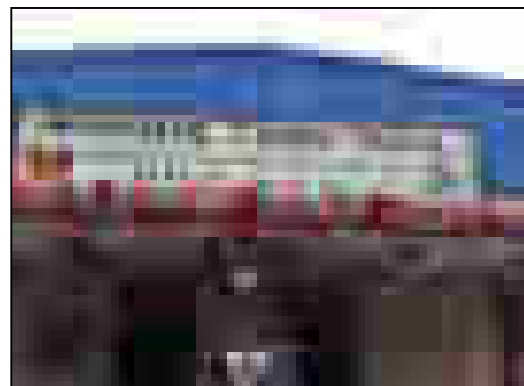
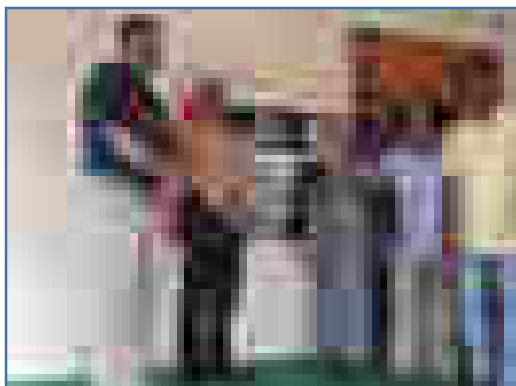
### **Livelihood**

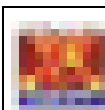
- Vegetable seeds support to 84 farms; and
- Agricultural input to farmers.



### **Infrastructure**

- Constructed the bathing ghats and changing rooms for the convenience of the villagers at Nuagujatal and Dengimacha village;
- Town hall at Hirakud for community people;
- Senior citizens Hall for old age people;
- Temple renovation work at Hirakud;
- Funeral shed Tarasingh pada; and
- Cow shed at kalapataru ashram.





**Addendum Report For Installation of Ultra Clean Coal Gasification System For Replacing Furnace Oil in the Cast Houses of Aluminum Smelter Located in Hirakud Village of Sambalpur District, Odisha**

As per the office memorandum about Corporate Environment Responsibility (CER) issued by Ministry of Environment, Forest and Climate Change (MOEF&CC) on dated 1<sup>st</sup> May, 2018, for brownfield projects of the total cost (Rs.60 crores) of the project to be earmarked towards the Corporate Environment Responsibility (CER) based on local needs. The project proponent kept Rs. 60 lakhs of the total cost of the project based on local needs. The slabwise break-up is given in **Table-36**. The proposed CER activities budget for 2020-21 to 2022-23 is given in **Table-37**.

**TABLE-36**  
**SLAB WISE-BREAK-UP**

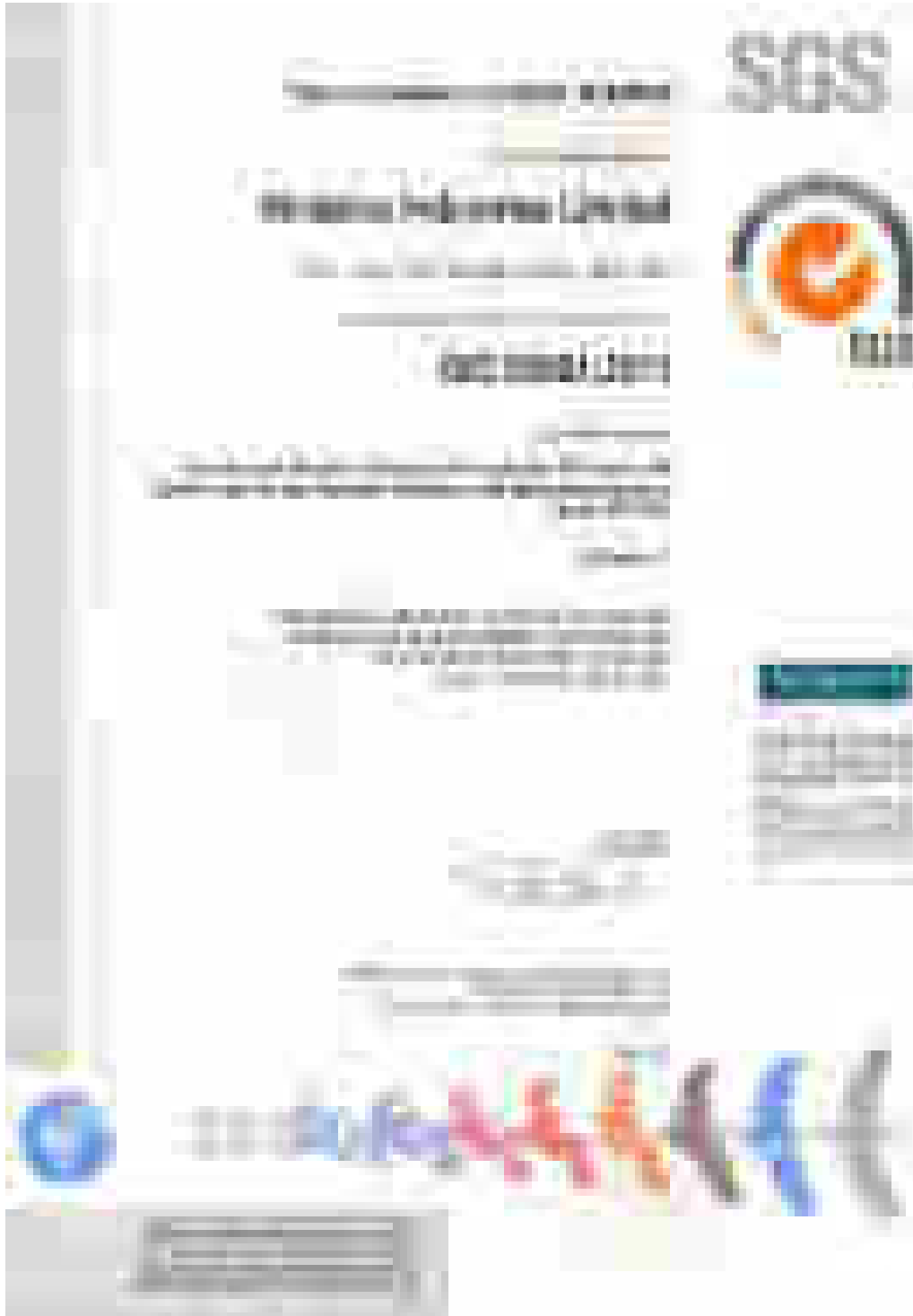
Sr. No	Capital Investment / Additional Capital Investment / (in Rs)	Brownfield Project - % of Capital Investment	Detailed break-up for Rs. 600 Crores	Amount in Rs. Lakhs
1	< 100 crores	1.00%	Rs. 60 lakhs @ 1%	60
2	> 100 crores to < 500 crores	0.75%	Nil	Nil
3	> 500 crores to < 1000 crores	0.50%	Nil	Nil
4	> From 1000 crores to < 10000 crores	0.25%	Nil	Nil
	<b>Grand Total</b>		<b>Rs.60 Crores</b>	<b>60</b>

**TABLE-37**  
**CORPORATE ENVIRONMENT RESPONSIBILITY BUDGET FOR THREE YEARS**

Sr. No.	Main Area	Proposed Budget (Rs. in Lakhs)
1	Health and Hygiene	10
2	Education	10
3	Skill Development & Self Employment	10
4	Drinking Water	10
5	Infrastructure	10
6	Environment Protection and Others	10
	<b>Total</b>	<b>60</b>

8.9 Energy Conserveation Certification

Hindalco has been certified ISO 50001: 2001 for energy management system from SGS. The ISO certificate is given in **Figure-15**.



**FIGURE-15**  
**ISO CERTIFICATION 50001: 2011**