JSW STEEL LIMITED

PROPOSED EXPANSION FROM 10.0 MTPA TO 16.0 MTPA STEEL PLANT AT TORANAGALLU, KARNATAKA

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) & ENVIRONMENTAL MANAGEMENT PLAN (EMP)

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SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
1.	A site location map on Indian map of 1:10, 00,000 scale followed by 1:50,000/1:25,000 scale on an A3/A2 sheet with at least next 10 Kms of terrains i.e. circle of 10 kms and further 10 kms on A3/A2 sheets with proper longitude/latitude/heights with min. 100/200 m. contours should be included. 3-D view i.e. DEM (Digital Elevation Model) for the area in 10 km radius from the proposal site.	Chapter 3 Refer Drawing No. MEC/Q6S4/11/S2/02	
2.	Present land use should be prepared based on satellite imagery. High-resolution satellite image data having 1m-5m spatial resolution like quickbird, Ikonos, IRS P-6 pan sharpened etc. for the 10Km radius area from proposed site. The same should be used for land used/land-cover mapping of the area.	Land use is given in Chapter 6 page	
3.	Topography of the area should be given clearly indicating whether the site requires any filling. If so, details of filling, quantity of fill material required, its source, transportation etc. should be given.	Refer Drawing No. MEC/Q6S4/11/S2/02	
4.	Location of national parks / wildlife sanctuary / reserve forests within 10 km. radius should specifically be mentioned. A map showing landuse/landcover, reserved forests, wildlife sanctuaries, national parks, tiger reserve etc in 10 km of the project site.	Chapter 3 Clause 3.1.5, 5th para Refer Drawing No. MEC/Q6S4/11/S2/02	
5.	Project site layout plan showing raw materials, fly ash and other storage plans, bore well or water storage, aquifers (within 1 km.) dumping, waste disposal, green areas, water bodies, rivers/drainage passing through the project site should be	Refer Drawing No. MEC/Q6S4/11/S2/01	

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
	included.		
6.	Coordinates of the plant site as well as ash pond with topo sheet co-ordinates of the plant site as well as ash pond with topo sheet should also be included.	Refer Drawing No. MEC/Q6S4/11/S2/01	
7.	Details and classification of total land (identified and acquired) should be included.	Chapter 3 , Clause 2.12, page 2-58	
8.	Proposal should be submitted to the Ministry for environment clearance only after acquiring total land. Necessary documents indicating acquisition of land should be included.	-	The proposed expansion is with in the existing plant premises and no additional land is required.
9.	Rehabilitation & Resettlement (R & R) should be as per policy of the State Govt. and a detailed action plan should be included.	-	No R & R issue involved.
10.	Permission and approval for the use of forest land and recommendations of the State Forest Department regarding impact of proposed expansion on the surrounding reserve forests, if applicable, should be included, if applicable.	No forest land is involved and impact is given in Chapter 4 , Clause 4.1.1.7, Page 4-34	
11.	A list of industries containing name and type in 25 km radius should be incorporated.	Refer Chapter 6, page 6-37 to 6-38	
12.	Residential colony should be located in upwind direction.	Located in up wind direction	
13.	List of raw material required and source alongwith mode of transportation should be included. All the trucks for raw material and finished product transportation must be environmentally compliant.	Refer Chapter 2 , Clause 2.11, page 2-57 to 2-58	
14.	Quantity of coking coal to be imported from each port, method of movement of raw material including coke and product.	Refer Chapter 2 , Clause 2.11, page 2-57 to 2-58	
15.	Commitment and permission from the Port Authorities for handling raw materials and products.	We have developing new links in addition to Goa(Krishnapattanam, Mangalore, Chennai,	

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
		Gangavaram etc). We have also developing dedication Coal siding at Jaigarh. These ports will be adequate to handle the increased capacity.	
16.	A chapter on coking coal availability, source, blending, utilization.	Refer Chapter 2 , Clause 2.10.4, page 2-20 to 2-27	
17.	Undertaking and commitment from Authorities in Australia for supplying coking coal along with fall back plan.	Currently the coal required is met from 43 suppliers. The supplier have adequate reserves for supplying the additional quantities.	
18.	Analysis of coal for Arsenic content is necessary and should be included.	Refer Chapter 3 , page 3-83 to 3-84	
19.	Petrological and Chemical analysis and other chemical properties of raw materials used (with GPS location of source of raw material) i.e. ores, minerals, rock, soil, coal, iron, dolomite quartz etc. using high definition and precision instruments mentioning their detection range and methodology such Digital Analyzers, AAS with Graphite furnace, ICPMS, MICRO-WDXRF, EPMA, XRD, Nano studies or at least as per I30-10500 and WHO norms. These analysis should include trace element and metal studies like Cr (vi) Ni, Fe, As, Pb, Zn, Hg, Se, S etc. Presence of radioactive elements (U, Th etc.).	Refer Chapter 3 , page 3-82to 3-84	
20.	Petrography, grain size analysis and Major element analysis of raw material and soil from project site and raw material should be done on the same parameters along with analysis for SiO_2, Al_2O_3, MgO, MnO, K_2O, CaO, FeO, Fe_2O_3, P_2O_5, H_2O, CO_2.	Refer Chapter 3 , page 3-82to 3-84	
21.	If the rocks, ores, raw material has trace elements their petrography, ore	Refer Chapter 3 , page 3-82to 3-84	

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
	microscopy, XRD, elemental mapping EPMA, XRF is required to quantify the amount present in it and hence future risk involved while using it and management plan.		
22.	Studies for fly ash, muck disposal, slurry, sludge material and other solid waste generated should also be included, if the raw materials used has trace elements and a management plan.	Refer Chapter 3 , page 3-65 to 3-71	
23.	Manufacturing process details for all the plants including slag-grinding unit should be included. A commitment that emission level from all the stacks should not be less than 50 mg/Nm^3.	Refer Chapter 2 , page 2-7 to 2-10	
24.	A complete table indicating existing, yet to be commissioned, proposed and cumulative facilities and capacities. Phasing of all the plants should be included.	Refer Chapter 2 , Table 2.2, page 2-5 to 2-7	
25.	A chapter on type and full details of coke oven plant including pollution control methods and justification for installing recovery type of coke oven, dry quenching should be included.	Refer Chapter 2 , Clause 2.10.4, page 2-20 to 2-27	
26.	Mass balance for the raw material and products should be included.	Refer Chapter 2 , Fig 2-1, page 2-66	
27.	Energy balance data for all the components of steel plant including proposed power plant should be incorporated.	Refer Chapter 2 , Table 2-4, page 2-67 to 2-68	
28.	A plan for the utilization of waste/fuel gases from all the sources including BF, coke oven in generating power have to be set out.	Refer Chapter 2 , Table 2-6, page 2-71	
29.	Site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall should be collected.	Refer Chapter 3 , Clause 3.2.1, page 3-5 to 3-8	
30.	One season site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall	Refer Chapter 3 , Clause 3.2.1 & 3.2.2, page 3-5 to 3-15	

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
	and AAQ data (except monsoon) should be collected. The monitoring stations should take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.		
31.	Data generated in the last three years i.e. air, water, raw material properties and analysis (major, trace and heavy metals), ground water table, seismic history, flood hazard history etc.	Refer Chapter 3 , Clause 3.2.1 & 3.2.2, page 3-5 to 3-15. Data generated in 2009-2010.	
32.	Data on existing ambient air, stack emission, fugitive emissions data; water requirement and water balance cycle; generation, re-utilization and disposal of solid/ hazardous waste for the existing plant and predicted increase in pollution load (GLCs) due to proposed expansion should be incorporated.	Refer Chapter 3 and Chapter 4 of EIA report	
33.	All the environment clearances accorded by the Ministry, Consent to Establish and Operate and point-wise compliance to the specific and general conditions stipulated in the environmental clearance and Consent to Establish and Operate for all the existing plants.	Refer Chapter 3 , Clause 3.2.13 page 3-86 to 3-107	
34.	Ambient air quality at 8 locations within the study area of 10 km., aerial coverage from project site with one AAQMS in downwind direction should be carried out.	Refer Chapter 3 , Clause 3.2.2, page 3-9 to 3-15	
35.	The suspended particulate matter present in the ambient air must be analyzed for the presence of poly-aromatic hydrocarbons (PAH), i.e. Benzene soluble fraction. Chemical characterization of RSPM and incorporating of RSPM data.	Refer Chapter 3 , page 3-76 to 3-77	
36.	Determination of atmospheric inversion level at the project site and assessment of ground level	Refer Chapter 3 , page 3-5 to 3-9	

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
	concentration of pollutants from the stack emission based on site-specific meteorological features.		
37.	Air quality modelling for steel plant for specific pollutants needs to be done. Air pollution control devices installed and proposed for the control of emissions from all the sources should also be included.	Refer Chapter 4 , Clause 4.5.3.4, page 4-60 to 4-61	
38.	Ambient air quality monitoring modelling along with cumulative impact should be included for the day (24 hrs) for maximum GLC along with following :	Refer Chapter 4 , Clause 4.1.4.2.1, page 4-10 to 4-19 and annexure at the end of chapter	
	• Emissions (g/second) with and without the air pollution control measures	-do-	
	• Meteorological inputs (wind speed, m/s), wind direction, ambient air temperature, cloud cover, relative humidity & mixing height) on hourly basis	-do-	
	• Model input options for terrain, plume rise, deposition etc.	-do-	
	• Print-out of model input and output on hourly and daily average basis	-do-	
	• A graph of daily averaged concentration (MGLC scenario) with downwind distance at every 500 m interval covering the exact location of GLC.	-do-	
	• Details of air pollution control methods used with percentage efficiency that are used for emission rate estimation with respect to each pollutant	-do-	
	• Applicable air quality standards as per LULC covered in the study area and % contribution of the proposed plant to the applicable Air quality standard. In case of expansion project, the contribution should be inclusive	-do-	

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
	of both existing and expanded capacity.		
	• No. I to VII are to be repeated for fugitive emissions and any other source type relevant and used for industry	-do-	
	• Graphs of monthly average daily concentration with down-wind distance	-do-	
	• Specify when and where the ambient air quality standards are exceeded either due to the proposed plant alone or when the plant contribution is added to the background air quality.	-do-	
	• Fugitive dust protection or dust reduction technology for workers within 30 m of the plant active areas.	-do-	
39.	Impact of the transport of the raw materials and end products on the surrounding environment should be assessed and provided. The alternate method of raw material and end product transportation should also be studied and details included.	Refer Chapter 4 , Clause 4.1.4.3, page 4-19 to 4-21	
40.	One season data for gaseous emissions other than monsoon season in 10 km radius is necessary.	Refer Chapter 3 , Clause 3.2.2, page 3-9 to 3-15	
41.	An action plan to control and monitor secondary fugitive emissions from all the sources as per the latest permissible limits issued by the Ministry vide G.S.R. 414(E) dated 30th May, 2008.	Refer Chapter 4 , Clause 4.5.3.1, page 4-53 to 4-57	
42.	Information regarding surface hydrology and water regime should be included.	Refer Chapter 3 , Clause 3.2.5, page 3-19 to 3-21	
43.	Presence of an aquifer/aquifers within 1 km of the project boundaries and management plan for recharging the aquifer should be included.	Refer Chapter 3 , Clause 3.2.5, page 3-19 to 3-21	
44.	Source of surface/ground water level, site (GPS), cation, anion (Ion Chromatograph), metal trace	Refer Chapter 3 , page 3-27 to 3-32	

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
	element (as above) chemical analysis for water to be used. If surface water is used from river, rainfall, discharge rate, quantity, drainage and distance from project site should also be included.		
45.	Ground water analysis with bore well data, litho-logs, drawdown and recovery tests to quantify the area and volume of aquifer and its management.	Refer Chapter 3 , Clause 3.2.6, page 3-21 to 3-26	
46.	Ground water modelling showing the pathways of the pollutants should be included.	Refer Chapter 3 , Clause 3.2.6, page 3-21 to 3-26	
47.	Column leachate study for all types of stockpiles or waste disposal sites at 20^{o}C-50^{o}C should be conducted and included.	Refer Chapter 3 , page 3-65 to 3-71	
48.	Permission for the drawl of water from the concerned authority for the existing as well as proposed plant from the Almatty dam and Tungbhadra dam and water balance data including quantity of effluent generated, recycled and reused and discharged is to be provided. Methods adopted/to be adopted for the water conservation should be included.	Refer Chapter 4 , page 4-62 to 4-64 for water conservation	JSW has permission to draw 32.8 MGD from TB dam and 40 MGD from Almatti dam.
49.	A note on the impact of drawl of water on the nearby River during lean season.	-	Not applicable
50.	Surface water quality of nearby River (60 m upstream and downstream) and other surface drains at eight locations must be ascertained.	Refer Chapter 3 , page 3-27 to 3-32	
51.	If the site is within 10 km radius of any major river, Flood Hazard Zonation Mapping is required at 1:5000 to 1;10,000 scale indicating the peak and lean river discharge as well as flood occurrence frequency.	-	Not applicable
52.	A note on treatment of wastewater from different plants, recycle and reuse for different purposes should	Refer Chapter 4 , page 4-62 to 4-64 for water conservation	

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
	be included.		
53.	Provision of traps and treatment plants are to be made, if water is getting mixed with oil, grease and cleaning agents.	Refer Chapter 4 , page 4-62 to 4-64 for water conservation	
54.	If the water is mixed with solid particulates, proposal for sediment pond before further transport should be included. The sediment pond capacity should be 100 times the transport capacity.	-	Two Guard ponds are already existing
55.	Wastewater characteristics (heavy metals, anions and cations, trace metals, PAH) from washed / beneficiated plants / washery.	Refer Chapter 3, page 3-81	
56.	The pathways for pollution via seepages, evaporation, residual remains are to be studied for surface water (drainage, rivers, ponds, lakes), sub-surface and ground water with a monitoring and management plans.	Refer Chapter 3 , page 3-27 to 3-32	
57.	Ground water monitoring minimum at 8 locations and near solid waste dump zone, Geological features and Geo-hydrological status of the study area are essential as also. Ecological status (Terrestrial and Aquatic) is vital.	Refer Chapter 3 of EIA report	
58.	Geotechnical data by a bore hole of upto 40 mts. in every One sq. km area such as ground water level, SPTN values, soil fineness, geology, shear wave velocity etc. for liquefaction studies and to assess future Seismic Hazard and Earthquake Risk Management in the area.	Refer Chapter 3 , Clause 3.2.4, page 3-17 to 3-18	
59.	Action plan for solid/hazardous waste generation, storage, utilization and disposal particularly slag from all the sources, char and fly ash. Copies of MOU regarding utilization of ash and slag should also be included.	Refer Chapter 4 , Clause 4.8, page 4-64 to 4-67	
60.	Details of evacuation of ash, details	Ash will be transported	In emergency ash will

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
	regarding ash pond impermeability and whether it would be lined, if so details of the lining etc. needs to be addressed.	to cement plant in dry form.	be dumped in existing ash pond
61.	Green belt development plan in 33 % area. Details of greenbelt i.e. land with not less than 1,500 trees per ha. giving details of species, width of plantation, planning schedule etc. Cement manufacturers for utilizing granulated BF slag and fly ash should be included.	Refer Chapter 4 , Clause 4.9, page 4-67 to 4-76 Refer Chapter 3, page 3-64 to 3-71	
62.	A note on the treatment, storage and disposal of all type of slag should be included.	Refer Chapter 3, page 3-64 to 3-71	
63.	Identification and details of land to be used for SMS slag disposal should be included.	Bund of Slime disposal facilities	
64.	End use of solid waste and its composition should be covered. Toxic metal content in the waste material and its composition should also be incorporated particularly of slag.	Refer Chapter 3, page 3-64 to 3-71	
65.	All stock piles will have to be on top of a stable liner to avoid leaching of materials to ground water.	Slag & Clay will be used as stable liner	
66.	Acton plan for the green belt development plan in 33 % area should be included. The green belt should be around the project boundary and a scheme for greening of the traveling roads should also be incorporated. All rooftops/terraces should have some green cover.	Refer Chapter 4 , Clause 4.9, page 4-67 to 4-76	
67.	Details regarding infrastructure facilities such as sanitation, fuel, restroom etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.	Refer Chapter 4, Clause 4.1.3, page 4-2 to 4-5	
68.	A scheme for rainwater harvesting have to be put in place. Incorporation	Refer Chapter 4, Clause 4.6, page 4-64	

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
	of water harvesting plan for the project is necessary, if source of water is bore well.		
69.	Detailed description of the flora and fauna (terrestrial and aquatic) should be given with special reference to rare, endemic and endangered species.	Refer Chapter 3, Clause 3.2.9, page 3-35 to 3-54	
70.	Socio-economic development activities need to be elaborated upon. Measures of socio economic influence to the local community proposed to be provided by project proponent. As far as possible, quantitative dimension should be given. Provision of schools, college, technical institutes, training centres, recreation parks, water supply to nearby villages etc should be incorporated.	Refer Chapter 6, Clause 6.3, page 6-30 to 6-44	
71.	Impact of the project on local infrastructure of the area such as road network and whether any additional infrastructure would need to be constructed and the agency responsible for the same with time frame.	Refer Chapter 4, Clause 4.1.4.3, page 4-19 to 4-21	
72.	A detailed disaster management plant including risk assessment and damage control needs to be addressed.	Refer Chapter 6, Clause 6.2, page 6-2 to 6-30	
73.	Occupational health of the workers needs elaboration. Health effects of other metals used and health hazard plans based on monthly correlation of these metal related diseases and people affected and mitigation plans. Arsenicosis Management Plan if Arsenic is present in ore, rock, coal, fly ash, water. Action Plan for protecting the workers against hazardous chemicals such as Sulphuric acid, pesticides, solvents etc.	Refer Chapter 4, Clause 4.1.1.8, page 4-35 to 4-36	
74.	Occupational health of the workers	Refer Chapter 3, Clause	

SN.	TOR POINTS GIVEN BY MOE&F	COVERAGE IN EIA REPORT	REMARKS
	needs elaboration including evaluation of noise, heat, illumination, dust, any other chemicals, metals being suspected in environment and going into body of workers either through inhalation, ingestion or through skin absorption and steps taken to avoid musculo-skeletal disorders (MSD), backache, pain in minor and major joints, fatigue etc. Occupational hazards specific pre-placement and periodical monitoring and periodical monitoring should be carried out. The detailed plan to carry out above mentioned activity should be mentioned.	3.2.12, page 3-84 to 3-86	
75.	EMP to mitigate the adverse impacts due to the project along with item-wise cost of its implementation.	Refer Chapter 5 of EIA report	
76.	Plan for the implementation of the recommendations made for the steel plants in the CREP guidelines must be prepared.	Refer Chapter 4, Clause 4.1.1.9, page 4-36 to 4-37	
77.	A note on identification and implementation of Carbon Credit project should be included.	Refer Chapter 4, Clause 4.5.2, page 4-50 to 4-53	
78.	Total capital cost and recurring cost/annum for environmental pollution control measures.	Refer Chapter 5, Clause 5.3.7, page 5-13	
79.	Public hearing issues raised and commitments made by the project proponent on the same should be included separately in EIA/EMP Report in the form of tabular chart.	Agreed	
80.	Any litigation pending against the project and / or any direction / order passed by any Court of Law against the project, if so, details thereof.	Refer Chapter 3, Clause 3.2.14, page 3-107	

LIST OF ABBREVIATIONS, SYMBOLS AND UNITS

Abbreviation / Symbol / Unit	Full Form
µg/m³	*Micrograms per Cubic Metre*
AAQ	*Ambient Air Quality*
ac	*Acre*
AGM	*Asst. General Manager*
BDL	*Below Detection Limit*
BF	*Blast Furnace*
BOD	*Biochemical Oxygen Demand*
BOD Plant	*Biological Oxidation & De-Phenolization Plant*
BOF	*Basic Oxygen Furnace*
CDI	*Coal Dust injection*
MPCB	*Maharashtra Pollution Control Board*
CO gas	*Coke Oven gas*
CPCB	*Central Pollution Control Board*
CREP	*Charter on Corporate responsibility for Environmental Protection*
D/s	*Downstream*
dB(A)	*Decibels*
DGM	*Deputy General Manager*
Drg	*Drawing*
EC	*Electrical Conductivity*
ED	*Executive Director*
EIA	*Environmental Impact Assessment*
EMP	*Environmental Management Plan*

Abbreviation / Symbol / Unit	Full Form
EMD	*Environment Management Department*
ESP	*Electro static precipitator*
Fig	*Figure*
$g/m^2/d$	*Grams per Square metre Per Day*
g/s	*Grams per Second*
GCA	*Gross Cropped Area*
GCP	*Gas Cleaning plant*
GHG	*Green house gas*
GLC	*Ground Level Concentration*
GM	*General Manager*
ha	*Hectare*
HPLA	*High Pressure liquor aspiration*
HR Coil	*Hot rolled Coil*
HVAS	*High Volume Air Sampler*
IMD	*India Meteorological Department*
Kcal/Nm3	*Kilo calorie per normal meter cube*
Kg/thm	*Kilogram per tones of hot metal*
km	*Kilometre*
km/hr	*Kilometre per Hour*
km^2	*Square Kilometre*
l	*litre*
Leq	*Log Equivalent*
LF	*Ladle Furnace*
LPG	*Liquefied Petroleum gas*
m	*Metre*
m/s	*Metres per Second*
m^2	*Square Metre*
m^2/s	*Square Metres per Second*
m^3	*Cubic Metres*
m^3/d	*Cubic Metres per day*
m^3/h	*Cubic Metres per hour*
mc	*Machine*
MEC/MECON	*MECON Ltd*

Abbreviation / Symbol / Unit	Full Form
meq/gm	*Milli Equivalents per Gram*
mg/l	*Milligrams Per Litre*
mg/Nm3	*Milligrams per normal meter cube*
mm	*Millimetre*
Mm^3	*Million Cubic Metres*
MoEF	*Ministry of Environment and Forests, Govt. Of India*
MPN	*Most Probable Number*
MT	*Million Tonnes*
MTPA	*Million Tonnes per Annum*
MWe	*Mega Watt Electricity*
NAAQS	*National Ambient Air Quality Standards*
Nm3	*normal meter cube*
NOx	*Oxides of Nitrogen*
NTU	*Nephelometric Turbidity Units*
Pb	*Lead*
PF	*Protected Forest*
PP	*Power plant*
QOL	*Quality of Life*
qtl/ac	*Quintal per acre*
R & D	*Research and Development*
R & R	*Rehabilitation and Resettlement*
RDS	*Respirable Dust Sampler*
RF	*Reserved Forest*
RMP	*Refractory Material Plant*
RPM	*Respirable Particulate Matter*
SMS	*Steel Melting Shop*
SO_2	*Sulphur Dioxide*
SPM	*Suspended Particulate Matter*
Sq	*Square*
t	*tonnes*
t/m2/h	*Tones per meter square per hour*
TCS	*Tonnes of Crude Steel*
tpd	*Tonnes Per Day*

Abbreviation / Symbol / Unit	Full Form
U/s	*Upstream*
VD	*Vaccum Degasser*

1.0 INTRODUCTION

M/s Jindal South West (JSW) Steel Ltd., formerly known as Jindal Vijayanagar Steel Ltd. (JVSL), is a flag ship company of OP Jindal group of industries. This integrated steel plant at Toranagallu is the most modern, technologically efficient and eco-friendly integrated steel plant in India.

JSW Steel Ltd now intends to enhance the steel manufacturing capacity from 10.0 Mtpa to 16.0 Mtpa and produce a wide variety of steel products to meet the requirements of the customers. The expansion facilities will be built within the existing manufacturing facilities. With this expansion, JSW Steel will be in a stronger position to supply a wide variety of steel products to the consumers in South and Central India. The product mix that will be offered by JSW Steel Ltd will then include flat products, long products, wire rods, re bars, light & heavy sections, besides the semis like billets and blooms.

This is an EIA / EMP report for the proposed expansion steel project from 10.0 mtpa to 16.0 mtpa of JSW Steel Limited. The report is prepared as per the procedure specified in 14th September 2006 Notification of Ministry of Environment and Forests (MoEF).

1.1 PURPOSE OF THE REPORT

In pursuance of Government of India policy vide Environmental (Protection) Act, 1986, any expansion project necessitates statutory prior environmental clearance in accordance with the objectives of National Environmental policy as approved by the Union Cabinet on 18th May, 2006 and MoEF EIA Notification dated 14.09.06, by preparing Environmental Impact Assessment (EIA) report. All the Steel plants are kept at S.N. 3(a) under Category A and are appraised at the Central level. In view of the above, the EIA report has been prepared taking into consideration the requirement and guidelines of statutory bodies and also client's requirement.

The objective of the EIA study report is to take stock of the prevailing quality of environment, to assess the impacts of proposed industrial activity on environment and to plan appropriate environmental control measures to minimise adverse impacts and to maximise beneficial impacts of proposed project. The following major objectives have been considered:

- Assess the existing status of environment.
- Additional impacts, if any due to the proposed expansion.
- Suggest additional pollution control and ameliorative measures to minimize/reduce the impacts.
- Prepare an action plan for implementation of suggested ameliorative measures.
- Suggest a monitoring programme to assess the efficacy of the various adopted environmental control measures.
- Assess financial considerations for suggested environmental control plans.
- Clearances from statutory authorities

1.2 IDENTIFICATION OF THE PROJECT AND PROJECT PROPONENT

1.2.1 Nature of the Project

The proposed plant falls under Category 'A' (Sl.No. 3 (a) of Schedule : "Primary and Secondary Ferrous Metallurgical Industries"). It intends to maintain production of long and flat products based on BF-BOF route.

1.2.2 Size of the Project

JSW Steel Limited has proposed to enhance the plant capacity from 10.0 mtpa to 16.0 mtpa due to growing domestic demand of long products in today's market conditions. Further, size of the project is of crucial importance for making it economically viable. At the same time the proposed project will help in long term development of the region and the state of Karnataka.

1.2.3 Project Proponent

JSW Steel Limited operates an Integrated Steel plant at Vijayanagar, Karnataka based on COREX&BF-BOF process route for steel making. JSW Steel also operates a 1.0 mtpa integrated steel making afcaility at Salem, Tamilnadu and has two cold rolling, galvanizing and colour coating plants at Tarapur and Vasind in Maharashtra. The next phase of expansion will take the capacity of this plant at Vijayanagar to 16.0 mtpa by the year 2015.

1.2.4 Importance of the Project

The Indian steel industry is poised for faster growth in the decades ahead as the industrial and economic development of the country gains pace. The total steel consumption of finished steel has been estimated to touch 120 MT in the year 2012 from the current level of over 60 MT compared to China's (Our neighbour) steel production of >500 Mtpa. Even after approximately doubling the production capacity the per capita domestic consumption would continue to be substantially below the world average of 197 Kg. There is good prospect of domestic steel consumption growing at about 6 – 7% up to the year 2015. The national steel policy has set a target of 110 million tonne (MT) of steel production by 2015 and to increase it to a level of 200 million tonne by 2020. JSW Steel Limited is well positioned to fulfill its role in the nation's quest for higher growth and development in the new millennium.

The growth of the steel industry significantly contributes to economic growth of the Nation as well as to the region as it generates employment both directly and also due to development of downstream industries. The infrastructural and other social amenities grow in the region leading to overall development of the region.

1.2.5 Location of the Project

The existing integrated steel plant is situated between 15°10' - 15°12' N latitude and 76°38' - 76°40'E longitude, near Toranagallu village of Bellary district in the state of Karnataka. The site is at a distance of 32 km from Bellary, 33 km from Hospet and about 340 km from Bangalore by road. Nearest railway station to the steel plant is Toranagallu. Broad gauge railway lines between Guntakal and Hubli are passing through this station. The eastern port of Chennai is 460 km and western port of Goa is 430 km. Mumbai is about 740 km on the North West. Location map is shown as **Fig. 1-1**.

1.3 SCOPE OF THE STUDY

The following Terms of Reference (TOR) has been finalised during the 3rd meeting of the Expert Appraisal Committee (Industry) of Ministry of Environment & Forest held on 23rd to 24th September, 2009 for preparation of EIA/EMP report for expansion of Integrated Steel Plant (10.0 MTPA to 16.0 MTPA) along with Captive Power Plant (600 MW) near village Toranagallu, district Bellary, Karnataka.

1. A site location map on Indian map of 1:10, 00,000 scale followed by 1:50,000/1:25,000 scale on an A3/A2 sheet with at least next 10 Kms of terrains i.e. circle of 10 kms and further 10 kms on A3/A2 sheets with proper longitude/latitude/heights with min. 100/200 m. contours should be included. 3-D view i.e. DEM (Digital Elevation Model) for the area in 10 km radius from the proposal site.

2. Present land use should be prepared based on satellite imagery. High-resolution satellite image data having 1m-5m spatial resolution like quickbird, Ikonos, IRS P-6 pan sharpened etc. for the 10Km radius area from proposed site. The same should be used for land used/land-cover mapping of the area.

3. Topography of the area should be given clearly indicating whether the site requires any filling. If so, details of filling, quantity of fill material required, its source, transportation etc. should be given.

4. Location of national parks / wildlife sanctuary / reserve forests within 10 km. radius should specifically be mentioned. A map showing landuse/landcover, reserved forests, wildlife sanctuaries, national parks, tiger reserve etc in 10 km of the project site.

5. Project site layout plan showing raw materials, fly ash and other storage plans, bore well or water storage, aquifers (within 1 km.) dumping, waste disposal, green areas, water bodies, rivers/drainage passing through the project site should be included.

6. Coordinates of the plant site as well as ash pond with topo sheet co-ordinates of the plant site as well as ash pond with topo sheet should also be included.

7. Details and classification of total land (identified and acquired) should be included.

8. Proposal should be submitted to the Ministry for environment clearance only after acquiring total land. Necessary documents indicating acquisition of land should be included.

9. Rehabilitation & Resettlement (R & R) should be as per policy of the State Govt. and a detailed action plan should be included.

10. Permission and approval for the use of forest land and recommendations of the State Forest Department regarding impact of proposed expansion on the surrounding reserve forests, if applicable, should be included, if applicable.

11. A list of industries containing name and type in 25 km radius should be incorporated.

12. Residential colony should be located in upwind direction.

13. List of raw material required and source alongwith mode of transportation should be included. All the trucks for raw material and finished product transportation must be environmentally compliant.

14. Quantity of coking coal to be imported from each port, method of movement of raw material including coke and product.

15. Commitment and permission from the Port Authorities for handling raw materials and products.

16. A chapter on coking coal availability, source, blending, utilization.

17. Undertaking and commitment from Authorities in Australia for supplying coking coal alongwith fall back plan.

18. Analysis of coal for Arsenic content is necessary and should be included.

19. Petrological and Chemical analysis and other chemical properties of raw materials used (with GPS location of source of raw material) i.e. ores, minerals, rock, soil, coal, iron, dolomite quartz etc. using high definition and precision instruments mentioning their detection range and methodology such Digital Analyzers, AAS with Graphite furnace, ICPMS, MICRO-WDXRF, EPMA, XRD, Nano studies or at least as per I30-10500 and WHO norms. These analysis should include trace element and metal studies like Cr (vi) Ni, Fe, As, Pb, Zn, Hg, Se, S etc. Presence of radioactive elements (U, Th etc.).

20. Petrography, grain size analysis and Major element analysis of raw material and soil from project site and raw material should be done on the same parameters along with analysis for SiO_2, Al_2O_3, MgO, MnO, K_2O, CaO, FeO, Fe_2O_3, P_2O_5, H_2O, CO_2.

21. If the rocks, ores, raw material has trace elements their petrography, ore microscopy, XRD, elemental mapping EPMA, XRF is required to quantify the amount present in it and hence future risk involved while using it and management plan.

22. Studies for fly ash, muck disposal, slurry, sludge material and other solid waste generated should also be included, if the raw materials used has trace elements and a management plan.

23. Manufacturing process details for all the plants including slag-grinding unit should be included. A commitment that emission level from all the stacks should not be less than 50 mg/Nm^3.

24. A complete table indicating existing, yet to be commissioned, proposed and cumulative facilities and capacities. Phasing of all the plants should be included.

25. A chapter on type and full details of coke oven plant including pollution control methods and justification for installing recovery type of coke oven, dry quenching should be included.

26. Mass balance for the raw material and products should be included.

27. Energy balance data for all the components of steel plant including proposed power plant should be incorporated.

28. A plan for the utilization of waste/fuel gases from all the sources including BF, coke oven in generating power have to be set out.

29. Site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall should be collected.

30. One season site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall and AAQ data (except monsoon) should be collected. The monitoring stations should take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.

31. Data generated in the last three years i.e. air, water, raw material properties and analysis (major, trace and heavy metals), ground water table, seismic history, flood hazard history etc.

32. Data on existing ambient air, stack emission, fugitive emissions data; water requirement and water balance cycle; generation, re-utilization and disposal of solid/ hazardous waste for the existing plant and predicted increase in pollution load (GLCs) due to proposed expansion should be incorporated.

33. All the environment clearances accorded by the Ministry, Consent to Establish and Operate and point-wise compliance to the specific and general conditions stipulated in the environmental clearance and Consent to Establish and Operate for all the existing plants.

34. Ambient air quality at 8 locations within the study area of 10 km., aerial coverage from project site with one AAQMS in downwind direction should be carried out.

35. The suspended particulate matter present in the ambient air must be analyzed for the presence of poly-aromatic hydrocarbons (PAH), i.e. Benzene soluble fraction. Chemical characterization of RSPM and incorporating of RSPM data.

36. Determination of atmospheric inversion level at the project site and assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features.

37. Air quality modelling for steel plant for specific pollutants needs to be done. Air pollution control devices installed and proposed for the control of emissions from all the sources should also be included.

38. Ambient air quality monitoring modelling along with cumulative impact should be included for the day (24 hrs) for maximum GLC along with following :

    i) Emissions (g/second) with and without the air pollution control measures

    ii) Meteorological inputs (wind speed, m/s), wind direction, ambient air temperature, cloud cover, relative humidity & mixing height) on hourly basis

    iii) Model input options for terrain, plume rise, deposition etc.

    iv) Print-out of model input and output on hourly and daily average basis

    v) A graph of daily averaged concentration (MGLC scenario) with downwind distance at every 500 m interval covering the exact location of GLC.

    vi) Details of air pollution control methods used with percentage efficiency that are used for emission rate estimation with respect to each pollutant

    vii) Applicable air quality standards as per LULC covered in the study area and % contribution of the proposed plant to the applicable Air quality standard. In case of expansion project, the contribution should be inclusive of both existing and expanded capacity.

viii) No. I to VII are to be repeated for fugitive emissions and any other source type relevant and used for industry

ix) Graphs of monthly average daily concentration with down-wind distance

x) Specify when and where the ambient air quality standards are exceeded either due to the proposed plant alone or when the plant contribution is added to the background air quality.

xi) Fugitive dust protection or dust reduction technology for workers within 30 m of the plant active areas.

39. Impact of the transport of the raw materials and end products on the surrounding environment should be assessed and provided. The alternate method of raw material and end product transportation should also be studied and details included.

40. One season data for gaseous emissions other than monsoon season in 10 km radius is necessary.

41. An action plan to control and monitor secondary fugitive emissions from all the sources as per the latest permissible limits issued by the Ministry vide G.S.R. 414(E) dated 30th May, 2008.

42. Information regarding surface hydrology and water regime should be included.

43. Presence of an aquifer/aquifers within 1 km of the project boundaries and management plan for recharging the aquifer should be included.

44. Source of surface/ground water level, site (GPS), cation, anion (Ion Chromatograph), metal trace element (as above) chemical analysis for water to be used. If surface water is used from river, rainfall, discharge rate, quantity, drainage and distance from project site should also be included.

45. Ground water analysis with bore well data, litho-logs, drawdown and recovery tests to quantify the area and volume of aquifer and its management.

46. Ground water modelling showing the pathways of the pollutants should be included.

47. Column leachate study for all types of stockpiles or waste disposal sites at 20^{o}C-50^{o}C should be conducted and included.

48. Permission for the drawl of water from the concerned authority for the existing as well as proposed plant from the Almatty dam and Tungbhadra dam and water balance data including quantity of effluent generated, recycled and reused and discharged is to be provided. Methods adopted/to be adopted for the water conservation should be included.

49. A note on the impact of drawl of water on the nearby River during lean season.

50. Surface water quality of nearby River (60 m upstream and downstream) and other surface drains at eight locations must be ascertained.

51. If the site is within 10 km radius of any major river, Flood Hazard Zonation Mapping is required at 1:5000 to 1;10,000 scale indicating the peak and lean river discharge as well as flood occurrence frequency.

52. A note on treatment of wastewater from different plants, recycle and reuse for different purposes should be included.

53. Provision of traps and treatment plants are to be made, if water is getting mixed with oil, grease and cleaning agents.

54. If the water is mixed with solid particulates, proposal for sediment pond before further transport should be included. The sediment pond capacity should be 100 times the transport capacity.

55. Wastewater characteristics (heavy metals, anions and cations, trace metals, PAH) from washed / beneficiated plants / washery.

56. The pathways for pollution via seepages, evaporation, residual remains are to be studied for surface water (drainage, rivers, ponds, lakes), sub-surface and ground water with a monitoring and management plans.

57. Ground water monitoring minimum at 8 locations and near solid waste dump zone, Geological features and Geo-hydrological status of the study area are essential as also. Ecological status (Terrestrial and Aquatic) is vital.

58. Geotechnical data by a bore hole of upto 40 mts. in every One sq. km area such as ground water level, SPTN values, soil fineness, geology, shear wave velocity etc. for liquefaction studies and to assess future Seismic Hazard and Earthquake Risk Management in the area.

59. Action plan for solid/hazardous waste generation, storage, utilization and disposal particularly slag from all the sources, char and fly ash. Copies of MOU regarding utilization of ash and slag should also be included.

60. Details of evacuation of ash, details regarding ash pond impermeability and whether it would be lined, if so details of the lining etc. needs to be addressed.

61. Green belt development plan in 33 % area. Details of greenbelt i.e. land with not less than 1,500 trees per ha. giving details of species, width of plantation, planning

schedule etc. Cement manufacturers for utilizing granulated BF slag and fly ash should be included.

62. A note on the treatment, storage and disposal of all type of slag should be included.

63. Identification and details of land to be used for SMS slag disposal should be included.

64. End use of solid waste and its composition should be covered. Toxic metal content in the waste material and its composition should also be incorporated particularly of slag.

65. All stock piles will have to be on top of a stable liner to avoid leaching of materials to ground water.

66. Acton plan for the green belt development plan in 33 % area should be included. The green belt should be around the project boundary and a scheme for greening of the traveling roads should also be incorporated. All rooftops/terraces should have some green cover.

67. Details regarding infrastructure facilities such as sanitation, fuel, restroom etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase.

68. A scheme for rainwater harvesting have to be put in place. Incorporation of water harvesting plan for the project is necessary, if source of water is bore well.

69. Detailed description of the flora and fauna (terrestrial and aquatic) should be given with special reference to rare, endemic and endangered species.

70. Socio-economic development activities need to be elaborated upon. Measures of socio economic influence to the local community proposed to be provided by project proponent. As far as possible, quantitative dimension should be given. Provision of schools, college, technical institutes, training centres, recreation parks, water supply to nearby villages etc should be incorporated.

71. Impact of the project on local infrastructure of the area such as road network and whether any additional infrastructure would need to be constructed and the agency responsible for the same with time frame.

72. A detailed disaster management plant including risk assessment and damage control needs to be addressed.

73. Occupational health of the workers needs elaboration. Health effects of other metals used and health hazard plans based on monthly correlation of these metal related diseases and people affected and mitigation plans. Arsenicosis Management Plan if

Arsenic is present in ore, rock, coal, fly ash, water. Action Plan for protecting the workers against hazardous chemicals such as Sulphuric acid, pesticides, solvents etc.

74. Occupational health of the workers needs elaboration including evaluation of noise, heat, illumination, dust, any other chemicals, metals being suspected in environment and going into body of workers either through inhalation, ingestion or through skin absorption and steps taken to avoid musculo-skeletal disorders (MSD), backache, pain in minor and major joints, fatigue etc. Occupational hazards specific pre-placement and periodical monitoring and periodical monitoring should be carried out. The detailed plan to carry out above mentioned activity should be mentioned.

75. EMP to mitigate the adverse impacts due to the project along with item-wise cost of its implementation.

76. Plan for the implementation of the recommendations made for the steel plants in the CREP guidelines must be prepared.

77. A note on identification and implementation of Carbon Credit project should be included.

78. Total capital cost and recurring cost/annum for environmental pollution control measures.

79. Public hearing issues raised and commitments made by the project proponent on the same should be included separately in EIA/EMP Report in the form of tabular chart.

80. Any litigation pending against the project and / or any direction / order passed by any Court of Law against the project, if so, details thereof.

1.4 BASIC DATA GENERATION, FIELD STUDIES AND DATA COLLECTION

This report has been prepared on the basis of one full season baseline environmental data monitored and completed during December 2009 to February 2010 by M/s Richardson & Cruddas. The data includes meteorological conditions, ambient air quality, noise, water quality and soil quality. Site survey has been conducted for studying the flora and fauna, socio-economic conditions including public consultation, land use, hydrology, geology, ecology etc. Additional information is also collected from several agencies and departments, both under State and Central Governments pertaining to above.

The collected data have been analysed in detail for identifying, predicting and evaluating the environmental impacts of the proposed project. The maximum anticipated impacts on environment are assessed and suitable environmental management plan has been suggested.

1.5 REPORT COVERAGE

The report provides information on the existing state of environmental conditions vis-a-vis contribution of incremental pollution by the proposed expansion. These environmental factors include air quality, surface water & ground water quality, soil quality, flora & fauna, agricultural pattern, health & welfare facilities, transport & communication systems, socio-economic patterns etc. The report evaluates the predicted impact of the proposed expansion activities on all the above factors. The report also covers the various remedial measures considered by the plant management like changes to technological processes, air and water pollution control system, solid wastes re use opportunities, green belt development plans along with the environmental management system proposed to be adopted by the Company. A detailed coverage of background environmental quality, pollution sources, anticipated environmental impacts (including socio-economic impacts) and mitigation measures, environmental monitoring programme, additional studies, project benefits, environmental monitoring plan and all related aspects have been covered in this report.

The report including this introduction chapter includes:

- Project Description
- Description of the Environment
- Anticipated Environmental Impacts and Mitigation Measures
- Environmental Monitoring Programme
- Additional Studies: Public Consultation
- Additional Studies: Socio-economic Studies
- Additional Studies: Risk Assessment Studies
- Project Benefits
- Environmental Management Plan (EMP)
- Summary and Conclusion
- Disclosure of Consultant engaged

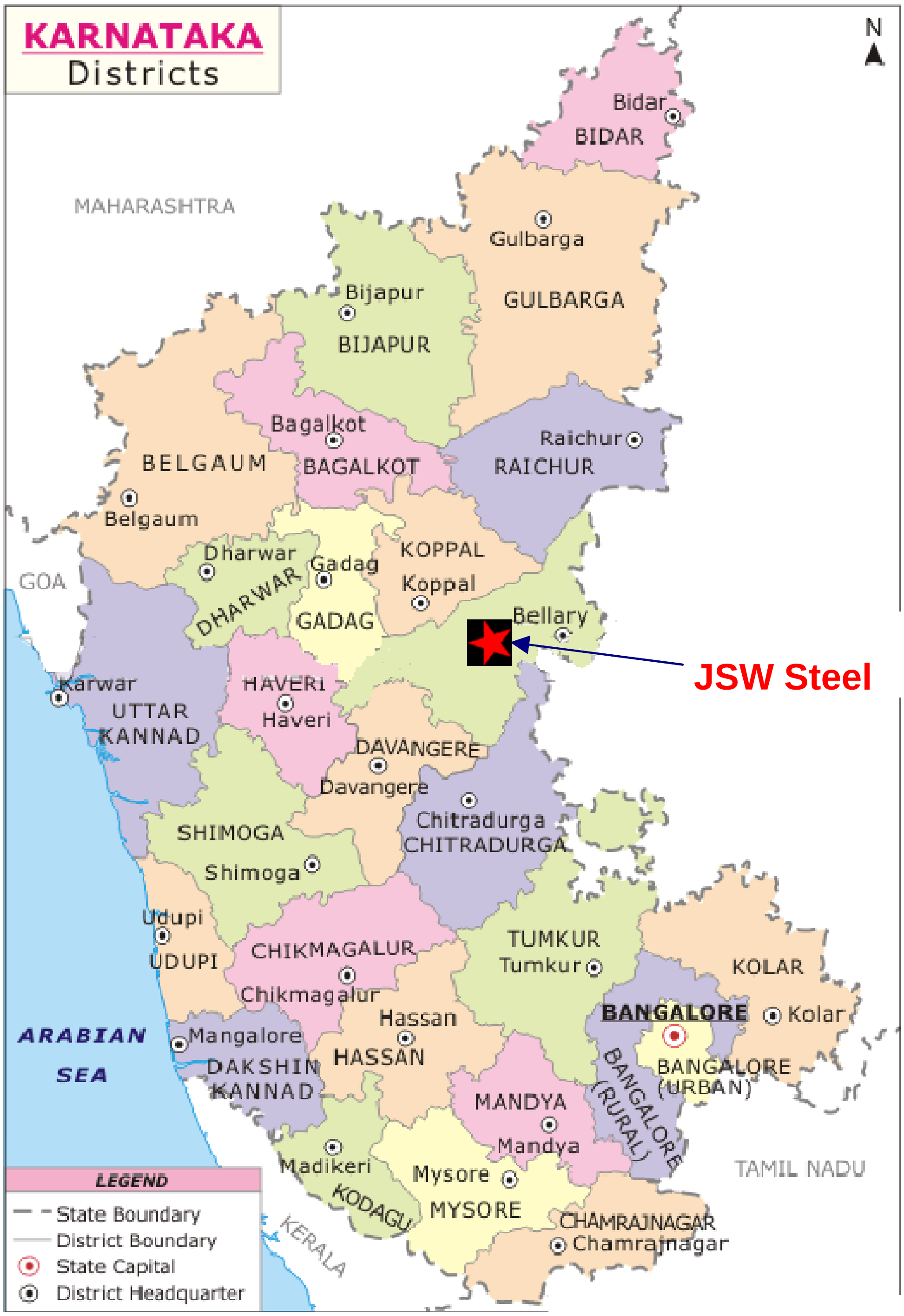


Fig. 1.1a LOCATION OF SITE

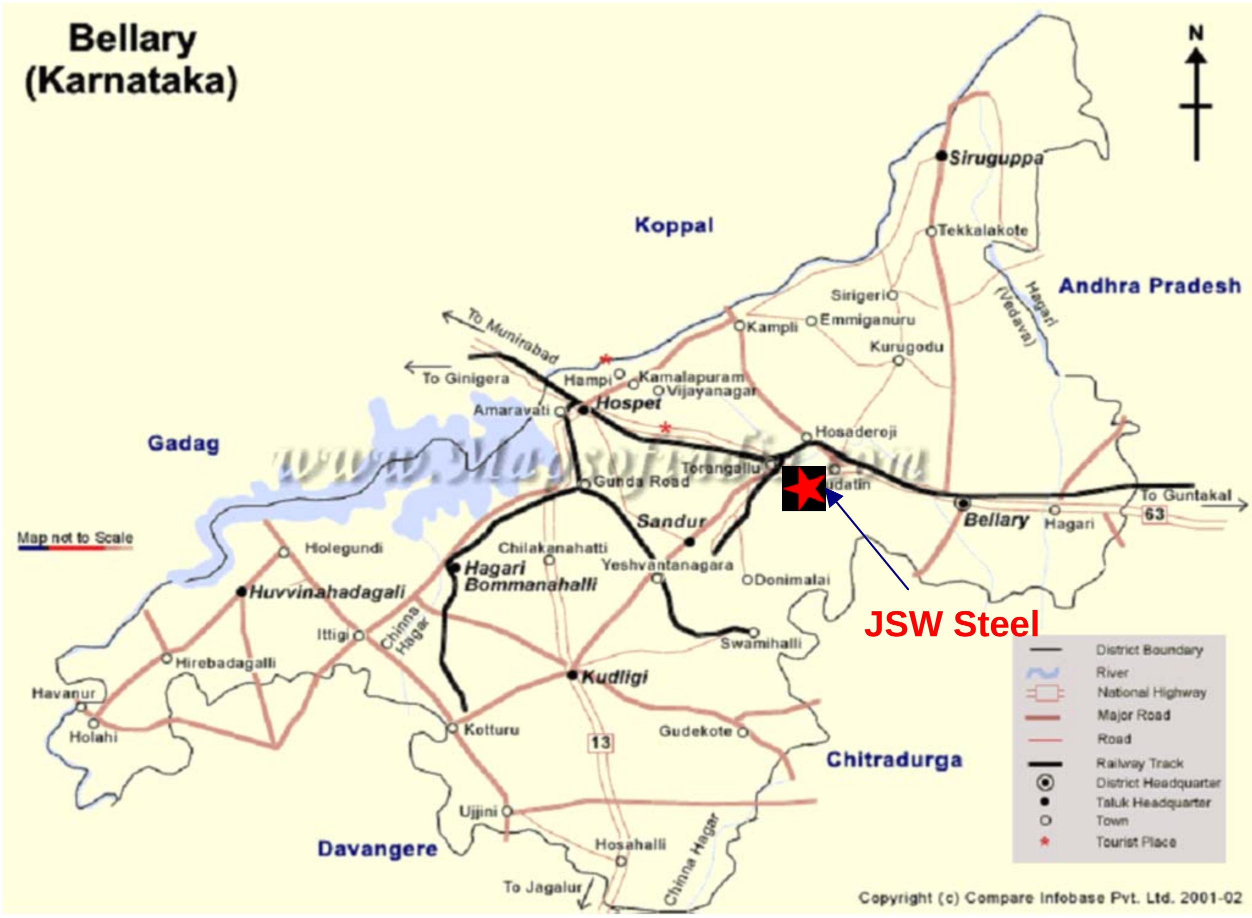


Fig. 1.1b LOCATION OF SITE

2.0 PROJECT DESCRIPTION

2.1 INTRODUCTION

JSW Steel Limited have plans to enhance the installed production capacity of the plant from 10.0 MTPA to 16.0 MTPA steel products for Techno-Commercial viability. The proposed facilities are presented in **Table 2.1. It may be noted that the capacities indicated are rated capacities and the facilities will have the flexibility to produce ± 5%of the rated capacities depending on the quality of raw materials.**

Table 2.1: Facilities envisaged for the expansion project

Sl. No.	Plant facilities	Capacity
1.	Beneficiation Plant	10.00 mtpa of product with 4 units of x 500 t/h
2.	Pellet plant	4.2 mtpa pellet plant of 464 m2 grate area
3.	DR Plant	1.2 Mtpa Corex gas based DR plant of 150 tph (To be executed by expert agencies.
4.	Coke Oven Battery	3.02 mtpa recovery type ovens 4 x 69 ovens x 7.0 m tall
5.	Sinter Plant	7.2 mtpa sinter machine of 700 m^2 grate area
6.	Blast Furnace	6.23 mtpa with 2 furnaces of x 4,019 m^3 inner volume
7.	Steel Melting Shop - HMDS - BOF converters - Ladle furnace (LF) - RHOB -	6.187 mtpa liquid steel capacity with 2X 180 t 4 x 180 t 4 x 180 t 2 x 180 t
8	Continuu casting facilities - Blank Caster - Bloom Caster - Billet Caster	6.0 mtpa of crude steel 2 x 3 strand – 2.2 Mtpa 2 x 6 strand – 2.2 Mtpa 2 x 6 strand – 1.9 Mtpa
8.	Finihing Mills - Wire Rod Mill - SBQ Mill - Medium Section Mills - Universal Beam Mills	 2 x 0.5 Mtpa 1X 0.8 Mtpa 2.1 Mtpa 2.1 Mtpa
9.	Captive Power Plant	1 unit of 300 MW (dual fuel namely Coal & surplus gas based) 1 unit of 300 MW coal based 2 unts of 12 MW TRT (24 MW), 1 unit of 55 MW from CDQ (To be executed by expert agencies)
10.	Lime Calcination Plant Dolo Calcination Plant	6 x 300 tpd 2 x 300 tpd
11.	Oxygen plant	2 x 1800 t/d (To be executed by other expert agencies)

The following changes from the earlier proposal considered at the time of issue of TOR have become necessary due to detailed engineering and changed market conditions, although the additional crude steel capacity remains at 6.0 mtpa.

1. Ore beneficiation plant of 10.3 mtpa product for utilizing declining quality of iron ore.
2. A Pellet plant of 4.2 mtpa for utilizing the ultrafines present in the iron ore
3. Recovery type coke ovens of 3.06 mtpa with 4x69 ovens of 7.0 m tall batteries in place of 3.65 mtpa with 4X65 ovens of 7.6 m tall batteries
4. Installation of a 1.2 mtpa DR iron plant using the corex gas produced in Corex units
5. Enhancing the capacity of two Blast furnace of 4019 m3 capacity from 6.0 to 6.23 mtpa due to use of pellets & DRI in the burden
6. Enhancing the capacity of Converter shop from 6.0 mtpa to 6.187 mtpa due to use of DRI
7. Modification to the CPP from two units of 300 MW with 100% coal based to one unit of 300 MW with 100% coal and another 300 MW with dual firing facility of coal and surplus byproduct gases.
8. Two units of oxygen plant of 1800 tpd in place of one unit.

However, there has been no change in the capacities of steel casting and finishing facilities . It may be noted that the actual crude steel production may vary by ± 5% of the above rated capacities.

The details of products manufactured will be as follows:

Sl. No.	Item	Product Size (mm)	Annual Production (t/yr)
1	Semis	Blanks, Blooms & Billets	6,000,000
2	Finished products		
(a)	Heavy Sections		6,000,000
(b)	Beams	350-750	2,100,000
		200-1000	
	Channels	200-400	
	Medium Sections		2,100,000
(c)	Beams	120-500	
		100 – 300	
		100 – 220	
(d)	Angles	100 x 100 – 250 x 250	
		120 x 180 – 200 x 100	
(e)	Channels	140 – 400	
3 (f)	Wire Rods	Ø 5.5 – Ø 22	1,000,000
4(g)	Special Bars	Ø 80 – Ø 250	800,000
5	Intermediate products		
	Hot metal		6.23 mtpa
	Coke		3.06 mtpa
	Sinter		7.2 mtpa
	Pellets		4.2 mtpa
	DRI		1.2 mtpa
6	By Products		
	Granulated slag		1.4 mtpa
	Coal tar		0.125 mtpa

2.2 TYPE OF PROJECT

The proposed project falls under Category 'A' (Sl.No. 3 (a) of Schedule : "Primary and Secondary Ferrous Metallurgical Industries") of the "List of project or activities requiring prior environmental clearance" of MoEF notification dated 14th September, 2006 in connection with Environment (Protection) Rules 1986.

2.3 NEED FOR THE PROJECT

Steel being a basic commodity for all industrial activities, quantum of its consumption is considered as an index of industrial prosperity. Since independence, there has been a substantial growth in the steel production in India from 1.5 Mt in 1950-51 to about 60 Mt in 2007-2008. Despite the above growth in the steel sector, the per capita finished steel consumption continues to remain at a level of about 48 kg only, compared to about 350 kg to 626 kg in the developed countries and 197 kg as world average. Further, with nearly 20% of the world population, India's contribution is only of the order of 3.4% of world steel production. Hence, short-term and long-term strategies are necessary in planning the development of the steel industry in the country to improve the level of per capita steel consumption.

While modernisation of the existing steel plants in India may increase steel output marginally, setting up of new steel plants facilities will be essential to meet the increasing steel demand.

The project is needed to increase Steel Production in the country as per National Steel Policy to bridge the gap between demand and supply.

2.4 LOCATION

The existing integrated steel plant is situated between 15°10' - 15°12' N latitude and 76°38' - 76°40'E longitude, near Toranagallu village of Bellary district in the state of Karnataka. The site is at a distance of 32 km from Bellary, 33 km from Hospet and about 340 km from Bangalore by road. The site is well connected by road SH-40 and NH-63. The State Highway SH-40 passes on the west side of the plant, from Tornagallu to Harnapahalli via Sandur. National Highway NH-63 (Gooty- Toranagallu-Hospet) passes on the north side of the plant. Nearest railway station to the steel plant is Toranagallu. Broad gauge railway lines between Guntakal and Hubli are passing through this station. The eastern port of Chennai is 460 km and western port of Goa is 430 km. Mumbai is about 740 km on the North West.

2.5 SIZE OR MAGNITUDE OF OPERATION

The expansion plant is intended to increase the steel production from 10.0 MTPA to 16.0 MTPA. The capacities of different units are presented in **Table 2.1.** The process-cum-material flow for the expansion plant is given in **Fig. 2-1.**

2.6 PROPOSED SCHEDULE FOR APPROVAL AND IMPLEMENTATION

The expansion is proposed to be implemented within 48 months from the date of start of the project (Zero date).

2.7 TECHNOLOGY & PROCESS DESCRIPTION

The manufacturing process will be of conventional blast furnace (BF)-basic oxygen furnace (BOF) route with continuous casting of liquid steel to blooms/billets followed by steel finishing operations to meet the specific quality and shape requirements of the consumers.

The principal process steps involved are :

(i) Coke making in by-product recovery type coke ovens;

(ii) Sintering of iron ore fines with coke and recycled dusts to make sinter burden of BF;

(iii) Pelletisation of iron ore for producing pellets for DRI snd Blast furnace

(iv) DRI making using Corex gas as the reducing agent for feed to blast furnace and BOF converters

(v) Iron making in Blast Furnaces (BFs) from lump iron ore and sintered ore (with or without pellets), coke and fluxing materials;

(vi) Conversion of hot metal to liquid steel by oxygen blowing in BOFs followed by refining of liquid steel in ladle furnaces with addition of alloying materials for micro adjustment of steel chemistry;

(vii) Continuous casting of refined liquid steel to billets/bloom/blank in suitable casters;

(viii) Hot rolling operations to produce various types of shaped steel products of desired size and dimensions.

2.8 EXISTING PLANT & FACILITIES

The major technological & auxiliary facilities at the 10.0 Mtpa steel plant stage for which clearance from MOEF has been obtained earlier are as follows:

i) Raw materials: Coal & ore receiving, storage and handling plant.
ii) Ore beneficiation plant of 19.5 Mtpa
iii) Pellet plant of 10.0 Mtpa
iv) Sinter plant of 10.35 Mtpa
v) Coke Ovens(Non recovery type) of 1.28 Mtpa

vi) Coke Ovens(Recovery type) of 3.5 Mtpa
vii) Hot metal production facilities:
- 2 Corex units of 1.6 Mtpa.
- 1 Blast furnace of 1250 m^3 of 0.9 mtpa capacity
- 1 Blast furnace of 1650 m^3 of 2.17 mtpa capacity
- 2 Blast furnace of 4019 m^3 of 3.0 mtpa capacity

viii) Pig casting m/c (1x1200 tpa & 2x3600 tpa)
ix) 7 BOF converters of 9.8 Mtpa with steel refining facilities.
x) Continuous slab casters(1 of 1600mm, 2 of 1250 mm and 3 of 2200 mm) of 8.0 Mtpa
xi) Continuous billet caster of 1.5 mtpa
xii) 2 nos of Hot strip mill of 8.2 Mtpa
xiii) 2 nos of Cold rolling mill of 3.0 Mtpa
xiv) 8 nos Lime kilns (300 tpd each) & 4 nos lime kiln (600 tpd each).
xv) 2 nos of Gas based captive power plant of 230 MW
xvi) 2 nos of Coal based power plant of 300 MW each
xvii) Slag cement crushing units of 4.2 Mtpa
xviii) 4 units of Oxygen plants totalling 7000 tpd operted by expert agencies
xix) 4 townships of 8000 dwelling units

The facilities for which the clearance has been obtained and are stil to be executed are upgrading of BF-1, One lime pant of 600 tpd, one oxygen plant of 900 tpd.CRM-2 of 2 mtpa; colour coating line of 0.5 tpa and galvanizing line of 1.0 mtpa.

2.9 TECHNOLOGY/ PROCESS DESCRIPTION

JSW is planning to augment the plant capacity from 10.0 Mtpa to 16.0 Mtpa with the addition of manufacturing facilities. The expansion to 16 Mtpa will be similar to the expansion of the plant capacity from 4.0 to 10 mtpa and will be stand alone unit of 6.0 Mtpa steel making facility and will have minor integration with the existing plant production facilities, except for the infrastructural and administrative activities. The commissioning of the 16 Mtpa units will thus be carried out seamlessly. The details of the proposed facilities are given in the **Table 2-1**. **Table 2-2** shows the phasing of the facilities upto 16 MTPA expansion from 7.0 Mtpa stage. **Drg. No. MEC/Q6S4/11/S2/01** (enclosed) presents the lay out of the plant showing the existing and proposed facilities.

Table 2.2 : DETAILS OF EXISTING AND PROPOSED FACILITIES PRODUCTS AND PRODUCTION CAPACITIES

Sl. No.	Manufacturing Facilities	Facilities Installed (7 MTPA)	Facilities proposed to be installed (10 MTPA)	New facilities now proposed (10 to 16 MTPA)
1	Ore benificiation Plant	1x4.5 MTPA, 1X2.5 MTPA & 1X7.5 MTPA	1X5.0 MTPA	1x10.3 MTPA
	Cumulative	14.5 MTPA	19.5 MTPA	29.8 MTPA
2	Pellet Plant	1 unit	1x5 MTPA	1x4.2 MTPA
	Cumulative	5.0 MTPA	10.0 MTPA	14.2 MTPA

Sl. No.	Manufacturing Facilities	Facilities Installed (7 MTPA)	Facilities proposed to be installed (10 MTPA)	New facilities now proposed (10 to 16 MTPA)
3	Sinter Plant	2x204 m2	1x496 m2	1X700 m2
	Cumulative	4.6 MTPA	10.35 MTPA	17.55 MTPA
4	Coke Oven – NR	Two batteries of 0.64 MTPA each	No addition	No addition
	Cumulative	1.28 MTPA	1.28 MTPA	1.28 MTPA
5	Coke Oven –Recovery type	4x56, 4.5 m tall coke oven batteries of 1.5 MTPA coke	4x72, 4.5 m tall coke oven batteries of 2.0 MTPA coke	4x69, 7.0 m tall coke oven batteries of 3.06 MTPA coke
	Cumulative	1.5 MTPA	3.5 MTPA	6.56 MTPA
6	Hot metal –Corex	2 Corex units of 0.8 MTPA	No addition	No addition
	Cumulative	1.6 MTPA	1.6 MTPA	1.6 MTPA
7	Hot metal-Blast Furnace	BF-1 of 1250 m3, BF-2 of 1650 m3 & 1X4019 m3 BF Upgrade BF-1to 1650 m3	1X4019 m3 BF	2X4019 m3 BF
	Cumulative	6.07 MTPA	9.07 MTPA	15.30 MTPA
8	DRI Plant	Nil	Nil	1.2 MTPA
9	Pig Casting Machines	1 X 1200 tpd and 1 X 3600 tpd	1 X 3600 tpd	1 X 3600 tpd
	Cumulative	4800 tpd	8400 tpd	12000 tpd
10	Crude steel - BOF & auxuilaries	3X130 t and 2x175 t converter	2x175 t converter	4x180 t converter
	Cumulative	6.8 MTPA	9.8 MTPA	16.0 MTPA
11	Lime Kilns	8X300 tpd	4X600 tpd	8X300 tpd
	Cumulative	2400 tpd	4800 tpd	7200 tpd
12	Slab Caster	2X 1250 mm, 1X1600 mm & 1X 2200 mm slab casters of 1.6 MTPA	2X 2200 mm slab casters of 3.2 MTPA	No addition
	Cumulative	4.8 MTPA	8.0 MTPA	8.0 MTPA
13	Billet/Bloom caster	1X8 strand billet caster	No addition	Billet caster (2 nos of 1.0+0.9 MTPA), 2.2 MTPA bloom & 2.2 MTPA blank caster
		1.5 MTPA	1.5 MTPA	7.8 MTPA
14	HSM	I unit of HSM of 3.2 MTPA capacity	1 x2000 mm wide 5.0 MTPA HSM	No addition
	Cumulative	3.2 MTPA	8.2 MTPA	8.2 MTPA
15	Wire rod mill	1 unit of 0.6 MTPA	No addition	2 units of 0.5 MTPA
	Cumulative	0.6 MTPA	0.6 MTPA	1.6 MTPA

Sl. No.	Manufacturing Facilities	Facilities Installed (7 MTPA)	Facilities proposed to be installed (10 MTPA)	New facilities now proposed (10 to 16 MTPA)
16	Rebar & Section mill	1x1.0 MTPA	No addition	1 SBQ mill (0.8 MTPA), 1 section mill (2.1 MTPA) & 1 beam mill (2.1 MTPA)
	Cumulative	1.0 MTPA	1.0 MTPA	6.0 MTPA
17	Cold Rolling Mill Complex	1 unit of 1.0 MTPA	1 unit of 2.0 MTPA	No addition
	Cumulative	1.0 MTPA	3.0 MTPA	3.0 MTPA
18	Galvanizing Lines	Nil	4x0.25 MTPA	No addition
	Cumulative	-	1.0 MTPA	1.0 MTPA
19	Color Coating Line	Nil	1x0.5 MTPA	No addition
	Cumulative	-	0.5 MTPA	0.5 MTPA
20	Power Plant and process steam boilers	Gas based CPP- 1x 100 MW and CPP – 1x130 ,Coal based 1x300 MW	Coal based 1x300 MW	Coal based 1x300 MW Gas based 300 MW
	Cumulative	530 MW	830 MW	1430 MW
21	Incinerator	1 unit of 250 kg/hr	1 unit of 500 kg/hr	1 unit of 250 kg/hr
	Cumulative	250 kg/hr	750 kg/hr	1000 kg/hr
22	Cement plant - Slag Grinding and mixing unit	1x0.2 MTPA & 1x0.6 MTPA Balance 1.4 MTPA not executed.	1x 2.0 MTPA	1 unit of 2.0 MTPA Grinding Plant
	Cumulative	2.2 MTPA	4.2 MTPA	6.2 MTPA
23	Oxygen Plant	2X2500 & 1x1800 tpd	1X1800 & 1X900 tpd	2X1800 tpd
	Cumulative	4300 tpd	7000 tpd	10,600 tpd
24	Township	3 townships for 4000 dwelling units	2 townships for 4000 dwelling units	1 township of 5000 dwellings

The following units have been outsourced to other expert agencies as under;
Oxygen plant to Praxair, BOC & Bellary oxygen
Pipe plant to Jindal Saw pipe and
Cement plant to JSW Cement

In the proposed expansion to 16 mtpa, It is also proposed to out source the DRI plant to an expert agency - JSW Projects.

A brief description of each of the steel making process steps is presented below:

Coke making: Metallurgical coke is used as the reductant for reduction of iron ore to produce hot metal. Metallurgical coke is produced by carbonizing the coking coal at a temperature of around 1200^{0}C in absence of oxygen atmosphere in closed door multiple tall ovens. The volatile matter is liberated resulting in formation of coke due to carbonization in the ovens. The energy necessary for the carbonization process is provided by the Blast furnace or the coke oven gases. The coke thus produced in the oven after 16 to 18 hours of coking is quenched, cooled and screened for feeding to the Blast furnaces.

The crude coke oven gas, having a potential heat value is cooled, separated from tars, napthalenes and ammonia to produce clean coke oven gas for use as plant fuel in various heating applications.

Sintering: Sintering is a high temperature (1200-1300^{0}C) process for agglomeration of iron ore fines with coke breeze and other fluxes like limestone, pyroxinite and recyclable solid wastes like lime fines, BOF sludge, BF flue dusts etc which are blended in base mix yard.
The sintered mass known as Sinter having higher strength is one of the main metallic bearing burden material for BF. The hot sinter product after cooling is screened and desired size of sintered product is sent to the BF stock house for charging to the BF along with lump iron ore.

Pelletisation: Palletising turns very fine-grained iron ore (even low grade iron ore) into balls of a certain diameter, which are suitable for blast furnace and direct reduction. Iron ore is crushed and the impurities are removed. The ore mix is moistened and a binding agent is added. The iron-rich ore is heated with a binding agent to create durable marble sized "green” pellets in rotating drums or on rotary discs. These green pellets are dried and indurated at temperatures of more than 1000 °C. This can take place in shaft or rotary furnaces or on a travelling grate. The pellets are with excellent physical and metallurgical properties and can be easily transported, due to their high strength and suitability for storage. The pelletisation process involves three steps.

- Raw material preparation
- Forming pellets
- Pellet hardening

Prior to the formation of pellets, water is added to iron ore fines to adjust the moisture content to approximately 9 % and the ore is mixed with small amounts of binding agents such as bentonite (approximately 0.5 %) and fluxes such as limestone, lime olivine and dolomite (1–5 %). These give the pellets the proper physical and metallurgical properties needed in further processing. Mixing takes place in continuously operating drum or pan-type mixers with of suitable capacity. Pellets are formed either in pelletizing discs or drums, drums usually being connected to roller screens used for separating undersized pellets. The pellets thus formed have low mechanical strength; they are hardened in Travelling Grate coupled with drying and furnace.

Iron making: Sized iron ore, pellet, sinter and coke along with other fluxing materials are charged to the tall vertical BF for production of hot metal in presence of hot blast air. The temperature within the furnace is above 1600^{0}C. The gangue minerals present in the iron ore are converted to slag known as BF slag and ‘Fe’ content of the oxide ore gets converted to molten iron due to reduction of iron oxides of the ore with carbon present in the coke. In order to have adequate carbon for reduction purpose, as well as to reduce coke consumption, powdered coal is injected into the furnace. The hot iron metal after desulphurization with carbide compound is ready for conversion to steel in BOF. For balancing the hot metal production, provision of pigging of the hot metal becomes necessary. The BF slag is granulated by water jetting and granulated BF slag produced can be used for cement making. The BF gas containing mostly Carbon monoxide (CO) is wet cleaned in venturi scrubbers, to bring down the dust level in the gas to below 5 mg/N cu m. The cleaned BF gas is used as plant fuel and for heating the BF stoves to produce hot blast air.

Direct Reduced Iron Making : Direct reduction is an alternative route of iron making in which molten iron is produced using coal / gas as a reducing agent instead of Coke as in conventional Blast Furnaces. It overcomes some of the difficulties of conventional blast furnaces. The specific investment and operating costs of direct reduction plants are low compared to integrated steel plants, and are more suitable for developing countries where supplies of coking coal are limited.

DRI is produced by reduction of iron ore (in the form of lumps, pellets or fines) in rotary kilns in the solid phase at 800—1050 °C by using either solid (non coking coal) or gas (reformed natural gas or coal gasification) as reductant. Besides supplying the reducing agents, namely carbon monoxide (CO) and hydrogen (H_2), the energy requirement for the reduction reaction is also supplied by a part of the reductant as fuel. This process of directly reducing the iron ore in solid form by reducing gases is called **direct reduction**.

Reaction mechanism

There are two major temperature zones in the kiln. The first pre-heat zone is where the charge is heated to 900 – 1000°C. The second metallization zone is held fairly constant at 1000-1050°C.

In the pre-heating zone, the moisture is driven off first, and then the hydrocarbons and hydrogen evolve by thermal decomposition of the coal. Here, the reduction of iron oxide proceeds only to ferrous oxide (FeO) (Equation I).

$Fe_2O_3 + CO = 2\ FeO + CO_2$ .... (I)

In metallization zone the final reduction of ferrous oxide to metallic iron occurs by reaction of CO with FeO to form CO_2 and metallic iron (Equation II).

$FeO + CO = Fe + CO_2$ .... (II)

Most of the CO_2 reacts with the excess solid fuel in the kiln and is converted to CO according to the Boudouard reaction (Equation III), being an endothermic reaction this helps in maintaining desired kiln temperature by controlling air injection in the kiln..

$CO_2 + C = 2\,CO$ .... (III)

Lime calcining: Burnt lime (CaO) is required for steel making. Limestone is burnt in the tall vertical limekilns at a temperature of around 1050^{0}C to produce burnt lime. The energy required for the endothermic reaction is provided by fuel gases. The burnt lime collected at the bottom of the kilns is screened. Lime dusts are recycled to the Sinter Plant.

Steel making: In the Steel Melt Shop (SMS), the desulphurised hot metal along with burnt lime and fluxing agents is charged to the BOF. Carbon present in the hot metal is oxidized by controlled blowing of oxygen. The temperature of BOF is around 1700^{0}C, with the energy generated by the combustion of carbon present in the hot metal. The BOF gas having carbon monoxide and dust passes through the wet gas cleaning plant, comprising of venturi scrubber where the dust in the gas is separated due to inertial impaction. The water containing dust is treated in a water treatment plant and recycled to the system. The clean BOF gas depending on 'CO' content is recovered and used as a fuel within the plant.

After tapping of BOF slag, the crude liquid steel is poured and transferred to ladle for further refining and chemistry adjustment in the subsequent steel refining operations. In this special type of ladle, crude liquid steel is vacuum-degasified and chemistry adjusted by addition of micro alloys to produce liquid steel of desired chemistry. Thereafter, the refined liquid steel is continuously cast to the billets/blooms in the casting machines.

Hot rolling of billets/blooms: The billets/blooms are reheated to a temperature of around 1250^{0}C in walking beam type reheating furnace. After descaling of heated billets/blooms by high pressure water jet, the same is hot rolled in separate mills to produce shaped products like wire rods, sections, rebars etc. The products are ready for dispatch. Some of the intermediates like blooms and billets are also sold outside for carrying out finishing operations at the customer end.

Air separation: Steel making in the BOFs requires oxygen of high purity. Similarly the blast furnaces also require large quantity of oxygen to facilitate coal injection. The oxygen required for the above processes is produced in Air separation plant. This is a cryogenic process to produce liquid oxygen, nitrogen and argon. Oxygen is consumed in the BOFs for oxygen lancing in the BOFs and in BF blast air for enrichment. Nitrogen is used at many locations within the plant for inert gas blanketing and Argon is used for steel refining.

Incinerator: During the steel manufacturing and finishing process, organic wastes like waste oils, sludge, grease etc are generated. These wastes are recycled to a large extent. The balance amount will have to be incinerated in an incinerator, specially designed for this purpose.

Captive Power Plant : It is proposed to install two 300MW captive power plants identical to the existing one with the following configurations;

1. One 300 MW coal based power plant
2. One 300 MW coal and surplus fuel gas fired power plant.

2.10 PROJECT DETAILS

The general layout of the existing and proposed plant is shown in **Drg. No. MEC/ Q6S4/11/S2/01.** The major plant facilities as envisaged for the proposed project and their capacities are already indicated in **Table 2.1.**

2.10.1 BENEFICIATION PLANT

JSW Steel Limited plans to set up 4 x 500 t/h beneficiation plant complex at Vijayanagar to supply beneficiated ore to the pellet plant and sinter plant which in turn will supply pellets and sinter respectively to the Blast furnaces and DR Plant.

The iron ore in Bellary-Hospet region is fragile in nature and at present it contains around 3.2% alumina and 4% Silica. The Fe content is also reducing. Since the availability of good quality lump ore is limited it is expedient to use the low grade ore fines. The iron ore will be beneficiated fully to upgrade Fe content to >62% and Alumina & Silica less than 5% for use in Pellet Plant and Sintering Plant.

Beneficiation Plant Capacity

Parameter	Value
Feed	
Input Material	13,375,000 t/yr
Capacity	2000 tph
No. of Modules	4
Capacity per module	500 tph
Product	
Recovery	75%
Output Product	10,031,000 t/yr
Sinter grade product	5,854,000 t/yr
Pellet grade product	4,177,000 t/yr

Operating Regime

a) Working days : 300 days/year
b) Working hours : 24 hrs/ day
c) Plant Utilisation Efficiency : 95 %

Raw Materials, Quality and Sources

The annual requirements of raw material for the proposed beneficiation plant is furnished in table below:

Raw material requirement (Net and dry)

Raw Materials	Size	Quantity	
		t/y	tph
Iron Ore Fines	0 -12 mm	13,375,000	2000

Quality of Raw Materials

The Beneficiation Plant is designed to handle low-grade iron ore fines of the following specification:

a) Size of ROM : -12 mm
b) ROM Bulk density : 2.2 t/m3
c) Specific Gravity : 4.2

Chemical composition of raw materials

Raw Material	Iron ore fines
Fe (t)	58 - 60
FeO	
Fe2O3	-
SiO2	8.0
Al2O3	5.0
CaO	0.1
MgO	0.1
LOI	3.0
Others	0.06

Sources of raw materials

Iron ore fines

The iron ore fines used in Beneficiation plant will be low-grade iron ore with high alumina and silica content. The iron ore fines required for the beneficiation plant will be procured from local iron ore mines.

Product quality

Sl. No.	Parameter	Sinter Grade	Pellet Grade	Tailing
1.	Specific gravity	4.4	4.4	3.8
2.	Size	+0.15 - 3 mm	+0.01 - 0.15 mm	-10um
3.	Fe	63%	> 64%	40%
4.	Al2O3 + SiO2	< 5%	< 5%	> 15%

Major Plant Facilities

The beneficiation plant will comprise the following major facilities:

- Raw Material Handling System.
- Screening, Crushing, Classification & Up gradation (SCCUP) System
- Product Handling System
- Tailing Disposal System

A brief description of the plant facilities is furnished below :

Raw Material Handling System (RMHS)

The Beneficiation Plant will receive iron ore fines either through track hoppers and/or through truck unloading station. A conveying system will convey iron ore fines from the track hopper system to raw material storage yard. Raw material received at truck unloading system will be discharged on the above stacking conveyors for further conveying to the raw material storage yard. The reclaim conveyor will feed raw material to surge bunkers.

Screening, Crushing, Classification & Up-gradation (SCCUP)

The 500 tph stream consists of two nos. 250 tph streams. The following is the brief description of one stream of 250 tph.

Belt Feeder

Belt feeder at the bottom of surge bunker will feed raw material to a screen feed conveyor at 250 tph (max) capacity.

Screen

The oversize material (+3 mm) from the screen will be conveyed to a crusher & the crushed material will be fed back to the screen feed conveyor. The Screen feeding conveyor shall have a capacity of 500 tph and provided with a belt weigher. The fine ore through the screen-feeding conveyor is fed on to the vibrating screen (500 tph capacity) through a slurry box.

Crusher

The oversize material from the screen will be transferred to a crusher through a crusher-feeding conveyor. The crusher will be located outside the main plant building and nearer to the surge bins protected by structural sheds. The crushed material will further transfer on to the screen-feeding conveyor.

Classifier (Primary & Secondary)

The screen undersize material (in slurry form) will be fed to the primary classifier. The classifier shall have a capacity of 250 tph. The coarse material (underflow) from Primary Classifier will be fed to Scrubber. The scrubbed material will be fed to Secondary Classifier which is also of 250 tph capacity. The fines (overflow) from both the classifiers will be collected in a sump by gravity through open launder. Density transmitters has been envisaged in the overflow lines of the both the classifiers, which is used to control the speed of the spiral.

Scrubber

The coarse material (underflow) from Primary Classifier will be fed to Attrition Scrubber. Attrition Scrubbers performs better with feed material less than 3mm. The retention time in the scrubber will be around 4 to 6 minutes. The Scrubber shall have a capacity of 250 tph.

De-Watering Screen

The coarse material (underflow) from secondary classifier will be fed to Dewatering Screen for removal of moisture. The Dewatering screen shall have a capacity of 300 tph.

Sinter Product

The final discharge (0.15mm - 3mm) from the Dewatering Screens (which is the feed to Sinter Plant) from all the four modules of 500 tph will be collected on a conveyor. The material will be further transferred to base blending yard of Sinter Plant (700 m^2) through conveyor.

Cyclones

The fines (overflow) from both the classifiers & dewatering screen (-100 mesh / -0.15 mm) will be collected in a sump by gravity through open launder. The slurry will then be pumped to a battery of cyclones. The overflow from the cyclones (-10 micron) will be transferred to tailings thickener.

Magnetic Separation (WLIMS & HGMS)

The cyclone underflow will be fed to Wet Low Intensity Magnetic Separator (WLIMS) by gravity through launder to recover magnetite ore. From WLIMS, the feebly magnetic fraction will be collected in a sump located at ground level. The slurry will be pumped to High Gradient Magnetic Separator (HGMS) for recovering hematite ore.

Belt Filter

The magnetic fraction from HGMS and WLIMS will be transferred to Belt Filter via dewatering cyclone for removal of moisture. The discharge from Belt Filters from all the four modules will be collected on a conveyor to further transfer the same through pipe conveyor to the Pellet Plant Storage Yard. The product of the Belt filter will have moisture content of about 8-10 %.

Product Handling System

It is envisaged to produce following grades of beneficiated iron ore concentrate in the beneficiation plant:

• Sinter product (Size: +0.15 mm to -3 mm) from dewatering screen
• Pellet product (Size: +0.01 mm to -0.15 mm) from belt filters.

Sinter and pellet feeds will be further conveyed to sinter plant and pellet plant.

Tailings Disposal System

The Cyclone overflow and the tailings fraction from HGMS is transferred to tailings Thickener. The tailings pumps shall pump the underflow solids from the Thickeners to the existing tailings pond. The overflow from the Thickeners is circulated back to the process water reservoir.

2.10.2 PELLET PLANT

JSW Steel Limited plans to set up 4.2 Mtpa pellet plant complex for their additional 6.0 Mtpa integrated steel plant at Vijayanagar, Karnataka. The pellet plant will operate on haematite iron ore concentrate having about 8 % moisture.

Beneficiated iron ore or iron ore concentrate from beneficiation plant, limestone and coke breeze from local ground storage will be conveyed to the silos of iron ore concentrate and additive storage unit within the pellet plant.

From these silos limestone and coke breeze are collected in preset quantities and dried in rotary kilns to reduce the moisture content to below 1% before feeding it to the ball mills for co-grinding to get the requisite fineness. Grinding of coarse bentonite will be done separately in a Raymond mill.

Then the Iron ore concentrate, ground additives and bentonite are transported to the respective silos in ground material storage unit. Further, mixing in paddle mixer, green pellet formation in pelletising discs and heat hardening of green pellets in indurating machine will be carried out.

One travelling grate indurating machine of 464 m^2 grate area will be installed with all other associated service facilities. Mixed gas will be used for drying before grinding and finally during induration of green pellets.

However, the exact size of the pellet plants will be finalized after discussion with the technology supplier during the detailed engineering stage.

Design Criteria

Capacity	: 4.2 Mtpa
No. of annual working days	: 330 days
Indurating machine area	: 464 m2
Pallet width	: 4.0 m
Useful strand length	: 116 m
Fuel for induration	: Mixed gas (CV = 2200 kcal/Nm3)
L/S & coke breeze additive grinding	: Ball mill (1 no.)
Bentonite grinding	: Roller mill (1 no.)
Mixing	: Paddle mixer horizontal type (1 no.)
Balling	: Balling discs (7.5 m dia.) – 6 nos.
Feeding green balls on machine	: By double deck roller screen for narrow size (9–16 mm) distribution onto the indurating machine
Induration	: Travelling Grate (TG) Indurating Machine
Separation of hearth layer	: By natural segregation / HL vibrating screen

Raw Materials, Quality and Sources

The annual, daily and hourly requirements of raw materials for the proposed pellet plant are furnished in table below:

Raw Material Requirement (Net and dry)

Raw materials	Size	Quantity		
		t/y	t/d	t/h
Iron Ore Concentrate	0 – 325 mesh	4,177,000	12,657.5	527.4
Limestone	0 – 20 mm	84,000	254.5	10.6
Coke Breeze	0 – 15 mm	84,000	254.5	10.6
Bentonite	0 – 5 mm	30,000	90.9	3.79

Quality of Raw Materials

The average chemical composition of raw materials to be used for pellet production are shown below.

Chemical Composition of Raw Materials (%)

Raw Material	Fe (t)	FeO	Fe2O3	SiO2	Al2O3	CaO	MgO	LOI	Others
Iron ore conc.	63.5-64	-	90.5	3.5	2.0	0.02	-	4.0	-
Limestone	-	-	-	5.0	2.0	47.0	2.0	41.0	3.0
Coke breeze	7.55	-	10.8	53.3	28	2.9	0.71	-	0.34
Bentonite	6.70	-	9.57	46.0	26.0	3.0	3.0	12.0	0.43

Sources of Raw Materials

Iron Ore Concentrate

Beneficiated iron ore concentrate of size +0.01 to -0.15 mm having about 8% moisture will be transported from Beneficiation plant to the pellet plant site.

Bentonite

The bentonite requirement of the proposed plant will be met through purchase. The quality of bentonite envisaged for this plant is as follows.

Swelling index :25-30%
pH value :8.0-9.0

Limestone

Limestone of (-) 20 mm size required for the pellet plant will be met from local mines.

Coke breeze

Coke breeze of (-) 15 mm size required for the pellet plant will be met through internal generation from coke oven plant.

Operating regime

The proposed pellet plant will be operating on the basis of three shifts a day and 330 days in a year after taking into consideration the shutdowns required for the planned maintenance and unscheduled breakdowns.

Quality of pellets

The expected chemical composition of finished pellets is placed below.

Constituents	Value,%
Fe (t)	> 64
SiO2 + Al2O3	3 -4

Constituents	Value,%
CaO + MgO	1
FeO	< 0.5

The expected mechanical and metallurgical properties of finished pellets are placed below.

Sl. No.	Item	Value
i)	Size + 9 to 16 mm +16 mm - 9 mm	93 % 5 % max 3 % max
ii)	Porosity	24 to 28 %
iii)	Cold crushing strength	~ 250 kg/p min.
iv)	ASTM tumble index(+6.35 mm)	94 % min.
v)	Abrasion Index (-0.6 mm)	4 % max.
vi)	JIS swelling index	18 % max.
vii)	JIS reducibility	70 % min.
viii)	Compression strength after reduction	30 kg/p

Technological facilities

The pellet plant proper will comprise the following major technological units.

- Iron ore concentrate and additives storage bin unit
- Lime stone & coke grinding unit (ball mill)
- Bentonite storage and grinding unit
- Ground material (concentrate, Lime stone, Coke & bentonite) storage and mixing unit
- Balling unit
- Induration unit
- Pellet segregation and hearth layer separation
- Finished pellet stockpiles

Apart from the above units, all major services facilities like material handling, water supply system, compressed air, mixed gas, ventilation and air-conditioning, plant dedusting, building structures, civil works and industrial safety, electrics, instrumentation and automation have been envisaged for the proposed pellet plant.

2.10.3 DIRECT REDUCTION PLANT

Direct-reduced iron (DRI), also called sponge iron, is produced from direct reduction of iron ore (in the form of lumps, pellets or fines) by a reducing gas produced from natural gas or coal or gases from Blast Furnace / Corex / Coke oven plant. The reducing gas is a mixture of Hydrogen (H_2) and Carbon Monoxide (CO) which acts as reducing agent. This process of directly reducing the iron ore in solid form by reducing gases is called direct reduction.

JSW Steel Limited propose to install Direct Reduction (DR) Plant based on the surplus corex gas produced by the corex plant. The capacity of the DR plant will be about 1.2 Mtpa.

The corex gas based DR Process provides a strategic opportunity to manufacture DRI at attractive costs. Since the COREX off gas contains hydrogen and carbon monoxide, the DR Plant shall be designed and constructed without a natural gas reformer. This arrangement provides an economic and environmentally friendly use for a valuable by-product and increases the flexibility of the DR Process.

The Direct Reduction (DR) plant shall comprise of one nos. of 150 tph shaft furnace capable of producing 1,200,000 t/yr DRI production from shaft based on 100 % iron ore pellet as the charge material.

Production program

The production program of the direct reduction plant, as envisaged, is given below.

Product	Capacity, t/yr
Direct Reduction Iron Produced	**1,200,000**
- Blast furnace	643,000
- SMS	557,000

Technological parameters of DR Plant

The technological parameters of DR Plant are as follows.

Nominal Diameter of Shaft (ID), m	7.1
Burden Height in reducing zone, m	10.0
No. of Unit	1
Production, t/h	150 (Normal)
Annual Production, t	1,200,000
Working hours/year	8000
Shifts per day, No.	3

Quality of Sponge Iron

The typical quality of DRI would be as follows:

Degree of metallisation, %	92 - 94
Fe (t), %	90 - 91
Fe (m), %	82 - 83
C, %	1.5 – 2.5
Gangue, %	3.5 – 4.0

Major plant facilities

The Direct Reduction (DR) Plant will be equipped with the following facilities for the production of DRI.

1. Corex Export Gas Compressor
2. Mist Eliminator
3. Vacuum Pressure Swing Absorption Plant / CO2 Removal System
4. Gas Heater
5. Partial Combustion System
6. MIDREX DR Shaft – 150 tph
7. Scrubber

2.10.4 COKE OVEN AND BY-PRODUCT PLANT

The battery will be of twin flue, under-jet, regenerative type along with provision of recirculation of a part of waste gas. Oven width of 410 mm is envisaged for the proposed coke oven plant. For the annual production of gross coke of about 3,062,000 tonnes, one coke oven plant with four batteries of 69 ovens each have been selected. The major cold dimensions of the ovens will be as follows.

Total length (between buck stays)	:	16,000 mm
Total useful length	:	15,160 mm
Total height	:	7,000 mm
Useful height	:	6,700 mm
Width at pusher side	:	385 mm
Width at coke side	:	435 mm
Average Width	:	410 mm
Taper	:	50 mm
Useful volume of the oven	:	41.6 m^3
Axial distance between oven	:	1,400 mm
Number of flues in heating wall	:	32
Distance between flues	:	480 mm
Number of charging holes	:	3
No. of gas off-take holes	:	2
No. of ovens	:	69
Coking time	:	16 h

Coking coal will be the main raw material required for the proposed coke oven plant complex.

Quality of Coking Coal and Coke

The proposed coke oven plant is designed, based on the use of up to 60% imported coking coal and 40% indigenous coking coal to produce metallurgical coke. The quality of coal will be such that the coke should be of acceptable quality to the high capacity blast furnaces, and a suitable blend of indigenous and imported coal would be worked out during detail engineering. The general quality of imported coal and coke thus produced are given in the tables below.

General Quality of Imported Coking Coal

Sl. No.	Quality parameters	Unit	Value
1.	Size	mm	0 to 50
2.	Ash	%	9.0-9.5% (max.)
3.	VM	%	24 to 26
4.	Moisture	%	8 to 10
5.	Sulphur	%	0.5% (max.)
6.	Phosphorous	%	0.06% (max.)
7.	Grey king coke type	-	G 5 (min.)
8.	Crucible swelling No.	No.	6.5 (min.)
8.	Mean max. reflectance (R0 max)	-	1.10 to 1.30
10.	Gieseler fluidity	ddpm	600-2000

Note: Indigenous coking coal from captive mines/ other sources will also be used depending on availability and quality of available coal.

Quality of coke

Quality parameters	Value
Ash, % (max.)	12
VM, % (max.)	1.0
M10 (max.)	8.0
CSR (min.)	64
Moisture, % (max.)	4

Requirement of coal

Based on the design norms adopted and elaborated later in this chapter the annual requirement of coking coal will be about 4,195,000 t/yr.

Source of coal

The major source of imported coking coal is Australia, which is the largest exporter of coking coal in the world. Steelmakers in India are also importing coking coal from Australia. However, possibilities can be explored to import coking coal from New Zealand, China and South Africa.

Yield norms

Based on the above, assumed blend composition, characteristics and three grades of coke size requirement, the norms for the yield of coke from 7 m tall ovens with Imported Coking Coal and Indigenous Coking coal in the proportion of 60 : 40 is taken into consideration are indicated in the table given below.

Norms for yield and consumption

Sl. No.	Particulars	Unit	Quantity
i)	Dry equivalent bulk density of coal charge	t/m3	0.76
ii)	Yield of dry gross coke as % of dry coal charge	%	73
iii)	Yield of sized coke as % of gross coke 25-80 mm 15-25 mm 0-15 mm	% % %	83 4 13
iv)	Yield of coke oven gas per tonne of dry coal blend charge	Nm3/t	320
v)	CV of coke oven gas	Kcal/Nm3	4,300
vi)	Heat consumption for coke oven battery per kg of coal - With mixed gas (BF & CO gas) (Mixed Gas CV=1000 kcal/Nm3)	Kcal	600
vii)	Yield of other by–products as % of dry coal. -Crude tar (water free)	%	3.02

Volume of Production and Consumption

The volume of production/consumption of various materials and quality of coal & coke for the proposed plant on annual basis has been tabulated in the table below.

Sl. No.	Item	Unit	Quantity
1.	**Production**		
i)	Gross coke (dry)	t/yr	3,062,000
ii)	Sized coke (dry) 25-80 mm 15-25 mm 0-15 mm	t/yr t/yr t/yr	2,520,000 133,000 409,000
iii)	Clean coke oven gas	10^6 Nm3/yr	1343
iv)	Crude tar (water free)	t/yr	125,000
2)	**Consumption**		
i)	Imported/indigenous coal Dry (as charged to ovens)	t/yr	4,195,000
ii)	Mixed gas (BF + CO gas) for under firing of ovens & other internal use.	Gcal/hr	287.3

Coke Dry Quenching Plant

Two coke dry quenching plants (CDQP) of 175 t/h capacity consisting of three cooling chambers each will be installed to cool coke produced in the batteries.

Technological parameters

The technological parameters/ features of coke dry quenching plant will be as indicated in table below.

Features of Coke Dry Quenching Plant (CDQP)

Description	Value
Capacity of CDQ unit	175 t/h
Quantity of CDQ unit	2 unit
Temperature of coke charged in the chamber	1050°C
Temperature of coke after cooling	200°C
Temperature of circulating gas before entering cooling chamber	170 -180°C
Temperature of circulating gas before waste heat boiler	800 – 1020°C
Thermal efficiency	80 - 85 %
Pressure of steam generated	9.3 MPa(g)
Temperature of steam generated	540°C
Temperature of Feed water	120°C
Generation of steam/boiler	105 t/h
Cycle Time of Coke Charging	514 sec.

Process description

Hot coke pushed from ovens will be received in a special type of coke car which has a detachable bucket with mechanism for bottom discharge. The coke car with hot coke will be brought to coke dry quenching installation. The coke bucket will be lifted to the top of cooling chamber with the help of coke bucket lifter. Each chamber will be provided with an independent coke bucket lifter. The bucket during lifting will be covered with a special type of screen. This will help in retaining the heat as well as protect the working area from emission of heat. Hot coke will be charged into the chamber through coke charging device. As the coke travels down the chamber, it gets cooled by the counter current stream of inert gases, which will be recirculated by a mill fan provided for each chamber. Cooled coke will be discharged on the conveyor running below the chamber through the coke-discharging device. The entire operation from lifting of the hot coke to the discharging of cooled coke is carried out in automatic mode.

The inert circulating gas will get heated during its contact with hot coke and enter waste heat boiler through a dust catching bunker, where coarse dust will be separated from the gas. The hot gas will be sent to the waste heat boiler, where high-pressure steam is generated utilising the sensible heat of hot gases. The cooled gas will be re-circulated to the cooling chamber after removing fine dust in cyclones.

Major plant facilities envisaged for each CDQP unit are given below:

- Cooling chamber
- Waste heat boiler
- Coke bucket lifter
- Mill fan and auxiliary fan
- Hoisting and handling equipment
- Dust cyclones
- Boiler circulating pumps
- Pneumatic transport system for coke dust
- Ventilation equipment
- Coke charging device
- Coke discharging device

Coke Sorting Plant

The coke sorting plant has been envisaged to cater to the needs of the four batteries. Coke sorting plant of 300 t/h capacity has been envisaged to receive the dry cooled coke from 2 sets of CDQP units. The coke sorting plant will sort out the coke into three fractions e.g. 25-80 mm, 15-25 mm and 0-15 mm. The coke will pass through a series of screens and coke cutters for this purpose. Size degradation of coke will be kept minimum. While (-) 25 mm fraction will be sent and stored in the 200 t capacity RCC bunkers and the 25-80 mm fraction will be sent to the blast furnace zone.

CO gas flare stack

CO gas flare system is meant to control the pressure of CO gas network by flaring the excess gas to atmosphere. The excess gas released through the bleeder will be burnt in the burner located at the top of the stack. The height of stack will be 45 metres.

To ignite the CO gas at the main burner tip and to maintain the flame, a system of pilot burners and ignition device will be provided. The pilot burners will be ignited by CO gas. Propane shall also be available as a alternative fuel for this purpose.

Pilot burners will be ignited through automatic ignition system from the local control panel as well as from CO battery control room.

Indication with alarms shall be provided at the main CO control room for the operating condition of the flare system. Remote operation of the ignition system for pilot burner shall be provided from CO battery control room.

COG holder include two gas holders of 50,000 m3 capacity

Operating parameters and location

- Capacity : 30,600 Nm^3/h (max) -Pressure in CO gas header : 800 mm WC
- Temperature :45-50°C
- Calorific value : 4300 $kcal/Nm^3$

- Stack height : 45 m

The flare stack will be located by the side of interplant pipeline route near CO battery.

By Product Plant

The by-product plant will be designed for recovery of only essential by-products like ammonia and crude tar. In addition to that, naphthalene scrubbing unit will be installed to remove and recover naphthalene from coke oven gas. Naphthalene rich solar oil generated in naphthalene scrubbing unit will be sold to outside parties for recovery of naphthalene from solar oil. This regenerated solar oil (stripped off naphthalene) will be reused in the scrubbing unit with addition of make-up fresh solar oil.

Facilities proposed in the by-products plant have been summarized below.

Technological Units of By-product Plant

SN	Plant	Facilities proposed
1.	Gas condensation plant for cooling of gas, removal of tar fog, separation of tar and liquor by cooling water and chiller water	Primary gas coolers, electrostatic tar precipitator (ETP), exhauster (electrical driven), decanter with tar and liquor handling facilities
2	Ammonium sulphate plant for removal of ammonia in the form of ammonium sulphate	Saturator, centrifuge, pumps, salt drying and bagging system, ammonia column and associated equipment
3.	Final gas cooling	Final gas cooler
4.	Naphthalene scrubbing unit	Naphthalene scrubber, tanks, pumps etc.

Characteristics of coke oven gas after cleaning in by-product plant

SN.	Ingredients	Value
	% Composition	
1	Hydrogen	52-59
2	Carbon monoxide	6-7
3	Carbon dioxide	3-4
4	Oxygen	0.3-0.7
5	Methane	24-28
6	Nitrogen	4-7
	Residual Impurities in gas, g/Nm3	
7	Tar	0.02
8	H2S	3-4
9	Ammonia	0.05
10	Napthalene	0.08
11	Benzol hydro-carbons	30-32

Air Pollution Control Measures

Air emissions from coke oven operations at the proposed plant will be controlled by smokeless charging techniques, such as **High Pressure Liquor Ammonia** (HPLA) system, Pushing Emission Control (PEC), leak proof doors etc, as described below:

b) Leak Proof Oven Doors and Hydro-jet door cleaners

Doors will be of leak proof oven doors with flexible sealing strips. The door design will provide flexible sealing strip and other modified features to ensure leak proof sealing. The door will be of heat resistant cast iron provided with spring-loaded latches and spring loaded sealing strips. Hydro-jet door cleaner system will be provided to reduce the pollution and improved working environment. The system will be complete with high-pressure water pump, tank, hose, nozzles etc. with pressure and volume control arrangement. The hydro jet cleaning system will be used for door and the doorframe cleaning.

c) Charging Lids (Holes)

Each Oven will be provided with 3 numbers of charging holes. These will be of modified type to suit magnetic lid lifting and provided with proper insulation to reduce lid top temperature. Sodium silicate mortar will be used for luting of the lids. The charging hole frames and lids will be of heat resistant cast iron.

d) Screw Feeders with Hydraulically Pressed Sleeves as Part of Charging Cars

Coal charging car will be designed for single spot operation of lid/opening and screw feed charging ovens. Feeding of coal into ovens will be carried out with control speed by screw feeders. During charging hydraulically pressed sleeves will be helping to eliminate leakage around charging holes. The charging cars will be of modern single spot type with hydraulic drives to cater to the needs. The charging cars will be provided with PLC and air-conditioned operator's cabin.

e) High Pressure Ammonia Liquor Aspiration (HPALA) System:

To control charging emissions from Coke Oven Battery, water sealed ascension pipe covers and high pressure ammonia liquor aspiration (HPALA) system will be provided. It will consist of high pressure booster pumps for ammonia liquor, spray nozzles and pipelines. The low pressure ammonical liquor will be drawn from the liquor mains and injected into the gooseneck while charging. The charging gases evolved will be sucked in to the gas collecting mains, preventing emission of dust and smoke into the atmosphere.

HPLA system will be provided with pumps, HP nozzles, LP nozzles, goosenecks, pipes, valves and fittings, electrics, instrumentation. Pumps will be housed in a separate room near the pusher car track. Required MCC and instruments will also be provided.

f) Water Sealed Ascension Pipe (AP) Covers

The gas off-take system will comprise base castings, ascension pipes (AP), water sealed AP covers, goosenecks, isolation valves, gas collecting mains, necessary flushing liquor spraying and injection devices. The system will be complete with inlet and outlet water pipe network, water sealed AP covers, return trough, etc. Proper sealing of gas will be obtained with the help of water in the covers.

g) Leveler Muffs as Part of Coke Pusher Machines

New modern single spot coke pusher machines with leveler muff and hydraulic drives will be provided. Leveler muff will help to eliminate gas leakage during leveling operation. The pusher machines will be provided with PLC and air-conditioned operator's cabin.

h) High Pressure Water Jet Door and Frame Cleaners

It is proposed to provide a water jet door and frame cleaner on the oven machines i.e. on pusher cars and door extractor cars. This will ensure proper cleaning of door frames and doors which in turn will ensure less or no leakage from the doors.

i) High Pressure Water Jet Goose Neck Cleaners as Part of Charging Cars

The charging cars as proposed above will be provided with High Pressure water jet (hydro-jet) gooseneck cleaners. This will ensure proper flow of gas to gas collecting mains. This will control the building of pressure in the ovens, which will again prevent leakage through doors.

j) Oven Top Vacuum Cleaners as Part of Charging Cars

This is essential for proper upkeep of oven top. This system will be provided in coal charging cars.

k) Spillage Chain Conveyor on Service Platforms

The spillage coke conveyor will be provided for removing the hot coke spillage likely to fall during opening of the coke oven doors and pushing of oven pusher side service platform. The total system will consist of special chain conveyor fitted with drag plates running inside a lined trough on the service platform. The chain conveyor will discharge the material on belt conveyor, which will carry the same to structural storage hopper for disposal be trucks. Proper water spraying arrangement before belt conveyor will be provided in the system to take care of temperature of coke to be transported on to belt conveyor.

l) Pushing Emission Control (PEC) System

Pushing emission control system has been considered for the coke oven plant. This system will consist of a duct running along the length of battery on coke side (away from the quenching car track), a traveling hood with one side connected to door extracting machine and other running on a 3rd rail supported on the trestle of the duct, spark arrester, bag filter house, fans and stack.

2.10.5 SINTER PLANT

The proposed sinter plant complex will consist of one sinter machine of 700 m^2 grate area along with associated services facilities. The plant capacity has been selected as 7.2 Mtpa for charging about 70-75% sinter in BF burden at a rated productivity of 1.3 $t/m^2/h$.

The proposed sinter plant will be of state-of-the-art technology and will operate on blended mix. The basic design parameters envisaged are as given below.

Item description	Unit	Value
Sinter machine area	m2	700 m2
Productivity	t/m2/h	1.3
Annual sinter requirement (gross)	t/yr	7,195,000
Annual skip sinter requirement	t/yr	6,541,000
Size of finished sinter	mm	6-50
Annual working regime	days/yr	330
No. of working hours/day	h/day	24
Gaseous energy consumption for ignition per tonne of BF sinter	kcal/t	20,000
Coke breeze consumption per tones of skip sinter	kg/t	70
Mixing and nodulising drum (dia x length)	m x m	4.6 x 21
Under-grate suction of sinter machine	mm WC	1500
Sinter machine bed height (including 40-50 mm hearth layer depth)	mm	650
Cooler type		Circular
Cooler bed height	mm	1400 -1600
Temperature of cooled sinter	deg. C	Below 100
Exhauster (no. and capacity)	no. x m3/min	2 x 14,400
Dust content in exhaust gases at stack	mg/Nm3	Below 50

Operating regime

The sinter plant will be operating on the basis of 3 shifts a day and 330 days in a year, taking into consideration the shutdowns required for the planned maintenance and unscheduled breakdowns as indicated below.

Sl. No.	Item	Duration in days/ yr
1.	Scheduled repairs	15 (10 shutdowns of 36 hours each year)
2.	Unforeseen downtime and maintenance	15
3.	Capital repairs	5 (10 days every two years)
	Total	**35**

Modern features

The following state-of-the-art features are envisaged for the proposed sinter plant complex.

- Use of blended mix
- Electronic weighing and proportioning system
- Combined mixing and balling drum
- Improved sealing system (spring loaded pallet cars) and higher under-grate suction.
- SG iron pallets with high chrome (28-30%) cast steel grate bars
- Energy efficient ignition furnace with top fired/multi slit burners
- Deep bed dip rail circular sinter cooler
- Elimination of maintenance intensive hot sinter screen
- Process gas and plant dedusting systems using dry ESPs
- Process control and automation
- Cooler waste heat utilization in ignition furnace

Quality of Raw Materials

The physical and chemical characteristics of various raw materials to be used in the proposed sinter plant are given below.

Constituent, %	Iron ore fines	Limestone	Dolomite	Coke breeze (Ash)
Size, mm	0-8	0-3	0-3	0-3
Fe (t)	63-64	1.0	1.0	3-5
SiO_2	3-4	4-6.1	5-8	52-58
Al_2O_3	1.5-2	1-2	1-2.5	26-32
CaO	-	42-46	24-28	1.5-3.5
MgO	-	4-6	15-21	0.7-1.2
$Na_2O + K_2O$	0.03	0.05	-	
S	0.008	n.a.	n.a.	0.8
LOI	1.5-3.0	40-45	38-42	81-87

Sinter quality

The expected quality of sinter is projected below.

Constituent	%
Fe_2O_3	73.37
FeO	8.00
SiO_2	4.58
Al_2O_3	2.25
CaO	8.31
MgO	1.98

Constituent	%
S	0.006
P2O5	0.12
MnO	0.014
Others	1.36
Basicity	1.81

Main plant facilities

The sinter plant complex will consist of the following main technological units.

Proportioning Unit

Suitable capacity of storage and proportioning bins have been envisaged for the proposed sinter plant. The blended mix, corrective additions and in-plant returns will be fed to the common collecting conveyor by electronic belt weigh feeders, whereas, lime will be fed to common collecting belt conveyor by loss in weigh feeder and ESP dust from ESP dust bin.

Combined Mixing and Nodulising Unit

Material from belt weigh feeders below respective proportioning bins will be transported to a combined mixing and nodulising drum by a belt conveyor where the various raw materials will be moistened and mixed by 4.6m dia. X 21m length drum mixer installed in the building.

A fixed quantity of water of about 60% of requirement will be added in the mixing part and the rest variable quantity will be added in the nodulising part depending on requirement. The raw mix discharged from mixing and nodulising drum will be transported to sinter plant main building by a belt conveyor.

Sinter Plant Main Building

The sinter plant main building will mainly consists of hearth layer and raw mix feeding units, ignition furnace, sinter machine proper, hot sinter breaker etc.

Hearth Layer Storage Unit

Sinter of size 15 to 25 mm as hearth layer will be brought from sinter screen building to sinter machine building and stored in a hearth layer bin located at the feed end of the sinter machine with suitable feeding facility and fed on to the sintering machine strand.

Raw Material Feeding Unit

The raw sinter mix will be fed from raw material hopper to the sintering machine strand through drum feeder and deflector plate. It is located at the feeding end of the sintering machine after the hearth layer hopper. The drum roll feeder surface will be suitably lined. The raw material feeding unit will be designed to change the feed rate instantly according to the requirements of the sintering process i.e. according to the increase or decrease in the speed of the sintering process. Sector/ sub gates will be installed along the width at the drum feeder discharge for suitable adjustment of the bed height widthwise. After the raw mix drum feeder, a cut off plate is installed to level and smoothen the top surface of the charge to facilitate a better and uniform ignition of the top surface when the strand passes under ignition furnace.

Ignition Furnace

The ignition furnace with post heat hood and pre heating (before ignition furnace) will be installed just after the sinter mix drum feeder. The ignition furnace will have suitably located energy efficient type gas firing burner designed for 2000 Kcal/ Nm^3 of mixed gas (CO gas + BF gas). Gas mixing station and gas boosting station (if gas pressure is not sufficient for ignition burners) will be located outside sinter plant battery limit. Hot air from waste heat recovery system of sinter cooler will also be used for preheating of raw material before ignition furnace and post heat hood after ignition furnace.

Sintering machine proper

Sintering machine having 700 m^2 effective sintering area with associated facilities have been envisaged for new sinter plant complex. Sinter raw mix will be fed uniformly on the pallets over the hearth layer material. The height of the mix will be 650 mm max. including 40-50 mm hearth layer height. Ignition hood will be provided for ignition of the mix to ensure ignition temperature of 1200 to 1300 ^oC. This will be achieved by means of mixed gas (CV 2000 Kcal/Nm^3) fired heat efficient burners. A post ignition hood will also be provided to avoid chilling of top layer of sinter bed. The recovered waste heat from cooler will be utilized for ignition, post ignition and preheating of raw-mix.

Hot Sinter Breaker

Hot sinter breaker of suitable size will be provided at the discharge end of sinter machine along with trolley mounted grizzly assembly. Hot sinter passing through hot sinter breaker will be crushed to -150 mm size before feeding to sinter cooler.

Sinter Cooling Unit

Circular sinter cooler will be used to cool the sinter to less than 100^{o}C after it is discharged from hot sinter breaker at approximately 800^{o}C upto -150 mm size, so that it can be transported through conventional conveyor system. Three numbers of forced draught fans of adequate capacity for each size of cooler will be provided to cool the sinter in sinter cooler.

Screening Unit

The sinter after being cooled in the sinter cooler is transported to the screening house.

The size fraction +25 mm, 15 – 25 mm, 6 – 15 mm and -6 mm will be separated out from cold sinter screens. The size fraction of +6 mm to -15 mm, +25 mm and the excess amount of +15 mm to -25 mm will be dispatched to blast furnace and -6 mm fraction will be transported back to proportioning building through belt conveyors and flexo-well conveyors.

Emergency Sinter Storage Unit

An emergency storage has been envisaged to hold around 6,000 tonnes of product sinter, in order to meet any eventuality in sinter plant/ blast furnaces.

Waste Gas Dedusting Unit

Dry type electrostatic precipitators of suitable capacity at 160°C - 250°C will be envisaged for dedusting of waste gases before entering the main exhausters. The unit will have high efficiency to ensure less than 50 mg/Nm^3 of dust in the outgoing gases from the stack.

Main Exhauster Unit

Cleaned gas from ESP will be exhausted by means of two exhausters, each of capacity 14,400 m^3/min at 160 deg C and 1600 mmWC at fan inlet.

Plant Dedusting Unit

ESPs will be used for plant dedusting and dedusted clean air will be let into atmosphere through stack of suitable height. In addition to above, service facilities like power, water, compressed air, electrics, instrumentation and automation, material handling etc. have been envisaged for smooth functioning of the sinter plant.

2.10.6 BLAST FURNACE

The blast furnace complex will comprise of two blast furnaces of 4019 m^3 inner volume each along with its auxiliaries. These are similar to the existing BF#3 and BF#4 at Vijayanagar.

The blast furnace is envisaged to operate with pellet, sinter, DRI, coke, coal dust, fluxes and additives.

The hot metal produced will be charged in BOFs. The liquid slag will be granulated at cast house slag granulation unit. The BF top gas will be cleaned in dust catcher and gas cleaning system, and distributed to the stoves, runner drying and boiler for steam generation for process and turbine requirement. Excess BF gas will be provided to the plant network.

Production

The production of the proposed blast furnace complex is given below.

Production programme of blast furnace complex

Sl.No.	Product	Annual Quantity (t/yr)
1.	Hot Metal - BF	5,600,000
2.	Hot Metal - DRI	632,800
3.	Gross hot metal	6,232,800
4.	Granulated slag (dry)	1,400,000

Operating conditions

The operating parameters of each blast furnace are given below.

No. of operating day/yr	350
No. of shifts/ day	3
No. of hot metal tapping/day	10 - 12

Technological parameters

The major technological parameters of each blast furnace are given below.

Sl. No.	Parameter Quantity	Quantity
1.	No. of blast furnace	2
2.	Inner volume, m3	4019
3.	Productivity, t/d/m3 (on inner volume)	2.215
4.	Production, t/d	8,904
5.	Coke rate (dry), kg/thm	450
6.	Slag rate, kg/thm	250
7.	Slag basicity, CaO/SiO2	0.95
8.	Top pressure, kg/cm2(g) (operating)	2.5
9.	Hot blast temperature, Deg. C	1200
10.	Blast humidity, g/Nm3	50
11.	Blast volume, Nm3/thm	823
12.	BF gas generation, Nm3/thm	1550

Requirement of raw materials

The requirement (dry and net) of raw materials for the blast furnaces is given below.

Sl. No.	Raw material	Requirement, kg/thm	Requirement, t/yr (net & dry)
1.	Iron ore pellet	432	2,419,000

Sl. No.	Raw material	Requirement, kg/thm	Requirement, t/yr (net & dry)
2.	Sinter	1,168	6,541,000
3.	Coke	450	2,520,000
4.	Quartzite	14	78,000
5.	Coal dust (PCI)	125	700,000

Quality of products and by-products of blast furnace

Hot metal

Carbon	4.3%
Silicon	0.6%
Phosphorus	0.12%
Sulphur	0.05%
Hot metal temperature	1400 °C

Slag

CaO	33.62%
SiO2	35.39%
Al2O3	20.0%
MgO	8.0%
Slag temp. (°C)	1450
Slag rate (kg/thm)	250
CaO/SiO2	0.95

Top gas

CO2	CO	CH4	H2	N2	CO/CO2	CV, kcal/Nm3
26	27	0.069	3.19	44.16	1.045	904

Raw material characteristics

The physico-chemical characteristics of the raw materials envisaged for blast furnace are as follows.

Iron Ore Pellet	Value
Fe (t)	> 64%
SiO2 + Al2O3	3 - 4
CaO + MgO	1
FeO	< 0.5
Size	+9 -16 mm

Sinter	Value (%)
Fe_2O_3	73.37
FeO	8.00
SiO_2	4.58
Al_2O_3	2.25
CaO	8.31
MgO	1.98
S	0.006
P_2O_5	0.12
Basicity	1.81

Coke	Value (%)
Ash	12% (Max.)
CRI	23% (Max.)
VM	1%
Moisture	5% (max.)
Size	25 – 80 mm (min. 90%, with 5% under size & 5% oversize)

Limestone	Value (%)
CaO	48%
Total of SiO_2, Al_2O_3, Fe_2O_3	4.5%
Size	10 – 50 mm (min 90%, with 5% under size & 5% oversize)

Dolomite	Value (%)
CaO	30% (min)

Technological units for blast furnace

Stock house and charging system

The transportation of raw material from storage yard to the stock house will be done by belt conveyors. Coke, sinter and pellet bunkers will be provided with individual feeders and screens. The bunker storing additives, nut coke will be provided with floor mounted vibro-feeders. Rod gates will be provided below all the bunkers to isolate the bunkers during maintenance.

Coke will be extracted from coke bunkers by vibro-feeders and fed into screens. Screened coke will be fed into weigh hoppers. The screened undersize fraction of coke will be carried to fines bunker building. In fines bunker building the coke will be further screened by coke screen to separate out (15-25 mm) fraction and kept in nut coke storage bunkers. The nut coke will be fed back to stock house by dumpers or belt conveyors as and when required.

Iron ore pellet will be extracted from stock house bunkers by vibro-feeders and screened by screens. The over size portion of feed will be discharged into weigh hopper. The under size potion will be carried to fines bunker building and disposed by dumpers. Sinter will be extracted from bunker by vibro-feeders and screened by screens. The under size will be carried to fines bunkers building for disposal. The over size fraction will be fed to weight hopper.

Additives like limestone, dolomite, quartzite will be drawn by floor mounted vibro-feeders and fed into weigh hoppers.

Nut coke will be drawn by vibro-feeders and fed into weigh hoppers.

All materials, stored in different weigh hoppers will be charged sequentially into collecting conveyors which will discharge material into common charging conveyor which in turn will feed the material to the blast furnace top charging equipment.

Blast furnace proper

The blast furnace shall be of structural steel construction of free standing design and provided with 4 – post tower structure. The furnace shall be provided with under – hearth water cooling system in close circuit. The blast furnace shall have a hearth diameter of 13.5 m with 38 Nos. of tuyeres.

Cast house

The blast furnace will be provided with 2 cast houses with two tap holes in each cast house. The cast houses will be connected to each other and will be provided with a ramp from the road network. Design considerations for the study are as follows.

Cast house, overall size	:	~ 140 m x 100m
Flooring	:	Flat floor type
Production through C/H	:	8904 tpd
Slag rate	:	2000 tpd (max.)
No of tappings for hot metal	:	10 – 12 taps/ day
Tap holes	:	4 nos., 2 nos. per cast house
Slag notch	:	Not provided
Ladles	:	350 t torpedo ladles
Slag treatment	:	Normal : Total granulation
Dry slag pit	:	Emergency : Dry slag pits on each cast house.

Iron and slag runner system

Main Trough Type	:	Fixed refractory lined trough for metal holding with / without trough steel cooling
Broad dimensions	:	~ 2.3 m wide : 16 m long
Iron and slag runners with slag stopper	:	4 sets

Splash cover and runner cover Cast house equipment

Trough cover	:	4 sets
Iron runner cover	:	4 sets
Slag runner cover	:	4 sets
Drain runner cover		4 sets
Tilting runner	:	4 sets
Type	:	Trunnion with cotter
Trough length	:	~ 10 m
Drive	:	Hydraulic power Manual drive at emergency
Hydraulic Equipment with oil pump and valve stand, pumping unit	:	Tilting runner main trough cover manipulator
Main trough cover manipulator	:	4 sets
Clay guns	:	4 sets
Type	:	Hydraulic power type
Clay barrel	:	250 l
Pressure on clay	:	250 bar
Force on ramming piston	:	345 t
Holding force	:	50 t
Ramming angle	:	10°
Ramming speed	:	5 to 6 L/sec
Operation	:	Local control panel Radio operation system
Top hole drills	:	4 sets
Type	:	Hydraulic
Angle	:	10°
Stroke	:	4500 mm (total)
Operation	:	Local control panel
Hydraulic Equipment	:	Pump tank, valve stand, control dust
Drill angle	:	9 - 12 deg.

Main trough cover manipulator

Type	:	Hanging Type
Drive	:	Hydraulic power
Lift Capacity	:	15 t

Cast house slag granulation

The various cast house granulation systems are the PW-INBA, VAI-RASA, NSC- AJO. The PW-INBA has been considered for the report with cold water system, details of which are furnished below.

No. of systems	:	2 (For circular cast house with four tap holes)
Molten slag production	:	2000 tpd
Slag flow rate	:	Avg. 5 t/min
Transient excess	:	7 t/min
Design maximum	:	10 t/min
Spray box	:	Perforated plates with ceramic nozzle.
Granulation tank	:	Overflow type
Material	:	Steel plate
Accessories	:	Grid, outlet channel, wearing liner, hood connected to stack, expansion flaps.
Stack Dia	:	4.5 m
Height	:	80 m
Material	:	Steel plate
De-watering drum	:	INBA type
Size	:	To be finalized during detail engineering
Drive	:	Hydraulic motor
Speed	:	0.2 – 1.2 rpm
Drive unit of de-watering drum	:	Hydraulic motor
		Transmission chain
		Chain wheels
		Pillow blocks.
Lubrication spectrum	:	Lubrication oil unit for drive chain
Support structure, chain cover, hood for de-watering drum		
Hot water tank	:	Steel plate
Cooling tower	:	RCC
Hydraulic equipment	:	Comprising main pump, oil tank, circulation pump and accessories.
Pumps	:	Granulation pump
		Cooling tower pump
		Booster pump
		Drain pumps
Valves and fillings, piping		
Belt conveyor inside de-watering drum		
Capacity	:	~ 420 t/h ~ 525 t/h with moisture
Belt	:	1200 mm
Slope	:	1°
Length	:	~ 15 m

Coal dust injection system for blast furnace

Coal dust injection system with dense phase conveying of pulverized coal with nitrogen for fluidizing and inertisation and nitrogen/air for injection with static distributors for uniform distribution of pulverized coal across tuyeres is proposed for incorporation in BF.

Basic parameters of CDI system

- Daily hot metal production - 8904 t approx.
- Coal injection rate @ 125 kg/thm (Normal) and 150 kg/thm (Max for Design)
- Coal Ash – 10 % (Imported coal)
- Moisture – 10 % (Max)
- Size of pulverized coal – 0.075 mm (80 % Min) (100 % < 1mm)
- Moisture of pulverized coal < 1 % at output of grinding mill.

The system of pulverized coal injection can be divided mainly in the following three units.

i. Raw coal handling and storage section (outside battery limit)
ii. Coal drying and pulverising section
iii. Coal injection section

For the blast furnace, the PCI system will have two feed tanks, one distributor and one injection system. The pulverised coal is fed from the pulverised coal bin to the feed tanks in batch mode, where each tank is operated in the following sequence and repeated at the end of each cycle: filling, pressurising, holding, injecting and depressurising. Automatic control of filling, injecting and change-over will be incorporated into the system. After leaving the feed tank, the coal/nitrogen mixture is mixed with transport nitrogen in the mixing tee, and the resulting mixture is proportioned suitably in the distributor (sited near the top of the furnace) before being injected into the individual tuyeres.

The entire PCI system may be operated by a suitably-integrated PLC system, resulting in a highly automated system requiring minimum manual inputs.

BF gas cleaning plant

The dust laden blast furnace gas after dust catcher shall be cleaned in the gas cleaning plant. The raw gas main will connect scrubber to a gravity dust catcher. The system will be completed with external demister arranged in clean gas main immediately down stream of the scrubber vessel. Provision of a top gas recovery turbine (TRT) will be made in the clean gas system down stream from the mist separator. The turbine will provide blast furnace top gas pressure control. When the TRT is out of service, the scrubber will take over the pressure control function.

Design data of the blast furnace gas cleaning plant

i)	Medium to be handled	:	Blast furnace gas
ii)	C.V. of gas	:	904 kcal/Nm^3
iii)	Type	:	Two – stage cleaning in prescrubber and RS scrubber
iv)	No. of units	:	One
v)	Volume of BF gas	:	516,700 Nm^3/h (max.)
vi)	Pressure of the gas at inlet	:	2.5 kg/cm2 (g)
vii)	Dust content of the inlet gas to GCP	:	17.0 gms/Nm^3 (max) 8.0 – 10.0 gms/Nm^3 (normal)
viii)	Moisture content of inlet gas to GCP	:	7.5 % by volume
ix)	Outlet pressure of the gas	:	2.2 kg/cm^2(g)
x)	Dust content of the gas at	:	5 mg/Nm^3(max) the outlet
xi)	Outlet temp. of the gas	:	40 – 45°C (avg.)

Pig casting machine (PCM)

Two nos. of double strand pig casting machine of adequate capacity have been envisaged for production of pig iron. The PCM will consist of the following units / facilities.

- PCM proper
- Lime preparation unit
- Settling tank and pump house -Pouring end and discharge end sprocket
- Centralised grease lubrication system
- PCM control room and sub-station.
- Pig storage yard with magnet crane.

BF gas flares stack

BF gas flare system is provided to control the pressure of BF gas network by flaring the excess gas to atmosphere. The excess gas released through the bleeder will be burnt in the burner located at the top of the stack. The height of stack will be 45 metres.

To ignite the BF gas at the main burner tip and to maintain the flame, a system of pilot burners and ignition device will be provided. The pilot burners will be ignited by CO gas.

Pilot burners will be ignited through automatic ignition system from the local control panel as well as from BF control room.

Indication with alarms shall be provided at the main BF control room for the operating condition of the flare system. Remote operation of the ignition system for pilot burner shall be provided from BF control room.

Operating parameters and location

- Capacity	:	514,900 Nm^3/h (max)
- Pressure in BF gas header	:	800 mm WC
- Temperature	:	45-50°C
- Calorific value	:	904 $kcal/Nm^3$
- Stack height	:	45 m

The flare stack will be located by the side of interplant pipeline route near to the blast furnace.

BF gas holder of 100000 m3

2.10.7 STEEL MELTING AND CONTINUOUS CASTING SHOP

A state-of-the-art steel melting facilities to produce 6,187,000 t/yr of liquid steel.The production of steel has been envisaged through BOF – LF – RH-TOP degasser route.

In order to achieve the liquid steel production of 6,187,000 t/yr, four (4) basic oxygen furnaces of 180 t nominal capacity each have been envisaged. Steel melting shop (SMS) will run based on four out of four converter concept.

There will be four (4) 180 t ladle furnaces (LF) of 35 MVA transformer rating each and two (2) RH-TOP degasser unit of 180 t capacity for degassing of high grade steel products. However, the actual size of the converters will be finalized before placement of order and after discussion with the technology supplier during the detailed engineering stage.

Steelmaking facilities

The steelmaking shop will constitute the following major plant facilities. 2 x 180 t Hot metal desulphurisation (HMD) units 4 x 180 t Basic oxygen furances (BOFs) 4 x 180 t Ladle furnaces (LF) 2 x 180 t RH-TOP degasser unit Brief technological parameters of major steelmaking production units envisaged are given as follows.

Hot metal desulphurization

Two (2) twin hot metal desulphurisation stations of 180 t ladle capacity have been envisaged to bring down the sulphur content in hot metal received from blast furnaces. Desulphurisation of hot metal will be carried out in the hot metal charging ladles of steelmelting shop prior to charging into BOFs. Hot metal from blast furnace to steelmelting shop will be received by torpedo ladles and will be reladled at reladling pits. Hot metal will be pretreated in desulphurisation stations before being used for steelmaking. The desulphurisation facilities will be based on lance injection process. Desulphurisation facilities are planned in hot metal receipt-cum-charging bay. Calcium carbide and magnesium based reagents will be used for desulphurisation of hot metal.

Nitrogen will be used as the carrier gas during injection.

Hot metal desulphurisation stations will have the following facilities :

- Reagent storage facilities
- Reagent injection system
- Deslagging facilities
- Dedusting system

The technical/operating parameters of the desulphurisation station are as given in the following table.

Technical parameters of the desulphurisation station

Description	Parameters
Type of desulphurisation	Calcium carbide and magnesium based injection system
Amount of hot metal to be treated for desulphurisation	6,139,000 t/yr
Sp. consumption of materials	
- Calcium Carbide	2 kg/t of HM
- Magnesium granules	0.75 kg/t of HM
N2 consumption, max (per station)	0.12 Nm3/t of HM
Nominal capacity of hot metal ladle	180 t
Ladle type	Open top
Type of desulphurisation station	Co-injection type
Conveying and injection medium	Dry nitrogen gas
Typical injection rate - for CaC2 - for Mg	 40 - 50 kg/min 12 - 15 kg/min
Treatment time	12-15 min
Hot metal temperature, oC	1,350
Sulphur content in hot metal	
-Before treatment, %	0.05
-After treatment, % (avg.)	0.008

Basic oxygen furnaces (BOFs)

The BOF shop is envisaged to produce 6,187,000 t of liquid steel per annum for which four (4) Nos. of 180 t capacity each converters will be installed. The shape of the converter will be symmetrical top with fixed converter bottom. Facilities for inert gas purging from converter bottom have been envisaged. Medium for inert gas blowing will be argon / nitrogen depending upon the grade of steel. Top conical portion of converter vessel will be of water-cooled.

The shop will be provided with following major design features.

- 4/4converter operation practice
- Combined blowing facilities in converters
- Nitrogen slag splashing facility
- Top relining facilities in converter
- Converter top cone cooling system
- Facilities for minimising slag carryover into steel ladles during tapping
- Emergency lance lifting facilities in case of power failure
- Hot metal temperature measurement in charging ladle
- Slag sensing device in steel ladle
- Automatic and dynamic process control model based on BOF gas analysis
- Secondary emission control facilities.

Technological parameters of BOF

The major technological parameters of basic oxygen furnaces are given in the table below.

Sl. No.	Item	Unit	Quantity
1.	Liquid steel production	t/yr	6,187,000
2.	No. of converters installed	Nos.	4
3.	No. of converters in operation	Nos.	4 out of 4 in operation
4.	Nominal heat weight	t	180
5.	Working volume of converter, (with new lining)	m3	180
6.	Tap-to-tap time, average	min	50
7.	Oxygen blowing rate, Nm3/min – Average – Maximum	--	500 750
8.	Specific consumption of oxygen for blowing	Nm3/t	55
9.	Converter lining life, approx.	Heats	4,000
10.	Converter relining time	h	168 (7 days)
11.	No. of heats / day/ converter, max.	Nos.	28.8
12.	Availability of each BOF	d/yr	330
13.	No. of days BOF shop operating	d	350

Ladle furnace (LF)

Four (4) nos. of ladle furnaces of 180 t capacity each have been envisaged for refining of 6,187,000 t/yr of liquid steel. Ladle furnace is widely used as secondary refining unit for carrying out heating, deoxidation, desulphurisation, alloying and homogenisation of temperature and chemical composition of steel tapped into ladle from steelmaking vessels.

The ladle furnace will help to produce various steel grades, improve productivity, steel quality and operating indices of the melting unit. In addition, the ladle furnace will be used as a holding furnace when casters are not ready to receive heat or during emergency situations.

Technological parameters of the ladle furnace are given below.

Technological parameters of ladle furnace

Sl. No.	Parameter	Unit	Value / Feature
1.	Liquid steel to be treated	t/yr	6,187,000
2.	Heats to be treated per day (max.)	No	75
3.	Ladle capacity	t	180
4.	Treatment time	min	30-40
5.	Type of ladle furnace	-	Single station with water-cooled roof
6.	Transformer capacity	MVA	35
7.	Heating rate	°C/min	3-4
8.	Method of charging additives	-	Mechanised
9.	Method of argon purging	-	Porous plug at the ladle bottom
10.	Main functions of ladle furnace	-	- Alloying - Heating - Homogenisation of chemical composition and temperature - Desulphurisation - Holding of liquid steel in case of emergency
11.	Fume collection and cleaning	-	Bag filters with ID fan, chimney, etc.

RH – TOP degasser

In view of the envisaged product mix, two RH-TOP degassing units of 180 t capacity each have been considered. The degassing system is used extensively for removal of gases such as hydrogen, oxygen, etc. It also helps assist in production of low carbon steel grades. Oxygen and fuel gas mix are used to provide heating of vessel refractories at high temperature. The main technological parameters of the RH-TOP vacuum degassing unit are given below.

Major technological parameters of RH-TOP degassing unit

Sl. No.	Item	Unit	Value / feature
1.	Type of degasser unit		Fixed treatment station vessel
2.	Heat weight	t	180
3.	Circulation speed	t/min	100
4.	Hydrogen level in steel - before treatment - after treatment	 ppm ppm	 5-10 < 1.5
5.	Minimum vacuum level achievable	torr	0.1
6.	No. of working days/yr	d/y	300
7.	Treatment time	min.	20-25
8.	Heats to be treated / day	Nos.	24 (max.)
9.	Preheating temperature of degassing vessel	°C	1,350-1,400

Continuous Casting Shop

A casting shop has been envisaged for JSW Steel Ltd. in Vijayanagar, Karnataka.The casting shop is designed to produce about 6,187,000 t/yr of liquid steel and cast the same into 6,032,300 t/yr of billets, blanks and blooms.

Continuous Casting Facilities - Blank Caster, Billet Caster and Bloom Caster

In order to produce wire rods, special bars, medium sections and heavy sections like beams, channels and angles, billet, blank and bloom casters are the present choice. The technology of continuous casting of steel into billets/blanks has been fully mastered today for any grade of steel. The continuous casting process has gained worldwide acceptance, mainly because of high yield, good product quality and good economics of operation. In order to cast 6,187,000 t/yr liquid steel into long products, blank, billet and bloom casters will be installed in the steel melting shop along with necessary auxiliary and service facilities.

Two nos. Three Strand Blank Caster for heavy sections, Two nos. Six Strand Bloom Caster for medium sections, One no. Six Strand Billet Caster for wire rods and One no. Six Strand Billet Caster for special bars will be installed. in the steel melting shop along with necessary auxiliary and service facilities.

Technological parameters of continuous casters

The main technological parameters of continuous casters are furnished below.

Sl. No.	Item	Unit	Parameter	Parameter	Parameter	Parameter
1.	Type of Caster	-	Blank Caster	Bloom Caster	Billet Caster	Billet Caster
2.	Annual Production	t/yr	2,111,300	2,111,300	1,005,400	804,300
3.	Liquid steel to be cast	t/yr	2,165,400	2,165,400	1,031,200	825,000
4.	No. of machine	No.	2 x 3-strand	2 x 6-strand	1 x 6-strand	1 x 6-strand
5.	Type of machine	-	Radial with curve mould	Radial with curve mould	Radial with curve mould	Radial with curve mould
6.	Design range	mm x mm x mm	400 x 320 x 100 610 x 320 x 100	150 x 150 sq. - 335 x 300	100 x 100 sq. - 160 x 160 sq.	130 x 130 sq. 160 x 160 sq.
7.	Length	mm	6000/8000/12000	6000/8000/12000	6000 / 12000	6000 / 12000
8.	Type of bending		Multi-point unbending / Continuous straightening	Continuous straightening	Continuous straightening	Continuous straightening
9.	Bending radius	m	12.0	12.0	9.0	9.0
10.	Nominal heat size	t	180	180	180	180
11	Heat delivery cycle	min.	50	50	50	50
12.	Design casting speed	m/min.	0.2 – 2.0	0.6 – 6.0	0.6 – 6.0	0.6 – 6.0
13.	Casting time	min.	50	50	50 - 60	50 - 60
14.	Casting practice	-	Sequence casting	Sequence casting	Sequence casting	Sequence casting
15.	Preparation time	min.	60	30 - 40	25 - 30	25 - 30
16.	No. of heats / day / caster	Nos.	28	26 - 27	24 - 26	24 - 26
17.	Caster availability	d/yr	330	330	330	330
18.	Mould type	-	Curved, plate mould, adjustable width	Curved mould, cartridge type design	Curved mould, cartridge type design	Curved mould, cartridge type design
19.	Ladle holding device	-	Turret with lift/lower & weighing facilities	Turret with lift/lower & weighing facilities	Turret with lift/lower & weighing facilities	Turret with lift/lower & weighing facilities
20.	Tundish holding device	-	Tundish car with lift/lower & weighing facilities	Tundish car with lift/lower & weighing facilities	Tundish car with lift/lower & weighing facilities	Tundish car with lift/lower & weighing facilities
21.	Casting practice	-	Closed	Closed	Closed	Closed
22.	Mould oscillating mechanism	-	Hydraulic/Electro mechanical	Hydraulic/Electro mechanical	Hydraulic/Electro mechanical	Hydraulic/Electro mechanical
23.	Mould level	-	Automatic	Automatic	Automatic	Automatic

Sl. No.	Item	Unit	Parameter	Parameter	Parameter	Parameter
	controller					
24.	Strand cooling	-	Dynamic, air-mist spray	Dynamic, air-mist spray	Dynamic, air-mist spray	Dynamic, air-mist spray
25.	Tundish practice	-	Hot	Hot	Hot	Hot
26.	Product cutting	-	Automatic oxy-propane torch cutting	Automatic oxy-propane torch cutting	Automatic oxy-propane torch cutting	Automatic oxy-propane torch cutting
27.	Product discharge	-	Through run-out rolling table, cross transfer etc.	Through run-out rolling table, cross transfer etc.	Through run-out rolling table, cross transfer etc.	Through run-out rolling table, cross transfer etc.

BOF Gas Cleaning Plant

It is proposed to install 4 Nos. of 180t nominal capacity LD converters along with suppressed combustion gas cleaning plant (GCP) for each of the converter of the BOF shop. The function of BOF GCP is to collect, cool, clean, discharge and either recover or flare the gas, released at converter mouth during steel making. Gas cleaning plant for each converter will have the following systems.

- Gas collection system comprising skirt, hood and cooling stack as its main equipment.
- Gas cooling system comprising circulating water pumps, expansion vessel, fin-fan cooler, as its main equipment alongwith inter connecting piping network.
- Gas cleaning system comprising of saturator, venturi scrubber unit 1 and 2 and water droplet separator for each stage after venturi 1 and 2 (these are self contained in two stage scrubbing tower), recycling tank, re-circulation pump, emergency water supply system and interconnecting piping.
- Gas discharge system (for gas recovery and as well as for gas flaring system) comprising, I.D fan, change-over valve, flare system as its main equipment along with interconnecting ducting and piping network.

Gas recovery system common for gas cleaning plants will have the following systems / equipment.

Dry seal gas holder of adequate capacity (approx. 40,000 m^3/h) to store the BOF gas recovered from each of the converter as and when available, at the same time ensuring availability of sufficient volume of gas for the required delivery to the consumers.

Electrostatic precipitators (ESP) to further clean the gas to meet the maximum permissible dust content of the gas as required by the consumers along with interconnecting ducting and piping network

Booster-fans to increase the discharge pressure of gas to meet the minimum required pressure by the consumer(s)/gas network along with inter connecting ducting and piping network

2.10.8 ROLLING MILLS

Based on the product-mix, two universal beam mills, two medium section mills, two wire rod mills and one Special Bar Quality mill of suitable capacity has been proposed for the project. The continuous cast beam blanks, billets and blooms will be rolled into heavy sections like H-beams and channels in universal beam mill, medium sections like angles, channels, beams in medium section mill, wire rods in wire rod mill and special bars in SBQ mill. The Mills shall produce about 1,000,000 t/yr wire rods, 800,000 t/yr special bars, 2,100,000 t/yr medium sections & 2,100,000 t/yr of heavy sections.

Universal Beam Mill	:	2.1 Mtpa
Medium Section Mill	:	2.1 Mtpa
Wire rod Mill	:	1.0 Mtpa
Special Quality Bar Mill	:	0.8 Mtpa

Wire Rod Mill

A continuous wire rod mill is proposed to be installed to produce 1,000,000 tons per year of rods. The input material will be billets.

The wire rod mill will produce 1,000,000 tons per year of wire rods in coils in the size range of 5.5 mm to 22 mm diameter. The reference size of input billets for the wire rod mill will be 100 mm x 100 mm - 160 mm x 160 mm x 12 m long.

Billet for rolling will be inspected and conditioned before charging to the billet-reheating furnace of wire rod mill. Billet inspection and conditioning facilities will include billet tilting device, scarfing torches, auto billet grinding machine, etc. Billets will be charged to the furnace by billet charging skids and billet charging conveyor. A billet discard skid will be provided for reject billets. Billet reheating furnace will reheat the incoming billets to an exit temperature of 1150°C to 1250°C. Furnace discharge mechanism will discharge the billets from furnace for rolling though the mill.

A toggle shear will be provided on the entry side of roughing stand No.1 for emergency cutting of cobbles, etc. The billets will be rolled through a continuous roughing mill train comprising of seven 2-Hi stands followed by an intermediate mill train comprising of eight 2-Hi stands. A crop and cobble shear will be installed after each rolling train for crop and cobble cutting.

Following the intermediate train, a No-twist finishing block with ten rolling stands will be provided to finish roll the rods to the required sizes.

The finished wire rods will pass through a water-cooling section and will thereafter enter a laying head which will form coil loops of the wire rod.

The wire rod loops will be air cooled in a Stelmor conveyor. A coil reform tub will further form the wire rod coils and the finished coils will be delivered at unloading stations through a hook conveyor comprising of compacting, strapping and weighing facilities.

For regrinding of mill rolls, other rolls and shear knives and for disassembly, cleaning, inspection and assembly of bearings and chocks, a roll and bearing shop is envisaged in the wire rod mill. This shop will also serve the requirements of the rebar mill.

Auxiliary facilities like direct & indirect water closed circuits with treatment facilities and cooling towers are envisaged. Compassed air, hydraulic and lubrication facilities serve various mill equipment in their operation. Wire Rods are stored in closed area stacks and in open areas as per importance of finished product qualities. A maximum of 7 days storage is only planned.

Finished products are dispatched through rail and road ways. Lot of care is being planned for preventing handling damages like floors, Teflon liners to prevent metal contacts, nylon lashings etc.

The basic data of the mill are as follows :

Annual capacity	:	1,000,000 t/yr
Grade to be produced	:	Carbon steels and low alloy steels
Input material:	:	
Type	:	Concast billet
Size	:	100 mm x 100 mm – 160 mm x 160 mm, square, length upto 12 m

Finished product	:	
Rounds Re-bars	:	5.5 mm to 22 mm dia in coil form
Bars	:	5.5 mm to 22 mm dia in straight lengths upto 18 m (Equivalent flats, squares, hexagons and octagons are also in product range).
Mill delivery speed (max)	:	Wire rod outlet : 30 m/sec Straight length : 10 m/sec

Special Quality Bar Mill

A Special Quality Bar (SQB) mill is proposed to be installed to produce 800,000 tons per year of special bars. The input material will be billets. This 0.8 Mtpa mill will mainly produce a wide variety of higher-quality carbon and alloy bars that are used in the forging, machining and cold-drawing industries for the production of automotive parts, hand tools, electric motor shafts and valves. SBQ generally contains more alloys than merchant quality and commodity grades of steel bars, and is produced with more precise dimensions and chemistry.

Input		
- Reference billet size	:	130 mm x 130 mm
	:	160 mm x 160 mm
- Billet length	:	About 12 m
- Billet weight	:	About 1500 kg
Output		
Special Quality Bars		Ø 80 - Ø 250

To maintain higher productivity even in cases of smaller rounds slit technology combined with high speed bar delivery to cooling bed is used. For bigger sections brake slider are used for transferring cut length bars on to walking type rake cooling beds.160 t/hr walking beam type with mixed gas firing is planned for heating billets to rolling temperatures upto 1160 ^{0}C. Hot charge is also placed to save heat energy by good production planning between steel making and rolling. Billets are transported through roller tables from casters to mill re-heating furnaces.

The mill working level is planned at elevated I floor level (+5.0 mt). Hot billets from furnace pass through high pressure water descaler on roller tables for entering into roughing group of stands. 6 stand roughing and 6 stand intermediate group and 6 pre-finishing stands are planed with shears in between for rolling billet into final product as pass design. Arrangement is single strand rolling normally with Horizontal Vertical stand arrangement. For certain products where required with help of convertible stands a vertical housing is used as a horizontal housing as per pass rolling schedule. Shears do crop cuttings and chopping of stock in case of problems.

For smaller sizes upto φ22 mm bar is slit in a power slitter and further reduction as done in two separate lines in 6 stand no tourist block mill. Bigger sizes which are finished rolled by pre-finishing group pass through a central line of channels, water boxes, roller tables and dividing shears be fore shifting onto sake type cooling beds. Smaller sizes rolled after slitting also pass through water boxes, roller tables and dividing shears before directed to rotating channels where these are slowed down by pinch roll drives. Slowed down bars are guided onto same cooling bed for cooling. Due to controlled use of water in water boxes the product outer is formed martensite layer with central perlite structure. This method helps in achieving good properties from ordinary steel saving in alloy additions in steel making.

Bars from cooling bed while cooling are transferred to cold shear for cutting to market order lengths. Cut pieces are transferred to two bundling areas for sorting, segregating short pieces, counting and bundling as per order plan. Tiring machines provide ties with labeling details to bundles for further handling. EOT cranes collect ready bundles to assigned stacks or to dispatch vehicles. During in-process samples are checked for weight per meter, notch profile on bars, mechanical properties etc.

Medium Section Mill

This 2.1 Mtpa mill will produce medium sections like angles, channels and beams required in structural works.

Input			
1.	Bloom	150 x 150 sq. - 335 x 300 x 6000/8000/12000	2,111,300
Output			
1.	Medium Sections		2,100,000
(a)	Beams	120 – 500 100 – 300 100 – 220	
(b)	Angles	100 x 100 – 250 x 250 120 x 180 – 200 x 100	
(c)	Channels	140 – 400	

Different input materials are used as per end product size and its pass design.

160 t/h walking beam further with mixed gas firing is planned for heating of input materials upto 1250^{o}C. Input material travel through roller tables from bloom caster to reheat furnace.

Heated bloom pass through high pressure descaler to breakdown stand. This is a 2 high heavy duty torque stand. Stock is rolled in revering made for 5 to 7 passes to get rough finishing shape. Gap adjustment is done by AGC system as per pass schedule programmed in automation.
Material form breakdown mill after cropping at hot shear is fed to universal reversible tandem mill. On each end universal stands with edger stand sandwiched between are 3 stands to roll the semi shaped product to final product. Rolling is done in to & from reversible form as per pass schedule each time closing the roll gap as per predicted plan. Final 3 passes are done from universal rougher, edger through universal finisher. Rolling is done with XH form in each pass schedule.

Rolling is done as per production planning requirement. Roll changes, pass changes and stand changes and carbide changes are done as per pass life of grooves. Used rolls and carbide rings are redressed for fresh use in roll turning shop. Direct & indirect water is used in the mill with treatment facilities, cooling towers and pump houses just outside mill. Hydraulic & lubrication facilities are planned for various equipment movements and bearing lubrications.

Finished products are stored partly in covered area and partly in open area. Dispatches are planned by both rail and road.

Universal Beam Mill

This 2.1 Mtpa mill will produce Heavy Sections like channels and beams required in structural works.

Input			
1.	Blank	400 x 320 x 100 610 x 320 x 100 x 6000/8000/12000	2,111,300
Output			
1. (a) (b)	Heavy Sections Beams Channels	 350-750 200-1000 200-400	2,100,000

The Universal Beam Mill will be a modern mill with the state of the art facilities for production of beams and channels. The input material for the mill will be continuous cast beam blanks. The mill shall be designed to achieve higher yields, superior surface finish, close tolerances. The Beam Blanks coming from the storage yard are charged onto the cold charging table by means of crane for cold charge or directly from the CCM run-out roller table and charged directly to the Furnace in case of hot charge. The starting material are loaded into re-heating furnace, heated up to the required rolling temperature, discharged one at a time and transferred to the rolling mill. Before entering the roughing mill, the staring materials are descaled by means of a high pressure (250 bar max.) water descaler. Products are continuously rolled in (15) fifteen stands in H, V and U configuration. The rolling mill is completely arranged over SHS Housingless cartridge stands, five in the rougher and ten in the intermediate/finishing mill. The roughing mill is composed of (5) five stands arranged in H-V-H-H-V, where the vertical stands have the function of edging and shaping the rolled stock sides so that several beams sizes can be rolled with the same roughing roll set. A roller table is installed between the roughing stands and intermediate/finishing stands foreseen to free the bar for high speed roughing. At intermediate/finishing mill entry side a Crop shear for head cropping and emergency is provided. The roll pass sequence is based on a symmetrical shape throughout the mill and provides stable rolling conditions. The first intermediate/finishing stand is 2-high horizontal and has the function of controlling the elongation ratio between rolled-stock web and flange, thus setting the final beam-flange height. In the Intermediate/finishing stands the Horizontal stands have a function to control the web and flange, with very strict tolerances on the dimensional shape of the finished beam. A roller table with lifting aprons conveys brakes and discharges the multiple bar lengths onto the mechanically driven cooling bed. This is also fitted with lining-up grooved rolls and a hot saw for head cropping and sampling. To achieve the target temperature for straightening, the necessary time of cooling is adjusted from the automatic system rolling schedule table.

On the exit side of the cooling bed an exit carrying transfer is provided for smooth take off of the sections from the cooling bed. After the cooling bed, the bars are automatically fed into the straightening machine for simultaneous in-line of one or two profiles. The straightening machine performs the "Full Length in Line" straightening of the multiple length bars. After straightening, the bars are grouped in regular layers and transferred to the cold cutting-to-length area. The provided cold saw with the associated overhead beam type gauges provides max. flexibility in cutting patterns as well as highest productivities. Here the bar layers are cut at the same time, which also performs head and tail cutting. The saws are equipped with automatic clamping devices ensuring a vibration free saw cutting procedure. Special care has been taken to avoid any defect on the finishing sections. Saws are equipped with a special fast changing mandrels for quick changing times. This is important, since usually the saw blades must be changed during the operation of the mill. To avoid remaining water in the top chamber of the beams/sections an air spray system is provided after the cutting procedure. After the cutting, bar layers are automatically conveyed to the two independent inspection beds, where the bars are tilted and inspected and after checking transferred to the to a magnetic stackers. The stacking stations consist of one + one independent stacking systems of 24m. Layer of bars are automatically separated in the chain transfer stacker according to the required number of pieces and conveyed to the magnetic heads where they are automatically stacked. After piling the stacks will be transferred trough the discharging area, which consists of two Sund Tying Machine designed for compact and strong bindings. Prior to the last strapping procedure the packs are weighed and the weight is printed on a label that is tagged to the strap and than finally collected and stored in a collecting bed. The finished products are then loaded into the trailers / railway wagon by EOT cranes and dispatched from the Yard.

2.10.9 LIME AND DOLOMITE PLANT

The lime and dolomite plant will comprise of 6 nos. vertical lime shaft kiln and 2 no. vertical dolomite shaft kiln of capacity 300 tpd each to meet the requirement of soft lime and calcined dolomite for steelmaking process.

The lime and dolomite plant will have the following production capacity as given below.

Sl. No.	Item	Quantity (t/yr)
1.	Size lime for SMS	353,000
2.	Calcined dolomite for SMS	124,000

Technological parameters

Lime and dolomite calcination unit

i) Nos. of lime kiln -6
ii) Capacity of lime kiln -300 tpd each
iii) No. of dolomite kiln -2
iv) Capacity of dolomite kiln -300 tpd each
v) Kiln feed size, mm -25-55
vi) Calcination temp., °C -950-1150
vii) Specific consumption of fuel -920 (kcal/kg of burnt lime and dolomite)

viii) Working schedule of the plant -330 days/yr (3shifts/day)

Operating condition

Lime stone / raw dolomite of size 25-55mm will be charged into shaft kiln for calcination. The undersize limestone/ dolomite of size 0-25mm shall be separated out by the screen before feeding to the kiln. Limestone and dolomite will be subjected for calcination at a temperature 950-1150°C to achieve soft burnt reactive lime / dolomite for steelmaking. Mixed gas will be used as fuel.

Limestone and dolomite of size 25-55mm will be received from mines and stored in raw material storage yard. From there these materials will be conveyed to raw material storage bunker. The limestone and raw dolomite from storage bunkers will be fed to the screen by belt conveyor and undersize lime stone and dolomite of size 0-25mm will be screened out and stored in another bunker which is meant to store the undersize material.

There will be 1 no. storage bunker for each kiln and 1 no. undersize bunker for each kiln. The undersize limestone and raw dolomite will be stored for onward disposal to other consuming units. Screened materials of size 25-55mm will be fed to shaft kilns by means of skip hoist through a weigh hopper. Limestone and raw dolomite will be calcined at temperature of 950-1150°C.

The lime and calcined dolomite from the kilns will be discharged to two different conveyors which are placed below the kilns. The lime and calcined dolomite will then be fed to single deck screen to separate out undersize (0-25mm) material. The undersize (025mm) lime and dolomite material will be stored in two separate bunkers. The sized lime and calcined dolomite of 25-55mm will be stored in nine nos. of bunkers (six nos. of bunkers for lime and three nos. of bunkers for calcined dolomite). Lime and calcined dolomite of size 25-55mm will be conveyed to SMS through belt conveyor and undersize lime (0-25 mm) will be transported through trucks/cement tanker to other consuming units.

The waste gas which is coming out from the kiln is having 5-10 gm/Nm^3 dust. This gas will be cleaned in waste gas cleaning system to vent out the clean gas to atmosphere. The dust load at clean gas will be as per norms of country.

The dedusting system will be provided for raw material storage building, screen house building and lime delivery bin building to keep dust free atmosphere in the lime kiln area.
1 no. passenger-cum-freight lift has been provided for ease of movement to different floors.

2.10.10 OXYGEN PLANT

Oxygen will be required for oxygen enrichment in the blast furnace, injection in the DR plant, blowing in the BOF, heating of BOF lining, secondary refining in RH–TOP, cutting of blanks, beams and billets in continuous casting plant, and for general purpose use in various units of the steel plant . The average demand of the oxygen is estimated to be about 2.12 MNm^3/d. Nitrogen will be mainly required as carrier gas in de-sulphurisation unit, DR plant, slag splashing in BOF, stirring in BOF, cold dust injection system, bell less top equipment for blast furnace, purging in GCP of BOF and also for occasional purging of fuel gas pipelines and equipment. Argon will be required for shrouding in the tundish and mould in the continuous casting plant, stirring in BOF and ladle. Argon will also be required for laboratory purpose.

In order to meet the above requirement of oxygen, nitrogen and argon, 2 (two) air separation unit of 1800 t/d capacity each will be installed based on BOO concept. Argon requirement will be met from argon produced from the oxygen plant as envisaged for the proposed project.

Requirement of Various Gases

Sl. No.	Product	Purity,%
1.	Gaseous oxygen	99.6
2.	Gaseous nitrogen	99.995
3.	Argon	99.995

Oxygen, nitrogen and argon will be produced by air separation process based on low pressure cryogenic cycle and double column rectification system. The unit will be able to produce gaseous as well as liquid products.

Gaseous products from the oxygen plant will be distributed through pipeline network system consisting of pressure regulating and metering station to various consumers.

2.10.11 POWER & BLOWING STATION

1. Power and blowing station

   - 3 nos of BF/CO/converter gas fired boilers.
   - 4 nos of Steam turbine driven turbo blowers

2. 2 units of Top pressure recovery turbine
3. 1 unit of Coke Dry Quenching Plant (CDQP)

Power and blowing station

Based on the above, following facilities have been envisaged for power and blowing station.

- Mixed gas fired boilers and auxiliaries – 3 x 300 t/h
- Steam turbine driven turbo blowers - 5 x 100% (4W+ 1SB)

• Deaerator - 2 Nos.
• Boiler feed pumps - 3 Nos.(2W +1SB)

Requirement of input materials and services

Requirement of input materials and services for the power and blowing station are given below.

Requirement of input materials and services

Sl. No.	Input Materials /Services	Unit	Quantity
1.	Mixed gas 1. BF gas 2. CO gas 3. BOF gas	Kcal/h	531.43 x106
2.	DM water as make up for BF gas fired boilers including process steam	m3/h	215
2.	Cooling water for main steam condensers of turbine	m3/h	34,100
4.	LDO (during start up and flame stablisation)	t/h	2.2 t/h

Steam balance

The steam balance of the turbo blower station is given below.

_A. Steam Generation		
SL. No.	**Description**	**HP steam, t/h**
1.	Evaporated cooling for Converter	60
2.	Evaporated cooling for steel-rolling reheating furnace	130
3.	3 nos. mixed gas fired boilers (P & BS)	730
4.	CDQP	210
	TOTAL Steam Generation (max)	**1130 (max)**
B. Steam Consumption		
1.	Steam turbine driven turbo blower	900 (max)
2.	Process steam for steel plant	200
3	Auxiliary steam	30 (max)
	TOTAL Steam Consumption	**1130 t/h**

Top pressure recovery turbine

Top pressure recovery turbine (TRT) recovers pressure energy from outlet gases of blast furnace which was otherwise lost by the gas cleaning plant and converts it into electricity. Blast furnace gas after wet type gas cleaning plant and upstream of BF outlet gas main stop valve is fed through inlet main stop valve (Goggle valve), quick shut off valve and governor valve to a turbo expander to work to drive a generator for generating electricity for feeding to power net. The expanded gas is discharged into main BF gas distribution piping network downstream of main stop valve through outlet main stop valve (Goggle valve). A bypass control valve has been provided to the main stop valve in the BF gas outlet line. Changing the working angle of stator blades of TRT in order to match the changed operating conditions of the blast furnace, the TRT train could also control the top pressure of blast furnace.

The TRT unit along with its auxiliary units will be housed in a covered TRT house. Each TRT is expected to produce about 13-14 MW.

Coke Dry Quenching Plant (CDQP)

JSW Steel will set up a Coke Dry Quenching (CDQ) units for 3.062 Mtpar coke oven plant. CDQ is employed to cool off the red hot coke and to utilize the sensible heat of hot gases to generate High Pressure steam which is utilized in steam Turbine-Generator (TG) sets to generate power of about 55 MW. The power produced is proposed to be utilized for consumption of the CDQ system and for other units of the steel plant through its internal distribution systems.

Captive power plant:

In addition to the above it is proposed to install two 300MW captive power plants identical to the existing one with the following configurations;

1. One 300 MW coal based power plant
2. One 300 MW coal and surplus fuel gas fired power plant.

2.11 RAW MATERIALS AND CHEMICALS

The bulk consumption of raw materials are iron ore, coking coal and limestone. Of the chemicals, as such steel making process does not require any chemicals other than solar oil, caustic soda, lime, soda ash which are used in coke oven gas cleaning and water treatment. Some of chemicals are required in cold rolling are hydrochloric acid, alkali, inhibitor, degreasing chemicals, rust prevention oils, roll coolant oils, paints etc. The chemicals required for water treatment include sulphuric acid, salt, caustic soda and proprietary chemicals for corrosion and scale prevention.

The average annually consumption of major raw materials for the proposed 6.0 Mtpa expansion is indicated in the **Table 2-3**. The figures are estimated ones and will vary to some extent depending on the characteristics of the raw materials and chemistry of steel desired.

The total incoming solid raw materials for steel making works out to 3.2 tons per ton of crude steel. The relative share of iron ore is nearly about 51%, coal about 35% and balance 14 % accounts for other raw materials like limestone, quartzite etc.

Table 2-3 : Annual Raw Material Requirement (net & dry)

Sl. No.	Raw material	Source	Quantity (Mtpa)	Mode of transport
1.	Iron ore fines	Bellary / Hospet area	13,375,000	Rail
2.	Coking coal	Imported / Blended	4,195,000	Rail
3.	Non-coking coal for BF	Imported / Blended	700,000	Rail
4.	Limestone fines for pellet plant	Bagalkot / Dronachalam region	84,000	Rail
5.	Limestone fines for sinter plant	Bagalkot / Dronachalam region	530,000	Rail
6.	Dolomite fines for sinter plant	Bagalkot / Dronachalam region	543,000	Rail
7.	Quartzite for BF	Belgaum region	78,000	Road
8.	Limestone for SMS	Imported / Bagalkot / Dronachalam region	1,029,000	Road
9.	Dolomite for SMS	Imported / Bagalkot / Dronachalam region	415,000	Road
10.	Bentonite for pellet plant	Belgaum region	30,000	Road
11.	Ferro-alloy for SMS	Local region	93,000	Road
12.	Iron ore for SMS	Bellary / Hospet area	124,000	Road
13.	Thermal Coal for Power plant (300 MW)	Indigenous coal linkages	1,750,000	Rail

2.12 LAND REQUIREMENT

The area requirement for the proposed plant has been minimized since the infrastructure and auxiliary facilities are already existing. The company has already a total of 7761 acres of land in its possession for its existing integrated steel plant complex. The layout of its existing plant was prepared keeping in mind the area requirement for infrastructure, material handling facilities, different shops / units as required and also area for steel plant ancillaries and for future expansion within the acquired land. The proposed additional capacity of 6.0 Mtpa is proposed to be setup in an area of 700 acres land area, within the acquired land area. There is no additional land area required for the expansion of the steel plant..

2.13 POWER REQUIREMENT

The estimated power requirement for the steel Plant of 6.0 Mtpa will be about 415 MW. This will be met from the following power generating units;

1. Coal based CPP of 300 MW each based on coal and gas
2. CDQ of 55 MW
3. TRT of 24 MW

The power required for the plant shall be received at 220 kV main receiving sub-station (MRS). Power from 220 kV level at MRS shall be stepped down to 33 kV level, which will serve as primary distribution level in the plant. 33 kV will be further stepped down to 6.6 kV level at various load centers to meet the medium voltage requirement of the plant. LT power requirement shall be met at 415 V level by stepping down the power from 6.6 kV to 415 V as per requirement at respective load centers. Number of 33/6.9 kV sub-station has also been envisaged at different load centers, which will be fed from main out door 220/33 kV switchyard through underground cables.

Power consumption & requirement from 7.0 MTPA to 16.0 MTPA is given in **Table 2-4**.

2.14 WATER SOURCE AND REQUIREMENT

Cooling water is required for steelmaking and casting which are heat intensive processes. Closed-circuit soft water re-circulation systems with water-to-water plate heat exchangers have been planned for indirect cooling circuits to affect extensive recycling of return water from critical cooling processes. Open-circuit industrial water re-circulation systems with evaporative cooling towers have been planned for the secondary side of plate heat exchangers as well as for direct cooling circuits.

Process water losses will be compensated by adding make-up water of respective qualities.

Source of water

The total additional requirement of fresh water for the plant for expansion by another 6.0 Mtpa will be about 23 million gallons per day (MGD) and 6.6 MGD for the captive 600 MW power plant.

The source of water for the proposed plant will be from the existing network of the operating plant and from the Almatti Dam Reservoir which is about 160 kms from plant site. Raw water, received at the plant water reservoir, will be clarified in the raw water treatment plant for use as make-up water. The clarified water will also be filtered and chlorinated for use as a drinking water.

The treated raw water will be collected in a partly on-ground reservoir in the plant. The reservoir will have two compartments and will be pumped to different units and for individual plant units re-circulating water systems will be provided.

The different categories of water to be used in the re-circulating system are:

a) Demineralised (DM) water for closed re-circulating cooling systems.
b) Soft water for closed re-circulating cooling systems.
c) Indirect cooling water (ICW) for secondary cooling of the water-to-water heat exchangers of the closed cooling circuits.
d) Direct cooling water (DCW) for gas cleaning circuits, slag granulation, open

machinery cooling and scale flushing.

e) Make-up water & service water for captive power plant.

For conserving water, independent re-circulating systems have been proposed along with cooling towers, pump houses and treatment units.

The total make-up water requirement is estimated to be 4328 m^3/hr including drinking water and excluding water for the captive power plant.

Make-up water for different process units will be made available from main plant make-up water ring main and will be conveyed to respective cold wells of various re-circulating systems and storage reservoirs. Suitable isolating and control valves will be provided in the make-up water pipelines conveying water to cold wells and storage units.

Waste water generated from different areas of plant will be treated to the desired extent and recycled in the re-circulating system as far as possible, facilitating adequate reuse of water. Backwash water generated from different pressure filters will be treated in a treatment plant having sludge disposal facilities. The treated water will be reused in the direct cooling circuit.

The main water recirculation systems envisaged are given below.

SN.	Re-circulation circuit	Process covered
1.	Closed soft water (primary circuit)	• Coke Oven • BF stave coolers, tuyers and stoves • Lance cooling • Converter top cooling • LF cooling • Top lance cooling • Vessel pre-heater cooling • Vessel cooling • Mould cooling for conventional billet, bloom and blank casters • Machine cooling for conventional billet, bloom and blank casters • Lintel cooling of pellet plant • For removing scales in mills
2.	Open industrial water (clean water cycle)	- Secondary side cooling of plate heat exchangers. - Compressed air station - RH degasser cooling - LF transformer - BF cooling - Indirect cooling of bar and rod mill - Sinter Plant cooling - Pellet plant cooling - Power plant cooling - Uncontaminated circuit of by-product plant

SN.	Re-circulation circuit	Process covered
		- DR plant - Indirect cooling of re-heating plant
3.	Open industrial water (contaminated water cycle)	- Spray and machine cooling (direct cooling) in conventional billet, bloom and blank caster. - Effluent treatment plant of BF gas cleaning plant and BOF gas cleaning plant. - Contaminated circuit of by-product plant. - Direct cooling of Bar and Rod mill.
4.	Emergency water circuit (Through overhead tanks)	- Blast Furnace - LF, RH-OB, mould, machine and spray cooling of conventional billet, bloom and blank caster. - Reheating furnace cooling - DR plant - Coke Oven.

Estimated requirement of water for various plant units and processes is indicated below.

Sl. No	Consumer units	Circulating water m3/hr		Make-up water m3/hr	
		DM /Soft water	Industrial water	DM/Soft water	Industrial water
1.	RMHS	---	720		90
2.	Beneficiation Plant				714
3.	Sinter Plant	500	1500		60
4.	Pellet plant	600	1500	15	100
5.	Coke ovens plant	5000	18000	25	300
6.	Blast furnaces & PCM	7500	14500	50	455
7.	DR Plant				225
8.	Steel Melting Shop	3940	11500	20	360
9.	Continuous Casting Shop	2900	5000	30	130
10.	Beam Mill	---	4000		100
11.	Medium Section Mill	---	4000		100
12.	Wire Rod Mill	---	4200		176
12.	Bar Mill	---	4464		180
13.	Compressed air station		800		25
14.	Oxygen plant	250	4000		100
15.	Lime and dolo plant	150	720	10	140
16.	Laboratory	--			12
17.	ACVS	--	0		80
18.	Fire Fighting				125
19.	Miscellaneous				200
20.	CPP				1250
21.	Drinking Purpose				300
	Total			**150**	**3972**
22.	Treatment Losses etc.				**206**
	Total Raw Water Required				**5578**

The total requirement of raw water from water source is 5578 m^3/h including drinking needs which is estimated as 300 m^3/hrespectively. This will be further rationalized during detailed engineering.

Through cascaded reuse of blow-down, the water scheme ensures practically zero-discharge from the industrial water circuit. However, in such huge operation of integrated steel plant some water will be discharged, which will meet the statutory norm.

Water conservation schemes

In order to conserve water to the maximum possible extent, closed re-circulating cooling system have been adopted using re-circulating soft water as the primary cooling media and air or industrial water as secondary cooling media in heat exchangers. For some users, the industrial water will be used directly/ indirectly as primary cooling media. The hot re-circulating industrial water will be cooled in cooling towers.

To minimise water loss, blow down from the cooling tower of clean circuit will be fed as make-up to cooling circuit of dirty cycle. Contaminated dirty circuit will comprise necessary pressure filtration system.

Backwash water from the pressure filters will be treated in a sludge thickener and the concentrated sludge will be pumped to the sludge drying bed.

Rain water harvesting schemes will be included in the proposed project as part of water conservation measures.

Water pollution control system

In order to combat the industrial pollution and to comply with the guidelines (CPCB / KSPCB norms), treatment units to control water pollution have been considered for the direct cooling water (DCW) circuit, re-circulating industrial water and waste water discharge from DM plant. Major pollutant in DCW circuit are scales in suspension, oil, grease & temperature.

Cooling tower has been considered for removing heat from both industrial water & DCW in circulation. For treatment of contaminated DCW, scale pit, oil skimmer, pressure filters, thickener and sludge drying beds have been considered. Filtrate from sludge drying bed will be reused in the system. Dry sludge will be disposed off in a suitable manner. Waste water from DM plant will be treated in neutralisation pits and treated water will be used for afforestation with in the plant area.

Detailed unit wise water consumption & requirement is given in **Table 2-5.**

2.15 FUEL REQUIREMENT

BF gas

Blast furnace (BF) gas will be used mainly as fuel for stoves after augmenting its CV with CO gas. In addition to the above consumers, BF gas will also be used in CDI, cast house runner drying, LRS. Semi-clean BF gas will be used for pressure equalization of BF top. BF gas will be distributed to the consumers through pipeline system operating at a pressure of 800 mm WC. The network pressure will be maintained by flaring excess BF gas, if any, through BF gas flare system. Surplus BF gas can be used as fuel in power plant.

Coke oven gas

Coke oven gas will be used mainly as fuel in coke oven batteries, converter shop, blast furnace, sinter plant, etc. in association with other gas. CO gas will be distributed to the consumers through pipeline system operating at a pressure of 400 mmWC. Surplus CO gas can be used as fuel in power plant.

Mixed gas

Mixed gas will be used mainly as fuel for stove heating, sinter plant, CCM and reheating furnaces. For stove heating, BF gas, CO gas will be mixed in proper ratio to get required CV of 2000 kCal/ Nm^3. For other needs BF gas and CO gas will be mixed in proper ratio to get required CV of 2000 kCal/Nm^3. From mixing station mixed gas will be distributed to the consumers through pipeline system operating at a pressure of 600 mm WC.

BOF gas

BOF gas will be used as fuel in lime plant. Surplus BOF gas will be used as fuel in power and blowing station along with available surplus BF gas and CO gas.

The estimated generations of blast furnace gas, coke oven gas and BOF gas are 934.13, 658.94 and 130.51 Gcal /hr respectively. Blast furnace gas will be supplied to stoves for heating and other minor consumers. Mixed gas (mixture of blast furnace gas and coke oven gas) will be supplied to battery for under firing, pellet plant and sinter plant for ignition furnace firing, coke oven gas will be supplied to BOF shop and continuous casting shop for ladle heating and drying, lime and dolomite plant and rolling mills.

2.16 ENERGY

The total energy requirement of near about 6.0 Gcal/ton of liquid steel for the proposed production plan, nearly 90 per cent energy will be derived from the purchased coking coal, PCI coal. The balance 10% per cent energy shortfall will be met from the in-house generated electrical energy. The 6.0 Mtpa additional facilities at the 16 Mtpa stage do envisage use of steam coal for the captive power generation, as the surplus by-product fuel gases will be used partly as fuel for power generation in the captive power plants. The use of by-product fuel gases in the power plant eliminates much of the air pollution problem and ash disposal. The fuel balance for the proposed 6.0 Mtpa expansion is given in **Table 2- 6**.

The lay out individual units has been planned in such a way that the energy recovery facilities can be installed at a later date as and when the technologies become cost effective or alternate sources of funding/subsidy is available from national/international agencies. These include waste heat recovery systems from waste gases of sinter, stoves, furnaces, coke quenching etc and installation of energy efficient equipment.

2.17 UTILITIES

The other utilities and services required for operation of the proposed production facilities would be by-product fuel gas recovery and pipeline transport within the plant, compressed air, instrument grade air, oxygen, nitrogen and argon and chilled water for air conditioning and refrigeration purposes.

2.18 MANPOWER

The requirement of manpower for the proposed new facilities has been estimated to be 5000. The estimate covers the top management; middle and junior level executives and other supporting staff. It is proposed to out source non-core area of operations to the out sourced agencies as practiced in the existing plant.

2.19 CAPITAL COST

Cost of expansion plant is estimated at Rs 16,000 crores.

2.20 DESCRIPTION OF MITIGATION MEASURES INCORPORATED INTO THE PROJECT TO MEET ENVIRONMENTAL STANDARDS AND ENVIRONMENTAL OPERATING CONDITIONS OR OTHER EIA REQUIREMENTS

The following mitigation measures have been envisaged for the proposed plant which will meet the relevant environmental standards.

Air Pollution Control Measures:

- Bag filter based DE system in BF with gas cleaning plant.
- Bag filter based DE system for ground based pushing emission control in Coke Oven battery
- Dry fog type DS system for material handling junction points
- Fume Extraction system for BOF & LF along with gas cleaning plant.
- Dust extraction system in Sinter Plant.
- Dedusting System in lime & dolo plant.

Water Pollution Control Measures:

- Re-circulating water in the process whereby discharged volume is minimum.
- Clarifier and sludge pond for removal of suspended solids.
- Neutralisation of acidic water by lime.
- Removal of oil and grease from the contaminated water by means if oil traps , skimming devices, etc.

Waste handling & Noise Control Measures:

- Solid waste generated will be reused/sold and rest will be disposed off as per statutory guidelines
- Noise level with in the shop will be less than 85 dB (A) at 1 m distance from the source

All the emissions / effluent quality parameters will be kept with in the stipulated norms. These are being taken as guaranteed parameters with suppliers for ensuring compliance.

2.21 IDENTIFICATION AND IMPLEMENTATION OF CARBON CREDIT PROJECT

The following projects have been identified for availing carbon credit in the proposed plant:

(i) Coal dust injection in Blast Furnace
(ii) Top Gas Recovery Turbine in Blast Furnace
(iii) CDQ in Coke Oven

Project Design Document (PDD) and Project Concept Note (PCN) will be prepared after detail engineering.

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

All other technology/ technologies envisaged for the project are established & working elsewhere in / World.
The new technology being introduced in India for the first time is the 1.2 mtpa DRI plant based as Corex gas. Conventional DRI making with coal & natural gas is an established technologies. However a smaller capacity DRI plant with corex gas is under operation in South Africa.

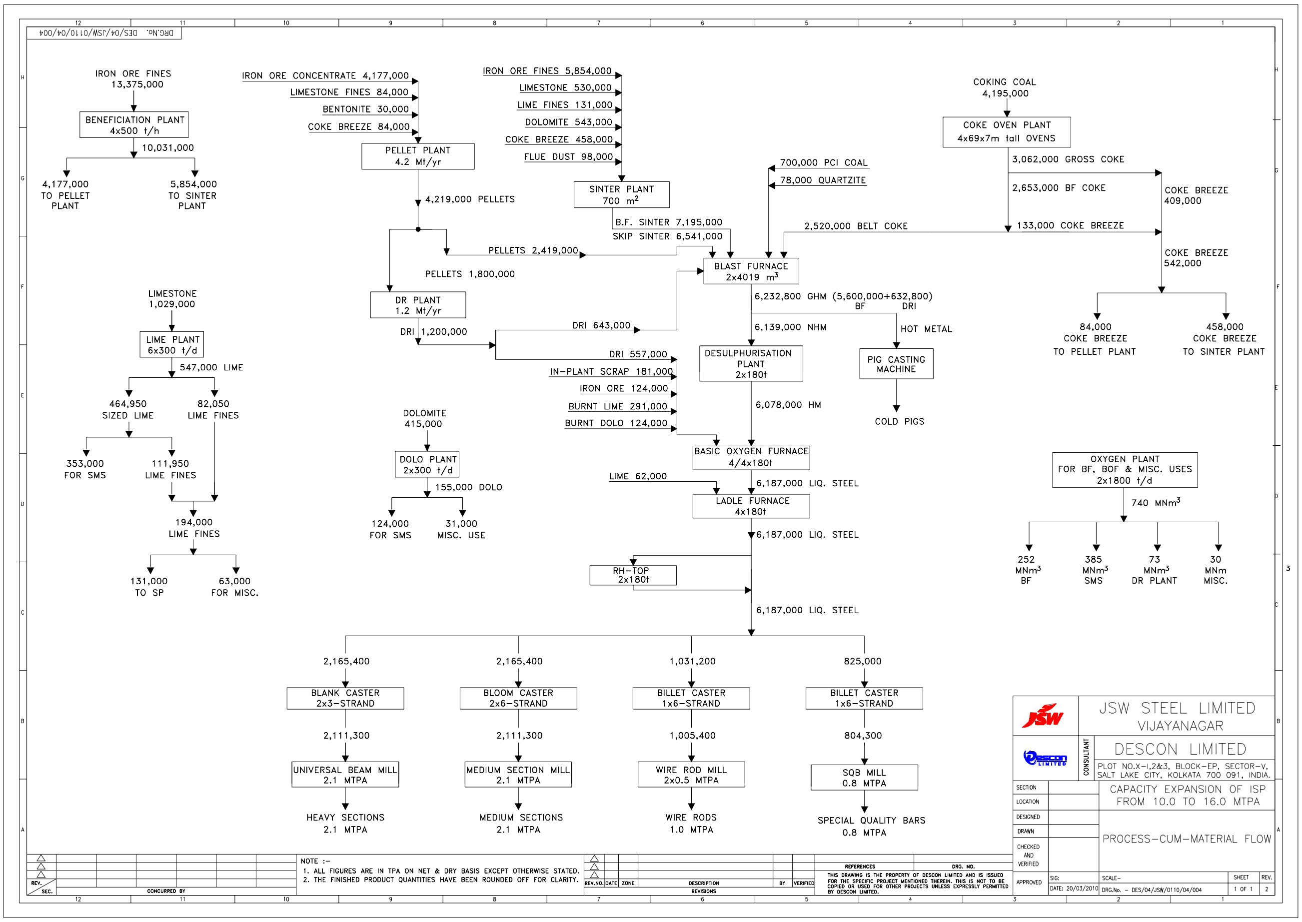


Fig. 2-1 : MATERIAL FLOW CHART

Table 2-4 : ELECTRICAL POWER CONSUMPTION AT DIFFERENT STAGES OF STEEL PLANT EXPANSION - MW

Sl. No.	Units	Specific Consumption (units/t)	Power requirement at 7mtpa		Power requirement at 10mtpa		Power requirement at 16 mtpa	
			Production (t/day)	MW	Production (t/day)	MW	Production (t/day)	MW
1	Ore Benificiation Plant-1	18	12000	9	12000	9	12000	9
	Ore Benificiation Plant-2	25			40000	42	40000	42
	Ore Benificiation Plant-3	25					28000	29.2
2	Sinter Plant1&2	40	16000	525	16000	525	16000	525
	Sinter Plant3	35			14000	20.4	14000	20.4
	Sinter Plant 4	35					20000	29.2
3	Pellet Plant 1	65	12000	32.5	12000	32.5	12000	32.5
	Pellet Plant 2	60			12000	32.5	12000	32
	Pellet Plant 3	60					11500	31
4	Coke-1&2	12	2400	1.5	2400	1.5	2400	1.5
	Coke-3&4	50	4200	8.5	8400	17.5	2400	17.5
	Coke-5&6	50					8383	15
5	Corex1&2	82	5000	17.2	5000	17.2	5000	17.2
	Blast Furnace 1,2&3	56+	6000	14	6000	14	14000	14
	Blast Furnace 4	55+90	8000	48.3	16000	96.6	8000	96
	Blast Furnace 5&6	50+90					17880	103
6	SMS-1	62	12000	31	12000	31	12000	31
	SMS-2	62	8000	20.1	16000	40.2	16000	40
	SMS-3	60					16000	40
7	HSM-1	110	9000	42	9000	42	9000	42
	HSM-2	110			14000	65	14000	65
	WRM & BRM	120	4500	22.5	4500	22.5	4500	22.5
	Long Products	180					16500	123
8	CRM 1	150	2600	16.5	2600	16.5	2600	16.5
	CRM 2	180			5200	33	5200	33
9	Captive Power Plant 1&2		230		230		230	
	Captive Power Plant 3		300		600		600	
	Captive Power Plant 4						600	
10	Others			15		60		70

Sl. No.	Units	Specific Consumption (units/t)	Power requirement at 7mtpa		Power requirement at 10mtpa		Power requirement at 16 mtpa	
			Production (t/day)	MW	Production (t/day)	MW	Production (t/day)	MW
11	Oxygen Plant, JPOCL 1&2			76		76		76
	Oxygen Plant, BOC 1			17		17		17
	Oxygen Plant, BOC 2			36		36		36
	Oxygen Plant, New Plant							72
	Auxillary			2		55		65
12	DRI							25
			TOTAL	**957.1**		**1302**		**1717**

Table 2-5 : WATER CONSUMPTION AT DIFFERENT STAGES OF STEEL PLANT EXPANSION - (m3/day)

Sl. No.	Units	Specific Consumption	Water requirement at 7mtpa		Water requirement at 10mtpa		Water requirement at 16 mtpa		Total as 16 mtpa
			Production (t/day)	Water (m3/d)	Production (t/day)	Water (m3/d)	Production (t/day)	Water (m3/d)	
1	Ore Benificiation Plant-1	0.06	12000	220	12000	720	12000	720	4120
	Ore Benificiation Plant-2	0.05			40000	2000	40000	2000	
	Ore Benificiation Plant-3	0.05					28000	1400	
2	Sinter Plant1&2	0.03	16000	480	16000	480	16000	480	1600
	Sinter Plant3	0.03			22000	660	14000	520	
	Sinter Plant 4	0.03					20000	600	
3	Pellet Plant 1	0.06	12000	720	12000	720	12000	720	1660
	Pellet Plant 2	0.04			12000	720	12000	480	
	Pellet Plant 3	0.04					11500	460	
4	Coke-1&2	0.03	2400	70	2400	70	2400	70	18530
	Coke-3&4	1.1	4200	4620	8400	9240	2400	9240	
	Coke-5&6	1					8383	9220	
5	Corex1&2	1.1	5000	5500	5000	5500	5000	5500	
	Blast Furnace 1,2&3	0.8	14000	11568	14000	11568	14000	11568	28356
	Blast Furnace 4	0.7			8000	56000	8000	5600	
	Blast Furnace 5&6	0.6					17880	10728	
5b	DM Plant	1.6					3200	5120	5120
6	SMS-1	0.4	12000	4800	12000	4800	12000	4800	20800
	SMS-2	0.5	8000	4000	16000	8000	16000	8000	
	SMS-3	0.5					16000	8000	
7	HSM-1	0.3	9000	2700	9000	2700	9000	2700	18400
	HSM-2	0.3			14000	5200	14000	5200	
	WRM & BRM	0.5	4500	2250	4500	2250	4500	2250	
	Long Products	0.5					16500	8250	
8	CRM 1	0.48	2600	1200	2600	1200	2500	1200	3600
	CRM 2	0.45			5240	2400	5240	2400	
9	Captive Power Plant 1&2	2.15	280	11800	28	11800	270	11800	83800
	Captive Power Plant 3	2.5	300	18000	600	36000	600	36000	
	Captive Power Plant 4	2.5					600	36000	
10a	Fire Fighting			1000		1500		2000	0
10b	Miscellaneous (RMHS, LCP, CementPlant,Uitility, HMPT)			3000		4500		6000	6000
11	Township(3 nos:)			8000		10000		15000	15000
12	Power plant, JSWEL	2.5	230	13800	230	13800	230	13800	49800
	Power plant, JSWEVL	2.5	600	36000	600	36000	600	36000	

Sl. No.	Units	Specific Consumption	Water requirement at 7mtpa		Water requirement at 10mtpa		Water requirement at 16 mtpa		Total as 16 mtpa
			Production (t/day)	Water (m3/d)	Production (t/day)	Water (m3/d)	Production (t/day)	Water (m3/d)	
13	Oxygen Plant, JPOCL	0.5	5000	2500	2500	2500	5000	2500	
	Oxygen Plant, BOC	1	1800	1800	3600	3600	7200	7200	
14	Other Miscellaneous		5000			7500		10000	9000
15	Drinking Water supplied to Villages			3500		7000		10000	10000
16	Auxiallaries units			7000		10000		20000	20000
17	Losses (Evaporation, treatment and leakages)			14452.8		25842.8		31352.6	31352.6
Total								m3/day	327138.6
								m3/h	13630.78
								MGD	71.96819

Table 2-6 : Hourly fuel gas balance

Sl No	Name of the shop/ uint	Product	Annual output/ input (x1000t)	Annual hrs of opera tion	Sp.yield/ consum ption (Gcal/t)	CV of gas (kcal/N m3)	Hourly fuel suply/ consu mption (Gcal / hr)	BF gas	CO gas	Conv erter gas
							Total			
	Generation									
1	Blast furnace	Hot metal	(5600 + 632.8)	8400	1.4	904	934.13	934.13	0	0
2	Coke oven battery	Blended coal	4195	8760	1.376	4300	658.94	0	658.94	0
3	Converter shop	Liquid steel	6187	7680	0.162	2000	130.51	0	0	130.51
	Total generation						**1723.58**	**934.13**	**658.94**	**130.51**
	Consumption									
1	BF stove, PCI, LRS,etc.	Hot metal	(5600 + 632.8)	8400	0.68	1150	453.33	330.54	122.78	0
2	Coke oven batteries	Dry coal	4195	8760	0.6	1000	287.33	252.40	34.93	0
3	Sinter plant on mixed gas	Sinter	7195	7920	0.02	2000	18.17	5.56	12.61	0
4	Pellet plant on mixed gas	Pellets	4219	7920	0.175	2000	93.22	28.54	64.68	0
5	Steel melting shop	Liquid steel	6187	7680	0.018	4300	14.5	0	14.5	0
6	Blank Caster	Blank	2111.3	7680	0.022	4300	6.05	0	6.05	0
7	Bloom Caster	Bloom	2111.3	7680	0.022	4300	6.05	0	6.05	0
8	Billet Caster	Billet	1809.8	7680	0.022	4300	5.18	0	5.18	0
9	Universal Beam Mill	H sections	2048	7920	0.289	1850	74.81	26.37	48.44	0
10	Mid Sec. Mill	Sections / channels	2100	7920	0.289	1850	74.81	26.37	48.44	0
11	Wire Rod Mill	Wire rods	975	7920	0.280	1850	34.50	12.16	22.34	0
12	SBQ Mill	Bars	780	7920	0.271	1850	26.71	9.42	17.30	0
13	Lime and dolo plant	Lime & dolo	702	7920	0.92	4300	81.54	0	81.54	0
14	Losses @ 1%						9.34	9.34	0	0
15	Losses @ 1%						6.59	0	6.59	0
	Total consumption						1192.13	700.7	491.43	0
	Surplus						**531.45**	**233.42**	**167.50**	**130.51**
	Power & blowing station						**531.45**			
	Available for Sale						**-**			

3.0 DESCRIPTION OF THE ENVIRONMENT

3.1 INTRODUCTION

3.1.1 General

EIA is the most important aspect of overall environment management strategy. EIA needs a datum on which the prediction can be done. Information on the existing baseline environmental status is essential for assessing the likely environmental impacts of the proposed project. For studying the existing baseline environmental status the following basic steps are required:

- Delineation of project site and study area.
- Delineation of the environmental components and methodology.
- Delineation of study period.
- Delineation of the location of Steel Plant and description of its surroundings based on secondary data.

After delineation of the above for the present case the following studies were conducted:

- Baseline data generation / establishment of baseline for different environmental components.
- Baseline status of the existing JSW Steel Plant operating facilities.

3.1.2 Project Site and Study Area

For the purpose of environmental impact assessment, the study area has been divided in two (2) zones, namely, (i) the core zone, the existing steel plant site, where the proposed production facilities will be set up, and (ii) the buffer zone, covering an aerial coverage of around 10 km from the core zone periphery. In the core zone, the impacts on the environment will be larger, needing specific environment mitigation plans. It is necessary to evaluate the impacts of the project activities, so that the surrounding area and communities are prevented from adverse impacts. The impact of the project area beyond ten kilometer is considered insignificant, excepting for air emissions, which needs to be evaluated using mathematical models. The location of the core zone & buffer zone is marked in **Drg. No. MEC/Q6S4/11/S2/01.**

3.1.3 Environmental Components and Methodology

The environmental components studied and the methodologies followed for the preparation of EIA report are given in **Table 3.1a**.

Table 3.1a: Environmental Components and the Methodologies Adopted For the Study

SN	Area	Environmental Components	Parameters	Methodology*
1	Study Area	Air	Meteorology • Ambient Air Quality (prescribed parameters by CPCB). • Pb in SPM • Hydrocarbon Noise Levels	Field Monitoring
2	Study Area	Water	Water Quality • Ground/Surface (parameters as per IS: 10500)	Field Monitoring
3	Study Area	Soil	Soil Quality (Physico-chemical characteristics)	Field Monitoring
4	Study Area	Ecological Features	Flora & Fauna	Field Study / Secondary Data
5	Study Area	Socio-economic Features	Parameters related to Social / Economic aspects/ Demography	Field Study (Public Consultation by questionnaire survey) / Secondary Data
6	Project Site	Work Zone Air	• Stack Emissions • Parameters related to work zone air quality • Work Zone Noise	Field Monitoring
7	Project Site	Water	• Effluent Quality at Outlet of Effluent Treatment Plant (parameters as per waste water discharge standard) • Sewage outlet	Field Monitoring
9	Project Site	Soil	• Soil Quality at Solid Waste Dumping Area	Field Monitoring
10	Project Site	-	• Solid Waste Generation, utilization and Dumping • Characterisation of Solid Waste	Field Monitoring / Secondary Data
11	Project Site	Geology & Hydrology	• Formation of rocks • Water use and impact	Field Monitoring / Secondary Data
12	Interface of Study Area & Project Site	-	• Health status and community development	Field Monitoring
*** Detailed in respective sections**				

3.1.4 Study Period

The baseline environmental data generation and other field studies for the preparation of Environmental Impact Assessment were conducted during December 2009 to February 2010 (Continuously for 13 weeks). The ambient air quality data is being generated by JSW regularly. For the present study the data generated by JSW during the period December 2009 to February 2010 (Continuously for 13 weeks) has been utilized. However, for all other attributes, sampling and analysis were carried out by Environmental Engineering Laboratory, MECON, Ranchi and existing laboratory of JSW at site and the same data has been used for establishing the base line status.

3.1.5 Location of JSW Plant and its Surroundings

The expansion plan of JSW is proposed to come within the existing plant premises.

Regional setting: The study area is located in Toranagallu in the Bellary district of Karnataka. The geographical grids of the study area approximately range from 76038' to 76040' East longitude and 15010'to 15012' North latitude. The area is rich in mineral resources such as iron ore and manganese ore. These mineral resources are mainly found in Sandur and Copper mountain ranges.

The study area is located in Daroji valley formed by Sandur hills on south, copper mountains on east and cluster of small Daroji hills on the north side. The steel plant site is located adjacent to the national highway 63 running from Bellary to Hubli. The site is about 2 km from the Toranagallu Railway Station. There are other small metallurgical plants like Kariganur sponge iron plant, Padmavati Ferro alloys, and associated units of JSW like JPOCL (oxygen plant), JTPCL (power plant), Jamipol (powder Injection compound), Bawalka steel tubes (pipe manufacture). Other steel industries of the area like Hospet steel, Kalyani steel, Kirloskar Ferro alloys, Mukund steel and Bellary steel are located beyond 30 kms from the existing steel works site.

Sandur hills begins at Mallapuram on the bank of Tungabhadra river and runs south-east, for over 48 km with only one break. The highest elevation of Sandur hills is 3400 feet (1036 m). Both the divisions slope gradually northwards towards Tungabhadra River flowing nearly 25 km north of the proposed project site. Copper mountain range runs from North-West to South-East, roughly parallel to Sandur hills about 8 km east of them. It runs from Daroji tank South-East for about 40 km and up to about 6 km west of the Hagari river. The highest elevation the Copper mountain is 3285 feet above sea level. Daroji hills, which are a cluster of several isolated hills, are on the North of Sandur hills. The two hills are separated from each other by the valley along which South-Central railway runs from Bellary to Hospet.

The area under Bellary taluk is almost flat treeless plain whereas major portions of Hospet and Sandur taluks are hilly. Forests in the area can be divided into two main divisions, dry deciduous and shrub forests. The deciduous forests are mostly situated in Sandur taluk at a distance of about 18 km from the site. Bellary and Hospet taluks have only shrub type of forests.

There is no national park, biosphere reserve, sanctuary, habitat for migratory birds, archeological site, defense installation, airports within 10 km of the periphery. Hampi village, which covers the ruins of Vijayanagar, the renowned capital of Vijayanagar Empire that flourished during 14th-16th centuries, is beyond 25 km away from the site. The bear sanctuary at Daroji is located beyond 12Km from the steel plant site. NH-63 connecting Guntakal to Hospet passes almost along E-W at approximately 4 km N from the site. The area does not fall in seismically active or land use prone zone.

Topography: The topography of the study area is gently sloping from south to north. The area is in a valley surrounded by small mountain ranges. The highest elevation of the existing steel plant and the proposed expansion site is 500m while the lowest is 430m above MSL.

Drainage: The proposed site is devoid of any river system. However, the site is drained by

Narihalla on the western side and Kaniganahalla on the eastern side. Narihalla and Kaniganahalla drain into Daroji tank which is the only noteworthy tank in Sandur taluk with a capacity of 788.28 Mcft (22.3million cubic meter) located about 5km North of the proposed site. Daroji tank also receives water from Tungabhadra high level canal. Important rivers of Bellary district are Tungabhadra and its tributaries namely Hagari and Chikka Hagari, which flow outside the study area. River Tungabhadra flows on the north side of Toranagallu at a distance about 25 km. The flow of Tungabhadra River and Narihalla nallah is regulated by respective reservoir authorities and the flow is very less during dry season. The natural nallah, Kaniganahalla is also dry during the dry seasons.

There are several ground water basins in the study area. The proposed plant site falls under Sandur ground water basin. The main source of recharge to ground water in the region is through infiltration of rainwater. The Narihalla to a little extent effects ground water recharge in the area.

Meteorology : As per IMD (Indian Meteorological Department) climatological data monitored during 1951 to 1980 at Bellary which is approximately 40 km from site shows that the coolest part of the year is from November to end of February. In December, when the mean temperature is the lowest, the mean daily minimum is 17.2°C. By the end of February, temperature begins to rise rapidly. By April, which is the hottest month, the mean daily maximum temperature goes up to 39°C. In May also, the weather is nearly as hot as April and in these two months the heat is oppressive. With the onset of monsoon in June, the weather becomes slightly cooler and continues to be so through out the monsoon period. The maximum temperature recorded at Bellary so far is 43.9°C while minimum is 10.6°C.

Summer and cold seasons are the driest part of the year when relative humidity levels vary from 53 to 74% in morning and 27 to 45% in the afternoons. Relative humidity are higher in the South-West monsoon and retreating monsoon seasons, when they are generally 50 to 75%. The average annual rainfall as recorded at Bellary is 529.2 mm.

South Easterlies and Easterlies are very predominant during winter season. South Easterly component is predominant till summer. Once the monsoon onsets, the winds start blowing from West and NW. Study of climatologically data reveals that winds are changing the directions only during winter and monsoon.

During the period from May to November, sky remains moderately to heavily clouded. Rest of the year, sky remains generally clear or lightly clouded.

Annually the predominant wind directions are shown in **Table 3.1b**.

Table 3.1b: Pattern of Annual Winds in Study Area

Wind	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**Calm**
Annual % Frequency	1	5	10	20	1	8	13	23	19
Predominance Sequence	**8th**	**6th**	**4th**	**2nd**	**7th**	**5th**	**3rd**	**1st**	

3.2 BASELINE DATA GENERATION / ESTABLISHMENT OF BASELINE FOR ENVIRONMENTAL COMPONENTS

The establishment of baseline for different environmental components in the study area and at the project site has been done by conducting field monitoring for baseline data generation. The data generation was carried out covering Meteorology, Ambient Air Quality, Noise Levels, Water Quality, Soil, Ecology, Hydrology and Socio-economic features. Besides additional data/information regarding water availability, ecology, demographic pattern and socio-economic conditions were collected from various central and state government agencies.

3.2.1 Meteorology

Meteorology plays a very important role in the environmental impacts of industrial project. Meteorological conditions govern the dispersion (and hence dilution) of air pollutants. Hence Meteorological studies form an integral part of environmental impact assessment studies.

A meteorological station was set up inside the plant premises at GM (works) office, which lies within the proposed study area. The meteorological data was generated hourly during the monitoring period. The location of the meteorological data monitoring stations is marked in **Drg. No. MEC/G23D/11/S2/02.**

At the meteorological station, Wind Speed & Direction, Temperature, Relative Humidity, Barometric Pressure and Cloud Cover were recorded at hourly intervals throughout the monitoring period. Total Rainfall for the entire monitoring period was also recorded. The summarised meteorological data is given in **Table 3.2a**.

Table 3.2a: Summarised Monitored Meteorological Data at JSW

Period	Wind Speed (m/s)			Temperature (°C)			Relative Humidity (%)			Rain Fall (mm)		
	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
December 09 - February 2010	7.56	0.11	2.9	36	18	26	96	20	56	18	6	12

Wind frequency distribution during the monitoring period at the site is given as **Tables 3.2b** for the period December 2009 to February 2010 (winter season). The Wind Rose diagrams for summer seasons are given as **Figs. 3.1a, 3.1b** and **3.1c** respectively.

From **Table 3.2b** it was observed that in summer season overall, the predominant wind directions for December 2009 – February 2010 were SSE (prevailing for 34.7% of the time), S (25.2%), SE (10.5%) and ESE (4.07%). Calm conditions prevailed for 2.55% of the time.

While during the Day, the predominant wind directions were SSE (prevailing for 39.8% of the time), S (20.7%), SE (14.15%) and ESE (5.79%). Calm conditions prevailed for 1.45% of the time. Whereas during the night, the predominant wind directions were SSE (prevailing for 39.43% of the time), S (29.44%), SE (8.46%) and ESE (2.71%). Calm conditions prevailed for 4.74% of the time.

Table 3.2b: Wind Frequency Distribution (%) at JSW During Winter Season, 2009-10

A: Day & Night (Overall)

Direction	Velocity Ranges (m/s)					Sum %
	0.44<V<=2	2<V<=3	3<V<=5	5<V<=6	V>6	
N	1.23	0.19	0	0	0	1.42
NNE	1.04	0.24	0	0	0	1.28
NE	0.71	0.95	0.19	0	0	1.84
ENE	0.66	1.09	0.95	0	0	2.7
E	0.52	0.85	2.32	0	0	3.69
ESE	0.76	0.57	2.74	0	0.33	4.07
SE	2.03	1.9	5.25	0.99	0.99	10.5
SSE	5.11	8.79	16.7	3.12	0.99	34.7
S	4.59	5.48	11.44	2.69	0	25.2
SSW	1.23	0.52	0.33	0.05	0	2.13
SW	1.09	0.14	0.14	0	0	1.37
WSW	1.56	0.43	0.14	0	0	2.13
W	2.13	0.38	0.05	0	0	2.55
WNW	1.42	0.19	0.09	0	0	1.7
NW	0.9	0.09	0	0	0	0.99
NNW	0.9	0.19	0.09	0	0	1.18
Sum %	25.86	21.99	40.43	6.86	2.32	95.5
CALM %	(**V< 0.44 m/s or <1.6 km/hr**) = 2.55					

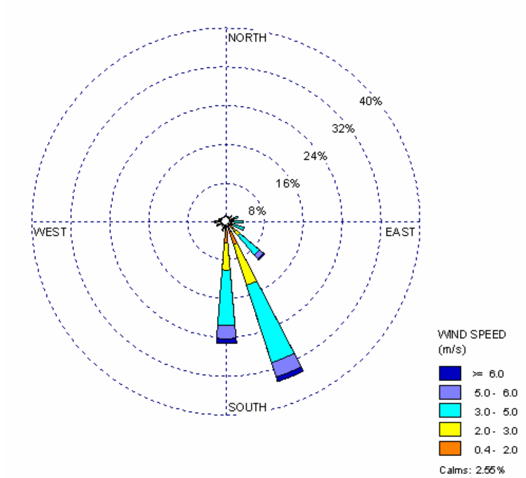


Fig. 3.1a: Wind-Rose at JSW During Winter: Day & Night (Overall)

B: Day

Direction	Velocity Ranges (m/s)					Sum %
	0.44<V<=2	2<V<=3	3<V<=5	5<V<=6	V>6	
N	1.34	0.31	0	0	0	1.65
NNE	1.03	0.31	0	0	0	1.34
NE	0.41	1.03	0.1	0	0	1.55
ENE	0.41	1.14	1.14	0	0	2.69
E	0.62	0.83	2.1	0	0	3.51
ESE	0.83	0.52	4.44	0	0	5.79
SE	2.07	2.48	6.82	2.1	0.72	14.15
SSE	3.31	7.75	21.8	4.75	2.2	39.8
S	2.17	3.1	11.26	3.31	0.83	20.7
SSW	0.72	0.1	0.31	0	0	1.14
SW	0.31	0.1	0	0	0	0.41
WSW	0.41	0.21	0	0	0	0.62
W	1.45	0	0.1	0	0	1.96
WNW	0.62	0.1	0	0	0	0.72
NW	0.72	0.21	0	0	0	0.93
NNW	1.34	0.21	0.1	0	0	1.65
Sum %	17.77	18.8	48.14	10.12	3.72	94.18
CALM %	(V< 0.44 m/s) = 1.45					

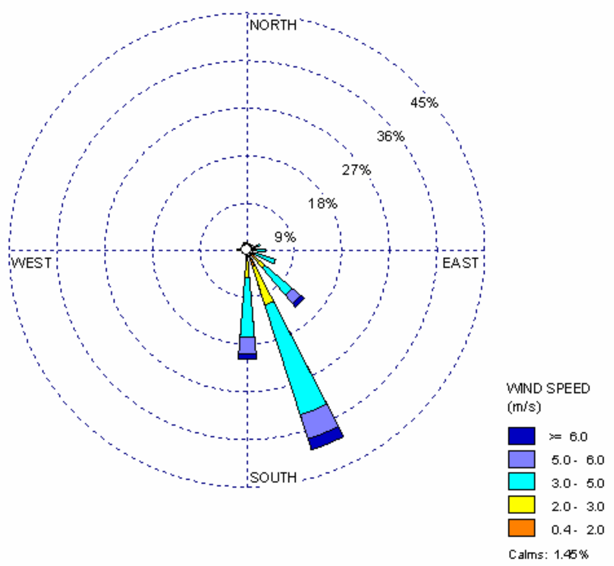


Fig. 3.1b: Wind-Rose at JSW During Winter - Day

C: Night

Direction	Velocity Ranges (m/s)					Sum %
	0.44<V<=2	2<V<=3	3<V<=5	5<V<=6	V>6	
N	0.68	0	0	0	0	0.68
NNE	1.02	0	0	0	0	1.02
NE	0.51	0.17	0	0	0	0.68
ENE	0.85	0.68	0	0	0	1.53
E	0.17	0.68	2.2	0	0	3.05
ESE	0.68	0.68	1.35	0	0	2.71
SE	2.54	2.2	3.72	0	0	8.46
SSE	7.11	13.03	17.26	2.03	0	39.43
S	6.6	8.8	12.52	1.02	0.52	29.44
SSW	1.52	0.51	0	0.17	0	2.2
SW	0.51	0	0	0	0	0.51
WSW	1.86	0.17	0.34	0	0	2.37
W	0.85	0	0	0	0	0.85
WNW	1.02	0	0	0	0	1.02
NW	0.17	0	0	0	0	0.17
NNW	0.68	0.34	0.17	0	0	1.18
Sum %	26.73	27.24	37.56	3.21	0.52	95.26
CALM % (V< 0.44 m/s) = 4.74						

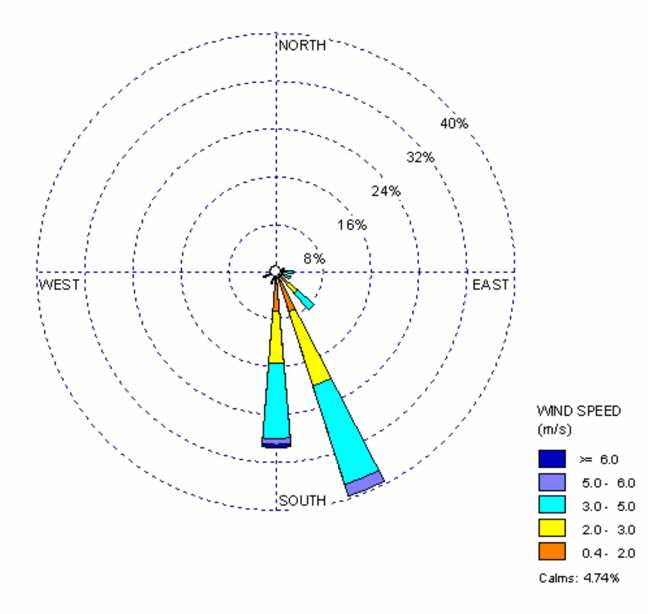


Fig. 3.1c: Wind-Rose at JSW During Winter – Night

Thermal Inversion Frequency

Ground based inversions were collected from IMD publications for Bangalore to have an idea about the dilution of pollutants in the area and are given below:

Months	Ground level inversions in %	
	5.30	17.30
January	19	1
February	19	0
March	20	0
April	6	3
May	8	2
June	4	0
July	2	1
August	0	1
September	1	0
October	6	3
November	3	2
December	8	3

3.2.2 Ambient Air

General

In order to evaluate the resultant air quality around JSW, it is necessary to determine the existing air quality in terms of Respirable Particulate Matter (PM10& PM2.5), Sulphur–di–oxide (SO_2), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO) and Ammonia (NH3). Accordingly these parameters were monitored at selected Ambient Air Quality (AAQ) monitoring stations.

Selection of Monitoring Stations

For locating the ambient air quality (AAQ) monitoring stations, the evaluation area may be considered a circle of radius 50 times the maximum stack height. Since the maximum stack height for the proposed project is 100 m, the evaluation area is a circle of radius 5.0 km. However, as the project site is large, so to have a conservative approach the monitoring stations has been fixed in a radius of 10Km around the JSW Plant taking mid point of JSW as centre.

To select the locations of the ambient air quality monitoring stations, information published by India Meteorological Department (IMD) was used. The IMD observatory nearest to plant site is at Bellary about 40 km from the project site.

The main objective of AAQ data generation / establishment of baseline for AAQ is to assess the future scenario of the surrounding environment by superimposing the predicted pollution levels on the existing pollution levels. Thus it will be possible to identify the location where maximum concentrations of pollutants are likely to occur due to emissions from the proposed plant. The location of AAQ stations were finalised with the help of screening models, which were run with actual source inventory and meteorological data. The predominant wind direction of nearest IMD observatory at Bellary was identified with the help of wind frequencies. The predominant annual wind frequencies of Bellary are NW (23.0%), SE (20.0%), W (13%) and E (10.0%). (**Table 3.1b**).

The locations of AAQ stations are given in **Table 3.3**. The AAQ stations were located in the upwind and downwind direction of annual winds with respect the existing JSW plant and by considering the additional points mentioned below:

1. Location of AAQ stations within 10 km radius around the proposed plant.
2. Approachability to and habitation near the monitoring stations.
3. Location of other industries within 10 km radius around the proposed plant.

Table 3.3: Location of AAQ Monitoring Stations

Station No.	Location	Distance & Direction With respect to	
		Project Site (JSW)	Relative Location With Respect to IMD Wind Pattern
A1	SG Colony, Tornagallu	3.5 km (ENE)	• D/W of 3rd & 5th predominant annual wind (W & SW).
A2	Sultanpur Village	7.5 km (SE)	• D/W of 1st predominant annual wind NW.
A3	JSW Township	0.5 km (SW)	• D/W of 6th predominant annual wind NE.
A4	Talur Village	4.5 km (WSW)	• D/W of 4th & 6th predominant annual wind (E & NE).
A5	Vaddu Village	1.5 km (WNW)	• D/W of 2nd & 4th predominant annual wind (SE & E).
A6	Gadiganur Village	6.0 km (NW)	• D/W of 2nd predominant annual wind SE.
A7	Basapura Village	4.0 km (NW)	• D/W of 2nd predominant annual wind SE.
A8	Kurekuppa Village	6.0 km (NNW)	• D/W of 2nd & 7th predominant annual wind (SE & S).
A9	Kudathini Village	11.0 km (E)	• D/W of 3rd predominant annual wind W.
A10	Karadidamma	12.0 km (NW)	• D/W of 2nd predominant annual wind SE.
A11	Hampi Village	26.0 km (NW)	• D/W of 2nd predominant annual wind SE.

Methodology

As per the CPCB guidelines on methods of monitoring & analysis, 11 (Eleven) AAQ monitoring stations were selected. These stations are marked in **Drg. No. MEC/Q6S4/11/S2/02.**

During the monitoring periods, 24 hourly samples were collected twice a week for PM10, PM2.5, SO_2, NO_x and NH3, whereas for CO three one hourly sample were taken on each monitoring day at all locations The methods of sample collection, equipment used and analysis procedure as followed are given in **Table 3.4a.** The AAQ results will be compared with MOE&F Revised National ambient Air Quality Standards 2009 as given in **Table 3.4b.**

Table 3.4a: Methodology of Sampling and Analysis for AAQ Monitoring

Parameter	Instrument/Apparatus Used	Methodology	Reference
SO_2 (µg/m^3)	HVAS with Impinger Tube, Spectro–photometer	Improved West & Gaecke Method	MOE&F G.S.R 826 (E) dtd. 16.11.09
NO_x (µg/m^3)	HVAS with Impinger Tube, Spectro–photometer	Jacobs & Hoccheiser Modified (Na-Arsenite) Method	-do-
PM_{10} (µg/m^3)	Respirable Dust Sampler	Gravimetry	-do-
$PM_{2.5}$ (µg/m^3)	PM 2.5 Sampler	Gravimetry	-do-
Ozone (O_3) (µg/m^3)	HVAS with Impinger Tube, Spectro–photometer	Chemical Method	-do-
Lead (Pb) (µg/m^3)	AAS, sampling on EPM 2000	Gravimetric followed by AAS	-do-
CO (mg/m^3)	CO Analyser	NDIR Method	-do-
Ammonia (NH_3) (µg/m^3)	HVAS with Impinger Tube, Spectro–photometer	Indophenol Blue Method	-do-
Benzene (C_6H_6) (µg/m^3)	Activated charcoal adsorption tubes	Adsorption & desorption followed by GC analysis.	-do-
Benzo-a-pyrine (BaP) – particulate phase only (ng/m^3)	HVAS using GF/A grade filter paper.	Solvent extraction followed by HPLC	-do-
Arsenic (As) (ng/m^3)	AAS, sampling on EPM 2000	AAS	-do-
Nickel (Ni) (ng/m^3)	AAS, sampling on EPM 2000	AAS	-do-

Table 3.4b: National Ambient Air Quality Standards

SN	Parameter	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Area (Notified by Central Government)
1	SO_2 ; (µg/m^3)	Annual*	50	20
		24 Hours**	80	80
2	NO_x ; (µg/m^3)	Annual*	40	30
		24 Hours**	80	80
3	PM_{10}; (µg/m^3)	Annual*	60	60
		24 Hours**	100	100
4	$PM_{2.5}$; (µg/m^3)	Annual*	40	40
		24 Hours**	60	60
5	Ozone (O_3); (µg/m^3)	8 Hours **	100	100
		1 Hour **	180	180
6	Lead (Pb); (µg/m^3)	Annual*	0.50	0.5
		24 Hours**	1.0	1.0
7	CO; (mg/m^3)	8 Hours **	02	02
		1 Hour **	04	04
8	Ammonia (NH_3); (µg/m^3)	Annual*	100	100
		24 Hours**	400	400
9	Benzene (C_6H_6); (µg/m^3)	Annual*	05	05
10	Benzo-a-pyrine (BaP) – particulate phase only; (ng/m^3)	Annual*	01	01
11	Arsenic (As); (ng/m^3)	Annual*	06	06
12	Nickel (Ni); (ng/m^3)	Annual*	20	20
*	Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals			
**	24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be compiled with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days.			

Results of Ambient Air Quality

The summarised AAQ results are given in **Tables 3.5a & 3.5b**. The results have been compared with Central Pollution Control Board (CPCB) norms.

The results of PM2.5, SO2, NOx, CO & NH3 at all the monitoring stations were well within the respective permissible limit for industrial, residential, rural and other areas except PM10 at Sultanpur, Gadiganur, Kurekuppa and Kudathini (**Table 3.5a & b**).

Table 3.5a: Summarised Results of AAQ Monitoring During Winter around JSW

Parameters		Results ($\mu g/m^3$)					
		SG Colony, Tornagallu (A1)	**Sultanpur Village (A2)**	**JSW Township (A3)**	**Talur Village (A4)**	**Vaddu Village (A5)**	**Gadiganur Village (A6)**
PM 10	Max	106	340	188	368	106	302
	Min.	68	64	22	22	52	44
	Avg.	85.6	150.8	80.3	82	84.2	122.4
	C_{98}	104	324	179	134	103	296
PM 2.5	Max	31	58	30	26	29	44
	Min.	10	17	7	8	10	15
	Avg.	18.3	32.5	14.7	16.4	23.1	28.2
	C_{98}	25	42	27	23	28	41
SO_2	Max	14.8	15.2	16.4	14.4	16.8	15.8
	Min.	12.4	12.6	12.8	12.2	12.2	12.2
	Avg.	13.4	13.6	13.9	13.4	13.9	13.1
	C_{98}	14.4	14.8	16.2	14.2	16.6	13.8
NO_X	Max	18.6	19.6	19.8	18.8	20.8	19.4
	Min.	15.2	16	15.2	15.2	15.8	14.4
	Avg.	17.1	17.4	17.4	16.6	17.7	16.6
	C_{98}	18.3	18.8	19.2	17.8	20.6	17.8
CO	Max	2000	2000	2000	2000	2000	2000
	Min.	1000	1000	1000	1000	1000	1000
	Avg.	1600	1700	1800	1200	1700	1000
	C_{98}	2000	2000	2000	2000	2000	2000
NH3	Max	Nil	Nil	Nil	Nil	Nil	Nil
	Min.	Nil	Nil	Nil	Nil	Nil	Nil
	Avg.	Nil	Nil	Nil	Nil	Nil	Nil
	C_{98}	Nil	Nil	Nil	Nil	Nil	Nil

Parameters		Results (µg/m^3)					
		SG Colony, Tornagallu (A1)	Sultanpur Village (A2)	JSW Township (A3)	Talur Village (A4)	Vaddu Village (A5)	Gadiganur Village (A6)
Lead (Pb)	Max	0.29	0.2	0.28	BDL	0.26	0.8
	Min.	0.07	0.1	0.08	BDL	0.17	0.38
	Avg.	0.2	0.2	0.2	BDL	0.2	0.6
	C_{98}	0.28	0.19	0.28	BDL	0.24	0.75
Benzene (C_6H_6)	Max	BDL	BDL	BDL	BDL	BDL	BDL
	Min.	BDL	BDL	BDL	BDL	BDL	BDL
	Avg.	BDL	BDL	BDL	BDL	BDL	BDL
	C_{98}	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a) Pyrene (BaP)	Max	BDL	BDL	BDL	BDL	BDL	BDL
	Min.	BDL	BDL	BDL	BDL	BDL	BDL
	Avg.	BDL	BDL	BDL	BDL	BDL	BDL
	C_{98}	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic (As)	Max	0.91	0.9	0.62	0.28	1.89	2.8
	Min.	0.4	0.4	0.16	0.07	1.06	1.6
	Avg.	0.7	0.6	0.4	0.2	1.4	2.0
	C_{98}	0.9	0.8	0.57	0.28	1.67	2.7
Nickel (Ni)	Max	2.6	0.98	0.78	0.98	2.6	2.9
	Min.	0.98	0.4	0.37	0.7	1.68	1.7
	Avg.	1.7	0.8	0.5	0.8	2.1	2.4
	C_{98}	2.4	0.98	0.75	0.94	2.4	2.9
Ozone (O_3)	Max	23	22	23	23	23	21
	Min.	20	20	21	20	21	20
	Avg.	21.6	21	22.5	22.8	22.3	20.6
	C_{98}	23	22	23	23	23	21

Note: Results of Bap,As & Ni are in ng/m^3

Table 3.5a: Summarised Results of AAQ Monitoring During Winter around JSW

Parameters		Results (µg/m^3)				
		Basapura Village (A7)	Kurekuppa Village (A8)	Kudathini Village (A9)	Karadidamma (A10)	Hampi Village (A11)
PM 10	Max	188	202	178	86	174
	Min.	48	48	60	22	36
	Avg.	89.7	114.5	118.7	39	85.3
	C_{98}	118	194	168	68	166
PM 2.5	Max	37	38	88	17	27
	Min.	9	12	12	9	7
	Avg.	21.5	24.8	30.7	11.5	16
	C_{98}	28	31	33	13	25
SO_2	Max	14.2	14.8	15.6	BDL	14.2
	Min.	12.2	12.4	12.2	BDL	12.2
	Avg.	13.2	13.3	14.1	BDL	13.2
	C_{98}	14	14.4	15.2	BDL	13.8
NO_X	Max	18.6	18.4	22.2	BDL	18.4
	Min.	14.6	14.6	16.7	BDL	14.8
	Avg.	16.6	16.6	18.6	BDL	16.7
	C_{98}	18.4	17.8	21.6	BDL	18.4
CO	Max	2000	2000	2000	2000	2000
	Min.	1000	1000	1000	1000	1000
	Avg.	1300	1500	1600	1000	1500

Parameters		Results (µg/m^3)				
		Basapura Village (A7)	Kurekuppa Village (A8)	Kudathini Village (A9)	Karadidamma (A10)	Hampi Village (A11)
	C_{98}	2000	2000	2000	2000	2000
NH3	Max	Nil	Nil	Nil	Nil	Nil
	Min.	Nil	Nil	Nil	Nil	Nil
	Avg.	Nil	Nil	Nil	Nil	Nil
	C_{98}	Nil	Nil	Nil	Nil	Nil

Parameters		Results (µg/m^3)				
		Basapura Village (A7)	Kurekuppa Village (A8)	Kudathini Village (A9)	Karadidamma (A10)	Hampi Village (A11)
Lead (Pb)	Max	0.24	0.48	0.24	Nil	0.19
	Min.	0.08	0.09	0.16	Nil	0.08
	Avg.	0.2	0.3	0.2	Nil	0.1
	C_{98}	0.23	0.45	0.23	Nil	0.18
Benzene (C_6H_6)	Max	BDL	BDL	BDL	BDL	BDL
	Min.	BDL	BDL	BDL	BDL	BDL
	Avg.	BDL	BDL	BDL	BDL	BDL
	C_{98}	BDL	BDL	BDL	BDL	BDL
Benzo(a) Pyrene (BaP)	Max	BDL	BDL	BDL	BDL	BDL
	Min.	BDL	BDL	BDL	BDL	BDL
	Avg.	BDL	BDL	BDL	BDL	BDL
	C_{98}	BDL	BDL	BDL	BDL	BDL
Arsenic (As)	Max	0.87	0.49	0.8	Nil	Nil
	Min.	0.44	0.16	0.4	Nil	Nil
	Avg.	0.6	0.3	0.6	Nil	Nil
	C_{98}	0.81	0.48	0.8	Nil	Nil
Nickel (Ni)	Max	1.17	0.88	1.4	Nil	Nil
	Min.	0.42	0.32	0.9	Nil	Nil
	Avg.	0.8	0.6	1.2	Nil	Nil
	C_{98}	1.17	0.87	1.4	Nil	Nil
Ozone (O_3)	Max	23	23	23	23	21
	Min.	20	21	20	20	20
	Avg.	20.9	21.8	21.5	21.9	20.6
	C_{98}	22	23	23	23	21

Note: Results of Bap,As & Ni are in ng/m^3

Table 3.5b: Average AAQ Monitored Values During Winter Season as Compared with CPCB Norms

AAQ Station/CPCB Standards	Ambient Air Quality					
	PM 10 (µg/m^3)	PM 2.5 (µg/m^3)	SO_2 (µg/m^3)	NO_X (µg/m^3)	CO* (µg/m^3)	NH3 (µg/m^3)
SG Colony, Tornagallu	85.6	18.3	13.4	17.1	1600	BDL
Sultanpur Village	150.8	32.5	13.6	17.4	1700	BDL
JSW Township	80.3	14.7	13.9	17.4	1800	BDL
Talur Village	82	16.4	13.4	16.6	1200	BDL
Vaddu Village	84.2	23.1	13.9	17.7	1700	BDL
Gadiganur Village	122.4	28.2	13.1	16.6	1000	BDL
Basapura Village	89.7	21.5	13.2	16.6	1300	BDL
Kurekuppa Village	114.5	24.8	13.3	16.6	1500	BDL

AAQ Station/CPCB Standards	Ambient Air Quality					
	PM 10 (µg/m^3)	**PM 2.5** (µg/m^3)	**SO_2** (µg/m^3)	**NO_X** (µg/m^3)	**CO*** (µg/m^3)	**NH3** (µg/m^3)
Kudathini Village	118.7	30.7	14.1	18.6	1600	BDL
Karadidamma	39	11.5	BDL	BDL	1000	BDL
Hampi Village	85.3	16	13.3	16.7	1500	BDL
Industrial, Residential, Rural & other Area Norm (24hr./*1hr.Av)	**100**	**60**	**80**	**80**	**4000**	**400**

AAQ Station/CPCB Standards	Ambient Air Quality					
	Lead (Pb) (µg/m^3)	**Benzene (C_6H_6)** (µg/m^3)	**Benzo(a) Pyrene (BaP)** (ng/m^3)	**Arsenic (As)** (ng/m^3)	**Nickel (Ni)** (ng/m^3)	**Ozone (O_3)** (µg/m^3)
SG Colony, Tornagallu	0.2	BDL	BDL	0.6	1.7	21.6
Sultanpur Village	0.2	BDL	BDL	0.6	0.8	21
JSW Township	0.2	BDL	BDL	0.4	0.5	22.5
Talur Village	BDL	BDL	BDL	0.2	0.8	22.8
Vaddu Village	0.2	BDL	BDL	1.4	2.1	23
Gadiganur Village	0.6	BDL	BDL	2.0	2.4	20.6
Basapura Village	0.2	BDL	BDL	0.6	0.8	20.9
Kurekuppa Village	0.3	BDL	BDL	0.3	0.6	21.8
Kudathini Village	0.2	BDL	BDL	0.6	1.2	21.5
Karadidamma	BDL	BDL	BDL	BDL	BDL	21.9
Hampi Village	0.1	BDL	BDL	BDL	BDL	20.6
Industrial, Residential, Rural & other Area Norm (Annual)	**0.5**	**5**	**1**	**6**	**20**	**100**

3.2.3 Noise

Selection of Monitoring Locations

A total of sixteen noise monitoring stations were selected to cover all type of areas as given in **Table 3.6**.

Table 3.6: Noise Monitoring Locations

Stn. No.	Location	Type of Area
N1	JSW Township	Residential
N2	Bellary - Toranagallu road	Commercial
N3	Vegetable market - Toranagallu	Commercial
N4	Between JSW Township & RM GATE	Industrial Area
N5	Toranagallu railway station	Commercial
N6	Sultanpur	Residential
N7	Vaddu	Residential
N8	Township	Residential
N9	Kurekuppa	Residential
N10	SGC	Residential

Stn. No.	Location	Type of Area
N11	Talur	Residential
N12	Basapur	Residential
N13	Gadignur	Residential
N14	Karadidama	Residential
N15	Hampi	Residential
N16	Kuditini	Residential

Methodology

To have an idea of the present background noise level of the project site, a detailed measurement of noise level was carried out at 8 locations thrice during the monitoring period. Precision integrated sound level meter (type 2221 of Bruel & Kjaer of Denmark) was used for measurement of noise level for the study. The measurements were carried out for 24 hours. Hourly readings were recorded by the operating the instrument for 15–20 minutes in each hour at one-hour intervals in which Leq. (A) have been measured.

Results

The results of ambient noise monitoring are given in **Table 3.7.** The results have been compared with MOE&F norms (Noise (Regulation & Control) Rules, 2000) given in **Table 3.8**. The result shows that near JSW township & RM Gate (N4) both day and night time noises are within the norm for Industrial area. At commercial area the values are within the norm for night time but slightly exceeding the norms for day time. At residential areas noise level is slightly exceeding the norm for day time but more or less within the norm for night time.

Table 3.7 : Results of Noise Monitoring (Winter Season)

Stn No.	Location	Day (06.00-22.00 hr.)			Night (22.00-06.00 hr.)		
		Max.	Min.	Mean*	Max.	Min.	Mean*
N1	JSW Township (Residential)	64.2	58.8	62.5	48.2	38.8	42.7
N2	Bellary - Toranagallu road (Commercial)	78.8	74.8	77	46.8	41.2	44.5
N3	Vegetable market - Toranagallu(Commercial)	81.2	75.8	78.2	54.2	47.4	49.6
N4	Between JSW Township & RM GATE(Indus.)	72.8	64.4	68.4	41.2	38.4	40.4
N5	Toranagallu railway station(Commercial)	84.2	68.4	75.6	48.6	39.4	42.5
N6	Sultanpur (Residential)	60.2	53.2	55.8	46.4	43.0	45.2
N7	Vaddu (Residential)	64.6	60.0	62.3	55.6	48.4	52.3
N8	Township (Residential)	62.8	57.6	59.5	51.3	44.8	48.0
N9	Kurekuppa (Residential)	50.4	49.0	49.6	39.2	35.5	37.2
N10	SGC (Residential)	68.2	66.2	67.1	53.2	46.4	50.9
N11	Talur (Residential)	49.6	40.2	43.9	36.8	33.6	34.8
N12	Basapur (Residential)	56.8	48.6	51.8	42.0	38.0	40.4
N13	Gadignur (Residential)	50.0	48.2	48.9	38.9	36.2	37.4
N14	Karadidama (Residential)	38.2	32.2	35.5	34.4	30.1	32.2
N15	Hampi (Residential)	58.6	50.3	54.3	37.6	30.2	33.6
N16	Kuditini (Residential)	64.8	56.0	60.4	49.4	44.0	46.7

Stn No.	Location	Day (06.00-22.00 hr.)			Night (22.00-06.00 hr.)		
		Max.	Min.	Mean*	Max.	Min.	Mean*
Day – 06.00 to 22.00 hrs.; Night – 22.00 to 06.00 hrs.; All values in dB(A); * *Logarithmic Averages*.							

Table 3.8 : Ambient Air Quality Norms in Respect of Noise

Type of Area	Day (0600-2200 hrs)	Night (2200-0600 hrs)
Industrial Area.	75	70
Commercial Area.	65	55
Residential Area.	55	45
Silence zone.	50	40
All values in dB (A)		

3.2.4 Geology

The geological disposition of the area is complex but well developed sequences of the rock from Archean to recent age. The basement rocks are over lained by proterozoic cainozoic, and by recent laterite alluvium on the top. The geologic succession of the study area is detailed below.

Stratigraphic position and Age	Formation and Lithology
Recent	Laterite , black cotton clay .
-------------Unconformity-------------------	
Cainozoic Proterozoic	Quartz vein Gabbro /dolerite dyke Granitoids
-------------Unconformity-------------------	
Archaeans	Metabasalt with iron and manganese Metabasalt Metavolcanics with quartzite's Granite and gneiss

The geology of the area is dated back to Pre-cambrian age. The rocks occurring in the district can be divided broadly into two types namely a) Schistose rocks of Dharwarian age b) Gneisses and granite belonging to Peninsular Gneissic Complex (PGC) and Hospet Granite. The schistose rocks occur as long and linear bands which comprise of both sedimentary and volcanic suites subjected to low grade regional metamorphism and different phases of deformation. There are a few major schist belts within the district, which trend in a major schist belts within the district, which trend in a general northwest – southeast direction. They are named as i) sandur schist belt ii) Pennar-Hagari schist belt and iii) southern part of Gadag belt. While the western part of the district exposes a fragment of the Sandur belt renowned for its rich iron and manganese deposits occupy the central part of the district and Hagari segment of Hungund –Kushtagi-Hagari belt is seen in the eastern part. In all these belts, volcanics are represented by repetitive sequences of meta / basalt, meta / andesite, meta/rhyholite and sheet like bodies of metagabbroid and

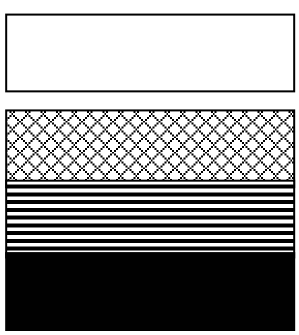
metadolerite. Metabasalt is predominant covering about 70% of the volcanic rocks, Sedimentary rocks are represented by quartzite, ferruginous/manganese phylite, greywacke and garntiferous mica schist. The schistose rocks have undergone lower greenschist to amphibolite facies of regional metamorphism.
Peninslar geneisses and Hosepet Granite constitute about 70% of the area of Bellary district. Peninsular Gneisses are the oldest rocks which form the basement and comprise migmatites and associated grey biotite-gneiss and granodioritic to tonalitic rocks. The younger Hospet granite shows intrusive relationship with the PGC and schistose rocks. The basic dykes occurring in the Bellary district are many and vary in size and composition. Thin pegmatite veins traverse the granites and occur profusely inmigmatite zones around band in the schistose rocks on both the sides of Tungabhadra dam and at Kampli.

The general strike of the schistose rocks varies from NW-SE to NNW-SSE with moderate dips of 50^0 - 60^0 both towards NE and SW. The general foliation trend of gneisses is NNW – SSE with almost subvertical dips. The tectonic history of the rock formations reveals that the Pre-cambrian schist belts have been initially fold into synclines and anticlines and the cores of anticline occupied by the gneisses and granites. These have been later refolded almost parallel to the early fold axis forming doubly plunging folds.

Profile of the site:

The top layer of the site is characterised by recent sand, murram, with rectangular pebbles of banded hematite and black cotton soil. This combination of topsoil ranges from 0 to 1.5 m, below 1.5 m the weathered schist formation is encountered upto depth of 8m. Beyond 8m the formations are found to be fractured. The basement/fresh rock occurs beyond 10 m. The general profile observed in the study area is as follows.

General profile observed in the study area



The above soil profiles was observed from the well and nallah cuttings which are located in the valley portion of the study area. The recent formation of murram and black cotton soil are observed to the depth of 0.5m to 1.0m. It appears that the fractured rock starts immediately and extends to the depth of 1.5m and the fresh rock strata 2 m below the ground level.

From the geotechnical map it is evident that three seismic zones have been identified at

Bellary district. There are three lineaments are also identified. All the lineaments are occurring at Zone II of seismic activities. The existing plant is located in seismic Zone II and without any lineament. From the map it also can be seen that the plant is located on pediplain plateau residual hill with structural hill ranges. The basement has crystalline, granite, charnockite .

3.2.5 Hydrology

In-order to understand the hydro geology of the area, hydrology of the area is to be studied in detail which is having direct bearing on the under groundwater. Hence a comprehensive study has been carried out and the outcomes are enumerated in the subsequent paragraphs.

The entire study area forms a part of Tungabhadra basin, down stream catchments. The study area is mainly drained by Kaniga nala and Nari nala and finally these two nala became tributaries to Daroji kere. The overflow of Daroji kere meets Tungabhadra at 25 Km towards North. Hagari and Chikka hagari are other tributaries to Tungabhadra which are not falling in the study area.

There are 15 minor and 2 major tanks are in Santur taluk. Daroji is one major tank with 1790 acres of command area with maximum water holding capacity of 788.28 Mcft located at 5 km in the north. Another one is man made exclusively meant for plant feed water located at south of the plant.

High level lined Tungabhadra irrigation canal is passing at about 8 km north of the plant site. The let out water from Tungabhadra dam to Andhra Pradesh flows in this canal for 8 to 9 months in a year with an average height of water column ranging from 2 to 3 meter. This water head influences the groundwater in the down gradient and in the vicinity of the canal to some extent till the groundwater head gets matched with running water head. Nevertheless this canal water is not used for any industrial purpose and it is unaffected by proposed activities. Hence further detailed study about the canal is not detailed in this report.

The climate of the area is interior arid zone and the total rainfall ranges from 331 to 626.7 mm. (Year 1998 to 2005). More than 80% of the rainfall received during the months of July to September from South West monsoon and the balance is equated in North East monsoon.

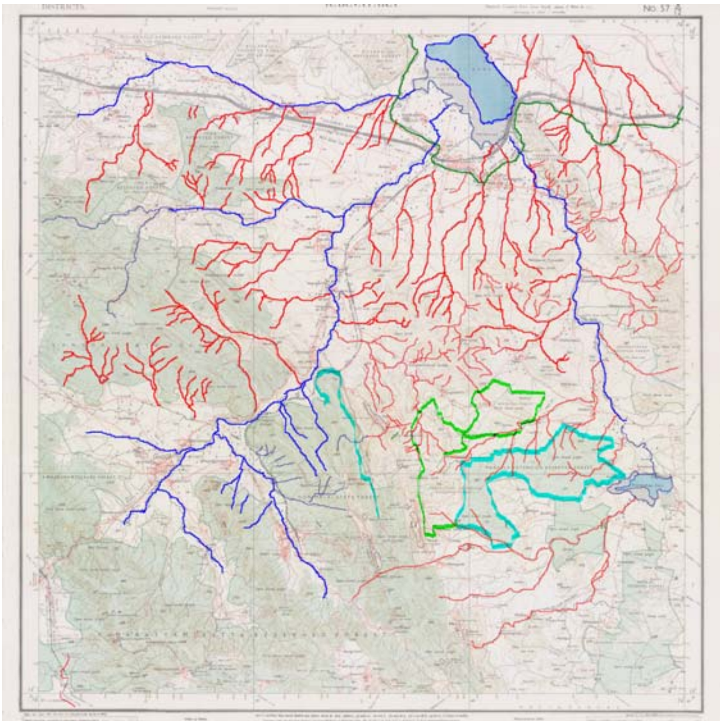
The study region is charecterised by hot and dry summer with temperature raising above 47 ^{0}C during the month of May.

Water shed & drainage:

The study area (10 km radius) drains in to main basin of Tungabhadra river. The plant area is drained in to Daroji lake. The surface water divide exists in the south part of the proposed plant site. There are three numbers of macro level water sheds are observed. All the water sheds are marked by dendritic type of drainge system. It reveals that the area is undulated and because of undulation minor streams are noticed. There are three streams are observed in the study area.

Physiography and drainage:

The location is characterized by two Ist order drainage of Karigana Halla, and Nari Halla which are flowing 800m east and west of the site respectively. The Kanigana Halla flowing South to North and joins Daroji Kare at about 5Km North of the site.
The drainage pattern of the study area has been is shown below. From the map it is evident that area is mostly characterized by Dentritic and intermittently characterised by parallel pattern of drainage. It reveals that the area is highly undulated (hill ranges) and are characterised by dendritic pattern, whereas the area falls in the pediplain portion of the hill range under seasoned (monsoonic) cultivation and it is characterized by parallel type of drainage pattern.



Physiography and drainage

While studying the drainage pattern, it was observed; by and large the study area has a distinct dendritic pattern drainage system owing to development of relief. There are some initial stage drainage impressions are observed in core zone. It indicates that the present plant is located an elevated area and dips to north.

The drainage density at core and buffer zone are as follows:

Location	Drainage density in km/ Sq. km
Core zone	2.3. km/sq.km

Buffer zone	5.1km/ sq km at Kodallu (South of the project site)
Average	3.7 km/sq.km

From the above table, it is ostensible that the drainage density is high in core zone when compared to normal density of 1 to 1.5 km/sq.km should exist in a relief cum undulating region. At bufferzone it is higher but the land use pattern is relatively non flat when compared to core zone. The hydrographs were drawn for the water shed falling in the study area to observe the discharge pattern. It was observed that the area is mainly possessing fan shaped hydrographs. Almost all water sheds in the study area, exhibits fan shaped hydrograph. It implies that the peak discharge of flood will occur relatively longer period during rainy season which may lead to flooding of the area.

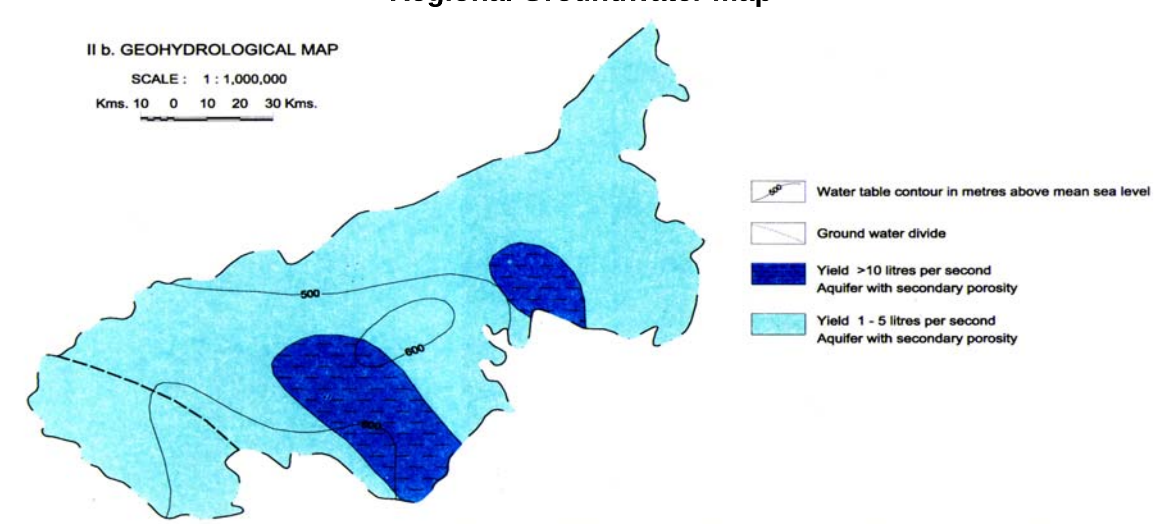
3.2.6 Hydrogeology

Hydrological study of any region is significant mainly for two reasons;

- Impact of the industrial complex on the water regime of the region.
- Optimum utilization of water and safeguards against the water pollution by the industry.

The regional groundwater study for Bellary district was carried out by GSI. The regional groundwater map as drawn by GSI is shown below. From the map it can be seen that the plant area falls under fracturred zone and the yield is observed >10 litres per second. A surface water divide was observed at south west of Bellary. In general the groundwater yield in Bellary district is in the range of 1-5 liters per second. A detailed hydrogeological study was carried out for the plant and surround ing area. The details are enumerated in the subsequent paragraphs.

Regional Groundwater map



Source : Central Ground Water Board 1994.

Core zone

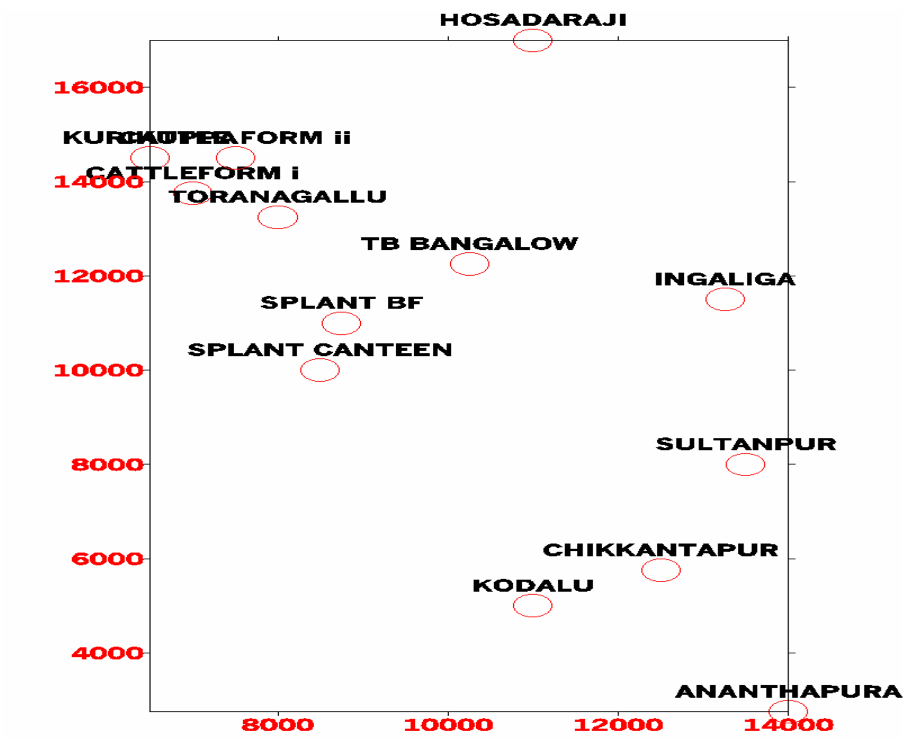
Hydrogeologically the area can be grouped under sedimentary cum metamorphosed rocky terrain overlain by sandy alluvium soil, followed by fractured schist aquifers. In the core zone the top layer consist of clayey - sandy soil.

To understand the groundwater table conditions, attempts have been made to measure the available dugwells at core zone and buffer zone with the intension of establishing groundwater map for the study area. Core zone is flat virgin area and do not have any habitations. However, several bore wells have been installed with in the plant boundary to meet construction water demand. Those well have been identitifed and the water levels have been measured. Dug wells are identified nearer to the proposed site ie at Toranagallu village. The other villages around the site are, Toranagallu, Talur, Vaddu, Basapur, Kurikuppai, Sultanpura and kodallu. Quite handsome numbers of dugwells are identified in these villages. The groundwater levels have been measured from the above village wells and the measured levels are shown below.

Buffer zone:

When compared to core zone, the buffer zone witnessed encouraging and convincing situation. The relief area is endowed with considerable amount of groundwater in water table condition. Obviously the availability of drinking water favors for livable condition and more habitations are noticed in this area. These habitations are mainly dependent of groundwater for their livelihood. Nowadays conducting groundwater study is trouble- some work due to two factors. One is municipal water supply to the habitant and another is depletion of groundwater table to deeper level in the dug wells. In the first case, the water is available at their courtyard, hence most of dug wells are defunct or filled with dirt. Another factor which is impeding the study is, advent of hand bore wells. As rare phenomena in this area both type of wells are in use and the available dug wells were measured to draw the groundwater table. The villagers are also using the hand borewell and dug wells provided by the government. It also reported at (Basapur) that the yield of the wells are in the increasing trend due freshwater stored in the plant feed water tank which is located higher gradient of the dam. The yield was in the range of 1.64 to 2 m^3/minutes before construction of the feed water tank (Mecon's report). The depth of the well was about 5 to 10m. However, in the present condition the groundwater yield along the streams and fracture zones are in the range 4 to 5 m^3/minutes within the depth less than 6m which is almost double of earlier yield. The availability of surface water head in the project plant site is the source for increase in the groundwater yield. The average water level at plant site 3.2 m below groundlevel.

About 19 wells have been inventoried in the buffer zone and data like total depth, depth to water, and their location were collected during the study. The location of the inventoried wells is shown below.



The hydrogeological details of the measured wells are shown in the following table.

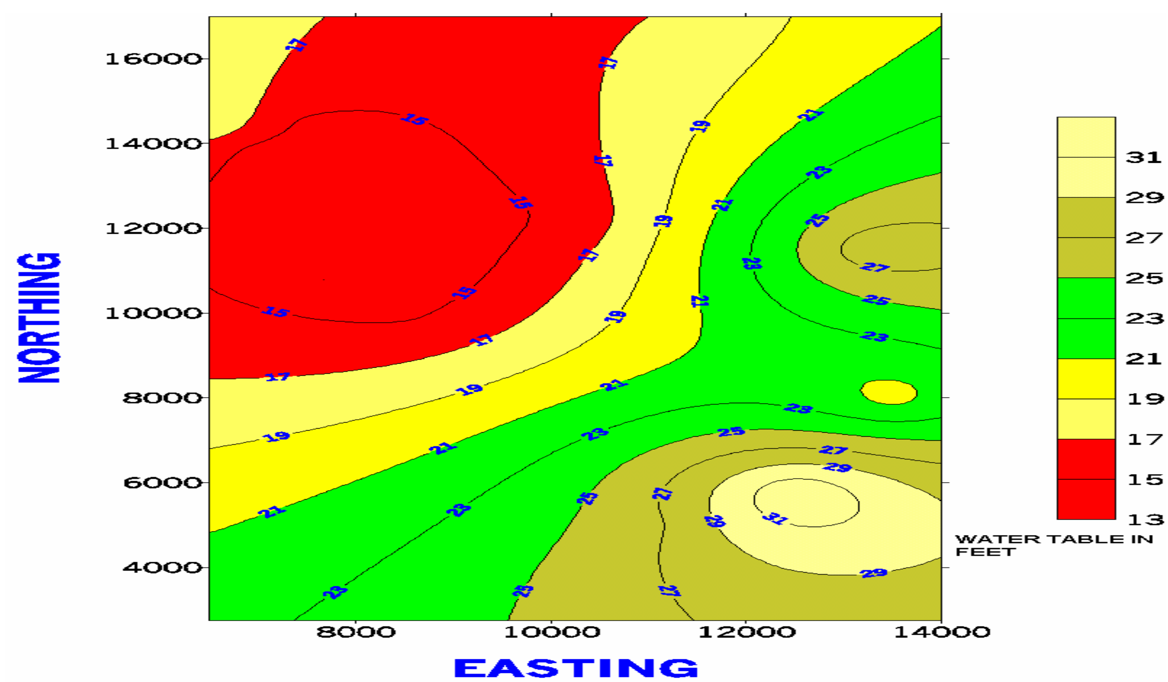
Hydrogeological data of wells inventoried from the surrounding villages

Well No.	Name of the village	Parapet	Height of water	Dia in (m)	Total depth of the well from surface
1	Talur	0.7	7.31	2.1	9.77
2	Talur	0.75	6.15	2.1	12.30
3	Vaddu	GL	9.1	8.5	12.71
4	Vaddu school	0.75	5.8	Not in use	
5	Vaddu	0.75	9.18	2.1	
5	Basapur	GL	5.8	5.0	12.7
6	Kurekuppai	GL	6.2	4 X 6	8.0
7	Kure kuppai Farm house	GL	4.1	6 X 6	5.9
8	High level canal quarters	0.9	8.2	0.9	11.0
9	Toranagallu brick factory	0.8	3.8	10 X 10	6.0

Well No.	Name of the village	Parapet	Height of water	Dia in (m)	Total depth of the well from surface
10	Toranagallu	GL	4.3	8.3	9.1
11	Sultanpura	GL	4.6	6 X 4	8.1
12	Chickanthapura	0.7	6.2	8.3	10.5
13	Kodallu	GL		8.3	12.0
14	Horticulture form Torannagallu	GL		7	4.8
15	Daroji old	0.73	Not in use	2.3	11.2
16	Daroji new	0.73	5.3	Dia	8.3
17	Daroji new	0.73	6.3	2.3	12.7

All values are in m. GL- Ground level

In each village minimum of one, & maximum of three wells were measured in the month of April 2010 . The measured levels were used for construction of the groundwater contour map for the site. From the data, it is evident that the water level ranges from 3 to 12.7 m bgl and maintains static flow. The ground water contour map has been shown below.



Even though the measured wells are regularly used for domestic consumption, there is no remarkable fluctuation in the water table is observed/reported in terms of draw down is concerned. Several villagers in the study area reported that fluctuation in water table do occur in advent of summer. It general, the measurement of water table level indicates that in most of the dug wells in the down stream villages wrt JSW plant the aquifer is recharged immediately by the interconnectivity of the rocks and higher storitivity due to existence of unlined feed water tank constructed by plant authorities. The aquifers are mostly composed of fragmented weathered rocks. The pheratic aquifer provides sufficient yield which meets the villager's day to day and agriculture consumption and it is occurring at 6 to 8 m depth. This may be a result of (i) Continuous recharge of groundwater either by rain or by the streams or by the plant feed water tank (ii) Extraction/draft of groundwater is lesser than the recharge quantity (iii) Thin population and non use of groundwater for agro and horticulture.

The reported water levels during the study period vary from 4m bgl to 9.1m bgl depending on the ground elevation. The water table is observed at about average depth of 3.2m in the project area and almost the same height is maintained all over the plant. Although, a minimum of one and maximum of three wells were measured in each village of the study area with the intension to establish groundwater contour map, presence of sudden relief of ground up to 10m and presence of nala on both sides of the plant creates problem in developing continuity of groundwater contour. These intermediate elevations/troughs of ground impeding the groundwater map of the study area. However, with minor correction a groundwater contour map was drawn to understand the movement of groundwater.

Pump test

To evaluate the aquifer chrecteristics of the plant area and to fix up economic discharge a pumping test was conducted in front of adminstrative block. The test was conducted for six hours and the test was repeated for two times. The static level of the well was at 3.2 m.The Q (discharge) was maintained at 210 litres per minute. The depth of the bore well is 60m. The pump was installed at a depth of 50 m. After six hours pumping the total draw down was in the rancge of 3 to 3.2m from the static level. The observed levels have been plotted in a semi log sheet. The estimated transmissivity of aquifer at plant site is 87 m^2/day which is good in hard rock area.

Total annual replenishable recharge

The study area reveals that the proposed expansion of plant is located on the immediate catchment's vicinity of Daroji lake and in Tungabhadra river. It has been planned to provide suitable intake facilities at the feed water tank to tap additional water requirements of the plant. The study area water shed spread about 3.25 sq km at an average altitude of 480 m above mean sea level. The aquifers are comprised of schist and consolidated formation. The rain fall infiltration method has been used for calculating replenishable recharge of groundwater. The study area comprised of one main and complete watershed and two minor incomplete water sheds. The annual replenishable recharge was calculated for 170 Sq km as per CGWB rainfall infiltration method. The following inputs have been considered for estimating TARR,

Annual Rainfall	-	626.7 mm (year 1981- 1977)
Infiltration co – efficient	-	0.09 (0.03 to 0.14 as per CGWB)
Water shed area	-	170 sq.km
Popultion in the water shed	-	5000 (in 10 villages+ town ship)
Per captita consumption	-	200 litres/ day

Influent to basin - Nil

Total annual replenish able recharge = 0.626.7 X 0.09 X 170 sq.km
= 9.56 Million m^3/year

With drawl due to population = 5000 X 200 = 1 00 000 l/ day = 3 65 00 m^3/ yr

Natural discharge by non- monsoon season = 5% on 9.56 Million m^3/year
= 0.47 Mm3

Balance = 9.56 – 0.47 - 0.0365 = 9.05 Million m^3

The stage of groundwater development has been computed as given below.

$$\text{Stage of groundwater development} = \frac{\text{Annual groundwater development}}{\text{Net annual groundwater availability}} \times 100 = \frac{0.0365 \times 100}{9.05} = 0.40\ \%$$

As per CGWB categorization the area falls under safe zone.

Conclusion:

From the hydrological studies the following conclusions are drawn.

1) The existing groundwater is in water table condition encountered at an average depth of 6m to 7m bgl and in pheratic aquifer condition.

2) The pheratic aquifer is semi confined and it is expected that the depth of the aquifer is extended up to 80 m.

3) It has been planned to utilise surface water from Tungabhadra dam for the project. The projected demand is 10,000 m3/hr which will not have any impact on the surface water flow when compared to massive flow and water available in the river.

4) Taping of groundwater is not envisaged for the project hence the existing ground water equilibrium will not be affected due to plant operation.

5) The terrain is favorable for groundwater recharge; hence the authorities are planning for groundwater recharge from the proposed plant structures.

6) The study reveals that project area is located in a replenishable groundwater area.

7) Plant operation may not have any impact on drainage pattern and the existing pattern is expected to remain as it is.

3.2.7 Water Environment

Water quality monitoring was carried out with the following objectives:

- To collect baseline data on existing water quality.
- To assess the impact of the existing JSW outfalls on quality of ground water.
- To assess the raw water quality to be used by the proposed project.
- To assess the impact of the existing JSW solid waste dumping area on ground water quality.

Selection of Sampling Locations

A total of twelve ground water water-sampling locations and four surface water locations were selected for the present study. The ground water sampling locations were selected up gradient and down gradient of JSW plant.

Layout of JSW showing ground & surface water monitoring locations is given in **Drg. No. MEC/Q6S4/11/S2/02**.

Methodology

In order study the existing water quality within the study area, grab samples of water were collected from sixteen (16) locations, as given in **Table 3.9.** Surface water samples were analysed for different parameters as required by CPCB surface water criteria and ground water samples were analysed for different parameters as per IS: 10500. The water samples analysed for different parameters as per American Public Health Association (APHA), 1995 - "Standard Methods for the Examination of Water and Waste Water".

Table 3.9 : Location of Water Monitoring Station

S No	Stn. No.	Location	Type
1	School,Toranagallu	GW 1	Ground Water
2	Talur village	GW 2	Ground Water
3	Vaddu village	GW 3	Ground Water
4	Chickanthapura bore well	GW 4	Ground Water
5	Kodalu bore well water	GW 5	Ground Water
6	Dump site bore well water	GW 6	Ground Water
7	Sultanpura well water	GW 7	Ground Water
8	Kurekuppa well water	GW 8	Ground Water
9	HLC open well	GW 9	Ground Water
10	Narihalla dam	SW 1	Surface Water
11	Guard Pond II	SW 2	Surface Water
12	Konaginaal U/S	SW 3	Surface Water
13	Konaginaal D/S	SW 4	Surface Water
14	Natural stream dump site	SW 5	Surface Water
15	Darojikere tank	SW 6	Surface Water
16	Guard Pond I	SW 7	Surface Water

Results of Ground Water Quality

The results of ground water quality are given in **Table 3.10a & 3.10b**. In the absence of any specific norms for Ground Water Quality, the results have been compared with drinking water specification (BIS: 10500 : 1991). All the parameters at all the nine locations are within the respective norms for different parameters except for dissolved solids which is exceeding the desirable limits at some locations but are within permissible norms in the absence of alternate source.

Table 3.10a: Ground Water Quality

Sl. No.	CHARACTERISTICS	* Norms	* Norms	Results				
		1	2	GW1	GW2	GW3	GW4	GW5
Essential characteristics								
1	Colour, Hazen units, Max.	5	25	<5	<5	<5	<5	<5.0
2	Odour	Unobj.	-	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.
3	Taste	Agreeable	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity, NTU, Max.	5	10	<5	<5	<5	<5	<5.0
5	pH Value	6.5 to 8.5	No relaxation	7.68	7.37	8.23	8.1	7.54
6	Total Hardness (as CaCO3), mg/l, Max.	300	600	248	218	125	139	398
7	Iron (as Fe), mg/l, Max.	0.3	1	0.08	0.08	0.05	0.05	0.07
8	Chloride (as Cl), mg/l, Max.	250	1000	205	170	102	120	158
9	Residual Free Chlorine, mg/l, Min.	0.2	-	Nil	Nil	Nil	Nil	Nil
Desirable Characteristics								
10	Dissolved Solids mg/l, Max.	500	2000	849	743	426	475	522
11	Calcium (as Ca), mg/l, Max.	75	200	59	52	30	33	69
12	Copper (as Cu), mg/l, Max.	0.05	1.5	<0.01	<0.01	<0.01	<0.01	<0.01
13	Manganese (as Mn), mg/l, Max.	0.1	0.3	<0.01	<0.01	<0.01	<0.01	<0.01
14	Sulphate (as SO4), mg/l, Max.	200	400	34	30	33	38	-
15	Nitrate (as NO3), mg/l, Max.	45	100	4.2	4	3.2	3.4	4.4
16	Fluoride (as F), mg/lit, max	1.0	1.5	0.06	0.02	0.04	0.04	0.02
17	Phenolic Compounds (as C6 H5OH), mg/l, Max	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
18	Mercury (as Hg), mg/l, Max.	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001
19	Cadmium (as Cd), mg/l, Max.	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
20	Selenium (as Se), mg/l, Max.	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
21	Arsenic (as As), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
22	Cyanide (as CN), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
23	Lead (as Pb), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
24	Zinc (as Zn), mg/l, Max.	5	15	<0.01	<0.01	<0.01	<0.01	<0.01
25	Anionic detergent (as MBAS) mg/l, Max.	0.2	1	Nil	Nil	Nil	Nil	Nil
26	Chromium (as Cr6 +), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
27	Mineral oil mg/l, Max	0.01	0.03	Nil	Nil	Nil	Nil	Nil
28	Alkalinity (as CaCO3) mg/l, Max.	200	600	116	88	58	66	-
29	Boron, mg/l, Max.	1	5	<0.1	<0.1	<0.1	<0.1	<0.1

* Norms as per Drinking Water – Specification - IS: 10500 (1991) and amendment no. 1, 1993

1. Requirement (desirable limits); 2.Permissible limits in the absence of alternate source

Table 3.10b: Ground Water Quality

Sl. No.	CHARACTERISTICS	* Norms	* Norms	Results			
		1	2	**GW6**	**GW7**	**GW8**	**GW9**
Essential characteristics							
1	Colour, Hazen units, Max.	5	25	<5	<5	<5	<5
2	Odour	Unobj.	-	Unobj.	Unobj.	Unobj.	Unobj.
3	Taste	Agreeable	-	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity, NTU, Max.	5	10	<5	<5	<5	<5
5	pH Value	6.5 to 8.5	No relaxation	7.58	7.43	7.51	8.1
6	Total Hardness (as CaCO3), mg/l, Max.	300	600	194	218	117	193
7	Iron (as Fe), mg/l, Max.	0.3	1	0.07	-	-	-
8	Chloride (as Cl), mg/l, Max.	250	1000	69	177	97	158
9	Residual Free Chlorine, mg/l, Min.	0.2	-	Nil	Nil	Nil	Nil
Desirable Characteristics							
10	Dissolved Solids mg/l, Max.	500	2000	320	742	398	664
11	Calcium (as Ca), mg/l, Max.	75	200	46	52	28	46
12	Copper (as Cu), mg/l, Max.	0.05	1.5	<0.01	<0.01	<0.01	<0.01
13	Manganese (as Mn), mg/l, Max.	0.1	0.3	<0.01	Nil	Nil	Nil
14	Sulphate (as SO4), mg/l, Max.	200	400	-	38	34	42
15	Nitrate (as NO3), mg/l, Max.	45	100	NIL	4.2	4.9	5.1
16	Fluoride (as F), mg/lit, max	1.0	1.5	0.02	0.08	0.09	0.06
17	Phenolic Compounds (as C6 H5OH), mg/l, Max	0.001	0.002	<0.001	<0.001	<0.001	<0.001
18	Mercury (as Hg), mg/l, Max.	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001
19	Cadmium (as Cd), mg/l, Max.	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01
20	Selenium (as Se), mg/l, Max.	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01
21	Arsenic (as As), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
22	Cyanide (as CN), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
23	Lead (as Pb), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
24	Zinc (as Zn), mg/l, Max.	5	15	<0.01	<0.01	<0.01	<0.01
25	Anionic detergent (as MBAS) mg/l, Max.	0.2	1	Nil	Nil	Nil	Nil
26	Chromium (as Cr6 +), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01
27	Mineral oil mg/l, Max	0.01	0.03	Nil	Nil	Nil	Nil
28	Alkalinity (as CaCO3) mg/l, Max.	200	600	-	100	57	88
29	Boron, mg/l, Max.	1	5	<0.1	<0.1	<0.1	<0.1

* Norms as per Drinking Water – Specification - IS: 10500 (1991) and amendment no. 1, 1993

2. Requirement (desirable limits); 2.Permissible limits in the absence of alternate source

Results of Surface Water Quality

The result of Surface Water quality is given in **Tables 3.10c**. The surface water quality was compared with CPCB norm for surface water, as given in **Table 3.10d.** The surface water quality is within the norms for Classes A. The BOD levels in all the samples were exceeding the norm for Class C (3mg/l max.).

Table 3.10c: Surface Water Quality

Sl. No.	Parameters	Units	SW1	SW2	SW3	SW4	SW5	SW6	SW7
1	pH	-	7.68	7.62	8.0	8.0	7.8	7.76	7.97
2	Colour	Hazen Units	<5	<5	<5	<5	<5	20	<5
3	Odour	As perceived	UO	UO	UO	UO	UO	UO	UO
4	Turbidity	NTU	15	10	5	5	5	20	15
5	Temperature	°C	26.5	26.4	27	27.3	27.1	26.8	27
6	Solids								
	a. Volatile	mg/l	-	-	-	-	-	14	14
	b. Suspended	mg/l	16	15	5	5.9	6.1	32	66
	c. Dissolved	mg/l	510	539	508	462	546	134	528
	d.Total solids	mg/l	526	554	513	468	552	166	594
7	Oil & Grease	mg/l	Nil	0.17	Nil	Nil	Nil	Nil	0.24
8	Dissolved Oxygen	mg/l	5.4	5.4	5.6	5.5	5.4	5.3	5.4
9	Residual Chlorine	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil
10	BOD - 5 days, 20°C	mg/l	5	6	5	5	6	5	6
11	COD	mg/l	33	64	38	49	59	37	85
12	Nitrogen								
	a. Ammonical	mg/l	-	-	-	-	-	-	-
	b. Total Kjeldhal	mg/l	-	-	-	-	-	-	-
	Free Ammonia	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil
13	Chloride (as Cl)	mg/l	127	164	123	113	132	34	122
14	Fluoride (as F)	mg/l	0.19	0.12	0.05	0.06	0.05	0.09	0.04
15	Sulphates (as SO_4)	mg/l	36	148	46	49	52	20	76
16	Sulphides (as S)	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil
17	Nitrates (as NO_3)	mg/l	4.8	6	3.2	3.4	3.2	6.2	3.8
18	Cyanides (as CN)	mg/l	Nil	Nil	Nil	Nil	Nil	Nil	Nil
19	Dissolved Phosphates (as PO_4)	mg/l	0.11	0.18	0.14	0.16	0.16	0.14	0.14
20	Insecticides/Pesticides	mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent
21	Phenols (as C_6H_5 OH)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22	Chromium (as Cr)								
	a. Hexavalent	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	b. Total	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Sl. No.	Parameters	Units	SW1	SW2	SW3	SW4	SW5	SW6	SW7
23	Iron (as Fe)	mg/l	0.11	0.12	0.14	0.14	0.13	0.18	0.08
24	Copper (as Cu)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Selenium (as Se)	mg/l	<0.01	<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	<0.01
27	Cadmium (as Cd)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Nickel (as N)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
29	Boron (as B)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
30	Mercury (as Hg)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Lead (as Pb)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Zinc (as Zn)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
33	Percent Sodium	%	32.48	34.68	32.3	33	34.2	31.14	33.68

Table 3.10d: Central Pollution Control Board (CPCB) Surface Water Quality Criteria

SN	Parameters	Class A	Class B	Class C	Class D	Class E
1.	pH	6.5–8.5	6.5–8.5	6.0-9.0	6.5–8.5	6.5–8.5
2.	Dissolved oxygen (as O_2), mg/l, min	6	5	4	4	-
3.	BOD, 5 days at 20° C, max	2	3	3	-	-
4.	Total coliform organism, MPN/100 ml, max	50	500	5000	-	-
5.	Free ammonia (as N), mg/l, max	-	-	-	1.2	-
6.	Electrical conductivity, μmhos/cm, max	-	-	-	-	2250
7.	Sodium absorption ratio, max.	-	-	-	-	26
8.	Boron (as B), mg/l, max.	-	-	-	-	2

Class A : Drinking water source without conventional treatment but after dis-infection
Class B : Outdoor bathing (organised)
Class C : Drinking water source after conventional treatment and after dis-infection
Class D : Propagation of Wild life and Fisheries
Class E : Irrigation, Industrial Cooling, and Controlled Waste Disposal
Below E : Not meeting A, B, C, D & E Criteria

3.2.8 Soil

The soil sampling locations were selected with the following objectives:

- To assess the background / baseline soil quality of the region.
- To assess the impact (if any) of existing JSW Plant air emissions, effluent outfall and

solid waste on soil of the study area.

A total of four sampling locations were selected for the study. The selected locations are given in **Table 3.11**.

Table 3.11: Selection of Soil Sampling Locations

Sample No.	Location	Type of Land
S1	Village Vaddu	Agricultural land
S2	Village Toranagallu	Agricultural land
S3	Proposed site	Barren land
S4	Village Talur	Agricultural land

Methodology

In order to have an idea about the baseline soil quality in the study area, samples of topsoil were collected from the four locations once during the study period. The soil samples were marked, brought to laboratory, air-dried and analysed for different physico-chemical characteristics.

Results of Soil Analysis

The results of analysis are given in **Tables 3.12, 3.13, 3.14** and **3.15**. Soil pH plays a very important role in the availability of nutrients. The composition of the soil microbial community is also dependent on the soil pH. In the study area the soil samples had neutral to alkaline pH. The alkaline pH in collected soil samples from different locations indicates that there is no acidic impact on soil due to of industrial activity.

Electrical conductivity is a measure of the concentration of soluble salts and ionic activity. Salt concentration is directly proportional to the osmotic pressure, which governs the process of osmosis in the soil – plant system. The electrical conductivity in all the soil samples ranged from 0.20ms/cm (S1) to 0.31 ms/cm (S2).

Table 3.12: Physico-Chemical Properties of Soils

Sample No.	Results						
Characteristics	Type of Soil	Colour	Texture	Bulk Density (gm/cc)	Water Holding Capacity (%)	PH (1: 5 ratio)	Electrical Conductivity (ms/cm)
S1	Agricultural	Reddish Brown	ClayeyLoam	1.30	53.3	7.1	0.20
S2	Agricultural	Brown	Loam	1.34	55	8.5	0.31
S3	Barren	Blackish	Loam	1.297	61.3	7.5	0.23
S4	Agricultural	Reddish brown	Loam	1.424	52.5	8.5	0.30

Phosphorus and Nitrogen are limiting nutrients. In the tested soil samples, availability of Nitrogen is high in S1 & S4 and Phosphorus is high in S1, medium in S2 and S4 and low in S3. Potassium is high in S1 & S4 and low in S2 & S3. Organic carbon content is low to medium in all the samples. The nutrient content of soil from different locations is also not showing any major deviation among the collected soil samples, thus indicating that there is no impact on nutrient contents of soil due to industrial activity.

Table 3.13: Available Major Nutrients in Soil

Nutrients and Ratings	Results			
	S1	**S2**	**S3**	**S4**
Organic Carbon (%)	0.69	0.61	0.41	0.65
Organic Matter (%)	1.19	1.05	0.71	1.12
Available Nitrogen (kg/ha)	566	323	276	593
Available Phosphorus (kg/ha)	32	20	06	24
Available Potassium (kg/ha)	481	44	22	347

Ratings:
Organic Carbon : <0.50 – Low; 0.50 to 0.75 – Medium; >0.75 – High
Available Nitrogen : <280 – Low; 280 to 560 – Medium; >560 – High
Available Phosphorus : <10 – Low; 10 to 25 – Medium; >25 – High
Available Potassium : <120 – Low; 120 to 280 – Medium; >280 – High

The results show that the Calcium and Magnesium constitutes the bulk of exchangeable cations in the tested soil samples whereas levels of exchangeable sodium and potassium are relatively low. This indicates that the collected soil samples are not showing any signs of increase in alkalinity (Sodium / Potassium) due to industrial activity.

Table 3.14: Exchangeable Cations

Sample No.	Results				
	Calcium (meq/100 gm)	Magnesium (meq/100 gm)	Sodium (meq/100 gm)	Potassium (meq/100 gm)	Total Bases (meq/100 gm)
S1	43.77 (90.32)	3.89 (8.03)	0.60 (1.24)	0.2 (0.41)	48.46
S2	115.16 (81.89)	24.84 (17.66)	0.40 (0.28)	0.23 (0.16)	140.63
S3	128.09 (93.67)	7.70 (5.63)	0.70 (0.51)	0.25 (0.18)	136.74
S4	108.58 (82.39)	22.39 (16.99)	0.59 (0.45)	0.23 (0.17)	131.79

Values in ( ) give the % of respective cation of the total cations.

Soil micro–nutrients also play an important role in plant growth and can act as limiting nutrients. Soil micro–nutrient analysis can be employed as a diagnostic tool for predicting the possibility of deficiency of a nutrient and the profitability of its application. For this it is necessary to fix the critical limits. The critical limit of a micro–nutrient is that content of extractable nutrient at or below which plantation practised on it will produce a positive response to its application. Iron, Copper and Zinc is high in all the tested soil samples and is crossing the critical limit. Iron is within the critical limits in twoof the soil samples. In the study area, the level of some micro–nutrients are above the critical limits. Hence, it implies that no external application of micro-nutrients is required (fertilisers) for good plant growth.

Table 3.15: Available Micronutrients

Sample No.	Results (in mg/kg)			
	Iron (as Fe)	Copper (as Cu)	Zinc (Zn)	Manganese (Mn)
S1	5.5	2.2	2.8	5.2
S2	5.8	1.9	5.2	4.1
S3	6.6	1.9	5.7	4.1
S4	6.3	2.4	1.9	4.5
Critical Limits (mg/kg)				
Iron: 4.5 – 6.0	Copper: 0.20 – 0.66	Zn: 0.50 – 0.65		

3.2.9 Biological Environment

Objectives of the study

The present study was undertaken with the following objectives:

- To assess the nature and distribution of vegetation in and around the project site within the study area;
- To assess the type of wild animals within the study area;
- To assess the biodiversity of natural system present in the study area;
- To ascertain migratory routes of fauna and possibility of breeding grounds within the study area;
- To assess the trophic status of the water bodies present in the study area.

Methodology of Ecology Study

The study area taken for the study is 10 km radius. The different methods adopted were as follows:

- Inventorisation of flora / fauna: The list of Flora and Fauna found in the Forest Division (Bellary) was collected from the Working Plan (2003 – 2004 to 2012 – 2013) of the division for reference. The list of flora and fauna found in the region was prepared by conducting field survey and by discussions with concerned Forest Department personnel using the list available in the Working Plan as a base.
- Generation of primary data through systematic ecological studies: The phyto-sociology of the vegetation (covering frequency, density, abundance and species diversity) in the forest areas falling in the study area was determined by conducting field studies in selected areas (by laying suitable sizes of quadrat).

- Discussion with local people so as to elicit information about local plant and animals.

The present study is based on field studies conducted during summer season March to May 2010.
The study area falls under **Semi Arid** climate region. The area is sparsely populated and is undulated and interspersed with small hillocks and hilly terrain ranging from W to NE, and from NW to N about 2.5 to 10 km from the project centre. The study area contains some forest patches. The newly declared "Daroji Bear Sanctuary" boundary is 6 km in NW direction from the project centre. The proposed expansion is planned within the existing plant premises of the JSW premises. The biotic environment can be described under following heads. The biotic environment can be described under following heads.

1. **Project Site:** The project site can be described under two heads:
   - Site of the existing plant premises

2. **Study Area:** The study area can further be described as per the type of land use**.**
   i) Agricultural land
   ii) Waste land
   iii) Vegetation around Human Settlements
   iv) Forest area
   v) Wild life and Avi-fauna
   vi) Water Bodies
   vii) Location of National Parks & Wildlife sanctuaries
   viii) Endangered Species

1. Project Site

There is no forest land involved within the project site. The ecological features of the project site can be described under following heads:

i) Plantations

The existing project has undertaken extensive plantations along road, different shops, in vacant spaces and in township. A total of 1264 Acres (511.53 ha) of green belt has already been planted. The species planted are given in **Table 3.16a**.

Table 3.16a: List of trees/shrubs planted with the project premises

SN	Scientific Name	Family	Habbit	Common Name
1	*Acacia auriculiformis*	Mimisideae	Tree	Bengali jali
2	*Acacia ferruginia*	Mimisideae	Tree	Banni
3	*Acacia mangium*	Fabaceae	Tree	Mangium
4	*Acacia nilotica*	Mimisideae	Tree	Karijali, Babool
5	*Achras zapota*	Sapotaceae	Tree	Sapota
6	*Adenanthera pavonina*	Fabaceae	Tree	Coral-wood tree
7	*Aegle marmelos*	Rutaceae	Tree	Bilvapatre; Bela

SN	Scientific Name	Family	Habbit	Common Name
8	*Ailanthus excelsa*	Simaroubaceae	Tree	Maddi / Haven Tree
9	*Albezziz lebbeck*	Mimisideae	Tree	Bage, Siris
10	*Alstonia scholaris*	Apocynaceae	Tree	Devils Tree
11	*Annona squamosa*	Anonaceae	Tree	Seethapal
12	*Anthocephalus cadamba*	Rubiaceae	Tree	Kadamb
13	*Areca catechu*	Piperaceae	Tree	Betul Nut
14	*Arecastrum romanzoffianum*	Arecaceae	Tree	Queen palm
15	*Artocarpus heterophyllus*	Moraceae	Tree	Jack Fruit
16	*Azadirachta indica*	Meliaceae	Tree	Neem
17	*Bauhinia blakeana*	Caeslpinnaceae	Tree	Orchid tree
18	*Bauhinia purpuria*	Caeslpinnaceae	Tree	Sannabasavanpada
19	*Bauhinia tomentosa*	Caeslpinnaceae	Tree	Yellow Bauhinia
20	*Bignonia megapotamica*	Bignoniaceae	Tree	Trumpet Flower
21	*Bixa orellana*	Bixaceae	Tree	Aploppas
22	*Bombax ceiba*	Bombacaceae	Tree	Red Silk Cotton Tree
23	*Brassaia actinophylla*	Araliaceae	Tree	Umbrella / Octopus Tree
24	*Brownea grandiceps*	Caesalpiniaceae	Tree	Scarlet Flame Bean
25	*Butea frondosa*	Fabaceae	Tree	Dhak
26	*Callistemon lanceolatus*	Myrtaceae	Tree	Bottle Brush
27	*Canangium odoratum*	Annonaceae	Tree	Perfume Tree
28	*Caryota urens*	Arecaceae	Tree	Fish Tail Palm
29	*Cassia fistula*	Caesalpiniaceae	Tree	Amaltas
30	*Cassia glauca*	Caesalpiniaceae	Tree	Glaucous Cassia
31	*Cassia grandis*	Caesalpiniaceae	Tree	Pink / Coral Shower
32	*Cassia javanica*	Caesalpiniaceae	Tree	Apple Blossom Tree
33	*Cassia marginata*	Caesalpiniaceae	Tree	Red Cassia
34	*Cassia renigera*	Caesalpiniaceae	Tree	Pink Cassia
35	*Cassia siamea*	Caesalpiniaceae	Tree	Kassod Tree
36	*Casuarina equisetifolia*	Casuarinaceae	Tree	Casurina
37	*Ceiba pentandra*	Malvaceae	Tree	The Silk Cotton
38	*Citrus latifolia*	Rutaceae	Tree	Mosambi
39	*Citrus lemon*	Rutaceae	Tree	Nibu
40	*Citrus maxima*	Rutaceae	Tree	Pomello
41	*Citrus sinensis*	Rutaceae	Tree	Kinnow Orange
42	*Coccos nucifera*	Arecaceae	Tree	Coco Palm
43	*Colvillea racemosa*	Caesalpinioideae	Tree	Colville's glory
44	*Cordia myxa*	Boraginaceae	Tree	Lasora
45	*Cordia sebastiana*	Boraginaceae	Tree	Mexican Jumping Bean
46	*Couroupita guianensis*	Lecythidaceae	Tree	Nagalinga Tree
47	*Dalbergia latifolia*	Fabaceae	Tree	Rosewood
48	*Dalbergia sissoo*	Fabaceae	Tree	Sisham

SN	Scientific Name	Family	Habbit	Common Name
49	*Delonix regia*	Fabaceae	Tree	Gulmohar
50	*Dolichandrone platycalyx*	Bignoniaceae	Tree	Nile Tulip
51	*Erythrina indica*	Fabaceae	Tree	Coral Tree
52	*Erythrina variegata*	Fabaceae	Tree	Indian Coral Tree
53	*Eucalyptus spp.*	Myrtaceae	Tree	Nilagiri
54	*Ficus bengalensis*	Moraceae	Tree	Aala
55	*Ficus benjamina*	Moraceae	Tree	Weeping Fig
56	*Ficus carisa*	Moraceae	Tree	Common Fig
57	*Ficus elastica*	Moraceae	Tree	Rubber plant
58	*Ficus glomerata*	Moraceae	Tree	Atti
59	*Ficus infectoria*	Moraceae	Tree	Kari basari
60	*Ficus krishnae*	Moraceae	Tree	Krishna's Fig
61	*Ficus obpyramidata*	Moraceae	Tree	Ficus King
62	*Ficus religiosa*	Moraceae	Tree	Arali, Peepal
63	*Grevillea robusta*	Proteaceae	Tree	Silver Oak
64	*Hardwikia binata*	Caesalpiniaceae	Tree	Anjan
65	*Hebe sp*	Scrophulariaceae	Shrub	Hebbevu
66	*Jacaranda mimosifolia*	Bignoniaceae	Tree	Jacaranda
67	*Jatropha sp*	Euphorbiaceae	Shrub	Budhas belly
68	*Kigelia pinnata*	Bignoniaceae	Tree	Sausage Tree
69	*Lagerstroemia flos-reginae*	Lythraceae	Tree	Lagerstroemia
70	*Lagerstroemia thorelli*	Lythraceae	Tree	Pride of India
71	*Leucaena leucocephala*	Mimoseae	Tree	Subabool
72	*Madhuca indica*	Sapotaceae	Tree	Mauhua
73	*Malpighia sp*	Malpighiaceae	Tree	Barbados cherry
74	*Mangifera indica*	Anacardiaceae	Tree	Mango
75	*Melaleuca sp.*	Myrtaceae	Shrub	Australian tea
76	*Michelia Champaka*	Magnoleaceae	Tree	China sampige
77	*Millettia ovalifolia*	Fabaceae	Tree	Millettia
78	*Millingtonia hortensis*	Bignoniaceae	Tree	Tree Jasmine
79	*Mimusops elengi*	Sapotaceae	Tree	Bakul
80	*Moringa oleifera*	Moringaceae	Tree	Saijan / Nugge
81	*Muntingia calabura*	Elaeocarpaceae	Tree	Singapore Cherry
82	*Murraya exotica*	Rutaceae.	Tree	Kamayani / Curry leaves
83	*Nyctanthes arbor-tris-tris*	Oleaceae	Tree	Parijat
84	*Parkia biglandulosa*	Fabaceae	Tree	Badminton Ball Tree
85	*Peltophorum pterocarpum*	Caesalpiniaceae	Tree	Peltophorum
86	*Phyllanthus emblica*	Euphorbiaceae	Tree	Amla
87	*Phyllostachys aurea*	Gramineae	Woody Grass	Golden Bamboo
88	*Pithecellobium dulce*	Mimosaceae	Tree	Sweet Tamarind

SN	Scientific Name	Family	Habbit	Common Name
89	*Plumeria alba*	Apocynaceae	Tree	Catterpilar Tree
90	*Plumeria rubra var. acutifolia*	Apocynaceae	Tree	Champa
91	*Polyalthia longifolia*	Annonaceae	Tree	Druping Ashok
92	*Pongamia pinnata*	Papilionaceae	Tree	Honge, Kanige
93	*Pritchardia sp.*	Arecaceae	Tree	Pritchardia Palm
94	*Psidium guajava*	Myrtaceae	Tree	Guava
95	*Pterospermum acerifolium*	Sterculiaceae	Tree	Kanak Champa
96	*Punica granatum*	Puniacaceae	Shrub	Pomegranate / Anar
97	*Putranjiva roxburghii*	Euphorbeaceae	Tree	Jaiputa
98	*Ravenala madagascariensis*	Strelitziaceae	Tree	Travellers Palm / Tree
99	*Roystonea regia*	Arecaceae	Tree	Royal Palm
100	*Samanea saman*	Mimosaceae	Tree	Rain Tree
101	*Santalum album*	Santalaceae	Tree	Sandal Wood Tree
102	*Sesbania grandiflora*	Papilionaceae	Tree	Corkwood Tree
103	*Spathodea campanulata*	Bignoniaceae	Tree	Spathodia
104	*Sterculia alata*	Sterculiaceae	Tree	Buddha Coconut
105	*Sterculia colorata*	Sterculiaceae	Tree	Scarlet Sterculia
106	*Swietenia macrophylla*	Meliaceae	Tree	Mahogany
107	*Syzigium jambolana*	Myrtaceae	Tree	Jamun
108	*Tabebuia argentea*	Bignoniaceae	Tree	Yellow Tecoma
109	*Tabebuia avalendae*	Bignoniaceae	Tree	Tabebuia
110	*Tabebuia rosea*	Bignoniaceae	Tree	Pink Tecoma
111	*Tamarindus indica*	Caesalpinaceae	Tree	Hunse
112	*Tectona grandis*	Verbinaceae	Tree	Teak
113	*Termanilaia catapa*	Combretaceae	Tree	Badam
114	*Terminalia arjuna*	Combretaceae	Tree	Arjun / Holematti
115	*Thespesia populnea*	Malvaceae	Tree	Tulip Tree
116	*Zizyphus mauritiana*	Rhamnaceae	Tree	Indian jujube

ii) Waste land

Wasteland has developed in the areas where the soil conditions are poor and under high biotic pressure. The rocky outcrops and adjacent slopes where soil depth is not appropriate to support plant growth are also commonly seen in the area. All such areas are either without any vegetation or are covered with species like Lantana sp., Calotropis spp, Croton sp., Zyziphus sp., Leonotis sp., Xanthium straumarium, Parthenium sp., Prosopis sp. etc.

2. Study Area

The study area covers 10km radius around the project site centre. The area exhibits an undulated topography with varying elevations from 442m to 926m above Mean Sea Level

(MSL). The study area can roughly be divided in to, Hillocks and undulated plain areas. The former is either barren or covered with scanty plant growth shrubby in appearance. Most of the hillocks covering scanty shrubby plant growth are the Reserved Forests classified as **Southern Tropical Thorn Forests** but excessive biotic influences have caused retrogressed to various stages of degradation. The hillock ranges in elevation from 500m to 800m above Mean Sea Level (MSL), with highest peak up to 926m. The undulated plains are best utilized for paddy cultivation during kharif season. The plant species commonly found in the forests in the study area is given in **Table 3.16b**.

Table 3.16b: List of plants growing in study area

Botanical Name	Family	Habitat	Local Name
Abrus precatorius	Faboideae	Tree	Gulganji
Acacia auriculiformis	Mimisideae	Tree	Bengali jali
Acacia catechu	Mimisideae	Tree	Kaggali
Acacia chundra	Mimisideae	Tree	Kempu jali
Acacia ferruginia	Mimisideae	Tree	Banni
Acacia leucpphloea	Mimisideae	Tree	Bili jali
Acacia nilotica	Mimisideae	Tree	Karijali, Babool
Acacia senegal	Mimisideae	Tree	Mugli
Aegle marmelos	Rutaceae	Tree	Bilvapatre; Bela
Agave sisalana	Liliaceae	Shrub	Kattale, Sisal fibre
Ailenthus excelsa	Meliaceae	Tree	Helarimara, Kudrebevu
Albezzia procera	Mimisideae	Tree	Beltai, Safed Siris
Albezziz amra	Mimisideae	Tree	Tugli
Albezziz lebbeck	Mimisideae	Tree	Bage, Siris
Albezziz odoratissma	Mimisideae	Tree	Bilwara
Aloe vera	Liliaceae	Shrub	Lolesara / Katadi
Annona squamosa	Anonaceae	Tree	Seethapal
Anogeissus latifolia	Combretaceae	Tree	Dindiga
Achras zapota	Sapotaceae	Tree	Chicku; Sapota
Azadirachta indica	Meliaceae	Tree	Bevu
Bambusa arundinaceae	Poaceae	Woody Grass	Bamboo
Bauhinia purpuria	Caeslpinnaceae	Tree	Sannabasavanpada
Bauhinia racemosa	Caeslpinnaceae	Tree	Sannabasavanpada
Bombax malabaricum	Bombaceae	Tree	Buruga
Boswellia serrata	Burseraceae	Tree	Dhupa
Buchnania latifolia	Anacardiaceae	Tree	Malli, Chiraonji
Butea monosperma	Papilionaceae	Tree	Muttuga
Calotropis spp	Asclepiadaceae	Shrub	Madar
Carica papaya	Carucaceae	Shrub	Papaya
Carissa carandus	Apocynaceae	Shrub	Kavale
Cassia auriculata	Caesalpiniacea e	Shrub	Thangadi

Botanical Name	Family	Habitat	Local Name
Cassia fistula	Caesalpinaceae	Tree	Kakke
Cassia siamea	Caesalpiniacea e	Tree	Seeme thangadi
Citrus lemon	Rutaceae	Tree	Neembu
Coccos nucifera	Arecaceae	Tree	Narial
Cordia dichotma	Boraginaceae	Tree	Challe / Kalle
Cymbopogan celoratus	Poaceae	Grass	Bodha grass, Bade
Delbergia sissoo	Papillionaceae	Tree	Sissoo
Delonix regia	Caesalpiniacea e	Tree	Gulmohar
Dendrocalamus strictus	Poaceae	W. Grass	Bamboo
Diospyros melanoxylon	Ebenaceae	Tree	Tupra, Tumri
Dodonia viscosa	Sapindaceae	Shrub	Bandarike
Emblica officinalis	Euphorbiaceae	Tree	Neli, Amla
Eucalyptus spp.	Myrtaceae	Tree	Nilagiri
Feronia limonia (F. elephantum)	Rutaceae	Tree	Bilwar, Wood Apple
Ficus bengalensis	Moraceae	Tree	Aala
Ficus glomerata	Moraceae	Tree	Atti
Ficus infectoria	Moraceae	Tree	Kari basari
Ficus religiosa	Moraceae	Tree	Arali, Peepal
Gmelina arborea	Verbenaceae	Tree	Shivani
Grewia salvitidia	Tiliaceae	Tree	Ulupi
Grewia tiliaefolia	Tiliaceae	Tree	Tadasalu, Jane
Ipomea cornea	Convolvulaceae	Shrub	Behaya
Ixora arborea	Rubiaceae	Tree	Goravi
Lantana camera	Verbenaceae	Shrub	Lantana
Lawsonia inermis	Lythraceae	Shrub	Hena
Mangifera indica	Anacardiaceae	Tree	Mavu, Mango
Melia azadirach	Meliaceae	Tree	Arebevu, Huchbevu
Morinda tinctoria	Rubiaceae	Tree	Maddi
Murraya koenigii	Rutaceae	Shrub	Karibevu
Musa sapientum	Musaceae	Shrub	Banana
Nerium odorum	Apocyanaceae	Tree	Kanagala
Opuntia dillenil	Cactaceae	Shrub	Papaskalli
Parthenium histerophorus	Asteraceae	Shrub	Congres grass
Peltophorum ferrugineum	Caesalpiniacea e	Tree	Peltoforum
Pheonix sylvestris	Palmae	Tree	Ichalu
Polyalthia longifolia	Annonaceae	Tree	Kambada mara
Pongamia pinnata	Papilionaceae	Tree	Honge, Kanige
Prosopis juliflora	Mimosoidae	Shrub	Bellary Jali; Rizar
Samania saman	Mimosoidae	Tree	Rain Tree
Spondias pinnata	Anacardiaceae	Tree	Ambatta

Botanical Name	Family	Habitat	Local Name
Syzizium cumni	Myrtaceae	Tree	Narale
Tamarindus indica	Caesalpinaceae	Tree	Hunse
Woodfordia fruticosa	Lytharace	Tree	Jali
Zizyphus horrida	Rhamnaceae	Tree	Asinaru / Asinagottemullu
Zizyphus jujuba	Rhamnaceae	Tree	Bore
Zizyphus xylopyrus	Rhamnaceae	Tree	Gotte

The ecological features of the study area can be described under following heads:

i) Agricultural land

Paddy is the major crop grown in the area. The agriculture is basically dependent on rain. The prevalence of traditional agriculture is common in the area. Among Cereals Paddy, Jwar (Sorghum), Bajra and Ragi are grown. Pulses grown are Arhar, Moong and Chana. Groundnut, Sunflower and Safflower are the principle oil seed crops. Among other crops Cotton, Corriander and Onion are grown. The crop productivity in the area is given in **Table 3.16c**.

Table 3.16c: Agricultural pattern and productivity in the area

SN	Kharif Crop (July - Sept)		Rabi Crop (Dec. - April)	
	Crop	Productivity (Kg/ha.)	Crop	Productivity (Kg/ha.)
1	Paddy	2777	Paddy	2777
2	Ragi	1210	Jwar	1080
3	Groundnut	1108	Ragi	1210
4	Sunflower	408	Bajra	725
5	Cotton	2940	Arhar (Toor)*	630
6	Onion	15000	Bengal Gram (Chana)	500
7	-	-	Green gram (Moong)	811
8	-	-	Safflower	600
9	-	-	Coriander	750

* Annual Crop

Source:
1. http://www.kar.nic.in/bellary/a.html "AGRICULTURE"
2. Taluk Industrial; Development Plan 2006-11; Bellary Taluk; Bellary District; Department of Industries & Commerce; Bangalore

ii) Waste land

The features and the vegetation found in the wasteland are same as described under project area.

iii) Vegetation Around Human Settlements

Near the villages, the vegetation pattern changes from that what it is seen in the forest areas. The species commonly found are given in **Table 3.16d** are mostly of economic importance and used in day to day life. Among the fruit trees, which are common are Mango, Guava, Drumstick, Bel, Jamun, Ber, Neebu, Banana, Papaya, etc. Among the non-fruit trees the common ones are Neem, Karanj, etc.

Table 3.16d: List of common trees/shrubs growing in and around human settlement

SN	Scientific Name	Common Name
1.	*Aegle marmelos*	Bilvapatre; Bela
2.	*Albezzia lebbeck*	Siris
3.	*Annona squamosa*	Sitaphal
4.	*Azadirchta indica*	Neem
5.	*Bambusa bambos*	Bamboo
6.	*Bougainvellea spectabilis*	Bougainvellea
7.	*Carica papaya*	Papita
8.	*Cassia siamea*	Seeme thangadi
9.	*Citrus lemon*	Nimbu
10.	Coccos nucifera	Narial
11.	*Delonix regia*	Gulmohar
12.	*Embelica officinalis*	Neli, Amla
13.	*Eucalyptus spp*	Eucalyptus
14.	*Ficus bengalensis*	Ala
15.	*Ficus religiosa*	Arli
16.	*Mangifera indica*	Mango
17.	*Moringa oleifera*	Sajana
18.	*Musa sapientum*	Banana
19.	*Pongamia pinnata*	Honge, Kanige
20.	*Pouteria sapota*	Chicku / Sapota
21.	*Syzigium jambolana*	Narale
22.	*Tamarindus indica*	Hunse
23.	*Zyziphus sp.*	Ber

iv) Forest areas

The forests in the study area are classified as **Southern Tropical Thorn Forests** type Southern Thorn Scrub. There are many stretches of forest with in the study area as shown in **Table 3.16e**.

The natural vegetation in the study area are stunted in growth and sparse thus presenting a poor quality vegetation. Extensive grazing, biotic pressure and water scarcity are the main contributors to the present stage of vegetation degradation.

The area is located in Arid zone, the scanty and capricious nature of rainfall and biotic pressure has greatly influenced the forests in the study area. The forests do not present a complex either in distribution or in composition. All the areas in the study area reported as forests do not have adequate vegetation cover and are reckoned as 'Forest" only by name. Extensive soil erosion resulting in deep gullies is common. Massive sheet erosion has added to the impoverishment of soil. Frequent forest fire has resulted in the destruction of undergrowth.. All the forests in the study area comprise crooked, malformed trees and are gradually invaded by grass and weeds.

The sampling locations for phyto-sociologial study and status of these forests patches is given in **Table 3.16e** .

Table 3.1e: Forest patches falling within 10km radius of the project site

SN	Forest Area / Nearest Location	From Project Center		Status
		Distance (km)	Direction	
1	Billakallu RF	6.0	SW to NSW	Open layer of scrub & thorny bushes.
2	Torangallu RF	4.0	NE	-do
3	Joga RF	7.5	W to WNW	-do
4	Donamalai State Forest	8.5	SW	-do-
5	Sandur State Forest	7.5	W to SW	-do-
6	Chikkantapur RF	7.0	SE	-do-
7	Kodalu RF	7.5	SSE	-do-
8	Marutla Extension RF	8.0	S	-do-

Billakallu RF

Billakallu RF falling in study area is in degraded state, devoid of tree growth with an open layer of scrub and thorny bushes. Goat browsing is a common feature. Much of the soil is bare. The shrub height is between 0.5 to 3m. The phyto-sociological features of the forest areas are shown in **Tables 3.17a & 3.17b**. Albezziz amra (Tugli) comprises the most dominant species followed by Carissa carandus (Kavale), Opuntia dillenil (Papaskalli), Spondias pinnata (Ambre), etc. The species diversity in forests is **1.91.**

Torangallu RF

Torangallu RF falling in study area is in degraded state, devoid of tree growth with an open layer of scrub and thorny bushes. Goat browsing is a common feature. Much of the soil is bare. The shrub height is between 1 to 3m. The phyto-sociological features of the forest areas are shown in **Tables 3.18**. Woodfordia fruticosa (Jalli) comprises the most dominant species followed by Albezziz amra (Tugli), Carissa carandus (Kavale), Opuntia dillenil (Papaskalli), Azadirachta indica (Bevu), Pongamia pinnata (Kanige) etc. The species diversity in forests is **2.33.**

Joga RF

Joga RF falling in study area is in degraded state, devoid of tree growth with an open layer of scrub and thorny bushes. It can be classed as very poor scrub forest. Much of the soil is bare. Goat browsing is a common feature. The scrub height is between 0.5 to 2m. The phyto-sociological features of the forest areas are shown in **Tables 3.19a & 3.19b**. Woodfordia fruticosa (Jalli) comprises the most dominant species followed by Albezziz amra (Tugli), Zizyphus jujuba (Bore), Morinda tinctoria (Maddi) etc. The species diversity in forests is **1.35.**

Donamalai State Forest

Donamalai State Forest falling in study area is in degraded state, devoid of tree growth with an open layer of scrub and thorny bushes. Goat browsing is a common feature. Much of the soil is bare. The shrub height is between 1 to 3m. The phyto-sociological features of the forest areas (sampling locations ES4) are shown in **Tables 3.20**. Albezziz amra (Tugli) comprises the most dominant species followed by Opuntia dillenil (Papaskalli), Acacia leucpphloea (Bili jali), Morinda tinctoria (Maddi), Zizyphus jujuba (Bore) etc. The species diversity in forests is **2.689.**

Table 3.17a: Plants growing in forest areas of Billakallu RF in study area

Plant species	No. of Quadrat (20m x 20m)																				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Total**
Albezziz amra (Tugli)	3	12	3	4	0	3	12	5	7	9	0	6	6	4	5	5	4	2	2	3	**95**
Opuntia dillenil (Papaskalli)	2	0	0	2	1	0	0	1	0	1	0	0	1	1	1	0	0	1	0	0	**11**
Aegle marmelos (Bilvapatre)	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**2**
Carissa carandus (Kavale)	1	0	3	1	2	1	0	1	2	1	2	5	3	2	1	3	3	2	5	5	**43**
Woodfordia fruticosa (Jalli)	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Spondias pinnata (Ambre)	0	0	1	0	0	0	0	0	0	0	8	2	1	0	0	0	0	0	0	2	**14**
Zizyphus jujuba (Bore)	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	**3**
Dodonia viscosa (Bandarike)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**2**
Pongamia pinnata (Kanige)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Total	**8**	**12**	**8**	**7**	**3**	**7**	**12**	**7**	**10**	**11**	**11**	**13**	**11**	**7**	**7**	**10**	**7**	**5**	**7**	**11**	**174**

Table 3.17b: Phyto-sociological features of forest areas of Billakallu RF in study area

Plant species	Frequency	Density	Abundance	RF	RD	IVI	Sp. Div
Albezziz amra (Tugli)	90	118.75	1.32	30	54.6	85	**1.91**
Opuntia dillenil (Papaskalli)	45	13.75	0.31	15	6.32	21	
Aegle marmelos (Bilvapatre)	10	2.5	0.25	3.3	1.15	4.5	
Carissa carandus (Kavale)	90	53.75	0.6	30	24.7	55	
Woodfordia fruticosa (Jalli)	15	3.75	0.25	5	1.72	6.7	
Spondias pinnata (Ambre)	20	17.5	0.88	6.7	8.05	15	
Zizyphus jujuba (Bore)	15	3.75	0.25	5	1.72	6.7	
Dodonia viscosa (Bandarike)	10	2.5	0.25	3.3	1.15	4.5	
Pongamia pinnata (Kanige)	5	1.25	0.25	1.7	0.57	2.2	
Total	**300**	**217.5**	**-**	**100**	**100**	**200**	

RF: Relative Frequency; RD: Relative Density; IVI Importance Value Index

Table 3.18: Plants growing in forest areas of Torangallu RF in study area

SN.	Plant species	No. of Quadrat (10m x 10m)										Total	Freq.	Density	Abun	RF	RD	IVI	Sp. Div
		1	2	3	4	5	6	7	8	9	10								
1	Albezziz amra (Tugli)	2	0	1	3	1	2	4	2	1	4	20	90	200	2.22	25	19.6	44.6	2.33
2	Opuntia dillenil (Papaskalli)	0	0	0	3	1	1	2	0	0	0	7	40	70	1.75	11.1	6.86	18	
3	Carissa carandus (Kavale)	4	5	0	4	0	3	0	5	2	2	25	70	250	3.57	19.4	24.5	44	
5	Woodfordia fruticosa (Jalli)	0	2	4	0	2	4	5	6	10	5	38	80	380	4.75	22.2	37.3	59.5	
6	Zizyphus jujuba (Bore)	0	0	0	0	0	0	0	0	0	1	1	10	10	1	2.78	0.98	3.76	
7	Dodonia viscosa (Bandarike)	3	0	0	0	0	0	0	0	0	0	3	10	30	3	2.78	2.94	5.72	
8	Azadirachta indica (Bevu)	2	2	0	0	0	1	0	0	0	0	5	30	50	1.67	8.33	4.9	13.2	
9	Pongamia pinnata (Kanige)	1	1	0	1	0	0	0	0	0	0	3	30	30	1	8.33	2.94	11.3	
	Total	**12**	**10**	**5**	**11**	**4**	**11**	**11**	**13**	**13**	**12**	**102**	**360**	**1020**	-	**100**	**100**	**200**	

RF: Relative Frequency; RD: Relative Density; IVI Importance Value Index

Table 3.19a: Plants growing in forest areas of Joga RF in study area

Plant species	No. of Quadrat (20m x 20m)																				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Total**
Albezziz amra (Tugli)	0	1	0	0	0	1	1	0	0	1	1	0	1	0	1	0	0	1	0	1	**9**
Zizyphus jujuba (Bore)	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	**3**
Diospyros melanoxylon (Bidi Patta)	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	**3**
Woodfordia fruticosa (Jalli)	6	4	2	7	2	7	5	5	6	7	3	2	3	5	1	4	6	3	4	5	**87**
Morinda tinctoria (Maddi)	0	0	0	2	2	0	1	1	0	1	0	0	2	0	0	0	1	1	0	1	**12**
Lawsonia inermis (Hena)	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	**3**
Total	**6**	**5**	**4**	**10**	**4**	**9**	**7**	**6**	**6**	**9**	**5**	**3**	**6**	**5**	**3**	**4**	**8**	**5**	**5**	**7**	**117**

Table 3.19b: Phyto-sociological features of Joga RF in the study area

Plant species	Frequency	Density	Abundance	RF	RD	IVI	Sp. Div
Albezziz amra (Tugli)	90	11.25	0.13	33	7.69	41	1.35
Zizyphus jujuba (Bore)	45	3.75	0.08	17	2.56	19	
Diospyros melanoxylon (Bidi Patta)	10	3.75	0.38	3.7	2.56	6.3	
Woodfordia fruticosa (Jalli)	90	108.75	1.21	33	74.4	108	
Morinda tinctoria (Maddi)	15	15	1	5.6	10.3	16	
Lawsonia inermis (Hena)	20	3.75	0.19	7.4	2.56	10	
Total	**270**	**146.25**	-	**100**	**100**	**200**	

RF: Relative Frequency; RD: Relative Density; IVI Importance Value Index

Table 3.20: Plants growing in forest areas and phyto-sociological features of Donamalai RF in study area

SN.	Plant species	No. of Quadrat (10m x 10m)																	
		1	2	3	4	5	6	7	8	9	10	Total	Freq.	Density	Abun	RF	RD	IVI	Sp. Div
1	Acacia leucpphloea (Bili jali)	2	0	0	1	0	0	0	1	0	1	5	40	50	1.25	12.5	11.1	23.6	2.689
2	Opuntia dillenil (Papaskalli)	2	0	0	2	1	0	0	1	0	1	7	50	70	1.4	15.6	15.6	31.2	
3	Morinda tinctoria (Maddi)	1	0	3	0	0	0	2	0	0	0	6	30	60	2	9.38	13.3	22.7	
5	Albezziz amra (Tugli)	1	3	3	1	2	1	0	1	2	1	15	90	150	1.67	28.1	33.3	61.5	
6	Zizyphus jujuba (Bore)	1	0	1	0	0	1	0	0	1	0	4	40	40	1	12.5	8.89	21.4	
7	Woodfordia fruticosa (Jalli)	0	2	1	0	0	0	0	0	1	0	4	30	40	1.33	9.38	8.89	18.3	
8	Cassia fistula (Kakke)	0	0	0	1	0	1	0	0	1	0	3	30	30	1	9.38	6.67	16	
9	Dodonia viscosa (Bandarike)	0	0	0	0	0	1	0	0	0	0	1	10	10	1	3.13	2.22	5.35	
	Total	**7**	**5**	**8**	**5**	**3**	**4**	**2**	**3**	**5**	**3**	**45**	**320**	**450**	-	**100**	**100**	**200**	

RF: Relative Frequency; RD: Relative Density; IVI Importance Value Index

v) Location of National Parks / Sanctuaries

The buffer zone boundary of the recently declared Daroji Bear sanctuary is about 6km from the project centre. Government of Karnataka declared 5,587.30 hectares of Bilikallu RF as Daroji Bear Sanctuary, specially created for preservation of the sloth bear. The sanctuary has a rocky terrain, boulders and caves, which is the ideal habitat for the sloth bear. It is estimated that about 120 Sloth Bears are living in this sanctuary, apart from Hyena, Jackals, Wild Boars, Porcupine, Pangolins, Monitor Lizard, Mongoose, Pea Fowls, Partridges, Painted Spur Hen, Quails etc. The sanctuary has wild fruit-bearing trees and bushes like Carissa carandas(kavale), Grewia teliafolia (jane), Grewia salvitidia (ulupi), Eugenea jambolana (nerale), Zyziphus jujuba (bore), etc in its premises. These trees and bushes yield fruits one after the other. Also, the authorities have started raising orchards of Annona squamosa (custard apple / seetaphal), Singapore cherry, Mango, Banana, Maize, etc within the ranges of the sanctuary. Bears are fond of termites and honey, which are also available in plenty here. There are waterholes which serve as water source for the wildlife.

vi) Wild life and Avifauna

There are a number of forest stretches in the study area. The forest patches away from human habitations in difficult terrain are grounds for wild animals found in the study area. The common wild life and avi-fauna found in the study area is given **Tables 3.21a** and **3.21b**, respectively.

Table 3.21a: List of Wild life species in the study area

SN	Common Name / Local Name	Scientific Name	Schedule of Wild Life Protection Act in Which Listed
	Mammals		
1.	Common house Rat	*Rattus rattus*	V
2.	Common Langur	*Presbytis entellus*	II
3.	Common Mongoose	*Herpestres edwardsii*	II
4.	Fruit Bat	*Cynopterus sphinx*	V
5.	Hyaena	*Hyaena hyaena*	III
6	Indian Field Mouse	*Mus booduga*	V
7	Indian Fox / Common Fox	*Vulpes bengalensis*	II
8	Indian hare	*Lepus nigricollis ruficaudatus*	IV
9	Indian Porcupine	*Hystrix indica*	-
10	Jackal	*Canis aureus*	II
11	Jungle Cat	*Felis chaus*	II
12	Kuji Neula	*Herpestres javanicus*	II
13	Mice	*Mus musculus*	V
14	Palm Squirrels	*Funambulus spp*	IV
15	Pangolin	*Manis crassicaudata*	I

S N	Common Name / Local Name	Scientific Name	Schedule of Wild Life Protection Act in Which Listed
16	Sloth Bear / Bhalu	*Melursus ursinus*	I, II
17	Spotted dear / Chital	*Axis axis*	III
18	Wild Boar	*Sus scrofa*	III
	Reptiles		
1.	Banded Krait	*Bungarus fasciatus*	IV
2.	Chameleon	*Chameleon calcaratus*	II
3.	Cobra	*Naja naja*	II
4.	Common Krait	*Bungarus caeruleus*	-
5	Common Skink	*Mabuya carinata*	-
6	Garden Lizard	*Calotes versicolor*	-
7	Land Monitor	*Varanus bengalensis*	I
8	Python	*Python molurus*	I
9	Russel's Viper	*Vipera russelii*	II
10	Saw Scaled Viper	*Echis carinatus*	IV
11	Yellow Rat Snake	*Plyas mucosus*	II

Table 3.21b: List of common birds found in the region

SN	Common Name	Scientific Name	Schedule of Wildlife Protection Act in which listed
1	Ashy Wern Warbler	*Prinia socialis*	IV
2	Black Drongo	*Dicrurus adsimilis*	IV
3	Black Headed Oriole	*Oriolus xanthornus*	IV
4	Black Winged Kite	*Elanus caerulus*	-
5	Blossum Headed Parkeet	*Psittachula cyanocephala*	IV
6	Blue jay	*Carcarius benghalensis*	-
7	Blue Rock Pegion	*Columba livia*	IV
8	Cattle Egret	*Bubulcus ibis*	IV
9	Common Crow	*Corvus splendens*	V
10	Common Kingfisher	*Alcedo atthis*	IV
11	Common Mynah	*Acridotheres tristris*	IV
12	Doves	*Streptopelia spp.*	IV
13	Golden Backed Wood Pecker	*Dinopium benghalensis*	IV
14	Great Horned Owl	*Bubo bubo*	IV
15	Grey Babbler	*Turdoides malcolmi*	IV
16	Grey Jungle Fowl	*Gallus sonerata*	IV
17	Grey Wagtail	*Motacilla caspica*	IV
18	House Sparrow	*Passer domesticus*	-
19	Indian Robbin	*Saxicoloides fulicata*	-

SN	Common Name	Scientific Name	Schedule of Wildlife Protection Act in which listed
20	Jungle Babbler	*Turdoides striatus*	IV
21	Jungle Crow	*C. marorhynchos*	IV
22	Jungle Myna	*Acridotherus fusens*	IV
23	Koel	*Eudynamis scolopacea*	IV
24	Luggar Falcon	*Falco biarmicus*	I
25	Munia	*Lonchura spp.*	IV
26	Pariah Kite	*Milvus migrans*	-
27	Partridge	*Francolinus spp.*	IV
28	Peafowl	*Pavo cristatus*	I
29	Pied Wagtail	*Motacilla maderaspatensis*	IV
30	Red Jungle Fowl	*Gallus gallus*	IV
31	Red Vent Bulbul	*Pycnonotus cafer*	IV
32	Rose Ringed Parakeet	*Psittacula krameri*	IV
33	Weaver Bird	*Ploceus spp*	IV

Due to biotic interference the only animals found near the project site are few rodents, reptiles and birds. Large mammals listed above are found in remote forests areas only, i.e. away from the project site. Due to human interference, in general the availability of animals in the study area is low.

vii) Water Bodies

The famous Tunga Bhadra (T.B.) Dam reservoir is nearly 30 km from the project site. However high level canal from T. B. Dam to Bellary flows close to the project site. Low level canal from T. B. Dam also passes through the study area. The water in these canals is only for six months.

Daroji tank is connected with another Dam in the region Narihalla Dam with Nari Halla and Kanigana Halla water channels flowing on the western and eastern side, respectively of project site. Daroji tank has a total water spread area of 800 ha, which dries to about 25-50% during summer season. From Daroji tank Banuchandra Vanka water channel flows towards the down gradient side of the tank. The agriculture of the study area is influenced by these water sources as the area receives very scanty rainfall.

<u>Planktons</u>

The water in the Daroji tank is clean. With scanty aquatic weeds at its edges are seen. So as to have the baseline status of the planktons (phyto and zoo) present in the lentic (Daroji Tank) present in the study area, plankton density was determined. There are no lotic water bodies in the study area. The Daroji tank water on physical appearance seems to be oligo to meso trophic in nutrient status. However, the color of water appears to be slight reddish in color, possibly due to rains in past few days before the study period. The planktons present in the water bodies are given in **Tables 3.22**.

Phytoplankton groups as observed are members of Basillariophyceae, Chlorophyceae, Myxophyceae and Euglenophyceae. About 21 species of phytoplankton were observed. The density of phytoplankton group ranged from 23 to 30 organisms / ml in the studied samples. Dominance of *Bacillariophyceae* members and least representation of euglenophyceae members indicated the oligotrophic status of the water bodies in the study area. The highest percentage was *Ankistrodesmus falcatus, Navicula sp.,* and *Volvox sp.* and the lowest percentage was *Euglena sp., Microsystis sp., etc.* was observed during study period.

Zooplankton biomass was 10ml/100 m³. Percentage composition of zooplankton species varied among different species. Among the zooplankton group, Rotifers like, Asplachna sp., Keratella sp., Filinia sp., Brachionous sp. constitute the highest percent composition, i.e. 35.6% followed by the members of Crustacea (*Bosmina sp. and Daphnia sp.)* 28.5% and Copepods (*Cyclops sp.* and *Cypris sp.)* 21.4%. Zooplankton species like Bosmina, Asplachna, Keratella and Filinia sp. indicate that the water in Darojee tank is un-polluted.

Table 3.22: Plankton Abundance in Daroji Tank

SN.	Plankton	Nos. / ml	% Composition
1	**Phytoplankton**		
2	*Achnanthes sp.*	1	3.3
3	*Anabaena sp.*	1	13.3
4	*Ankistrodesmus sp*	4	6.7
5	*Chlorella sp.*	1	3.3
6	*Chlorococcum sp.*	2	6.7
7	*Cladophora sp.*	2	6.7
8	*Euglena sp.*	1	6.7
9	*Melosira sp.*	1	3.3
10	*Microcystis sp.*	1	3.3
11	*Navicula sp.*	3	10.0
12	*Nitzschia sp.*	1	3.3
13	*Pandorina sp.*	1	3.3
14	*Pediastrum sp.*	1	3.3
15	*Pinnularia sp.*	1	3.3
16	*Pithophora sp.*	2	6.7
17	*Pluerosigma sp.*	2	6.7
18	*Scenedesmus sp*	1	3.3
19	*Spirogyra sp.*	1	3.3
20	*Volvox sp.*	3	3.3
21	*Zygnema sp.*	1	3.3
	Phyto-plankton density (nos./ml)	**30**	**100**
	Zooplankton		
1	*Arcella sp.*	1	7.1
2	*Asplancha sp.*	1	7.1

SN.	Plankton	Nos. / ml	% Composition
3	*Bosmina sp.*	1	7.1
4	*Brachionus sp.*	2	14.3
5	*Cyclops sp.*	2	14.3
6	*Cypris sp.*	1	7.1
7	*Daphnia sp.*	3	21.4
8	*Filinia sp*	1	7.1
9	*Keratella sp.*	1	7.1
10	*Tubifex sp. (Nematode)*	1	7.1
	Zoo-plankton density (nos./ml)	**14**	**100**
	Zooplankton Biomass (ml/100 m^3)	**10**	

Benthic Organisms

Benthic organisms commonly present are larval forms of flies attached to the bottom like, Plecoptera, Zygoptera, Trichoptera and Molluscans like, Pila sp., Edulis sp.

Hydrophytes

The hydrphytes growing along the water bodies are Ceratophyllum *sp.*, *Hydrilla verticellata, Pistia sp.*, *Silvania sp., Aponogeton sp., Potamogeton sp., Vallisneria spirals, Lemna sp.,* and *Nymphaea sp*., etc.

Fishes

The fishes commonly found in the study area are given in **Table 3.23**.

.

Table 3.23: Fishes found in the study area

Common Name	Scientific Name
Carps	
Bili Menu	*Barbus tor*
Gende	*Barbus carnaticus*
Katla	*Catla catla*
Kemmeenu	*Lebeo fimgriatus*
Matchalu	*Lebeo calbasu*
Cat Fish	
Bale Menu	*Wallago attu*
Girlu	*Mystus seengala*
Murrels	
Hoo Menu	*Ophicephalus marulius*
Korava	*Ophicephalus punctatus*
Kutchu	*Ophicephalus striatus*
Others	
Havu Menu	*Masta cembulus armatus*
Gende Korva	*Glasso gobius giuris*
Chavale	*Notopteris notopteris*
Saslu	*Rasbora sp.*

The important and perennial water bodies in the area are Daroji tank and Narihalla. Dam. Both these water bodies are planned by the State Fisheries Dept. to be developed as good fish production units. As revealed by State Fisheries Department, the water bodies in the study area seems to have quite high fish production potential as given in **Table 3.24**.

Table 3.24: Fish production potential of water bodies in study area

Type of Fish	Weight gain by fish in one year (kg)
Catla	3-4
Rohu	2.0
Mrigal	1.5
Common carp	1.5

viii) Endangered Plants

The study area did not record the presence of any critically threatened plant species.

3.2.10 TRAFFIC DENSITY

In order to assess the impact of future traffic load (due to the proposed plant) on the existing traffic infrastructure of proposed project site, the existing / baseline traffic density at road inlet locations of proposed site was studied. The existing traffic density for different types of vehicles was counted at two locations during the study on a particular day for 24 hours. The monitoring locations are as follows:

(i) On the Bellary – Hospet Road (NH-63)
(ii) On the Tornagallu – Sandur Road (SH-40)

Estimation of traffic is an essential step in understanding the traffic characteristics. The objective was to assess the prevailing traffic characteristics.

Traffic volume at NH-63

Vehicle type	Numbers	Percentage
Two wheelers	1127	18.1
Auto rickshaw	106	1.7
Car/Taxi/Jeep/Van	1212	19.5
Mini Bus	130	2.1
Bus	174	2.8
LCV	183	2.9
2 Axle Truck	1166	18.8
3 Axle Truck	1458	23.5
MAV	423	6.8

Others	233	3.7
Total	**6215**	**100%**

Traffic volume at SH-40

Vehicle type	Numbers	Percentage
Two wheelers	1386	15.4
Auto rickshaw	378	4.2
Car/Taxi/Jeep/Van	1107	12.3
Mini Bus	54	0.6
Bus	135	1.5
LCV	198	2.2
2 Axle Truck	3790	42.1
3 Axle Truck	1566	17.4
MAV	216	2.4
Others	172	1.9
Total	**9002**	**100%**

The above table indicates that freight vehicle category at NH-63 is 52% whereas at SH-40 it is 64.1%.

3.2.11 BASELINE STATUS OF EXISTING JSW STEEL PLANT

To establish the baseline scenario for different environmental components in the project site data generation has been done with respect to the followings:

- Stack emissions of the existing units of JSW.
- Solid waste characterisation.
- Work-zone air quality of existing units of JSW.
- Work-zone noise levels of existing units of JSW.
- Waste water discharge quality at different outlets of JSW.

Besides additional secondary data / information were collected from concerned agencies and JSW regarding the followings:

- Water availability.
- Solid waste generation its utilisation and quantities to be dumped (including Hazardous waste).
- Wastewater discharge quantity from different outfalls of JSW.

<u>Stack Emissions</u>

Selection of Stacks for Monitoring

Stack emissions of the existing units (process and de-dusting stacks) were monitored.

Methodology

Monitoring was done monthly so that all the stacks are covered in three months. The methodology adopted is given in **Table 3.23**.

Table 3.23: Methodology Adopted for Stack Monitoring

SN	Parameter(s)	Apparatus Used	Method Reference	Analysis Method
1.	Particulate Matter (PM)	Envirotech APM 610 Stack Sampling Kit	As per CPCB	Gravimetric
2.	Sulphur Di-oxide (SO2)	-do-; Titration	Turbidity, ASTM As per CPCB	Colorimetric
3.	Oxides of Nitrogen (NOx)	-do-; Spectro-photometer	Phenyl di-sulphonic Acid (EPA), ASTM	Colorimetric

Results

In **Table 3.24** the results of the stack monitoring are presented, from the Table it is inferred that all values are with in the specified norms of CPCB.

Table 3.24 : Stack Monitoring Results of Existing Units of JSW

SL.No	Name of the stack	Height	Dia	T (deg C)	Velocity (m/s)	Flow (Nm3/hr)	SPM (mg/m3)	So2 (mg/m3)	Nox (mg/m3)	Acid fume(mg/m3)	Oil Mist (mg/m3)
	Sinter Plant - I										
1	Process ESP	85	6.8	158	17.2	1589876	165	141	186	-	-
2	Dedusting ESP	85	2.6	77	17.9	292289	178	-	-	-	-
3	Flux & Coke Grinding	30	1.4	40	12.1	63818	30	-	-	-	-
4	Storage building	30	1	42	12	32082	48	-	-	-	-
	Sinter Plant - II										
1	Process ESP	85	6.8	139	12.7	1231867	176	159	242	-	-
2	Dedusting ESP	85	2.6	86	14.8	234719	185	-	-	-	-
	LCP - I										
1	Kiln I	30	1	109	14	30903	74	12.4	16.3	-	-
2	Kiln 2	30	1	100	15.3	34588	120	11.7	14.1	-	-
3	DBB	30	1	45	10.5	11760	28	-	-	-	-
4	RMSB	30	1	44	10.5	27930	26	-	-	-	-
	LCP - II										
1	Kiln 5	56	1	85	12.8	30110	39	9.6	11.2	-	-
2	Kiln 6	56	1	95	14.1	32267	55	8.8	10.6	-	-
	BF - I										
1	Cast House	47	3.5	66	10.8	328106	19	-	-	-	-
2	Stock House	40	2	44	9	105385	37	-	-	-	-
	BF - II										
1	Cast House	50	4	63	10.3	411219	22	-	-	-	-
2	Stock House	40	3	45	9.1	216739	31	-	-	-	-
	BF - III										
1	Caste House east	40	4.5	64	13.3	675539	11	-	-	-	-
2	Stock House	40	4.5	45	12.5	674350	21	-	-	-	-
	Corex										
1	Stock house Oxide line M2	37	1.4	45	9.5	49355	32	-	-	-	-

SL.No	Name of the stack	Height	Dia	T (deg C)	Velocity (m/s)	Flow (Nm3/hr)	SPM (mg/m3)	So2 (mg/m3)	Nox (mg/m3)	Acid fume(mg/m3)	Oil Mist (mg/m3)
2	Stock house Coal line M2	37	1.4	45	9.6	49875	26	-	-	-	-
3	Cast house 1& 2	47	4.4	64	13.5	654827	26	-	-	-	-
4	Coal transportation	30	1.7	45	9.7	74665	37	-	-	-	-
5	Coal Drier - I	30	1.7	60	9.3	68012	20	-	-	-	-
6	Stock house Coal line M1	37	1.4	45	8.6	46679	28	-	-	-	-
7	Stock house Oxide line M1	37	1.4	45	9.1	47277	32	-	-	-	-
8	Additional Dedusting system		1.1	40	18.9	61540	64	-	-	-	-
	Pellet Plant										
1	Drier -3	35	1.6	85	12	136554	124	-	-	-	-
2	Ball mill area - 1	30	1.2	63	9.8	35358	97	-	-	-	-
3	Ball mill area - 2	30	1.2	65	9.8	35148	54	-	-	-	-
4	Ball mill - 2	30	1	84	17.2	58406	112	-	-	-	-
5	Drier 1&2	100	2.6	100	12.7	187383	64	-	-	-	-
6	Drier Area	30	1	42	9.9	21683	70	-	-	-	-
7	Bentonite Bin	52	0.5	46	9	5932	37	-	-	-	-
8	Ground ore silo	30	0.65	65	16.4	17177	48	-	-	-	-
9	ESP	100	6.6	120	15.8	1474627	60	122	102	-	-
10	Drier ore bin - 1	30	0.5	53	11	7094	68	-	-	-	-
11	Drier ore bin - 2	30	0.5	51	12.6	8177	56	-	-	-	-
	RMHS										
1	FSB	30	1	40	9.5	25593	42	-	-	-	-
2	JH -17	30	1	45	12.6	27142	34	-	-	-	-
3	JH -16	30	1	45	10.5	22528	44	-	-	-	-
	SMS - II										
1	HMDS	50	4	50	11.9	498350	23	-	-	-	-
2	Dedusting System	40	5.6	66	14.3	1113735	6	-	-	-	-
	BOF										
1	LHF -1	70	2	91	9.8	91391	46	-	-	-	-
2	LHF - 2	70	2	92	10.4	96609	50	-	-	-	-

SL.No	Name of the stack	Height	Dia	T (deg C)	Velocity (m/s)	Flow (Nm3/hr)	SPM (mg/m3)	So2 (mg/m3)	Nox (mg/m3)	Acid fume(mg/m3)	Oil Mist (mg/m3)
3	BMCS	45	1.4	54	12.5	62732	34	-	-	-	-
4	HMDS 1&2	70	1.65	95	11.9	74342	63	-	-	-	-
1	**Wire Rod Mil**	60	2.5	338	8.9	75026	25	Nill	50.5	-	-
2	**Bar Rod Mill**	60	3	318	8	141430	14	18	52.2	-	-
	CPP - 1										
1	Boiler	60	5.5	135	7.4	456786	6	26.6	47.3	-	-
	CPP -2										
1	Chimney - 5	64	2.9	265	8.8	115814	33	175	74	-	-
2	Chimney - 6	64	2.9	270	9.6	125180	24	187	92	-	-
3	Chimney - 7	64	2.9	272	8.8	114327	14	64.2	45.3	-	-
4	Chimney - 8	64	2.9	275	9.7	125329	26	74.6	50.2	-	-
	CRM										
1	ARP	30	1.2	95	7.2	24839	21	-	-	7.9	-
2	CPL	30	0.6	71	12.4	10962	4	-	-	3.2	-
3	SPM	30	1.2	45	10.9	41552	-	-	-	-	2.1
4	BAF	45	1.8	185	8.1	48192	7	20.4	26.6	-	
5	CCM	30	1.9	40	6.7	64299	-	-	-	-	2.5
6	ECL	30	0.7	85	12.8	13502	2	-	-	-	
	COKE - 3										
1	Ground dedusting system - 1	40	3.3	53	14.4	405168	7	-	-	-	-
2	Ground dedusting system - 2	40	3.3	54	14.2	399326	10	-	-	-	-
	JSH										
1	Incinerator		1.4	79	5.9	27687	126	39	51.3	-	-
	HSM										
1	RHF - 1	100	4.2	293	8.6	226772	18	21.6	36	-	-
2	RHF - 2	100	4.2	292	9.5	248901	12	45.6	83.5	-	-
	Cement Plant - 1										
1	Packing Unit	30	0.6	45	16.2	15412	57	-	-	-	-
2	RM Feeding	30	1	44	10	26600	19	-	-	-	-

SL.No	Name of the stack	Height	Dia	T (deg C)	Velocity (m/s)	Flow (Nm3/hr)	SPM (mg/m3)	So2 (mg/m3)	Nox (mg/m3)	Acid fume(mg/m3)	Oil Mist (mg/m3)
	Cement Plant - 2										
1	VRM Grinding Mill		2.5	96	7.9	112980	84	-	-	-	-

Norms : PM = 150 / 50 mg/Nm3, Acid Fume = 35 mg/Nm3, Oil Mist = 30 mg/Nm3

In some of the existing stacks volatile organic compounds and diaoxins were also monitored. The results are given below:

Sampling DT 9th & 10th Apr 2010
Test start date 16.04.10
Test End date 22.04.10

Sl.no	Volatile Organic Compounds	Sinter Plant 2 Chimney	Sinter Plant 1 Chimney
1	Benzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
2	Bromobenzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
3	Bromochloromethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
4	Chloroform	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
5	Bromoform	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
6	n - Butyl benzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
7	ter - Butyl benzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
8	Carbontetra chloride	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
9	2 - Chlorotoluene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
10	4 - Chlorotoluene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
11	Dibromochloromethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
12	1,2 - Dibromo - 3 - Chloropropane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
13	1,2 - Dibromomethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
14	Dibromomethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
15	1,2 - Dichlorobenzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
16	1,3 - Dichlorobenzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
17	1,4 - Dichlorobenzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
18	1,1 - Dichloroethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
19	1,2 - Dichloroethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
20	1,1 - Dichloroethene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
21	Cis - 1,2 - Dichloroethene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
22	Trans -1,2 - Dichloroethene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
23	1,2 - Dichloropropane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
24	1,3 - Dichloropropane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
25	2,2 - Dichloropropane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
26	1,1 - Dichloropropane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
27	Cis - 1,3 - Dichloropropene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
28	Trans - 1,3 - Dichloropropene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
29	Ethyl benzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
30	Hexachloro - 1,3-butadiene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
31	Isopropylbenzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)

Sl.no	Volatile Organic Compounds	Sinter Plant 2 Chimney	Sinter Plant 1 Chimney
32	Propylbenzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
33	4 - Isoprpyltoluene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
34	Dichloromethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
35	Bromodichloromethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
36	Napthalene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
37	Sec - propylbenzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
38	Styrene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
39	1,1,1,2 - Tetrachloroethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
40	1,1,2,2 - Tetrachloroethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
41	Tetrachloroethene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
42	Toluene	0.50 ug/m3	0.67 ug/m3
43	1,2,3 - Trichloro benzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
44	1,2,4 - Trichloro benzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
45	1,1,1 - Trichloroethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
46	1,1,2 - Trichloroethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
47	Trichloroethylene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
48	1,2,3 - Trichloropropane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
49	1,2,4 - Trimethyl benzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
50	1,2,3 - Trimethyl benzene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
51	Xylene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
52	m - xylene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
53	p - xylene	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
54	Chloroethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
55	Chloromethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
56	Dichlorodifluromethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
57	Trichlorofluromethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
58	Bromomethane	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
59	Vinylchloride	BDL (DL : 0.01 ug/m3)	BDL (DL : 0.01 ug/m3)
BDL : Below Detection Limit			
DL : Detection Limit			

Sampling DT 9th & 10th Apr 2010
Test start date 16.04.10
Test End date 10.05.10

Sl.no	Location	Stack temperature (Deg K)	Stack velocity (m/s)	Average stack gas flow (Nm3/hr)	Diaoxins @ effective oxygen (ng I - TEQ/Nm3)	Diaoxins @ 11% oxygen (ng I - TEQ/Nm3)

1	Sinter plant 2 chimney	399	20.01	225965.6	0.0031	0.0036
2	Sinter plant 1 chimney	415	21	531882.9	0.001	0.001

The emission standard for Diaoxins is 0.1ng I - TEQ/Nm3 at 11% oxygen

Solid Waste

Generation

Solid waste generated from JSW from its different units and its re-utilisation and disposal is given in **Table 3.25**.

Table 3.25 : Solid Waste Generation and Disposal for the Existing Plant Facilities

Sl.No	Waste	Waste generated in tons	Utilized in	Total	
				Generation	Utilization
1	Coke & Coal fines	Coal fines from RMHS	BF	1558926	69892
			Coke Oven		172435
			JSWEL		856837
			Despatch		52490
			Shifted to 7MT yard		399664
			Boiler		34483
			Total		**1585801**
		Coal dust from COREX	JSWEL	49884	49884
		Coke fines	Sinter plant	44333	123226
		Coke breeze from COKE OVEN	Sinter plant	33952	
2	Slag	Dry pit slag from IM	–	209333	0
		Granulated slag from IM (BF & Corex)	Cement plant	1787333	346162
			Sold		1925638
			Total		**2271800**
		SMS # 1 slag from Steel Making Shop	BOF	780680	136648
			IM		36202
			Pellet plant		640
			Sinter plant		41989.7
			Land filling		406618
			Total		**622097**
		Slag from SMS # 2	as Process skull	503074	38930
		HMDS slag from SMS #1	Pellet plant	65910	0
		HMDS slag from SMS # 2		23173	0
3	Sludge from Water Treatment	Sludge from COREX	Pellet plant	108568	47612
		Sludge from SMS #1	Pellet plant	51897	39241
		Sludge from SMS #2	Pellet plant	32162	10004
		Sludge from HSM	Pellet plant	6403	6605
4	Dust from Process & Bagfilters	Flue dust from BF	–	106572	0
		Oxide dust from COREX	Pellet plant	14237	14237
		Dust from SMS #1	Pellet plant	967	222
		HMPT dust from SMS #1	–	950	160

Sl.No	Waste	Waste generated in tons	Utilized in	Total	
				Generation	Utilization
		Dust from Secondary fume extraction	–	1143	718
		Lime dust from LCP	Pellet plant	5875	5875
5	Mill scale	Mill scale from SMS #1	Pellet plant	8527	58698
			Sinter plant		
		Mill scale from HSM	Pellet plant	50171	
			Sinter plant		
6	Others	Burnt lime/dolo fines from LCP	BOF	23590	23590
		LS & Dolo fines from LCP	Sinter plant / pellet plant	226379	226379
		Refractories			
Total (excluding coal waste)				**4006944**	**3366168**
% of waste utilization (excluding coal waste)				**84.0**	
Total with BOF slag used as land filling				**5694039**	**5125079**
% of waste utilisation with landfilling				**90.0**	
Total without land filling				**5693672**	**4720477.457**
% of waste utilisation without considering landfilling				**83.0**	

Characterisation

Solid waste samples of the existing JSW operation, were collected for analysis. The samples were analysed for chemical composition and heavy metals as per standard analytical procedures.

The results of solid waste samples are given in **Table 3.26.**

Table No. 3.26 :Solid Waste Monitoring Results

Chemical Composition	Corex & Bf1& Bf2 sludge	BF-3 Sludge	SMS-1 Sludge	SMS-2 Sludge
Iron (as Fe2O3), %	36.18	54.13	94.9	75.6
Carbon as C, %	32.84	21.1	1.2	1.6
Silica (as SiO_2), %	9.97	9.67	2.31	1.98
Aluminium (asAl_2O_3), %	6.06	7.87	0.75	0.48
Calcium (as CaO), %	7.28	2.44	16	25.75
Magnesium (as MgO), %	3.67	1.09	5.33	7.5
Titanum(asTiO2),%	0.24	0.21	0.05	0.04
Phosphorous(as P2O5), %	0.137	Nil	0.1	0.12
Sodium (as Na_2O), %	0.02	0.35	Traces	Traces
Potassium (as K_2O), %	0.41	0.36	0.078	0.13
Zinc(as ZnO), %	0.43	1.7	0.08	0.086
Sulphur	0.88	Nil	0.1	0.1

Chemical Composition	BF Slag	BOF slag (ungranulated)	BOF slag (granulated)
Iron (as Fe2O3), %	0.525	26.24	30.76
Silica (as SiO_2), %	33.21	15.76	14.36
Aluminium (asAl_2O_3), %	20.01	1.18	2.2
Calcium (as CaO), %	33.06	48.01	48.7
Magnesium (as MgO), %	10.28	10.27	5.8
Titanum(asTiO2),%	0.82	0.88	0.81
Phosphorous(as P2O5), %	Nil	1.82	1.68
Sodium (as Na_2O), %	0.42	0.039	0.021
Potassium (as K_2O), %	0.41	0.35	0.31
Zinc(as ZnO), %	Nil	Nil	Nil
Sulphur	0.78	0.026	0.018

Chemical Composition	Mill scale	BF1 Flue dust	BF3 Flue dust	Corex Cast Dedusting Bagfilter dust	SMS1 Secondary dedusting baghouse dust	Slime
Iron (as Fe2O3), %	99.05	37.18	52.39	80.2	48.02	55.6
Carbon as C, %	0.9	38.74	28.79	4.83	4.4	Nil
Silica (as SiO_2), %	Nil	10.99	9.2	4.52	5.84	8.25
Aluminium (asAl_2O_3), %	Nil	5.34	5.47	1.93	3.8	5.84
Calcium (as CaO), %	Nil	4.62	3.1	0.99	24.9	0.5
Magnesium (as MgO), %	Nil	1.4	1.31	0.68	6.84	0.24
Titanum(asTiO2),%	Nil	0.2	0.21	0.11	0.28	0.2
Phosphorous(as P2O5), %	Nil	0.115	0.11	0.27	0.23	0.7
Sodium (as Na_2O), %	Nil	0.2	0.16	0.83	0.23	Nil
Potassium (as K_2O), %	Nil	0.38	0.2	3.1	0.89	Nil
Zinc(as ZnO), %	Nil	0.06	0.44	0.31	1.97	Nil
Sulphur	0.043	0.25	0.18	0.98	0.31	0.02

TCLP Results of Solid waste Samples as per EPA 1311

TCLP Parameters	Corex Sludge	BF3 Sludge	BF1 Flue Dust
Toxicity (40 Analytes)			
1 2 DICHLORO ETHANE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
2,4-D	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
2,4,6 TRICHLOROPHENOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
BENZENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
CHLORO BENEZE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
CARBON TETRA CHLORIDE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
CHLORDANE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)

TCLP Parameters	Corex Sludge	BF3 Sludge	BF1 Flue Dust
CHLOROFORM	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
1,1 DICHLOROETHYLENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
1,4 DICHLOROBENZENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
2,4,5 TP (SILVEX)	Absent*	Absent*	Absent*
2,4-DINITROTOLUENE	Absent*	Absent*	Absent*
CRESOL (Total)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
HEXACHLOROBUTADIENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
HEXACHLOROETHANE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
HEXACHLOROBENZENE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
m-CRESOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
METHYETHYLE KETONE	Absent*	Absent*	Absent*
o-CRESOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
p-CRESOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
PYRIDINE	Absent*	Absent*	Absent*
TETRACHLOROETHYLENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
TOXAPHENE	Absent*	Absent*	Absent*
TRICHLOROETHYLENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
ENDRIN	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
HEPTACHLOR	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
LINDANE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
NITROBENZENE	Absent*	Absent*	Absent*
PENTA CHLORO PHENOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
2,4,5 TRICHLOROPHENOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
BARIUM as Ba	0.6 mg/l	6 mg/l	0.5 mg/l
CADMIUM as Cd	BDL (DL:0.1 mg/kg)	0.2 mg/l	0.7 mg/l
TOTAL CHROMIUM as Cr	0.3 mg/l	BDL (DL:0.1 mg/l)	0.4 mg/l
LEAD as Pb	0.9 mg/l	13 mg/l	1.0 mg/l
ARSENIC as As	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
VINYL CHLORIDE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
MERCURY as Hg	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
SELENIUM as Se	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
SILVER as Ag	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
BISMUTH as Bi	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
BDL : Below Detection Limit, DL : Detection Limit			

TCLP Parameters	SMS-1 Ungranulated Slag	SMS-2Granulated Slag	BOF1 Sludge
Toxicity (40 Analytes)			
1 2 DICHLORO ETHANE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)

TCLP Parameters	SMS-1 Ungranulated Slag	SMS-2Granulated Slag	BOF1 Sludge
2,4-D	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
2,4,6 TRICHLOROPHENOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
BENZENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
CHLORO BENEZE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
CARBON TETRA CHLORIDE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
CHLORDANE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
CHLOROFORM	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
1,1 DICHLOROETHYLENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
1,4 DICHLOROBENZENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
2,4,5 TP (SILVEX)	Absent*	Absent*	Absent*
2,4-DINITROTOLUENE	Absent*	Absent*	Absent*
CRESOL (Total)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
HEXACHLOROBUTADIENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
HEXACHLOROETHANE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
HEXACHLOROBENZENE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
m-CRESOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
METHYETHYLE KETONE	Absent*	Absent*	Absent*
o-CRESOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
p-CRESOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
PYRIDINE	Absent*	Absent*	Absent*
TETRACHLOROETHYLENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
TOXAPHENE	Absent*	Absent*	Absent*
TRICHLOROETHYLENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
ENDRIN	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
HEPTACHLOR	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
LINDANE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
NITROBENZENE	Absent*	Absent*	Absent*
PENTA CHLORO PHENOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
2,4,5 TRICHLOROPHENOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
BARIUM as Ba	0.1 mg/l	0.06 mg/l	0.81 mg/l
CADMIUM as Cd	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
TOTAL CHROMIUM as Cr	0.4 mg/l	0.3 mg/l	0.38 mg/l
LEAD as Pb	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
ARSENIC as As	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
VINYL CHLORIDE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
MERCURY as Hg	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
SELENIUM as Se	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
SILVER as Ag	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)

TCLP Parameters	SMS-1 Ungranulated Slag	SMS-2Granulated Slag	BOF1 Sludge
BISMUTH as Bi	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
BDL : Below Detection Limit, DL : Detection Limit			

TCLP Parameters	HMDS Slag	Slime	Incinerator Ash
Toxicity (40 Analytes)			
1 2 DICHLORO ETHANE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
2,4-D	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
2,4,6 TRICHLOROPHENOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
BENZENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
CHLORO BENEZE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
CARBON TETRA CHLORIDE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
CHLORDANE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
CHLOROFORM	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
1,1 DICHLOROETHYLENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
1,4 DICHLOROBENZENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
2,4,5 TP (SILVEX)	Absent*	Absent*	Absent*
2,4-DINITROTOLUENE	Absent*	Absent*	Absent*
CRESOL (Total)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
HEXACHLOROBUTADIENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
HEXACHLOROETHANE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
HEXACHLOROBENZENE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
m-CRESOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
METHYETHYLE KETONE	Absent*	Absent*	Absent*
o-CRESOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
p-CRESOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
PYRIDINE	Absent*	Absent*	Absent*
TETRACHLOROETHYLENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
TOXAPHENE	Absent*	Absent*	Absent*
TRICHLOROETHYLENE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
ENDRIN	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
HEPTACHLOR	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
LINDANE	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
NITROBENZENE	Absent*	Absent*	Absent*
PENTA CHLORO PHENOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
2,4,5 TRICHLOROPHENOL	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)	BDL (DL:0.001 mg/l)
BARIUM as Ba	0.75 mg/l	0.96 mg/l	6.7 mg/l
CADMIUM as Cd	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
TOTAL CHROMIUM as Cr	0.35 mg/l	0.45 mg/l	914 mg/l

TCLP Parameters	HMDS Slag	Slime	Incinerator Ash
LEAD as Pb	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
ARSENIC as As	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	17.15 mg/l
VINYL CHLORIDE	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)	BDL (DL:0.02 mg/l)
MERCURY as Hg	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
SELENIUM as Se	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
SILVER as Ag	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
BISMUTH as Bi	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)	BDL (DL:0.1 mg/l)
BDL : Below Detection Limit, DL : Detection Limit			

TCLP Parameters	CRM ETP Sludge
Toxicity (40 Analytes)	
1 2 DICHLORO ETHANE	BDL (DL:0.02 mg/l)
2,4-D	BDL (DL:0.001 mg/l)
2,4,6 TRICHLOROPHENOL	BDL (DL:0.001 mg/l)
BENZENE	BDL (DL:0.02 mg/l)
CHLORO BENEZE	BDL (DL:0.02 mg/l)
CARBON TETRA CHLORIDE	BDL (DL:0.02 mg/l)
CHLORDANE	BDL (DL:0.001 mg/l)
CHLOROFORM	BDL (DL:0.02 mg/l)
1,1 DICHLOROETHYLENE	BDL (DL:0.02 mg/l)
1,4 DICHLOROBENZENE	BDL (DL:0.02 mg/l)
2,4,5 TP (SILVEX)	Absent*
2,4-DINITROTOLUENE	Absent*
CRESOL (Total)	BDL (DL:0.001 mg/l)
HEXACHLOROBUTADIENE	BDL (DL:0.02 mg/l)
HEXACHLOROETHANE	BDL (DL:0.001 mg/l)
HEXACHLOROBENZENE	BDL (DL:0.001 mg/l)
m-CRESOL	BDL (DL:0.001 mg/l)
METHYETHYLE KETONE	Absent*
o-CRESOL	BDL (DL:0.001 mg/l)
p-CRESOL	BDL (DL:0.001 mg/l)
PYRIDINE	Absent*
TETRACHLOROETHYLENE	BDL (DL:0.02 mg/l)
TOXAPHENE	Absent*
TRICHLOROETHYLENE	BDL (DL:0.02 mg/l)
ENDRIN	BDL (DL:0.001 mg/l)
HEPTACHLOR	BDL (DL:0.001 mg/l)
LINDANE	BDL (DL:0.001 mg/l)
NITROBENZENE	Absent*

TCLP Parameters	CRM ETP Sludge
PENTA CHLORO PHENOL	BDL (DL:0.001 mg/l)
2,4,5 TRICHLOROPHENOL	BDL (DL:0.001 mg/l)
BARIUM as Ba	3.1 mg/l
CADMIUM as Cd	BDL (DL:0.1 mg/l)
TOTAL CHROMIUM as Cr	1.76 mg/l
LEAD as Pb	BDL (DL:0.1 mg/l)
ARSENIC as As	BDL (DL:0.1 mg/l)
VINYL CHLORIDE	BDL (DL:0.02 mg/l)
MERCURY as Hg	BDL (DL:0.1 mg/l)
SELENIUM as Se	BDL (DL:0.1 mg/l)
SILVER as Ag	BDL (DL:0.1 mg/l)
BISMUTH as Bi	BDL (DL:0.1 mg/l)
BDL : Below Detection Limit, DL : Detection Limit	

The above sample results are compared with schedule (I) & (II) for Iron and Steel plant as per The Hazardous wastes (Management and Handling) Rules, 1989 as amended in September'2008 and hence are non hazardous.

Hazardous Waste

Hazardous Wastes produced from JSW, re-cycling and disposal practices are given in **Table 3.27.**

Table 3.27: Hazardous Waste Generated from JSW

Sl No	Process	Category No	Category	Units generating waste	Quantity KL or t / Year	Treatment
1	**Industrial operations using mineral / synthetic oil as lubricant in hydraulic or other applications**	5.1	Used Oil	Pellet Plant & Sinter Plant	875 KL / Year	A) Used in Coke Oven for Coke making. B) Sold to authorised party approved by CPCB & KSPCB
				Sinter Plant		
				RMHS		
				Utilities		
				CMD		
				COREX & Blast Furnace 1&2		
2		5.2	Waste Oil	HSM	1050 KL / Year	A) Used in Coke Oven for Coke making. B) Sold to authorised party approved by CPCB & KSPCB C)Incinerated in Incinerator
				CRM		
				WRM		
				BOF		
3		5.2	Oil Soaked Cotton waste	Pellet Plant & Sinter Plant	24 t	
				Sinter Plant		

Sl No	Process	Category No	Category	Units generating waste	Quantity KL or t / Year	Treatment
				RMHS		
				Utilities		
				CMD		
				COREX & Blast Furnace 1&2		
4	**Metal Surface Treatment Viz etching, staining Polishing, Galvanising, cleaning, cleaning, degreasing, plating**	12.1	Acid Residue	CRM	210 t	Neitralised in ETP of CRM
		12.2	Alkali Residue	CRM	105 t	Neitralised in ETP of CRM
		12.1	Waste Pickled liqoor	CRM	51200000 KL	The ARP Cacity is 6400 KL / hour. The ARP is having surplus capacity. We can treat 50 KL / month from outside industry
5	**Production of Iron and Steel including other Ferrous alloys (Electric furnace;Steel rolling and finishing mill; Coke oven and by product plant)**	13.3	Decanter tank sludge	Coke Oven & By product plant -3	120 t	To be incinerator
		13.4	Tar Storage tank residue		100 t	To be incinerator
7	**Purification and Treatment of Exhaust air, water & Waste water from the process in this schedule and common industrial effluent treatment plants (CETP's)**	34.2	Spent Ion Exchange resin containing toxic metals		50 t	Land filling
		34.3	Chemical Sludge from Waste water treatment	GCP, COREX, BF & CRM	5250 t	Used in Pellet making
		34.4	Oil & Grease Skimming residue	waste oil from TCM	660 t	To be incinerator
8	**Purification process for Organic compounds / solvents**	35.1	Filters and Filter materials which have organic liquids	Oil Filters from CRS	1 t/y	To be incinerator

Sl No	Process	Category No	Category	Units generating waste	Quantity KL or t / Year	Treatment
			in them e.g mineral oil, synthetic oil and organic chlorine compounds			
		35.2	Spent catalyst		1 t / y	Stored in designated area
		35.3	Spent Actvated Carbon	WTP/ETP	5 t/ y	Stored in designated area
9	**Hazardous waste treatment processes e.g Incineration, distillation, separation and concentration techniques**	36.1	Sludge from wet scrubbers	Wet scrubbers sludge of Incinerators	6 t	Incinerated in Incinerator
		36.2	Ash from incineration of hazardous waste, flue gas cleaning residue		10 t	Stored in designated area

Work Zone Air Quality

Selection of Monitoring Locations

Monitoring of work zone air quality was carried out at various locations spread over all the units of the plant. Parameters monitored were PM, PM10, PM2.5 , SO_2 , PAH & NO_X .

Methodology

The Methods of Sampling and Analysis, Equipment used is given in **Table 3.28.**

Table 3.28: Method of Sampling and Analysis of Work Zone Air Quality

Sl. No	Parameters	Instruments / Apparatus used	Method followed
1	Suspended Particulate Matter (SPM)	Respirable Dust Sampler (RDS/HVS), Balance	Gravimetry
2	Respirable Particulate Matter (RPM)	Respirable Dust Sampler (RDS), Balance	Gravimetry
3	Nitrogen Oxides (NOx)	RDS/HVAS with Impinger tubes, Spectrophotometer	Jacobs and Hochheiser modified (Na-arsenite) Method
4	Sulphur di-oxide (SO_2)	RDS/HVAS with Impinger tubes, Spectrophotometer	Improved West & Gaecke Method

Results of Work-zone Air Quality

The work-zone air quality of various areas are shown in **Table 3.29,** the monitored values are compared with Factories Act norm (as amended in 1994). The following is inferred from the table:

- At all the monitoring locations the values of different parameters are below the Factories Act norms.

Table 3.29 : Work-zone Air Quality of Different Shops/Units of JSW

Sl. No.	Air Quality - work area	PM 2.5 mg/m3	PM 10 mg/m3	TSP mg/m3	SO2 ug/m3	NOx ug/m3
1	LCP (Operation) / FSB area	0.006	0.653	1.112	26.6	30.8
2	LCP (Operation) / Skip bucket area	0.004	0.336	1.403	25.4	30.6
3	LCP (Operation) / DBB	0.004	0.707	1.746		
4	LCP (Operation) / RMSB Area	0.004	0.004	1.628		
5	LCP (Operation) / Kiln area	0.007	0.074	0.786		
6	Iron Making (Operation) / Corex 1 cast house (near tap hole)	0.042	0.249	0.351		
7	Iron Making (Operation) / Corex 2 cast house (near tilting runner)	0.006	1.229	2.004		
8	Iron Making (Operation) / Corex 1 sampling post	0.008	1.806	2.995	34.6	48.4
9	Iron Making (Operation) / Corex 2 Casthouse (near tap hole)	0.025	0.423	0.969	34.6	46.8
10	Iron Making (Operation) / Corex lab	0.02	0.068	0.357		
11	Pellet Plant (Operation) / Lime stone ore yard	0.017	0.987	1.372	36.7	49.4
12	Pellet Plant (Operation) / Addtive grinding ground floor	0.077	0.931	1.34		
13	Pellet Plant (Operation) / P7 Conveyor	0.074	0.795	1.059		
14	Pellet Plant (Operation) / P6 Conveyor	0.085	0.592	0.866		
15	Pellet Plant (Operation) / Addtive grinding top floor	0.068	1.268	1.814		
16	Pellet Plant (Operation) / HL Extraction	0.107	1.492	1.788	38.4	51.6
17	Pellet Plant (Operation) / HLSS	0.059	4.041	5.166		

Sl. No.	Air Quality - work area	PM 2.5 mg/m3	PM 10 mg/m3	TSP mg/m3	SO2 ug/m3	NOx ug/m3
18	CRM (Operation) / CRM SPM Roll shop gate No 1	-	1.219	-	26.8	34.2
19	LCP (Operation) / Skip bucket area	0.018	0.129	0.819		
20	LCP (Operation) / DBB	0.017	1.019	1.281		
21	LCP (Operation) / RMSB Area	0.242	1.859	2.925		
22	LCP (Operation) / Kiln area	0.011	0.612	0.762		
23	LCP (Operation) / FSB area	0.047	0.449	0.634		
24	CRM (Operation) / CRM Gate no 1	-	0.219	-	28.2	36.2
25	BOF (Operation) / BOF - 1, near control room	0.018	0.199	0.311		
26	BOF (Operation) / BOF 2 - Thundish area	0.041	0.903	1.492	28.6	41.8
27	BOF (Operation) / BOF - 1 , 9.1M tapping	0.023	0.131	0.488		
28	BOF (Operation) / BOF 2. 15M blowing	0.021	0.782	1.052	32.8	44.6
29	BOF (Operation) / BOF - 1 Caster plat form	0.013	0.053	0.354		
30	BOF (Operation) / BOF - 1, 15 meter blowing	0.009	0.009	0.887		
31	BOF (Operation) / BOF 1 - Thundish area	0.006	0.74	1.902		
32	BOF (Operation) / BOF 2, 9.1M tapping	0.01	1.608	2.92		
33	BOF (Operation) / BOF 2 - caster plat form	0.022	0.151	0.244		
34	Captive Power Plant1 / WTP area	0.013	0.08	0.117		
35	Captive Power Plant1 / 390 TPH Boiler area	0.029	0.13	0.174		
36	CRM (Operation) / ARP Blower	0.007	0.105	0.162		
37	Captive Power Plant2 / Fire pump house	0.051	0.555	0.683		
38	Pellet Plant (Operation) / P6 Conveyor	0.022	0.475	0.922		
39	Pellet Plant (Operation) / Addtive grinding top floor	0.031	0.555	0.795		
40	CRM (Operation) / Coil yard	0.014	0.299	0.448		
41	Pellet Plant (Operation) / HL Extraction	0.007	1.778	2.361		
42	CRM (Operation) / CPL EXIT	0.013	0.13	0.173		
43	Coke Oven Operation and	0.001	3.413	4.971	44.8	48.6

Sl. No.	Air Quality - work area	PM 2.5	PM 10	TSP	SO2	NOx
		mg/m3	mg/m3	mg/m3	ug/m3	ug/m3
	TCG / CO - 3, Oven top					
44	Pellet Plant (Operation) / HLSS	0.007	1.122	2.319		
45	Pellet Plant (Operation) / Lime stone ore yard	0.028	0.444	0.663		
46	CRM (Operation) / CCSU Blower	0.013	0.074	0.103		
47	Captive Power Plant2 / D M Plant	0.058	0.701	0.984		
48	Pellet Plant (Operation) / Addtive grinding ground floor	0.053	1.536	2.419		
49	CRM (Operation) / SPM mill	0.01	0.121	0.252		
50	CRM (Operation) / BAF Pulpit	0.007	0.12	0.202		
51	Sinter Plant (Operation) / SP2 MND discharge	0.011	0.866	1.274		
52	Sinter Plant (Operation) / SP 1 conveyor 7003	0.008	0.759	1.281	38.4	46.4
53	Sinter Plant (Operation) / SP2 Cooler discharge	0.021	0.77	1.398		
54	Sinter Plant (Operation) / SP 1, machine discharge	0.109	1.044	1.529		
55	Sinter Plant (Operation) / SP 2 Conveyor 7003	0.017	0.643	1.052	40.2	48.6
56	Sinter Plant (Operation) / SP 1 Conveyor 7002 & 7003	0.019	1.339	1.825	40.3	51.6
57	Sinter Plant (Operation) / SP 2, crusher building	0.051	0.907	1.33		
58	Sinter Plant (Operation) / SP 1 Cooler Discharge	0.043	1.226	1.972		
59	Sinter Plant (Operation) / SP2 Conveyor 7002	0.019	1.116	1.573		
60	Sinter Plant (Operation) / SP - 1, MND discharge	0.022	1.08	1.853		
61	Sinter Plant (Operation) / SP 2, machine discharge	0.069	0.503	0.722		
62	Sinter Plant (Operation) / SP 1 Crusher Building	0.022	0.788	1.081		
63	Pellet Plant (Operation) / P7 Conveyor	0.021	0.377	0.693		
	Norms of Factories Act as amended 1994	**-**	**5mg/m3**	**10mg/m3**	**5000**	**6000**

Sampling DT 7th to 12th Apr 2010
Test start date 16.04.10
Test End date 26.04.10

Sl.no	Location	Poly Aromatic Hydrocarbon
1	Lime Calcination Plant - Top of building	BDL (DL : 0.15 ug/m3)
2	Coke oven # 3 - Oven top	BDL (DL : 0.15 ug/m3)
3	Coke oven # 3 - Ground dedusting top floor	BDL (DL : 0.15 ug/m3)
4	Coke oven # 3 - between battery A & B	0.46 ug/m3
5	Coke oven # 3 - Project office	BDL (DL : 0.15 ug/m3)
6	Coke oven # 1 - Oven top	BDL (DL : 0.15 ug/m3)
7	Coke oven # 1 - between battery A & B	BDL (DL : 0.15 ug/m3)
8	Vidyanagar Township	BDL (DL : 0.15 ug/m3)
9	Vaddu village	BDL (DL : 0.15 ug/m3)
10	Shankar Gudda Colony Toranagallu village	BDL (DL : 0.15 ug/m3)

BDL : Below Detection Limit
DL : Detection Limit

Work Zone Noise

Work zone noise levels were monitored and the monitoring details in different units of JSW are given in **Table 3.30.** From the results it can be seen, the noise level in some work zone is below the norm as prescribed by OSHA norm for eight hours.

Table 3.30: Work Zone Noise

Sl. No.	Noise - Work area	Noise level dB(A)
1	Other Departments / RBM - near furnace	96.75
2	Iron Making (Operation) / Corex 2 CGC 2	107.8
3	Other Departments / WRM - vertical RM / 03 stand 4	103.45
4	Iron Making (Operation) / BF2 ID fan dedusting 1	98.9
5	Captive Power Plant2 / Boiler area	82.58
6	Other Departments / WRM - roll shop	92.05
7	Iron Making (Operation) / Corex II Caste house 4	81
8	Other Departments / RBM - vertical stand 4	97.05
9	Captive Power Plant2 / T G. 10.5 Metet Floor	96.7
10	Coke Oven Operation and TCG / CO 3 Ground dedusting 1	83.7
11	Coke Oven Operation and TCG / CO 3 Ground Dedusting 2	82.3
12	Sinter Plant (Operation) / SP 1 ID fan Dedusting ESP	99.4
13	Other Departments / SPCL CTL -3 Line	88.9
14	CRM (Operation) / ECL Mill Area	100.73
15	Slag Grinding Unit (Cement Plant) / CP 1 mill Motor 2	102.5
16	Iron Making (Operation) / BF 3 ID Fan Dedusting East 2	98.3
17	Slag Grinding Unit (Cement Plant) / CP1 Packing section	97
18	CRM (Operation) / CPL Drier area	104.15
19	Sinter Plant (Operation) / SP 1, Dedusting ESP	102.4
20	Iron Making (Operation) / BF-3 Blower room	106.7
21	HSM (Operation) / RHF-Chimney	97.2
22	Pellet Plant (Operation) / Balling Disc	97.8
23	Other Departments / WRM - laying head	105.45

Sl. No.	Noise - Work area	Noise level dB(A)
24	Iron Making (Operation) / BF2 CDP	98.4
25	Iron Making (Operation) / BF 3 ID Fan Dedusting East 1	97.95
26	Iron Making (Operation) / BF2 SGP pump celler 1	97.45
27	Iron Making (Operation) / BF3 Cast house west	83.2
28	Captive Power Plant1 / Store	85.6
29	Captive Power Plant2 / DM Plant	79.8
30	LCP (Operation) / LCP 1 '9.75' Metre	87.75
31	Other Departments / RBM - roll shop	93.25
32	BOF (Operation) / SMS 2 CCP gas cutting	94.2
33	Iron Making (Operation) / Corex II Caste house 3	86.7
34	Other Departments / RBM - vertical stand 3	95.25
35	Coke Oven Operation and TCG / CO 3 Project Office	68.3
36	Pellet Plant (Operation) / recuperation fan	103.2
37	CRM (Operation) / CCM mill	106.87
38	Slag Grinding Unit (Cement Plant) / CP 1 Mill motor 1	100.6
39	BOF (Operation) / BOF 1 - CCP Hydrolic	91.7
40	Sinter Plant (Operation) / SP2 ID Fan dedusting esp	101.93
41	Sinter Plant (Operation) / SP 1, Process ESP	104.3
42	Other Departments / WRM - vertical RM / 03 stand 3	101.6
43	Iron Making (Operation) / BF2 WTP pump house	89.55
44	BOF (Operation) / SMS 2 Ramp	79.8
45	Captive Power Plant1 / Office	80.7
46	LCP (Operation) / LCP 1 'O' Meter	91
47	Iron Making (Operation) / Corex-1 pumphouse	91.2
48	Iron Making (Operation) / BF2 CA fan	104.1
49	BOF (Operation) / SMS 2 Convertor	96.55
50	Sinter Plant (Operation) / SP 1 Crusher Building	99.4
51	Coke Oven Operation and TCG / CO 3 Charging Car Battery A	101.4
52	Other Departments / SPCL CTL 2 Line	87.3
53	Captive Power Plant2 / CW pump house	88.33
54	Captive Power Plant2 / D M Plant	78.95
55	CRM (Operation) / CPL Choppers Area	92.9
56	Slag Grinding Unit (Cement Plant) / CP 1 bags loading	80.5
57	Sinter Plant (Operation) / SP 2 Conveyor 7002 / 7003	82.25
58	Sinter Plant (Operation) / SP2 Bins area	90.65
59	Iron Making (Operation) / BF-3 Cast house east	87.25
60	Pellet Plant (Operation) / Ball mill	102.1
61	Other Departments / WRM - RSM	101.1
62	CRM (Operation) / CCSU Blower	86.5
63	Other Departments / WRM - vertical RM / 03 stand 2	100.8
64	Iron Making (Operation) / BF2 GCP Clarifier	90.9
65	Slag Grinding Unit (Cement Plant) / CP 1Control Room	86
66	Iron Making (Operation) / CoreX II Control room parking area	79.1
67	Other Departments / RBM - vertical stand 2	93.9
68	Iron Making (Operation) / corex-1 CDP Drier	91.2

Sl. No.	Noise - Work area	Noise level dB(A)
69	Iron Making (Operation) / BF2 Tyer Platform	80.2
70	Other Departments / SPCL Carpentary shop	105.9
71	CRM (Operation) / ARP Blower	105.33
72	Other Departments / SPCL CTL 1 Line	86.5
73	Slag Grinding Unit (Cement Plant) / CP 1Store room	93
74	BOF (Operation) / BOF 1 - CCP Gas Cutting	98.03
75	HSM (Operation) / D.C (CTL)	102
76	Slag Grinding Unit (Cement Plant) / CP1 Silo area	87.9
77	Sinter Plant (Operation) / SP 2 Cooler Discharge	105.65
78	Other Departments / WRM - NTM	101.55
79	Iron Making (Operation) / BF2 Trough cooling fan	100.65
80	Captive Power Plant1 / Boiler area	102.6
81	BOF (Operation) / SMS 2 Ramp office	81.9
82	Iron Making (Operation) / Corex II ETP MCC room	71.5
83	Other Departments / RBM - vertical stand 7	101.1
84	Other Departments / RBM - vertical stand 1	91.55
85	Iron Making (Operation) / Corex-1 Cast house	82.75
86	Coke Oven Operation and TCG / CO 3 Charging Car Battery B	103.8
87	Other Departments / SPCL Mechanical workshop	81.1
88	Sinter Plant (Operation) / SP 1 Bins Area	89.63
89	Slag Grinding Unit (Cement Plant) / CP 1 RM Feeding	90
90	BOF (Operation) / BOF 1 - Convertor	99.13
91	CRM (Operation) / BAF -2 Blower area	87.4
92	HSM (Operation) / F.M Motar	96.9
93	Other Departments / SPCL CRS - 2 Line	82
94	Sinter Plant (Operation) / SP 1 Cooler Discharge	100.1
95	Other Departments / RBM - vertical stand 8	94.25
96	Iron Making (Operation) / Bf2 ID fan dedusting fan 3	92.2
97	Captive Power Plant1 / Side stream filter	87.6
98	Other Departments / WRM - vertical stand	96.3
99	Iron Making (Operation) / Corex II Pump house	91.3
100	Other Departments / RBM - vertical stand 6	93.35
101	Iron Making (Operation) / BF2 Cast house 4	86.5
102	Coke Oven Operation and TCG / CO 3 Charging Car Battery D	101.8
103	Other Departments / SPCL APL Line	80.9
104	Other Departments / SPCL HSR Line	85.1
105	Slag Grinding Unit (Cement Plant) / CP 1 Mill 2	103.9
106	CRM (Operation) / ETP-2 Blower area	99.67
107	CRM (Operation) / ETP-I Blower area	95.65
108	Other Departments / WRM - vertical RM / 03 stand 6	111.15
109	Other Departments / SPCL CRS - 1 Line	81.5
110	Iron Making (Operation) / BF2 Id fan dedusting fan 2	92.15
111	LCP (Operation) / LCP 1 Skip bucket area	95.2
112	CRM (Operation) / CPL EXIT	99.75
113	CRM (Operation) / ECI Drier Area	104.7

Sl. No.	Noise - Work area	Noise level dB(A)
114	Other Departments / WRM - near furnace	94.45
115	Captive Power Plant2 / Control room	70.15
116	Iron Making (Operation) / Corex-1 CGM-1	102.35
117	Iron Making (Operation) / BF2 Cast house 3	87.8
118	Iron Making (Operation) / BF 3 Control Room	62.85
119	Sinter Plant (Operation) / SP 1 Conveyor 7002 & 7003	80.1
120	Sinter Plant (Operation) / SP2 MND discharge	101.3
121	HSM (Operation) / R.M Motar	95.95
122	Captive Power Plant2 / Turbine floor	89.7
123	Other Departments / WRM - vertical RM / 03 stand 5	102
124	BOF (Operation) / SMS 2 CCP hydraulic	96.6
125	LCP (Operation) / LCP 1 Blower Room 4	108.5
126	Iron Making (Operation) / Corex II 'O' meter	93.1
127	Other Departments / RBM - vertical stand 5	93.55
128	Iron Making (Operation) / Corex-1 "0" Meter	93
129	Iron Making (Operation) / BF2 Control Room	67.05
130	Coke Oven Operation and TCG / CO 3 Charging Car Battery C	102.7
131	Sinter Plant (Operation) / SP 1 ID Fan Process ESP	108.9
132	Other Departments / SPCL HRCTL Line	90.5
133	Iron Making (Operation) / BF 3 ID Fan Dedusting East 3	94.95
134	Sinter Plant (Operation) / SP 1 Scrubber Building	89
135	Slag Grinding Unit (Cement Plant) / CP 1 Mill 1	100.9
136	Sinter Plant (Operation) / SP2 ID fan Process ESP	111.07
137	CRM (Operation) / SPM mill area	105.25
138	CRM (Operation) / CPL Entry	106.85
139	HSM (Operation) / C.P.I- control ROOM	76.65
	OSHA Norm for eight hours	**90**

Effluent Quality & Sewage Effluent

No effluent is discharged outside plant boundary by JSW.

Sampling Locations

Effluent samples from outlets of treatment plants of different JSWunits as given below were collected for effluent quality analysis.

- Guard Pond I
- Guard Pond II
- STP (Sewage Treatment Plant) outlet

Samples for analysis were also collected from the above JSW outlets.

Methodology

Grab effluent samples were collected for analysis once each during December 2009,January 2010 and February 2010 and were analysed for different parameters. Samples were analysed for different parameters as required by MOE&F. Wastewater Discharge Standard. Samples were analysed for different parameters as per American Public Health Association (APHA), 1995 - "Standard Methods for the Examination of Water and Waste Water" and IS: 3205 (Part 39) 1990 (reaffirmed 1996).

Results

The average values of effluent characteristics as observed in the samples collected from Guard Ponds which receives treated blowdown from different plant units during monitoring period are found to be within the norms for different parameters as specified by KSPCB as given in **Table 3.31 & 3.32** below:

Table 3.31 :Effluent Analysis report for JSW (Average value)

Sl. No.	Parameters	Norms*	Guard Pond I	Guard Pond II
1	pH	5.5-9	7.38	7.67
2	Suspended Solids	100mg/l	58	23
3	Dissolved Solids	2100mg/l	469	826
4	Oil & Grease	10mg/l	0.9	0.6
5	BOD - 5 days, 20°C	100mg/l	8	6
6	Chloride (as Cl)	600mg/l	115	204
7	Sulphates (as SO_4)	1000mg/l	104	116
8	Cyanides (as CN)	0.2mg/l	Nil	Nil
9	Pesticides	Absent	Absent	Absent
10	Iron (as Fe)	3mg/l	0.04	0.16
11	Arsenic (as As)	0.2mg/l	<0.01	<0.01
12	Boron (as B)	2 mg/l	<0.01	<0.01
13	Lead (as Pb)	0.1mg/l	<0.01	<0.01
14	Zinc (as Zn)	5mg/l	<0.01	<0.01

* as per Karnataka State Pollution Control Board

Table 3.32 :Sewage Analysis report for JSW (Average value)

Sl. No.	Parameters	Norms*	Raw Sewage	Treated Sewage
1	pH	5.5-9	7.38	7.4
2	Suspended Solids	30mg/l	28	24
3	BOD - 3 days, 27°C	20mg/l	110	18
4	COD	250mg/l	224	90

* as per Karnataka State Pollution Control Board

Petrological & Chemical Analysis of Raw Materials

JSW is using various raw materials for their operations in the steel plant. Petrological and Chemical analysis of various raw materials are given below:

Sl. No.	Parameters	Associated Mining Company Iron Ore Fines	HRG, iron Ore fines	VS lad, Iro Ore fines	MT Lime Stone (10-30 MM)	Mysore Minerals Ltd, Lime stone
A	**Chemical Composition**					
1	Loss on ignition, %	2.87	2.97	3.66	40.9	39.80
2	Silica (as SiO_2), %	8.89	1.47	1.15	5.19	7.30
3	Aluminium (asAl_2O_3), %	4.52	1.90	1.78	0.99	1.48
4	Iron (as Fe_2O_3), %	58.17	65.13	65.01	0.70	1.14
5	Calcium (as CaO), %	-	-	-	49.25	47.20
6	Magnesium (as MgO), %	-	-	-	2.21	2.70
7	Sodium (as Na_2O), %	-	-	-	0.013	0.017
8	Phosphorou,as P %	0.056	0.067	0.089	0.022	0.019
B.	**Trace Elements / Metals**					
1	Arsenic (As), ug/g	0.002	0.002	BDL	BDL	BDL
2	Cadmium (Cd) ,ug/g	0.005	0.016	0.022	0.008	0.017
3	Chromium (Cr), ug/g	0.03	0.019	0.066	0.011	0.055
4	Copper (Cu), ug/g	2.02	1.126	1.26	0.09	0.062
5	Iron (Fe),ug/g	28.60%	33.50%	45.60%	0.43	0.45
6	Lead (Pb), ug/g	1.52	1.39	1.34	0.005	0.008
7	Mercury (Hg),ug/g	BDL	BDL	BDL	BDL	BDL
8	Manganese (Mn), ug/g	0.079	0.091	0.045	BDL	BDL
9	Nickel (Ni), ug/g	0.024	0.016	Bdl	BDL	0.011
10	Zinc (Zn), ug/g	0.319	0.029	0.054	0.13	0.07

Sl. No.	Parameters	Mallikarjuna Minerals Lime Stone , 10-30 MM	SWML Dolomite (10-30 MM)	Vijayanagar Mining Minerals) Quartzite, 15-30 MM)	Slime
A	**Composition**				
1	Loss on ignition, %	41.06	40.71	-	-
2	Silica (as SiO_2), %	6.20	9.40	99.2	8.56
3	Aluminium (asAl_2O_3), %	0.94	2.17	0.2	5.7
4	Iron (as Fe_2O_3), %	1.21	1.15	0.5	56.2
5	Calcium (as CaO), %	45.64	26.78	Nil	0.52
6	Magnesium (as MgO), %	4.08	18.50	Nil	0.27
7	Sodium (as Na_2O), %	0.018	0.012	Nil	Nil
8	Potassium (as K_2O), %	0.350	0.580	Nil	Nil
B.	**Trace Elements / Metals**				
1	Arsenic (As), ug/g	BDL	BDL	BDL	BDL
2	Cadmium (Cd) ,ug/g	0.006	0.013	BDL	0.008
3	Chromium (Cr), ug/g	0.073	0.09	BDL	0.015
4	Copper (Cu), ug/g	0.045	0.02	0.002	1.09

5	Iron (Fe),ug/g	0.54	0.31	0.001	46.40%
6	Lead (Pb), ug/g	0.095	0.011	-	0.056
7	Mercury (Hg),ug/g	BDL	BDL	-	BDL
8	Manganese (Mn), ug/g	BDL	BDL	0.005	0.096
9	Nickel (Ni), ug/g	0.028	0.002	-	BDL
10	Zinc (Zn), ug/g	0.15	0.22	-	0.426

Sl. No.	Parameters	Metropoliton Coal	Total South Africa Coal	Ensham Coal
A	**Composition**			
1	Loss on ignition, %			
2	Silica (as SiO_2), %			
3	Aluminium (asAl_2O_3), %			
4	Iron (as Fe_2O_3), %			
5	Calcium (as CaO), %			
6	Magnesium (as MgO), %			
7	Sodium (as Na_2O), %			
8	Potassium (as K_2O), %			
B.	**Trace Elements / Metals**			
1	Arsenic (As), ug/g	0.008	BDL	0.005
2	Cadmium (Cd) ,ug/g	0.007	0.008	0.065
3	Chromium (Cr), ug/g	0.152	0.225	0.145
4	Copper (Cu), ug/g	0.026	0.045	0.032
5	Iron (Fe),ug/g	2.00	2.00	1.50
6	Lead (Pb), ug/g	0.016	0.02	BDL
7	Mercury (Hg),ug/g	BDL	BDL	BDL
8	Manganese (Mn), ug/g	0.03	0.08	0.065
9	Nickel (Ni), ug/g	0.042	0.058	0.034
10	Zinc (Zn), ug/g	0.037	0.045	0.029

Source: Metropolitan (Coal) **Place: Australia**

Total moisture, %	9.1	CSN	1.5
Proximate analysis (Air dry basis)		HGI	70
Inherent moisture, %	1.5	**Petrographic analysis**	
Ash, %	12.3	Vitrinite, %	41
Volatile matter, %	26	Semi-vitrinite, %	2
Fixed carbon, %	53	Inertinite, %	46
Sulphur, %	0.35	Exinite, %	4
Calorific value, kcal/kg	7563	Mineral Matter, %	7
Ash analysis (Air dry basis)		**Vitrinite Distribution**	
SiO_2, %	53.26	V6, %	2
Al_2O_3, %	23.68	V7, %	8
Fe_2O_3, %	12.65	V8, %	2
CaO, %	3.72	V9, %	6
MgO, %	0.04	V10, %	22
Mn_3O_4, %	0.70	V11, %	32

TiO_2, %	1.14	V12, %	26
P_2O_5, %	1.05	V13, %	2
SO_3, %	0.32	V14, %	-
Na_2O, %	0.12	V15, %	-
K_2O, %	1.04	V16, %	-
Gieseler Plastometer		V17, %	-
IST, °C	413	V18, %	-
Max. fluidity, ddpm	1.0	V18 & above, %	-
Max. fluidity temperature, °C	456	V9-V13, %	88
FST, °C	468	Ro (average)	1.10
Plastic Range	55	MMR	1.17
Trace Elements / Metals			
Arsenic (As), ug/g	0.008		
Cadmium (Cd) ,ug/g	0.007		
Chromium (Cr), ug/g	0.152		
Copper (Cu), ug/g	0.026		
Iron (Fe),ug/g	2		
Lead (Pb), ug/g	0.016		
Mercury (Hg),ug/g	BDL		
Manganese (Mn), ug/g	0.03		
Nickel (Ni), ug/g	0.042		
Zinc (Zn), ug/g	0.037		

Source: Ensham non-coking Coal		**Place: Australia**	
Total moisture, %	10.7	CSN	1
Proximate analysis (Air dry basis)		HGI	58
Inherent moisture, %	3.2	**Petrographic analysis**	
Ash, %	9.5	Vitrinite, %	39
Volatile matter, %	27.2	Semi-vitrinite, %	2
Fixed carbon, %	60.1	Inertinite, %	49
Sulphur, %	0.57	Exinite, %	3
Calorific value, kcal/kg	6887	Mineral Matter, %	7
Ash analysis (Air dry basis)		**Vitrinite Distribution**	
SiO_2, %	50.4	V6, %	74
Al_2O_3, %	32.8	V7, %	18
Fe_2O_3, %	7.7	V8, %	8
CaO, %	2.8	V9, %	-
MgO, %	0.9	V10, %	-
Mn_3O_4, %	0.5	V11, %	-
TiO_2, %	1.4	V12, %	-
P_2O_5, %	1.4	V13, %	-

SO_3, %	1.2	V14, %	-
Na_2O, %	0.4	V15, %	-
K_2O, %	0.6	V16, %	-
Gieseler Plastometer		V17, %	-
IST, °C	423	V18, %	-
Max. fluidity, ddpm	1	V18 & above, %	-
Max. fluidity temperature, °C	450	V9-V13, %	8
FST, °C	460	Ro (average)	0.67
Plastic Range	37	MMR	0.71
Trace Elements / Metals			
Arsenic (As), ug/g	0.005		
Cadmium (Cd) ,ug/g	0.065		
Chromium (Cr), ug/g	0.145		
Copper (Cu), ug/g	0.032		
Iron (Fe),ug/g	1.5		
Lead (Pb), ug/g	BDL		
Mercury (Hg),ug/g	BDL		
Manganese (Mn), ug/g	0.065		
Nickel (Ni), ug/g	0.034		
Zinc (Zn), ug/g	0.029		

3.2.12 Occupational Health Status

Occupational Health of the workers in JSW is looked after by Occupational Health Centre which is managed by Factory Medical Officer, staff nurses and ward assistant under the supervision of chief of medical and health services.

Occupational health service activities being followed in the existing plant is as follows:

1.Pre-employment medical examination of employee

Employees recruited for employment undergo necessary pre employment medical examination for fitness for the job. In this way, right persons are selected for right job.

2. Periodical medical examination of employees:

Periodic medical examination of employees is being conducted regularly and necessary feed back is being provided to individuals. They undergo lung function test, audiometry test, X-ray chest, E.C.G., blood & urine examination and clinical examination. Year wise coverage is given below.

3. Industrial hygiene survey:

Industrial hygiene survey is being conducted at JSW through OHC to assess the nature and level of hazards inside the plant and for necessary planning & action to reduce these hazard levels. Due to very nature of operation in the plant, there were few incidences of noise. However, because of the excellent engineering control measures and hearing conservation programme like periodic audiometry examination, motivating employees to use personal protective equipments like ear muff & ear plugs, noise induced problems are negligible.

4. Eye check up for the employees:

Crane operators and drivers undergo eye check up for refractory error by Ophthalmologist once in two years. Year wise coverage is given below.

5. Food handlers hygiene check-up:

Food handlers in canteen undergo hygiene check up once in six months since they may be a source of infection to others. All of them undergo stool examination for ova and cyst. Treatment is given accordingly. All of them are given one dose of Albendazole 400 mg under direct supervision. They are given fitness certificate (Form 40) after ensuring fitness.

In addition to the above, first aid training & treatment and maintenance of first aid boxes are also looked after by the Occupational Health Services.

There is no evidence of Occupational disease at JSW.

OCCUPATIONAL HEALTH CENTRE - JSW SL SITE

SL. NO.	NAME OF THE EXAMINATION	2008	2009	TOTAL
1	Periodical Medical Examination(PFT & AUDIO) JSW EMP. & A E's	16952	21445	38397
2	P M E / Physical Fit-ness (ONLY AUDIO) / JPOCL	201	109	310
3	OPD CASES TREATED AT O H C	608	858	1466
4	CRANE OPERATORS (VISION TEST)	648	878	1526
5	CANTEEN WORKERS	434	94	528
6	Physical Fitness Certificate / HYDRO-OPERATORS (VISION TEST)	282	16	298
7	FIRST - AID TRAINING (JSW EMP. & A E's)	1559	556	2115
8	FREE MEDICAL CAMPS AT LABOUR COLONIES	3116	601	3717
9	ENT OPD AT O H C	268	613	881
10	Physical Fitness Certificate / New Cement Plant Employees	0	77	77
11	Physical Fitness Certificate / Others	48	96	144
12	Physical Fitness Certificate / OHC	NIL	NIL	NIL
13	Pneumoconeosis Cases	NIL	NIL	NIL
14	Arsenicosis Cases	NIL	NIL	NIL
15	Pulmonary Tuberculosis Cases	NIL	NIL	NIL
16	Chronic Lead Poisioning Cases	NIL	NIL	NIL
17	Total deafness cases	NIL	NIL	NIL
18	Sensory neural hearing loss cases	NIL	NIL	NIL
19	Total blindness cases	NIL	NIL	NIL
20	Partial blindness cases	NIL	NIL	NIL
21	Carbon Monoxide Exposure cases	2	0	2
22	Executive Health Check-up conducted at JSH	462	453	915
	GRAND TOTAL	**24580**	**25796**	**50376**

3.2.13 Compliance status to the environmental conditions stipulated by the Ministry & KSPCB for the existing plant

Environmental clearance was accorded for expansion of JSW Steel from 4.0 to 10 MTPA VIDE CONSENT NO. F.No. J-11011/364/2006-IA II (I) DATED 7th MAY 2007 and subsequent amendment dated 3rd July, 2008**.** The phase-1 namely the 7 mtpa stage has started and will be completed by Aug 2008. The second phase is slated to be commissioned by 2011. The following is the compliance status to the environmental conditions stipulated by the Ministry for the existing plant :

COMPLIANCE STATUS OF EC FOR JSW DATED 7TH May, 2007

Sl. No	Conditions	Compliance
I	**Specific Conditions**	
1	Gaseous emissions from various process units shall conform to the load/mass based standards On-line continuous monitors will be installed to monitor particulate matter in the stacks and air emissions from different sources shall not exceed 150mg/Nm3 Interlocking facilities shall be provided so that process can be automatically stopped incase emission level exceeds the limit.	There are a total of 156 stacks at 7 mtpa stage inclusive of non process stacks. We are regularly monitoring all the 156 stacks manually. However, we have identified 25 significant stacks from the above for installing continuous dust measurement facilities based on the following criteria; Flow exceeding 2,00,000 m3/h Units where the dust levels vary with the process Parameters. Units where the normal dust levels are close to the emission norms(> 50% of the norms) We have installed 16 continuous dust analyzers for measuring dust. There is proposal to install another 9 considering the expansion proposal for which action has been taken.
2	SO2 emissions from sinter plant shall be controlled by installing ESP and scrubbers. Secondary emissions from sinter plant shall also be controlled and monitored	As per the EIA report, we have provided ESP only for sinter Plant. The ESP is the Best Available Technology (BAT) for sinter plant. Scrubbers are of old design For process, ESP and stack height of 80 mtrs has been provided. ESP has also been provided for secondary dedusting SO2 emissions are controlled by stack height. As suggested by KSPCB, we are having action plan for modification of ESP to keep emission below the norms.
3	Three continuous ambient air quality monitoring stations shall be installed at the project site, one in	Six number of Continuous On line monitoring stations at installed at Vaddu

Sl. No	Conditions	Compliance
	downwind direction as well as where maximum GLC of SPM,SO2 & NOx are anticipated in consultation with KSPCB.Data on ambient air quality and stack emission shall be regularly submitted to the Ministry once in six months.	, Vidyanagar township , VV nagar Township , ShankarGudda Colony, MSDS and 10 MTPA gate In all the six as per new AAQ notification PM 10 & PM 2.5 monitoring facility provided. In addition AAQ is monitored monthly at 11 locations .
4	In plant control measures for checking the fugitive emissions from all vulnerable sources like spillage/raw materials/coal handling etc, shall be provided.Further, specific measures like provision of dust extraction and suppression system shall be installed at material transfer points and raw material handling areas. Fume extraction systems shall be provided at the cast house. Bag filter shall be provided at BF, BOF's Lime & Dolomite plant. Scrubber shall be provided to gas-based incinerator	To control fugitive emissions , yard sprinklers Dry fog system for transfer points, Wind curtains for coal yard, Tyre washing facility for Trucks provided. Materials are transported by covered trucks. Road sweeping machine are provided to control fugitive emissions. In addition thick green belt is provided. 10 nos of Dust extraction systems, Bag houses are provided for RMHS Application of road sweeping Four CCTV cameras have been located in the Corex area from where the fugitive emissions can be monitored
5	Centralized de-dusting system i.e., collection of fugitive emissions through suction hood & subsequent treatment through bag filter and finally emitted through a stack of appropriately designed height for induction & arc furnaces shall be provided. Secondary fugitive emissions shall be controlled, maintained within the permissible limits, regularly monitored and records maintained	Instead of Induction and arc furnaces we are having Blast furnaces and Basic Oxygen furnaces. We have provided in BF 3 (3 bag filters each with 9,00,000 nm3/h) and SMS -2 (2 bag houses with 16,00,000 and 6,00,000 nm3/h)
6	The particulate emissions from WHRB shall be controlled by installation of ESP & particulate emissions shall not exceed 50mg/Nm3.Further, company shall install bag filter, suction hood, dust extraction device & fume extraction system to control air emissions.	For WHRB boiler,ESP is installed and the particulate emissions are not exceeding the given standards. As ESP provided bag filters are not provided
7	Total water requirement from TB dam and Krishna River (Almatti dam) shall not exceed 2, 05,200 m3/d as per the agreement signed with the State Govt. The Blowdown from the system shall be treated in RO plant and reused as make up water.	This is a typographical error in the water requirement quantity. As per the agreement signed by State Govt (Copy Enclosed),the total water from TB dam is 1,36,080 m3/d & Daroji and Krishna river(Almatti dam) is 2,05,200 m3/d and our consumption will be with in the allotted quota We are installing 125 m3 / hr R.O Plant for the treatment of blow down water by Dec 2010

Sl. No	Conditions	Compliance
	The treated waste water from coke oven, scrubbed water from BF & BOF gas cleaning, slab caster, CRM, power plant etc shall be treated and recycled/reused in the process and for greenbelt development. No effluent shall be discharged outside the factory premises "Zero" discharge shall be followed strictly as proposed	This is being practiced We are utilizing the treated waste water for recycling into other less critical application area to achieve Zero discharge. How ever during monsoon season there will be discharge of run off water for which we have sought approval from KSPCB for the same.
8	Solid waste will be generated in the form of blast furnace slag, BOF slag, gas cleaning plant sludge DE system dust including fuel waste oil, organic waste etc. BF slag shall be used in cement plants.BOF slag, GCP sludge, DE system dust; mill scale etc shall be used in sinter plant. Coal fines shall be used in power plant. Used Refractory/debris shall be used in filling low lying areas. Oily waste and organic sludge shall be incinerated in the existing gas fired incinerator and waste oil and decanter sludge shall be used in Coke ovens. Chrome sludge generated shall be dumped in secured waste dump and then finally sent to TSDF	BF slag is being used for cement making. Other waste is used as recommended. Coal fines are used in Power plant Refractory/ debris are used for filling low lying areas. Being practiced There is no generation of chrome sludge in our plant
9	Entire quantity of ash/dust from ESP of WHRB and ash from AFBC boiler of CPP shall be collected and used for making bricks. Bottom ash shall be disposed off in a suitably designed landfill as per CPCB guidelines to prevent leaching to the sub-soil and underground aquifer.	Fly ash generated for use in cement making for which a contract with ACC exist.
10	The company shall develop surface water harvesting structures to harvest the rain water for utilization in lean season besides recharging the ground water table.	Roof top harvesting is provided for Vidyanagr School. Two number of guard ponds are proposed for the expansion project.
11	Green belt shall be developed in at least 615 ha (25%) out of total 2,458 ha. Area within and around the plant premises as per the CPCB guidelines in consultation with the DFO	Till date we have planted 1.2 million trees in our plant & township area in an area of 1264 acres. We have developed lawn over an area of 6, 75,000 Sq.M. For the year 2010 -11 the following activities have been planned. We have planned 40,000 trees in

Sl. No	Conditions	Compliance
		7 Mtpa area during 10-11, 15,000 already planted.
12	Occupational health Surveillance of the workers should be done on a regular basis and records maintained as per the Factories Act	The Jindal Sanjeevani Hospital (JSH) is established for Occupational Health Surveillance. Regular medical exam done. Records maintained.
13	Recommendations made in the Charter of Corporate responsibility for Environmental Protection (CREP) for the steel plants shall be implemented	For the existing plant we have complied with most of the CREP recommendations. The same shall be followed for the expansion project also
14	The company shall obtain necessary clearances for the linked iron ore mining component before undertaking any construction at the project site or operationalising the Iron & Steel unit	The bulk of our raw materials is being purchased from the local suppliers, and thus we are not depending on any captive mines.
	General Conditions	
1	The project authorities must strictly adhere to the stipulations made by the KSPCB and the state govt.	Noted
2	No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment and Forests	Approval of the MoEF being taken for any expansion or modifications in the plant, as and when required
3	Industrial Wastewater shall be properly collected, treated so as to conform to the standards .The treated wastewater shall be utilized for plantation purpose	Industrial water will be treated to conform to the standards. The treated waste water shall be used for plantation.
4	The overall noise levels in and around the plant area shall be kept well within the standards(85 dBA) by providing noise control measures including acoustic hoods,silencers,enclosures etc on all sources of noise generation. The ambient noise levels should conform to the stds namely 75dBA(daytime) and 70dBA(night time)	Noise monitoring being carried out regularly in different plant units and also in eight different locations around the plant area. Noise control measures are provided wherever required. The data obtained are found to be well within the standards.
5	Company must undertake socio-economic development activities in surrounding villages like community development pgms, educational pgms, drinking water supply and health care etc.	The JSW Foundation is carrying out the CSR activities in the surrounding villages.
6	As mentioned in EIA/EMP, Rs.1, 100.00 Crores and Rs.46.10 Crores earmarked towards the capital cost and recurring cost/annum for environmental pollution control measures shall be judiciously used to implement the conditions stipulated by the MoEF as well as the state govt.	Investment on Pollution Control Equipment is Rs 2598/- Recurring cost is Rs 250/ton of steel produced All projects suggested in EIA/EMP is being implemented.
7	The Regional Office of this Ministry shall monitor the stipulated conditions. A six monthly compliance report and the monitored data along with statistical interpretation shall be submitted to them regularly	The reports are being submitted to the Regional Office regularly
8	Project Proponent shall inform the public that the project has been accorded environmental clearance	Published in newspapers on 21.05.07

Sl. No	Conditions	Compliance
	by the Ministry and copies of the clearance letter are available with KSPCB and may also be seen at the Website of the MoEF at http:/envfor.nic.in.This shall be advertised within seven days from the date of issue of the clearance letter at least in two local newspapers of which one shall be in the vernacular language of the locality concerned and a copy of the same should be forwarded to the regional office.	
9	Project authorities should inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of commencing the land development work.	The phase-1 namely the 7 mtpa stage has started and will be completed by Aug 2008. The second phase is slated to be commissioned by 2011.

Compliance to EC Amendment Conditions for JSW Dated 3rd July,2008

Sl. No	Conditions	Compliance
1	No change in the overall capacity of the plant (10Mtpa) and further expansion/modifications in the plant shall be carried out without prior approval from MoEF	Approval of the MoEF being taken for any expansion or modifications in taken the plant beyond 10 mtpa
2	All the standards prescribed for the Coke Oven plant shall be followed as per the latest guidelines.	The Coke oven plant is designed based on the notification of 03.02.06
3	Proper and full utilization of coke oven gases in power plant using waste heat recovery steam generators shall be ensured and no flue gases shall be discharged into the air	A 130MW power plant has been put up to recover waste heat from non recovery Coke Oven 1 & 2
4	Total water requirement from TB dam and Krishna River (Almatti dam) shall not exceed 6508 m3/day	The Total water from TB dam is 1,36,080 m3/d and Krishna river(Almatti dam) is 2,05,200 m3/d and shall be maintained within this limit.
5	Continuous monitoring of the Total Organic Compounds (TOC) shall be done at the outlet of the ETP(BOD plant) and the wastewater shall be used for wet quenching	The TOC analyzer will be installed shortly at the outlet of BOD plant
6	All the recommendations made in the CREP for the Coke oven plants shall be implemented	All the recommendations made in CREP have been implemented as application
7	As proposed total cost of the project will be Rs. 16,454.00 Crores. Rs 1400.00 crores earmarked towards the environmental pollution control measures shall be judiciously used to implement the conditions stipulated by the MoEF as well as	Funds will be spent

	the State Government. The funds so provided shall not be diverted for any other purpose.	
8	Regular submission of compliance report to this Ministry including its Regional office at Bangalore, KSPCB and CPCB shall be ensured.	These reports are being submitted to the authorities regularly

POINTWISE COMPLIANCE TO CFE for 10 MTPA VIDE CONSENT NO. CFE-EIA/JSW/EIA -487/2005-2006/185 dt.12th OCTOBER 2006

Sl. No	Conditions	Compliance
	The details of additional facilities , products and production capacities are at Annexure – I	
I	**Water Consumption**	
1	Total water consumption for steel plant expansion shall not exceed 5140m3/hr(includes water consumption for establishment of 1 Million TPA CRM and new township) and the consumption of make up water shall be as per **Annexure II**	Noted. The consumption of water will be maintained within 5140 m3 /hr. At present the water consumption is 4000 m3/h
2	Total water consumption for power plant expansion shall not exceed 419KLD and the treated water from the DM water plant to be discharged to the guard pond	The power plant (CPP -2) has been designed to use water less than 419 m3 /day.
II	**Water pollution Control**	
1	The discharge of emissions from the premises of the applicant shall pass through terminal manholes where from the Board shall be free to collect the samples at any time in accordance with the provisions of the Act and Rules made there under.	**The treated waste water from the 10 MTPA plant will be collected in 2 Nos of Guard ponds after treatment** **a. 4.0 MTPA (already commissioned)** **b. 7 MTPA (Under Commissioning)** c. The water from all the guard ponds will be recycled in the plant during the dry seasons
2	Quantity of trade effluents not to exceed 104m3/hr and shall be treated to the standards given in Annexure-III. Treated trade effluent to be completely recycled back to the process. The cooling water blow down water shall be utilized for gardening /green belt within the industry premises in an area of 1192 acres. The quantity of sewage shall not exceed 90m3/hr (from township) and 50m3/hr (from industry). The sewage generated from the township shall be treated in the proposed Sewage treatment plant (STP) to the standards of BOD -20mg/l and SS - 30mg/l before discharging for on land irrigation/gardening within the industry premises.	The quantity of treated effluent will not exceed 104m3/hr during non rainy months and will meet the standards. The domestic sewage is treated in existing STP as follows • 1.5 MLD STP is provided for Vidya nagar town ship. • 1.2 MLD STP is provided for Vijaya Vittal Nagar town ship & for plant units. • 1.5 MLD STP is being provided for Shankar Gudda Colony. One more STP is planned for the new colony at Basapur. It may be noted that the water from STP is intended for gardening and the balance is planned to be put in guard pond. This arrangement has already been made at STP in VV nagar
3	Total quantity of trade effluent generation not to exceed 33KLD from the proposed power plant expansion and blow down of quantity 17KLD shall be discharged on land for irrigation after treatment.	From the proposed 130 MW power plant the trade effluent will not exceed 33KLD and 17 KLD blow down after treatment will be used for Irrigation. Currently it is being used in the coke oven for coke quenching
4	The blow down water from the major units to be treated in the RO plant to recover water and the	A Reverse Osmosis plant of 125 m3/hr is being planned to treat the b/d water from the

Sl. No	Conditions	Compliance
	rejects of the RO plant containing high TDS to be utilized in less critical applications like dust suppression , slag and coke quenching operations	CRM, BOF/ CCP and HSM. The blow down will be used for slag quenching
5	The applicant is liable to reinstate or restore, damaged or destroyed elements of the environment at his cost, failing which, the applicant shall be liable to pay the entire cost of remediation or restoration in advance an amount equal to the cost estimated by Competent Agency or Committee	There will not be any degradation of the environment by the operation of 10Mtpa plant units. However the condition is noted and will be complied
6	Raw material storage yard and finished product yard to be made totally impervious and storage to be suitably covered to prevent rainwater mixing and subsequent water pollution.	Three rows of plantations have been done on either sides of Raw material area and a wind curtain has been put up in the Coal storage area to avoid the carry over of fugitive emissions. Similar facility will be planned for the raw material yard for 7 and 10 Mtpa stages also.
7	Storm water mgmt plan top be provided for the collection of storm water and design details to be submitted within 30 days from the date of receipt of this CFE.	Storm water drains & Guard pond are provided for existing plant. Storm Water drains & Guard pond will be provided for expansion units.
III	**Air pollution Control**	
1	The discharge of emissions from the premises of the applicant shall pass through the stacks / chimneys mentioned in **Annexure - IV** where from the Board shall be free to collect the samples any time in accordance with the provisions of the Act and Rules made there under.	Stacks as per Annexure – IV are being provided. During operations we will ensure the emissions will pass through these stacks.
2	Stacks to be provided with port holes and platforms in order to facilitate monitoring of emissions	To facilitate monitoring sampling platform and portholes have been provided in all stacks at the design stage itself.
3	The industry shall get the samples of emissions from air pollution sources mentioned in **Annexure IV** analyzed **every month** at its own cost , in any laboratory and send the reports in duplicate to the Board every month	The emissions from the stacks will be measured regularly and checked for the effectiveness of the pollution control equipments. The results will be sent regularly to the KSPCB, as practiced in the present case.
4	Industry shall take necessary measures to avoid odor nuisance from the process area and ETP	Will be complied
5	There shall be net reduction in air pollutant load (i.e., Concentration of SO2, NOx, SPM) due to expansion of 100MW Coke Oven Flue gas Heat Recovery steam based power plant to 130MW	There has been net reduction in air pollution load due to the change in design of the process.
6	Industry to ensure that ambient air quality in its premises shall conform to the National Ambient Air Quality Standards specified in Environment (Protection) rules, as specified in **Annexure VI**	AAQ is being monitored in 8 locations in and around the steel plant. The monitored data presently conform to the standards.
7	The industry shall provide suitable Dust	JSW has got 40 Km of concrete roads. All

Sl. No	Conditions	Compliance
	suppression system for handling and storage of pellet, iron ore lump etc and also at the storage of granulated slag, junction houses and material transfer points. The industry shall take following measures to control fugitive emissions:	internal roads are made of concrete.
	a) Concrete roads to all the areas	Main arterial roads are of Concrete. Concrete roads will be provided in future expansion
	b) Efficiency of the scrubber provided for the hearth layer extraction system to be improved by providing additional spray nozzles. The water spray arrangements shall be made for dust suppression on conveyor belts and system shall be upgraded with automation.	The scrubber has been changed to bag house which is working efficiently
	c) Dust suppression system for the pellet stockyard to be implemented.	DSS was already provided for Pellet stockyard
	d) For suppression of dust near the ESP area, the screw conveyor to be provided with a slurry handling system by constructing a new tank provided with spray nozzles. The industry shall also take up landscaping work around the ESP and near Hearth extraction system and also take up plantations.	Screw conveyor & slurry handling system are provided for ESP of Pellet plant.
	e) For collection and sweeping of dust from the shop floors, the industry shall provide down comers, separate bob-cat m/c, and two wheel loaders for regular cleaning and sweeping of the dust in the pellet plant. Apart from the above, the industry shall maintain road sweeping and dust suction through special purpose vehicles.	There are down comer chutes from different floors of junction houses. Vacuum cleaning of junction houses is being done. This facility will be extended to the expansion units also
	f) Individual bag filters for in-house to be provided	Planning for 8 bag houses is being executed.
	g) dry fog dust suppression at hearth layer extraction, TT6 and TT8	A bag house is being planned for TT6 and TT8’
	h) A central dust collection system for all fugitive emissions , to monitor the AAQ	Fugitive emissions are monitored at 8 location to assess AAQ
8	Eleven AAQM stations to be provided and maintained along with the already existing monitoring stations in the JSW complex after consulting Regional office, Bellary, for monitoring SPM, RSPM, SO2, NOx, HCs, CO. Report of the	Ambient Air Quality Monitoring is being carried out at 8 Locations which includes 6 continuous on line Ambient Air quality monitoring at Vaddu & Vidyanagar town ship & SG colony.

Sl. No	Conditions	Compliance
	analysis shall be maintained in a register and a monthly extract sent to the Board..AAQM to be monitored at Hampi also.	
9	The applicant shall provide and maintain at his own cost a meteorological station to collect the data on wind velocity, directions, temperature, humidity, rainfall etc and the daily reading shall be recorded and the extract be sent to the Board office once in a month	A met station has been established at township. Reports are being sent to the Board regularly
10	The industry shall Upgrade/modify/replace the control equipments if they are found inadequate to meet standards stipulated. Prior permission of the Board shall be obtained for the same	Presently control equipments are adequate. The up gradation will be made if found required
IV	**Noise Pollution Control**	
1	The industry shall ensure that ambient noise levels within its premises shall not exceed 75dB(A) Leq during day time and 70dB(A) Leq during night time	Noise is being monitored at different locations and results are within the standards prescribed. This will be complied
V	**Solid waste(Other than Hazardous waste) disposal**	
1	The details of solid waste generation and disposal shall be as per **Annexure VII.**	Will be followed. More than 85% of the solid waste is being reused/recycled/sold
2	All the measures to avoid dust pollution, seepage/leachate from the dump yards shall be taken. Also solid wastes shall be stored on impervious surface and in closed enclosures. Measures shall be taken to avoid any runoff from the storage yard outside the premises of the industry.	The wastes are stored in an earmarked area. There is no runoff from the storage area.
3	The industry shall take afforestation measures on the landfill site.	Presently around 12 lakhs trees are planted with 36 % green cover. We are proposing 25 % green cover. A massive tree plantation is also being planned at the periphery of works wherever the plant units are not coming.
VI	**Water Cess**	
1	The industry shall comply with the provisions of Water(prevention and Control of Pollution) cess Act,1977, by installing water meters, filing water cess returns in Form-I and other provisions as contained in the said water(Prevention and Control of pollution) Cess Act, 1977 and 2003	Water cess returns are filed monthly
VII	**Hazardous waste (M&H) rules 1989 and 2003**	
1	The applicant shall apply and obtain authorization under Hazardous Waste (Management and Handling) amended Rules 2003 and comply with the conditions to handle, store and dispose hazardous waste generated	Presently we are having valid authorization under Hazardous Waste (Management and Handling) amended Rules 2003.
2	There shall not be generation of any Hazardous waste from the power plant expansion from	Since it is a gas based power plant there is no generation of any hazardous waste. The only

Sl. No	Conditions	Compliance
	100MW to 130MW.	hazardous waste is the waste oil for which we are setting.
VIII	**Health and Safety**	
1	Industry shall provide all necessary health care facilities to employees and local people	Jindal Sanjeevani Hospital is provided for the health care of employees and local people. This is also being expanded to meet the requirements of the increased number of persons in the expansion phases.
2	Industry shall regularly check the health of workers exposed to very high noise levels and suitable measures to avoid any ill effects shall be taken	Being done once in six months for crane operators and once in a year for all other employees by our Jindal Sanjeevani hospital
3	Industry shall take Safety measures to avoid injuries to the employees and local people as per the approved Onsite Emergency Plan	As per the approved onsite emergency plan safety measure will be proposed.,
IX	**Greenbelt**	
1	The industry shall develop Green belt of 100 meter width and shall maintain 33% green belt of the total area.	In the existing plant 36 % is covered with green belt. As committed 25% green belt shall be maintained in the expansion.
X	**General**	
1	The industry shall arrange for alternate power supply to run and operate essential units of ETP in event of brake down of regular supply from electricity Board.Seperate energy meters to be provided to the water and air pollution control systems	We are having our own captive power plant which will take care of eventualities. Thus no specific DG sets are planned.
2	Industry shall transport and store the Raw materials in a proper way so as not to cause any damage to the environment, life or property.	Raw materials are being transported in closed wagons and trucks. The dust suppression system present in the storage area
3	No commissioning of the proposed plant for trial/regular production unless necessary air pollution control equipments are installed to the satisfaction of the Board. The industry shall ensure that the treatment plant and control equipments are completed and commissioned simultaneously along with the construction of factory and erection of machineries	Noted and will be complied
4	The applicant shall not change or alter either the quality or quantity or rate of emission or install/replace or alter the air pollution control equipment, change in raw material or manufacturing process resulting in change in quality and /or quantity of emissions without the prior approval of the Board.	Noted and will be complied
5	Any accident resulting in discharge of effluents or emissions or solid wastes in excess of the standards stipulated, to be immediately reported to the Board and the industry shall immediately	Noted

Sl. No	Conditions	Compliance
	take appropriate corrective and preventive actions under intimation	
6	Exact date of commissioning of the plant to be informed to the Board 45 days in advance so as to take necessary inspection of the plant and the pollution control measures provided.	Noted and will be communicated
7	The applicant shall comply with all the Rules and guidelines issued from time to time.	Noted
8	The Board reserves the right to review, impose additional condition or conditions revoke change or alter the Terms and conditions of this consent	Noted
9	The industry shall take afforestation measures in the factory area, along the road sides, around various shops and buildings	Noted
10	Industry shall furnish point wise compliance to the conditions given within 30 days.	Being complied with

Point wise Compliance TO Amendment to Consent for Establishment for expansion of Steel Plant from 4 Million TPA to 10 Million TPA at existing premises, Toranagallu Village, Sandur Taluk, Bellary District, by M/s JSW Steel Limited. Vide No CFE-CELL / JSW /EIA -487 /2008 - 2009/1012 dt 7.3.2009.

Sl.No	Conditions	Compliance
1	The changes proposed in the capacity of the unit shall be as per **Annexure-I.**	Noted and will be complied.
2	The infrastructure facilities proposed in the revised 10 Million TPA (including Phase-I & Phase-II activity) project shall be as per **Annexure-II.**	Noted and will be complied
3	There shall not be any change in the overall capacity of the plant (10 Million TPA in 2 Phases) and any further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment & Forests.	Noted and Approval of the MoEF/ KSPCB being taken for any expansion or modifications in the plant, as and when required
4	The revised water balance shall be as per **Annexure – III** and shall not exceed 75 MGD	Noted and Water consumption will not exceed 75 MGD.
5	The applicant shall comply with all the earlier CFE/CFO condition issued by the Board	Noted and will be complied
6	The applicant shall comply with all the conditions stipulated in the Environmental Clearance issued by MoEF, GOI, vide letter cited at reference (2) & (3).	Noted and will be complied
7	The air pollution sources shall be as per **Annexure-IV**. Tolerance limits in respect of air emissions are fixed on the basis of Environmental Clearance.	The Air Pollution Sources will be as per Annexure – IV. But our submission regarding Tolerance limits for SPM emissions shall be stipulated as 100 mg / Nm3 instead of 50 mg / Nm3 for Coal based Thermal Power plant (Sources 58,59 & 61 of Annexure – IV). Because CPCB stipulated 150 mg / Nm3 and KSPCB made further stringent 100 mg / NM3 norm for the similar Power plant of JSWEL 2 X300 MW Caol based power plant.
8	All other terms & conditions stipulated in the CFE issued by the Board vide reference (1) remains unaltered.	Noted

POINTWISE COMPLIANCE TO CFO for 7 MTPA for discharge of effluents under the Water (Prevention & Control of Pollution) Act 1974 and Emission under the Air (Prevention & Control of pollution) Act 1981 Vide Combined Consent Order No KSPCB/JSW/CFO/SEO/ MINES / 2010 -11 /22 dt 20.04.2010

Sl.no.	Conditions	Compliance
A.	**Treatment and disposal of effluents under the water act, 1974.**	
I.	**Trade effluent & sewage effluent**	
1	The quantity of water used shall not exceed 8 cum/ton of finished products.	The figure was less than 3.0m3 in 2009-10.
2	The water consumption in different units and the quantity of trade effluent (blow down) discharge shall not exceed 2837 m3/hr and 1035 m3/hr respectively. Similarly, the water consumption and the quantity of sewage effluent discharged shall not exceed 315m3/hr and 177.5m3/hr respectively. The breakup of water consumption and the quantities of trade and sewage effluent discharge is given in Annexure – II	The water consumption in all the three townships is 6000 m3/day which is less than 315 m3/h The sewage is treated and use for gardening
3	The trade effluent as well as sewage effluent generated from each unit shall be treated and reused/recycled as indicated in Annexure – III.	The treated blow down is reused in pellet plant and ore beneficiation plant. Excess will be taken to guard pond for horticulture
4	The treated trade effluent shall conform to the standards prescribed in Annexure - IV	being complied
5	The treated trade effluent of 535 m3/hr pertaining to 4 MTPA units conforming to standards specified in Annexure - IV shall be collected in Guard Pond-1. Similarly the treated trade effluent of 500 m3/hr pertaining to 7 MTPA expansion units shall be collected in Guard Pond-2. The treated trade effluents collected in Guard Pond -I & 2 shall be reused within the plant especially in Pellet Plant and Ore beneficiation plant and also for horticulture	Being practiced
6	Two sewage treatment plants of capacity 1.2 MILD and 15 MILD provided at VV Nagar & from 4 MTPA process area and Shankargudda Colony respectively shall treat the sewage generated from the complex and the treated sewage effluent shall conform to the standards prescribed in Annexure - V and used for Horticulture	Being practiced. Reports are being sent to PCB
7	The industry shall measure the treated trade effluent quantity at the outlet of the Guard Pond-1 & 2 regularly by providing appropriate measuring devices as also the treated sewage and furnish the data to the Regional Office, Bellary, once a week. The applicant shall provide recording type effluent flow meters to record the effluent quantity discharged	The analysis of water at guard ponds is measured dily and reports sent to PCB

Sl.no.	Conditions	Compliance
8	During rainy season, the out flow from Guard Ponds will increase to 7453 and 11061 m3/hr from Guard Pond-1 & 2 respectively and the overflow which joins the natural valley shall conform to inland surface water standards stipulated in Schedule-VI of EP Rules, 1986	Being maintained
9	The industry should provide alternate power supply to the ETP for its continuous operation	Dedicated electric power is being provided to the ETP's from the JSWEL
10	The applicant shall adhere to the conditions stipulated for construction of slime pond and recycling of the tailing water for Ore Beneficiation vide CFE dated 30.4.2005. The groundwater monitoring in this area should be carried out as stipulated in the clearance	We have complied with the conditions in the CFE.The feasibility of recovery of tailing water is being studied. The ground water in the area is regularly monitored and submitted to KSPCB
11	The effluent generated from Recovery Coke Oven Plant shall not exceed 95 m3/hr and shall be treated in BOD Plant. The Treated effluent shall meet the standards stipulated in Annexure-VIII and shall be completely reused for quenching of Coke	
II.	**Self monitoring and reporting by the industry:**	
1	The industry shall at his own cost get the treated effluent samples collected and analyze the same on a daily basis for the parameters indicated in Annexure - IV& V and report submitted to the Regional Office, Bellary, once in a month along with the data of quantity of water used, the waste water generated, treated, recycled and discharged for greenbelt in a compiled statement, with a graphical and statistical analysis	Environmental monitoring work is being carried out by Richardson & Cruddas (1972) Ltd.Reports are being submitted regularly to KSPCB/CPCB.
2	The applicant shall continue to have qualified environmental engineer/scientist and have environmental cell for environment management in the steel complex	Environmental Management Department has been established with qualified Environmental Engineers.
3	The applicant shall establish a self-monitoring system for monitoring the effluents by procuring necessary monitoring equipment & by establishing a Laboratory	Environmental monitoring work is being carried out by Richardson & Cruddas (1972) Ltd.Reports are being submitted regularly to KSPCB/CPCB.
4	The applicant shall ensure continuous and effective operation and maintenance of pollution control systems	Pollution control systems are integral with operation units.
5	The applicant shall establish, implement and maintain an Environmental Management System in conformity with ISO 14001:2004 standards	We are certified to ISO 14001: 2004 standards and assessments are made by external agencies
III.	**Storm water management**	
1	Storm water shall not be allowed to mix the trade and/or sewage effluent on the upstream of the terminal manholes where the flow measuring devices will be installed	Due to legislation reasons, the storm water is getting mixed with the Blowdown water from the plant units. The combined water is led to the guard pond from where the quantity is measured.
2	The applicant shall implement rain water harvesting system	The guard ponds 1 and 2 are designed rain water harvesting structures.

Sl.no.	Conditions	Compliance
B.	**Discharge of emissions under the air act, 1981**	
1	The unit wise sources of air pollution and the corresponding chimney height, rate of emission, constituents to be controlled, tolerance limits and the pollution control equipment provided is indicated in Annexure - VI	Provided
2	At the Raw Material Handling and Storage (RMHS) area in respect of 4 MTPA and 7 MTPA air pollution control measures as stipulated below shall be adopted for suppression of dust	
	RM H S 4 MTPA	
	Dust Suppression Systems shall be provided at the following sources	
	• Coal Yard (SRI & SR2: Sprinklers • Ore/Lime Stone / Dolomite (SR3, SR4, SR5) Sprinklers • Ore/Coal (SR6) :Sprinklers • Iron Ore fines (SR7) :Barrel reclaimer • Junction Houses :Dust Suppression	Nearly 48 nos Provided
	RMHS 7 MTPA	
	Dust Suppression Systems shall be provided at the following sources	
	Iron Ore Yard : Sprinklers Base Mix : Barrel Reclaimer Junction Houses:Dust : Suppressions	Being planned. Delay is due to supplies from Chin got delayed. The order has been canceled and new order is being finalized.
3	The applicant shall operate the Air Pollution Control Equipment as specified in the Annexure - VI continuously so as to ensure that the emission does not exceed the limits specified. The operation of the control equipment shall be synchronized with the operation of the emission source	The applicant shall operate the Air Pollution control equipment as specified in the Annexure -II continuously so as to ensure that the emission does not exceed the limits specified. The operation of the control equipment shall be synchronized with the operation of the emission source
4	The applicant shall ensure that all the control equipments are operated continuously with required control measures and with necessary spares to avoid stoppage	Applicant shall ensure that all the control equipments are operated continuously with required control measures and with necessary spares to avoid stoppage
5	The applicant shall maintain access platforms for carrying out stack sampling with electrical outlet points for sampling the emissions from port holes in all the stacks, as per the guidelines stipulated in the Annexure - VII	Access plat forms, sampling port holes, electrical points are provided in all the stacks.
6	The applicant shall take suitable measures to control fugitive emissions. The raw material stock yard shall be cordoned with nettling of appropriate height. The yard periphery shall be provided with lined garland canal and a catch tank of appropriate size to ensure that there is no run off of fine particles with the rain water. Alternately,	Wind curtain is provided for the raw material yard in the coal yard.A peripheral drain has been provided with a catch pit to arrest dust laden water to be trapped

Sl.no.	Conditions	Compliance
	industry shall provide bio-shield i.e., 3 rows of plantations around the raw material, coal, solid waste storage yard, the species to be planted shall be in consultation with Forest Department and nettling of appropriate height in the predominant wind direction to mitigate fugitive emission	
7	The industry shall develop extensive green belt around the plant	
8	The applicant shall ensure 100% burning of waste gases and the minimal flame at the top of the flare stack shall be ensured	All the flares are provided with continuous pilot gas to facilitate burning.
9	The emissions from the recovery type Coke oven shall conform to the standards specified in Annexure - VIII	
10	The emissions from the non-recovery type Coke oven shall be canalized through a tunnel and finally emitted through a stack. Damper adjustment techniques shall be used to have optimum heat utilization and also to control the emission of un-burnt carbon particles and combustible flues gases	The coke ovens are of NR type. The waste gases are led to the 8 waste heat boilers, where the heat is converted to electrical power.
11	**LIQUID WASTES**: The applicant shall treat and dispose any liquid effluents produced in the course of control of air pollution by scrubbing, conditioning etc., of I fue gases in accordance with the provisions of the Water (Prevention & Control of Pollution) Act, 1974.	Direct cooling water circuits are provided in COREX, BF, BOF/CCP to treat the Gas Cleaning Plant water.
12	To avoid dust nuisance the following additional measures should be implemented	
	Dust suppression system at TT6 & TT8 in pellet plant. Dust suppression system for coal fines storage area. Dust suppression system for coke breeze storage area. Dust suppression system for truck unloading station of RMHS. The pre-wetting of wagons at wagon tippler of RMHS. Dust suppression for finished pellet stockpile. Renovation of coal screening plant bag filter. Dust extraction system in Corex stock house. De-dusting system for online pellet screening station at pellet plant. Secondary fume extraction system at BOF by March 2008 as per CREP. Additional dust control measures shall be provided within the time frames specified in the Action Plan vide Annexure - IX	Done Done Not done Done Done To be reviewed Done Done Done Done
13	The industry shall provide Continuous Emission Monitoring Equipments for 26 sources as indicated in Annexure - VI and shall ensure that the equipments work continuously and the data captured is recorded electronically and monthly extract sent to Regional Office, Bellary, once in a month	Provided
14	The industry shall establish Continuous Ambient Air Quality Monitoring Stations at six locations within the	

Sl.no.	Conditions	Compliance
	plant boundary including Vaddu and ensure that the stations work continuously and the data generated shall be recorded electronically and furnish to the Regional Office, Bellary, once in a month	
15	The industry shall also establish and maintain manual Ambient Air Quality Monitoring Stations at 10 locations (at places other than CAAQM stations) and monitor the AAQ as per CPCB norms for the relevant parameters as per the revised notification of MOEF (Annexure - X). The monitored data shall be recorded and furnished to the Regional Office, Bellary, regularly	Done at eleven locations over and above the CAAQ
16	The industry shall at its own cost get the emissions collected and analyzed every month for the parameters indicated in Annexure - VI and report submitted to the Regional Office, Bellary, once in a month along with the meteorological data, AAQM data, emissions results in statistical and graphical format	Being done . for special anlysis help from external lbs like SGS and Vimta labs is being taken.
C.	**ENVIRONMENTAL STATEMENT:**	
	The applicant shall submit the Environmental Statement every year for the period ending 31st March in Form-V of Rule as per Rule 14 of Environment (Protection) Rule 1986, on or before 30th September, failing which, the industry is liable for actions under Environment (Protection) Act, 1986	The Environmental Statement for the financial year 09-10 is being sent in july 2010.
D.	**HAZARDOUS WASTES MANAGEMENT, HANDLING& TRANSBOUNDRY MOVEMENT) RULES 2008**	
1	The industry shall apply and obtain authorization under Hazardous Wastes (Management, Handling & Transboundry Movement) Rules 2008, and comply with the conditions of the authorization	Applied and is pending with PCB
E.	**SOLID WASTE MANAGEMENT:**	
1	The applicant shall dispose off the solid waste other than those covered in the Hazardous Wastes (Management, Handling & Transboundry Movement) Rules 2008, as indicated in Annexure - XI	Being done
2	The solid waste collected in the factory premises such as sweepings wastage packaging empty containers, residue, sludge including those from air pollution control equipments shall be disposed off so as not to cause fugitive emissions, dust problems or water pollution problems through leaching etc., of any kind	All the wastes are reused / recycled or sold. A small portion of the wastes is stored in our waste dumpsite in a scientific manner
3	Following solid waste are permitted for use in construction of Bund for the Slime Pond	

	Sl. no.	**Solid Wastes**	**Generation in TPA**	**2009-10**
	1	Corex/BF Dry Slag	2,10,000	105000
	2	Corex Sludge	50,000	82125
	3	BF Sludge	40,000	
	4	BF Flue Dust	90,000	65700
	5	Steel Making Slag	13,00,000	1051200

Sl.no.	Conditions			Compliance
	6	BOF Sludge	45,000	9400
	7	HMDS Slag	90,000	87000
	8	Bag House Dust including HMPT Dust	10,997	2640
	9	Refractories	4,000	3000
	10	Slime stockpiled in Slime Pond at Sultanpura	70,00,000 (Dry)	5100000
4	Transportation of the solid waste to the slime pond area should be done in covered Trucks			Done in wet form by pipe line
5	The applicant shall provide impervious lining for the disposal area of slag and sludge and maintain log books			Not applicable
F.	**WATER CESS**			
1	The applicant shall provide water meter at all the intake points as under Section (5) of Water Cess Act and shall file the Water Cess returns regularly and also pay the Cess Assessed within the time stipulated			Water meters are provided at all intake points and water cess returns are filed regularly.
G.	**NOISE POLLUTION CONTROL**			
1	The applicant shall comply with the ambient noise standards as stipulated under the Environment (Protection) Rules, 1986			Ambient noise monitoring is being carried out at six locations and the reports are being sent to Board regularly. These are within permissible limits
H.	**GENERAL CONDITIONS:**			
1	The applicant shall not allow the discharge from the other premises to mix with the discharge from his premises. Storm water shall not be allowed to mix with the effluents on the upstream of the terminal manhole where the flow measuring devices are installed			Agreed
2	The applicant shall display flow diagram of the pollution control system at the site			It is available at the department
3	The applicant shall not change or alter quality or quantity or the rate of discharge or temperature or the route of discharge without the previous consent of the Board			Noted
4	The applicant shall promptly comply with all orders and instructions issued from time to time by the Board or any other officers of the Board duly authorized in this behalf			Noted
5	The applicant shall display the consent granted in a prominent place for perusal of the inspecting officers of the Board			Agreed. A display board has been displayed at the entrance to the main gate. This is being updated once in two months.
6	The applicant shall provide alternate power supply sufficient to operate all Pollution control equipments utilized by the applicant to maintain compliance with the terms and conditions of this consent			We have a dedicated power from JSWEL. In case of any power breakdown, the entire operations will be shut down. However, DG sets are provided to operate some of the critical facilities in case of local power failure.
7	The applicant shall provide port holes for sampling the emissions, access platforms for carrying out stack			Provided

Sl.no.	Conditions	Compliance
	sampling, electrical points and all other necessary arrangements including ladder	
8	The applicant shall comply with the "Charter on corporate Responsibility for Environment Protection" evolved by MOEF/CPCB during March 2003 for Steel Industries	CREP is a voluntary initiative of CPCB and we will attempt to comply in line with it to the extent possible. Compliance reports are being sent regularly
9	The applicant shall not change or alter either the quality or quantity or rate of emission or install/replace or alter the air pollution control equipment, change in raw material or manufacturing process resulting in change in quality and/or quantity of emissions without the prior permission of the Board	Noted
10	The applicant shall plant and maintain adequate number of trees in and around the industry to arrest the dust emissions escaping into the surrounding area and improve the environment and aesthetic appearance of the industry and the surroundings	Noted
11	The air pollution control equipments stack monitoring system, ambient air quality and meteorological monitoring station set-up by the Applicant and the Registers recording the monitoring results shall be open for inspection by the Board Officers at all time	Agreed
12	An inspection Book shall be opened and made available to the Board Officers during their visit to the factory	Noted
13	The applicant shall furnish to the inspecting officer and/or the Board any information regarding the constructions, installation or operation of the air pollution control equipments system and such other particulars as may be pertinent in preventing and controlling pollution of Air	noted
14	The Applicant shall keep the factory premises and air pollution control equipments clean and make all hoods, pipes, valves, stack/chimneys leak-proof. The air pollution control equipment, locations, inspection chambers, sampling port holes shall be made easily accessible at all times	Provided as per ACGIH standards
15	This consent for discharging sewage and/or Trade effluents from the factory shall not be taken or construed as the Board's permission to continue to discharge the sewage and/or Trade effluents from the factory into the place (as mentioned in this consent Order) which pollutes the water there-in endangering the life and property of the persons using the said water before, during or after the periods indicated in the Terms and Conditions of this Consent Order.	Agreed
16	The applicant shall display suitable caution boards at the places to be indicated by the Board or any other Officers of the Board for indicating that the Watercourse into which the effluents are discharged is not fit for domestic usage/bathing/agriculture	Not applicable.

Sl.no.	Conditions	Compliance
17	The applicant shall keep the Factory premises and the treatment plant site clean. The treatment plant site. Inspection chamber/sampling and flow measuring points, outlets should be made easily approachable	Agreed
18	The applicant shall comply with all the consent conditions and furnish report within 30 days to the Regional Office, Bellary	Being complied with
19	All suggestions enumerated in the EIA report of the MECON shall be complied with.	We have implemented all suggestions as enumerated in the EIA report prepared by MECON
20	The industry shall construct concrete dyke to all storage tanks with impervious floor. The capacity of dykes shall be sufficient to contain the quantity of raw material or product in the storage tank in case of accidental spills	Provided with concrete dykes for all chemical storage areas.
21	The applicant shall, upon the reduction, loss or failure of one or more of the primary sources of electric power to any facilities utilized by the Applicant to maintain compliance with the Terms and conditions of this consent, the applicant shall halt reduce or otherwise control production and/or all discharges in order to maintain compliance with the Terms and Conditions of this consent order	We have a dedicated power from JSWEL However; there are DG sets to operate some of the critical facilities. In case of any power breakdown, we will stop, reduce or otherwise control product and/or all discharges in order to maintain compliance with the terms and conditions of this consent order
I.	**MONITORING AND REPORTING:**	
1	The analysis of effluents and emissions may be carried out at in-house Laboratory/KSPCB approved laboratory/laboratories approved under Environment (Protection) Act, 1986	Done internally through R&C
2	The applicant shall maintain log books to reflect the working condition of pollution control systems and also self monitoring results and keep it open for inspection	maintained
3	The applicant shall set-up Environmental Cell comprising of qualified and competent personnel for complying with the conditions specified	Done
4	The applicant his heirs, legal representatives or assigns shall have no claims what so ever to the continuation or renewal of this consent after expiry of the period of consent.	noted
5	The applicant shall forth with keep the Board informed of any accident of unforeseen act or event of any poisonous, noxious or polluting matter or emissions are being discharged into stream or well or air as a result of such discharge, water or air is being polluted	There has been no incidents
6	The Board reserves the right to review, impose additional conditions, revoke, change or alter terms and conditions of this consent	Noted
7	The applicant shall make an application for consent at least 120 days before expiry of this consent	It is our practice to apply within 120 days before the validity of permits

STATUS OF ACTION PLAN AS PER ANNEXURE- IX
(As On 30.6.2010)

1	Bag filters in material handling area of RMHS&LCP	3 nos of bag filters commissioned in Dec 2009 & are in operation. Additional 29 bag filters planned	1 new bag filters for coal commissioned & ore screening by Aug 2010 7 new bag filters in LCP area by Aug 2010 2 new bag filters in LCP-1 area commissioned 6 nos of new bag houses in LCP-2 by Oct 2010 2 new bag filters in 4 mtpa stage by Dec 2010. 16 new bag filters in RMHS progressively by June 2011
	DSS at RMHS	Trials carried out with 3 types of spray nozzles. DSS to be introduced in 64 junction houses	6 Air compressors for DSS by Aug 2010. 3 installed DSS implementation progressively in 64 junction houses by Dec 2010. Order being placed.
	Wind curtain – 3 km	Wind curtains proposed at RMHS & PP	Progressively by Dec 2010. Areas identified
	Yard water spray	Planned in RMHS	Progressively by March 2011. pump house getting ready
2	Sinter Plant emissions	Investigation of unique technical problem established by detailed analysis. Use of low VM started in SP-1, with improvements	Reduce load of VM in base mix: 1. Reduction of coke load from 75 kg to <65 kg per ton of sinter-Done 2. Reduction to < 55 kg/t by Oct 2010 3. Use of Low VM breeze in SP-2 & SP-1 by Oct 2010 1. Design of Modification to ESP to accept VM ~ 3.0%: June 2010. Planned 2. Modification to ESPs for emission reduction and repair to be done in SP-2 by March 2011 & in SP-1 by June 2010
3	Coke oven wastewater	Improvement of performance of BOD Plant	1. Improvement of anaerobic reactor performance by Dec 2010. Expert agency identified 2. Scheme for re use of wastewater by Dec 2010 after conducting pilot plant scale trials.
	Control of intermittent charging emissions	Efficiency improvement by modification to the dedusting car.	Modification to be completed by June 2010. Oven top emission done

3.2.14 Litigation pending against the project

No litigation and / or any direction / order passed by any court of law against the project is pending.

4.00 ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 INTRODUCTION

In this chapter, the anticipated environmental impacts and the proposed mitigation measures for the expansion plant have been described.

Impact prediction is a way of mapping the environmental consequences of the significant aspects of the expansion plant. The impact assessment will focus on the expansion plant and will broadly cover the following information and components:

- Assessment of physical effects for all phases including location, design, construction, operation and possible accidents.
- Estimation by type and quantity of expected contaminants, residues, and emissions (air, water, noise, solid wastes) resulting from the operation of the proposed plant.

The anticipated environmental impacts of the expansion plant are discussed below under the following categories:

- Impacts and mitigation measures due to project location.
- Impacts and mitigation measures due to project design.
- Impacts and mitigation measures during construction.
- Impacts and mitigation measures during operation.
- Impacts and mitigation measures because of possible accidents.

4.1.1 IMPACTS AND MITIGATION MEASURES DUE TO PROJECT LOCATION

4.1.1.1 Impacts

The expansion of integrated steel plant will be done in the existing land. Therefore from location point of view, the expansion plant does not have any adverse impact.

4.1.1.2 Mitigation Measures

No impact envisaged.

4.1.2 IMPACTS AND MITIGATION MEASURES DUE TO PROJECT DESIGN

4.1.2.1 Impacts

The expansion plant is being envisaged based on techno-economic feasibility of the state of art technology as presently available in the country and thus no anticipated impacts are envisaged due to project design.

4.1.2.2 Mitigation Measures

A number of environmental friendly features have been envisaged in the proposed expansion due to which the anticipated adverse environmental impacts are either avoided or minimized. These features are briefly described here under.

i) Use of Continuous Casting Technology:
Hundred percent of the steel production through continuous casting facilities saves considerable energy and protects environment. The major environmental advantages are:
- Elimination of Soaking pits resulting in reduction in consumption of fuels and Electricity.
- Considerable energy is saved vis-à-vis less energy generation and reduces pollutant emissions.
- Less scrap production resulting in improved yield and less solid waste generation / handling.

ii) Incorporation of Coal Dust Injection System in Blast Furnaces.

iii) Top Pressure Recovery Turbine (TRT) in Blast Furnace and CDQ in Coke Oven, there by reducing power requirement.

iv) Coke Ovens provided with HPLA, Coal charging cars fitted with screw feeders and hydraulically pressed sleeves, Hydro Jet Door Cleaners, Leak Proof Oven Door, and Land Based Pushing Emission Control (PEC) resulting in pollutant emission reduction.

v) Dry-fog Dust Suppression System in Coke Cutter / Coke Conveyor.

vi) BF: Stock House and Cast House De-dusting System.

vii) State of Art Pollution Control system for Gaseous Emission Control, Process Dust Emission Control, Fugitive Dust Emission Control in different units of the proposed Integrated Steel Plant.

4.1.3 IMPACT AND MITIGATION MEASURES DURING CONSTRUCTION PHASE

Construction phase impact may be on land use, ground water, water quality, air quality, noise etc. These aspects are discussed here under.

4.1.3.1 Land Use

4.1.3.1.1 Impacts

The expansion plant will be accommodated in 700 acres of industrial land. Large-scale excavation, soil erosion, loss of topsoil is expected. Moreover, Tornagallu is already a fairly well developed area with all sorts of infrastructure available. It is therefore most unexpected that influx of construction labour is going to change present land use pattern. Further this land use change during construction is only temporary and will persist during construction phase only.

4.1.3.1.2 Mitigation Measures

No impact envisaged.

4.1.3.2 Air Quality

4.1.3.2.1 Impacts

The construction and other associated activities will lead to emission of different pollutants. During the construction phase, particulate matter will be the main pollutant. As plant will be constructed in phases, construction activity covering a large area is not expected. Therefore the particulate matter emission will not be much and will be localized only. Gaseous pollutants like SO_2, NO_x, CO will also be added to the ambient air due to vehicular traffic movement associated with this construction phase. Gaseous emissions from construction machineries and vehicles will be minimized by enforcing strict emission monitoring system for the suggested mitigation measures. The impact will be confined within the specific plant area where the construction is taking place. Further, the impact of such activities will be temporary and will be restricted to the construction phase only.

During the construction period the impacts that are associated with the air quality are:

- Deterioration of air quality due to fugitive dust emissions from construction activities (especially during dry season) like excavation, back filling and concreting, hauling and dumping of earth materials and from construction spoils.
- Generation of pollutants due to operation of heavy vehicles and movement of machineries and equipment for material handling, earth moving, laying of sands, metal, stones, asphalt, etc.

4.1.3.2.2 Mitigation Measures

The following mitigation measures will be employed during construction period to reduce the pollution level to acceptable limits.

- Proper and prior planning, appropriate sequencing and scheduling of all major construction activities will be done, and timely availability of infrastructure supports needed for construction will be ensured to shorten the construction period vis-à-vis to reduce pollution.
- Construction materials will be stored in covered godown or enclosed spaces to prevent the wind blown fugitive emissions.
- Stringent construction material handling / overhauling procedures will be followed.
- Truck carrying soil, sand, stone dust, and stone will be duly covered to avoid spilling and fugitive emissions.
- Adequate dust suppression measures such as regular water sprinkling at vulnerable areas of construction sites will be undertaken to control fugitive dust during material handling and hauling activities in dry seasons.
- The construction material delivering vehicles will be covered in order to reduce spills.
- Low emission construction equipment, vehicles and generator sets will be used.

- It will be ensured that all construction equipment and vehicles are in good working condition, properly tuned and maintained to keep emission within the permissible limits and engines turned off when not in use to reduce pollution.
- Vehicles and machineries would be regularly maintained so that emissions confirm to standards of Central Pollution Control Board (CPCB).
- Monitoring of air quality at regular intervals will be conducted during construction phase.
- Construction workers will be provided with masks to protect them from inhaling dust.

4.1.3.3 Water Quality

4.1.3.3.1 Surface Water

Impacts

The impacts on water quality during construction phase mainly arise due to site cleaning, leveling, excavation, storage of construction material etc. A leveling and excavation activity normally increases the level of suspended solids in the surface water runoff. However, for the expansion plant, no large scale leveling is required. Excavation will also be limited.

Mitigation Measures

- Quality of construction wastewater emanating from the construction site will be controlled through the existing drainage system with sediment traps (silting basin as water intercepting ditch) for arresting the silt / sediment load before its disposal.
- All the washable construction material will be stored under sheds or enclosed space by fencing it with brick or earth in order to prevent spillage into the drainage network, so that the same does not find its way into the surface water runoff.
- The sediment traps and storm water drainage network will be periodically cleaned and especially before monsoon season.
- A small quantity of effluent after treatment will be let out. Majority of the water generated will be utilized for dust suppression and plantation within the plant premises.

4.1.3.3.2 Ground water

Impacts

The water requirement during the construction phase will be low and will be met through the already existing water supply facilities. Thus no ground water extraction is envisaged. Therefore, it is most unlikely that construction phase will bring any significant modification in the ground water regime of the area. Therefore, the construction phase of the expansion plant will have insignificant impact on the ground water.

Mitigation Measures

No impact envisaged.

4.1.3.4 Noise

4.1.3.4.1 Impacts

Major sources of noise during the construction phase are vehicular traffic, construction equipment etc. The operation of the equipments will generate noise level ranging between 75 to 90 dB (A). However this noise level will be near the source only and is not expected to create any noise pollution problem at far off distances and outside the plant premises. The noise generated during the construction phase from different equipments may have some adverse impact on the operators.

4.1.3.4.2 Mitigation Measures

- Protective gears such as earplugs, earmuffs etc. will be provided to construction personnel exposed to high noise levels as preventive measures by contractors and will be strictly adhered to minimize / eliminate any adverse impact.
- It will be ensured that all the construction equipment and vehicles used are in good working condition, properly lubricated and maintained to keep noise within the permissible limits and engines turned off when not in use to reduce noise.

4.1.4 IMPACTS AND MITIGATION MEASURES DURING OPERATION PHASE

4.1.4.1 General

During the operation phase, depending upon operating condition environmental releases may occur from raw material and product handling, processing, fuel burning etc. Environmental releases may be in the form of

a) Air emission
b) Waste water discharges
c) Solid waste disposal
d) Noise etc.

These emissions, discharges and disposal may release different pollutants, which may affect air, water, land and ecological environment directly. However, all these are mainly primary impact. In addition to these primary impacts, any industrial project has some overall impact on its surrounding socio-economic environment through the existence of social and economic linkages between the project and society, which are actually secondary impact. Under this clause, all the primary impacts due to this expansion plant are being discussed and wherever required, impacts have also been quantified. Accordingly under subsequent clauses impacts on air environment, water environment, soil and noise due to the expansion plant are being elaborated. The socio-economic impacts due to the expansion plant are separately discussed .

4.1.4.2 Air Environment

In integrated Steel plant, air pollutants are generated at different stages of production. Air pollutants may be particulate matter, sulphur dioxide, oxides of nitrogen etc. The pollutants may be released as point source emission or fugitive emission. Accordingly it is most expected that there will be some variation in the emitted pollution load. It is therefore most justified to first assess the anticipated variation in the emitted pollution load. Once these variations vis-à-vis increase or decrease in emitted pollution load are estimated, its impact on air environment will be assessed and predicted.

Major unit wise emission potentials are discussed below.

a) Sintering Plant

During the process of agglomeration by sintering, waste gases are generated which carries along with it particulate matter, oxides of sulphur and nitrogen as major pollutant. The waste gases generated during the process stage and cooling of sinter after passing through an electrostatic precipitator are released to the atmosphere. Further transportation and handling of different material in the sinter plant area will also generate dust, for which dust extraction systems will be provided and the clean air will be discharged through stacks.

b) Pellet Plant

Palletising turns iron ore fines in to balls suitable for feeding to BF and DRI plants. Impurities are removed from crushed iron ores and is subsequently moistened and then heated with a binding agent to create "green” pellets in rotating drums or on rotary discs (in rotary kilns). These green pellets are subsequently dried and indurated at temperatures of more than 1000 °C travelling grate (induration units). Particulate matter is generated at Mixed material drying unit (rotary kiln), which is led to atmosphere through multicyclone-scrubber based de-dusting facility. The exhaust gases during induration process carries along with it particulate matter, oxides of sulphur and nitrogen as major pollutant, which will be cleaned in ESP and will be vented in to the atmosphere through common waste gas stack.

c) DRI Plant

DRI is produced in solid phase at 800—1050 °C using non coking coal as reductant. The kilns are fitted with separate off-gas circuit mainly consisting of dust settling chamber and after burning chamber (ABC). The gases from ABC are led to waste heat recovery boilers to generate steam for waste heat power generation. The exhaust gas carries along with it particulate matter, oxides of sulphur and nitrogen as major pollutant, are then cleaned in Electrostatic Precipitator (ESP, designed for 50 mg/Nm3 dust) before letting them out in to the atmosphere through ID fan and stack.

d) Blast Furnace

Flue gas from hot stoves is the main emission source from the operation of blast furnace. Hot stoves are fired with blast furnace and CO gas for heating air fed to blast furnace. Flue gas generated in the hot stoves is discharged to the atmosphere through stacks. This flue gas contains particulate matter (in very small quantity) and oxides of Sulphur and Nitrogen. Oxides of nitrogen are formed due to the high temperature of the stoves.

In addition to the above emissions fugitive emissions also occurs during charging and in cast house. During charging normally a sealed charging system is provided but since the furnace pressure is higher than atmospheric pressure, the components present in BF Gas along with particulate matter may be emitted.

e) Pig Casting

The pig casting facilities will cast surplus hot metal when during poor take off of hot metal from SMS. The casting of pig iron generates fugitive emissions, mainly arising from contact between hot metal and slag and ambient oxygen. The main pollutants in the fugitive emissions are particulate matter with some amount of sulphur dioxide.

f) Slag Granulation Plant (SGP)

The process of treating blast furnace slag involves pouring the molten slag through a high-pressure water spray in a granulated head. Due to high-pressure water spray no particulate matter is expected to be emitted.

g) De-sulphurisation

A de-sulphurisation unit for hot metal pre-treatment to ensure consistent supply of homogenous and low sulphur hot metal to the BOF has been envisaged. The process of de-sulphurization generates fugitive emissions. The exhaust air generated in the process is contaminated with particulate matter.

h) Basic Oxygen Furnace (BOF) Shop

The objective of Basic Oxygen Furnace (BOF), in steel making is to burn (oxidise) the undesirable impurities contained in the metallic feedstock. The main elements are thus converted into oxides are carbon, silicon, manganese, phosphorus, and sulphur. The purpose of this oxidation process is:

- To reduce the carbon content to a specified level
- To adjust the contents of desirable foreign elements
- To remove undesirable impurities to the greatest possible extent

The production of steel by the BOF process is a discontinuous process, which involves the following steps:

- Transfer and storage of hot metal
- Pre-treatment of hot metal (de-sulphurization)

- Oxidation in the BOF (de-carburization and oxidation of impurities)
- Secondary metallurgical treatment
- Casting (continuous or/and ingot)

The following emissions of off gases are generally recognized in BOF area:

- Oxygen blowing and BOF gas

Secondary off gases are generated during:

- Removal of undesirable impurities (to the maximum possible extent)
- BOF charging
- Tapping of liquid steel and slag from BOF and ladles
- Continuous Casting

Air pollution control system comprising of suction hood, duct and bag filters are provided in the existing BOF, for bulk material charging system, mixer and de-slagging systems. However due to different operational problems some times the pollution control systems are not functioning properly. Due to which the fumes generated due to puffing in the converters escapes into the BOF shop. Further the fumes generated during charging and tapping of converters are also not controlled at times. The fugitive emissions in the area will be limited within the limits given below:

i)	Respirable Particulate Matter	:	2000 microgram / m^3
ii)	Suspended Particulate Matter	:	5000 microgram / m^3
iii)	SO2	:	250 microgram / m^3
iv)	NOx	:	150 microgram / m^3
v)	CO (8 hr.)	:	55000 microgram / m^3

i) Secondary Refining Facilities:

The secondary refining is not an emission intensive process except for some fugitive dust emissions during the process. Necessary fume extraction system has been envisaged for the process.

j) Coke Oven

The operation of a Coke Oven battery comprises of the following activities:

- Coal charging
- Heating / Firing of the chambers
- Coking
- Coke pushing and
- Coke quenching

During coke making, heating of the Coke Oven chambers is carried out by burning Coke Oven / BF gas as fuel and the resultant flue gas is led to the stacks. Excess Coke Oven / BF gas is transported via pipeline to large gas holders to utilize these gases for Power generation and plant heating needs.

During operation of Coke Ovens fugitive emissions are also generated during charging, pushing, and quenching activity. However MOEF prescribed emission standard for coke oven emission shall be met.

k) Raw Material Handling Complex (RMHC)

Necessary pollution control facilities in the form of dust extraction / dust suppression system will be provided to restrict the emitted pollutant within statutory norms. Dust extraction system provided will discharge air after cleaning to limit the dust content in the emitted air within statutory norms.

The sources of emissions from the proposed steel plant and the control measures adopted are given below. In addition to the measures taken to control pollution, it is also proposed to limit the design emission norms to a maximum of 50 mg/Nm3 of particulates.

Sl. No	Area of operations	Air pollution control measures proposed to be adopted	Design limits
1	**Raw material handling**		
	Fugitive emissions in material handling	• Dust suppression systems (chemical and dry fog type) • Water sprinklers • DE systems with bag filters in case of conveyors, lime handling	• Work area 5.0 mg/Nm3 • Stack: 50 mg/Nm3
2	**Coke ovens**		
	Coal & Coke handling	• DE systems	• Stack: 50 mg/Nm
	Coal charging	• On main charging with HPLA aspiration • CGT car for aspirating gas into adjacent ovens	As per MOEF norms applicable for coke ovens
	Carbonization	• Leaking of doors, lids etc • Use of lean gas for under firing • Low NOx burners	As above
	Coke pushing	• Land based pushing emission control	As above
	Coke quenching	• Dry quenching with stand by wet quenching facility	As above
3	**Sinter Plant**		
	Sintering process	• ESP for collected waste gases	50 mg/Nm3
	Raw material preparation and handling	• Centralised De-dusting system with ESP common for both areas	50 mg/Nm3
	Sinter screening and transport		
4.	**Pellet Plant**		
	Raw material preparation and	• Dust suppression system	Work area 5.0 mg/m3

Sl. No	Area of operations	Air pollution control measures proposed to be adopted	Design limits
	handling		
	Mixed material drying unit (rotary kiln)	• Multicyclone-scrubber based de-dusting	50 mg/Nm3
	In-duration unit system (grate-kiln-cooler)	• ESP	50 mg/Nm3
5.	**DRI Plant**		
	Off gas system including waste heat power generation of Rotary Kilns	• ESP	50 mg/Nm3
6.	**Blast Furnaces**		
	Sinter, coke and flux handling in stock house	• ESP/Bag filters	50 mg/NM3
	BF processes	• Gas cleaning in venturi scrubbers	5 mg/NM3
	Cast house	• FE systems with ESP/Bag filter	50 mg/NM3
	Stoves heating	• Use of lean gas	50 mg/NM3
7.	**BOF**		
	Material handling operations	• Bag filters	50mg/NM3
	Converters	• Secondary fume extraction system	50 mg/Nm3
	Desulphurisation, RHFs, LHFs etc	• Spark arresters followed by Bag filters	
8.	**Billet/bloom casters**	• Use of low sulphur gases for SO2 control	
9.	**Rolling mills**	• Use of low sulphur gases for SO2 control • Low NOx burner	50 mg/NM3
10.	**Incinerator**	• Scrubber and alkali treatment	As per CPCB regulations
11.	**Cement grinding unit**	• Bag filters	50 mg/NM3
12.	**Power Plant**	• ESP • Low NOx burners	50 mg/Nm3

4.1.4.2.1 Methodology: Impact Assessment on Air Environment

The expansion plant will have an impact on the air environment. While the impact of fugitive emissions will be within the core area, the effect of emissions from the point sources is a major concern as it will have an impact on the ambient air quality in the surrounding area.

For prediction of impacts for any proposed projects, in order to study the impacts due to increase in pollution load, in general, contributions from the new units will be added to the existing back ground concentrations and predictions will be done accordingly.

Once the pollutants are emitted into the atmosphere, the dilution and dispersion of the pollutants are controlled by various meteorological parameters like wind speed and direction, ambient temperature, mixing height, etc. In most dispersion models the relevant atmospheric layer is that nearest to the ground, varying in thickness from several hundred to a few thousand meters. Variations in both thermal and mechanical turbulence and in wind velocity are greatest in the layer in contact with the surface. The atmospheric dispersion modeling and the prediction of ground level pollutant concentrations has great relevance in the following activities:

- Estimation of impact of setting up of new industry on surrounding environment.
- Estimation of maximum ground level concentration and its location in the study area.

The prediction of Ground level concentrations (GLC) of pollutants emitted from the stacks have been carried out using ISCST-3 / AERMOD Air Quality Simulation model released by USEPA which is also accepted by Indian statutory bodies. This model is basically a Gaussian dispersion model which considers multiple sources. The model accepts hourly meteorological data records to define the conditions of plume rise for each source and receptor combination for each hour of input meteorological data sequentially and calculates short term averages up to 24 hours.

The impact has been predicted over a 10 km X 10 km area with the proposed location of the stack as the centre. GLC have been calculated at every 500 m grid point.

JSW is currently in 7.0 MTPA stage. They will augment their capacity from 7.0 MTPA to 10.0 MTPA in next phase. Accordingly, the emissions are estimated from 7.0 MTPA to 10.0 MTPA & from 10.0 MTPA to 16.0 MTPA and the details of the stacks and emissions from them are given in **Table 4.1.**

Table 4.1A: Stack emission details (from 7.0 MTPA to 10.0 MTPA)

Unit	Source	Type of flue	Height (m)	Top Dia. (m)	Flow Rate Nm^3/h	Temp. ^0C	Emissions (g/s)		
							PM	SO_2	NO_x
1.	BF-4 Stove	C	60	3.0	3,60,000	200	0.0	3.0	5.0
2.	BF -4 Cast House East	DD	40	5.0	12,00,000	40	10.0	-	-
3.	BF -4 Cast House West	DD	40	5.0	12,00,000	40	10.0	-	-
4.	BF -4 Stock House	DD	40	3.5	5,00,000	40	4.2	-	-
5.	Coke Oven -5 Stack	C	90	2.0	1,20,000	200	1.7	13.3	13.3
6.	Coke Oven -6 Stack	C	90	2.0	1,20,000	200	1.7	13.3	13.3
7.	Coke Oven -7 Stack	C	90	2.0	1,20,000	200	1.7	13.3	13.3
8.	Coke Oven -8 Stack	C	90	2.0	1,20,000	200	1.7	13.3	13.3
9.	CO pushing emission 3	DD	40	3.0	4,00,000	55	5.6	6.7	5.56
10.	CO pushing emission 4	DD	40	3.0	4,00,000	55	5.6	6.7	5.56
11.	Ammonia Cracker-2	C	50	2.0	1,00,000	150	-	-	-
12.	Sinter Plant-3 de dusting	DD	65	4.5	5,40,000	40	7.5	-	-
13.	Sinter machine-3	C	130	7.7	15,84,000	150	22.0	88.0	220.0
14.	BOF-2 converter-2	C	60	2.0	1,50,000	60	2.1	4.17	8.33
15.	BOF-2 converter-3	C	60	2.0	1,50,000	60	2.1	4.17	8.33

Unit	Source	Type of flue	Height (m)	Top Dia. (m)	Flow Rate Nm^3/h	Temp. ^0C	Emissions (g/s)		
							PM	SO_2	NO_x
16.	Fume Extrac. Sys.BOF-2	DD	40	5.5	16,00,000	60	13.3	-	-
17.	BOF-2 LHF(3 nos)	DD	60	3.0	3,00,000	50	2.5	-	-
18.	RH degasser-1	DD	30	0.6	10,000	60	0.1	-	-
19.	Lime Plant -9	DD	45	1.75	1,20,000	130	1.0	0.1	0.17
20.	Lime Plant -10	DD	45	1.75	1,20,000	130	1.0	0.1	0.17
21.	Lime Plant -11	DD	45	1.75	1,20,000	130	1.0	0.1	0.17
22.	Lime Plant -12	DD	45	1.75	1,20,000	130	1.0	0.1	0.17
23.	Wire rod mill	C	45	1.2	50,000	250	0.7	2.1	2.78
24.	Section mill	C	45	1.5	70,000	250	1.0	2.9	3.89
25.	CRM-ARP Duct	DD	30	0.8	30,000	40	0.4	-	1.25
26.	CRM- Annealing exh.(2 nos.)	C	40	0.8	20,000	200	0.3	-	0.83
27.	Galv Line 1&2(2 nos)	C	65	1.5	1,00,000	200	1.4	2.8	2.78
28.	Color coating line	DD	40	1.0	50,000	40	-	-	-
29.	Slag Cement 1	C	40	1.5	1,00,000	60	1.4	0	-
30. -	Slag Cement 2	C	40	1.5	1,00,000	60	1.4	0	-
31.	Incinerator	C	30	0.5	6,000	50	0.1	0.2	0.33
32.	Pellet ESP	C	100	5.0	15,00,000	115	20.8	12.5	58.3
33.	Pellet m/c discharge	DD	30	1.5	1,11,220	45	1.5	0	0
34.	Power Plant-3(300 MW)	C	275	5.5	15,00,000	150	41.7	500	333
35.	Power Plant-4(300 MW)	C	275	5.5	15,00,000	150	41.7	500	333

Table – 4.1B : Stack emission details (Additional stacks proposed in 6.0 Mtpa expansion stage)

Unit	Source	Type of flue	Height (m)	Top Dia. (m)	Flow Rate Nm^3/h	Temp. ^0C	Emissions (g/s)		
							PM	SO_2	NO_x
1.	BF-5Stove	C	60	3.0	3,60,000	200	0.0	3.0	5.0
2.	BF -5Cast House East	DD	40	5.0	12,00,000	40	10.0	-	-
3.	BF -5 Cast House West	DD	40	5.0	12,00,000	40	10.0	-	-
4.	BF -5 Stock House	DD	40	3.5	5,00,000	40	4.2	-	-
5.	BF-6Stove	C	60	3.0	3,60,000	200	0.0	3.0	5.0
6.	BF -6 Cast House East	DD	40	5.0	12,00,000	40	10.0	-	-
7.	BF -6 Cast House West	DD	40	5.0	12,00,000	40	10.0	-	-
8.	BF -6 Stock House	DD	40	3.5	5,00,000	40	4.2	-	-
9.	Coke Oven -9 Stack	C	125	4.2	2,20,325	200	3.1	49.0	30.6
10.	Coke Oven -10 Stack	C	125	4.2	2,20,325	200	3.1	49.0	30.6
11.	Coke Oven -11 Stack	C	125	4.2	2,20,325	200	3.1	49.0	30.6
12.	Coke Oven -12 Stack	C	125	4.2	2,20,325	200	3.1	49.0	30.6
13.	CO pushing emission 5	DD	40	3.0	4,00,000	55	5.6	6.7	5.56
14.	CO pushing emission 6	DD	40	3.0	4,00,000	55	5.6	6.7	5.56
15.	Ammonia Cracker-3	C	50	2.0	1,00,000	150	-	-	-
16.	Sinter Plant-4 de dusting	DD	65	4.0	6,00,000	40	8.3	-	-
17.	Sinter machine-4	C	130	8.7	20,83,000	150	28.9	116	86.80

Unit	Source	Type of flue	Height (m)	Top Dia. (m)	Flow Rate Nm^3/h	Temp. ^0C	Emissions (g/s)		
							PM	SO_2	NO_x
18.	Sinter Plant-5 de dusting	DD	65	4.5	9,40,000	40	13.1	-	-
19.	Sinter machine-5	C	130	8.7	29,40,000	150	40.8	163	122.5
20.	DR kiln-1	C	75	3.75	2,50,000	387	3.5	-	-
21.	DR kiln-1 de dusting	DD	40	1.5	80,000	50	1.1	-	-
22.	BOF-3 converter-1	C	60	2.0	1,50,000	60	2.1	4.17	8.33
23.	BOF-3 converter-2	C	60	2.0	1,50,000	60	2.1	4.17	8.33
24.	BOF-3 converter-3	C	60	2.0	1,50,000	60	2.1	4.17	8.33
25.	BOF-3 converter-4	C	60	2.0	1,50,000	60	2.1	4.17	8.33
26.	Fume Extrac. Sys.BOF-3	DD	40	5.5	16,00,000	60	13.3	-	-
27.	BOF-3 LHF(4 nos)	DD	60	3.0	3,00,000	50	2.5	-	-
28.	RH degasser-2	DD	30	0.6	10,000	60	0.1	-	-
29.	RH degasser-3	DD	30	0.6	10,000	60	0.1	-	-
30.	Lime Plant -13	DD	45	1.5	60,000	130	0.5	0.1	0.08
31.	Lime Plant -14	DD	45	1.5	60,000	130	0.5	0.1	0.08
32.	Lime Plant -15	DD	45	1.5	60,000	130	0.5	0.1	0.08
33.	Lime Plant -16	DD	45	1.5	60,000	130	0.5	0.1	0.08
34.	Lime Plant -17	DD	45	1.5	60,000	130	0.5	0.1	0.08
35.	Lime Plant -18	DD	45	1.5	60,000	130	0.5	0.1	0.08
36.	Dolo Plant - 19	DD	45	1.5	60,000	130	0.5	0.1	0.08
37.	Dolo Plant - 20	DD	45	1.5	60,000	130	0.5	0.1	0.08
38.	Wire rod mill-2	C	45	1.5	50,000	225	0.7	2.1	2.78
39.	Wire rod mill-3	C	45	1.5	50,000	225	0.7	2.1	2.78
40.	SBQ mill	C	45	1.5	70,000	250	1.0	2.9	3.89
41.	Medium Section Mill	C	45	1.5	1,40,000	250	1.9	5.8	7.78
42.	Universal Beam Mill	C	45	1.5	1,40,000	250	1.9	5.8	7.78
43.	Incinerator	C	30	0.5	6,000	50	0.1	0.2	0.33
44.	Pellet -3 ESP	C	100	5.0	15,00,000	115	20.8	12.5	58.3
45.	Pellet -3 m/c discharge	DD	30	1.5	1,11,220	45	1.5	0	0
46.	Power Plant-3C (300MW)	C	275	6.0	29,00,000	150	41.7	500	333
47.	Power Plant-4G(300 MW)	C	275	6.0	15,00,000	150	41.7	500	333

Stack emission details are mainly based on the actual monitoring data done elsewhere, consumption, fuel balance, prevailing emission factors as available in literature for stainless steel plants, and different statutory regulations prevailing in the country.

Meteorological data plays an important role in computation of Ground Level Concentration using ISCST-3 / AERMOD model. Meteorological data of the project site is another input required for computation of the contribution by the expansion plant.

Data related to wind velocity and direction were generated during the monitoring period. Part of this site specific monitored data have been used as input data of the model during computation.

The input meteorological data used in the computation are presented in **Table 4.2** and uniform Cartesian grid system was used to locate/fix sources and receptors in the study area. The predicted GLC values are given in **Table 4.3.**

Table 4.2: Meteorological data used as input for Air quality modeling

Hour	Sensible heat flux (W/m2)	Surface friction velocity (m/s)	Vertical potential tep. Gradiant above PBL	Height of convectively generated PBL (m)	Height of mechanically generated PBL (m)	Monin-Obukhov length (m)	Wind speed (m/s)	Wind direction (degrees)	Ambient air temp. (°K)
01	-1.0	0.031	-9.000	-999.0	13.0	2.5	1.50	200.0	294.5
02	-0.5	0.021	-9.000	-999.0	7.0	1.7	1.00	191.0	294.2
03	-0.5	0.021	-9.000	-999.0	7.0	1.7	1.00	185.0	293.6
04	-0.5	0.021	-9.000	-999.0	7.0	1.7	1.00	171.0	293.4
05	-0.5	0.021	-9.000	-999.0	7.0	1.7	1.00	160.0	293.1
06	-1.0	0.031	-9.000	-999.0	13.0	2.6	1.50	172.0	292.8
07	-2.0	0.044	-9.000	-999.0	21.0	3.6	2.10	181.0	292.0
08	27.5	0.084	0.005	395.0	56.0	-1.8	1.50	155.0	294.1
09	89.6	0.068	0.005	607.0	41.0	-1.0	1.00	81.0	296.2
10	128.1	0.095	0.005	917.0	67.0	-1.0	1.50	64.0	297.5
11	143.5	0.123	0.005	1091.0	99.0	-1.1	2.10	56.0	298.4
12	158.6	0.146	0.005	1260.0	128.0	-1.7	2.60	63.0	299.0
13	160.2	0.124	0.005	1397.0	101.0	-1.0	2.10	74.0	298.9
14	165.5	0.097	0.006	1523.0	70.0	-1.0	1.50	62.0	299.2
15	138.2	0.123	0.006	1629.0	99.0	-1.1	2.10	42.0	299.2
16	73.1	0.159	0.007	1683.0	146.0	-4.6	3.10	73.0	298.4
17	45.0	0.154	0.007	1714.0	139.0	-6.9	3.10	78.0	297.4
18	-2.5	0.054	-9.000	-999.0	36.0	5.4	2.60	99.0	296.5
19	-3.1	0.054	-9.000	-999.0	29.0	4.5	2.60	145.0	296.1
20	-2.0	0.044	-9.000	-999.0	21.0	3.6	2.10	157.0	295.9
21	-2.0	0.044	-9.000	-999.0	21.0	3.5	2.10	183.0	295.8
22	-2.0	0.044	-9.000	-999.0	21.0	3.5	2.10	179.0	295.4
23	-2.1	0.044	-9.000	-999.0	21.0	3.5	2.10	196.0	295.1
24	-2.1	0.044	-9.000	-999.0	21.0	3.5	2.10	192.0	294.8

4.1.4.2.2 Results: Impact on Air Environment

The resultant ambient air concentrations after the setting up integrated steel plant has been presented in **Table 4.3** for PM10, PM 2.5, SO2 & NOx . Fugitive emission factor considered for stock yards was 0.0001754 g/s/m^2. Thus it is anticipated that there will not be any adverse changes in AAQ in the study area. The isopleths of the computed results for RPM, SO2 and NOx are presented in **Fig. 4.1, 4.2 & 4.3** respectively.

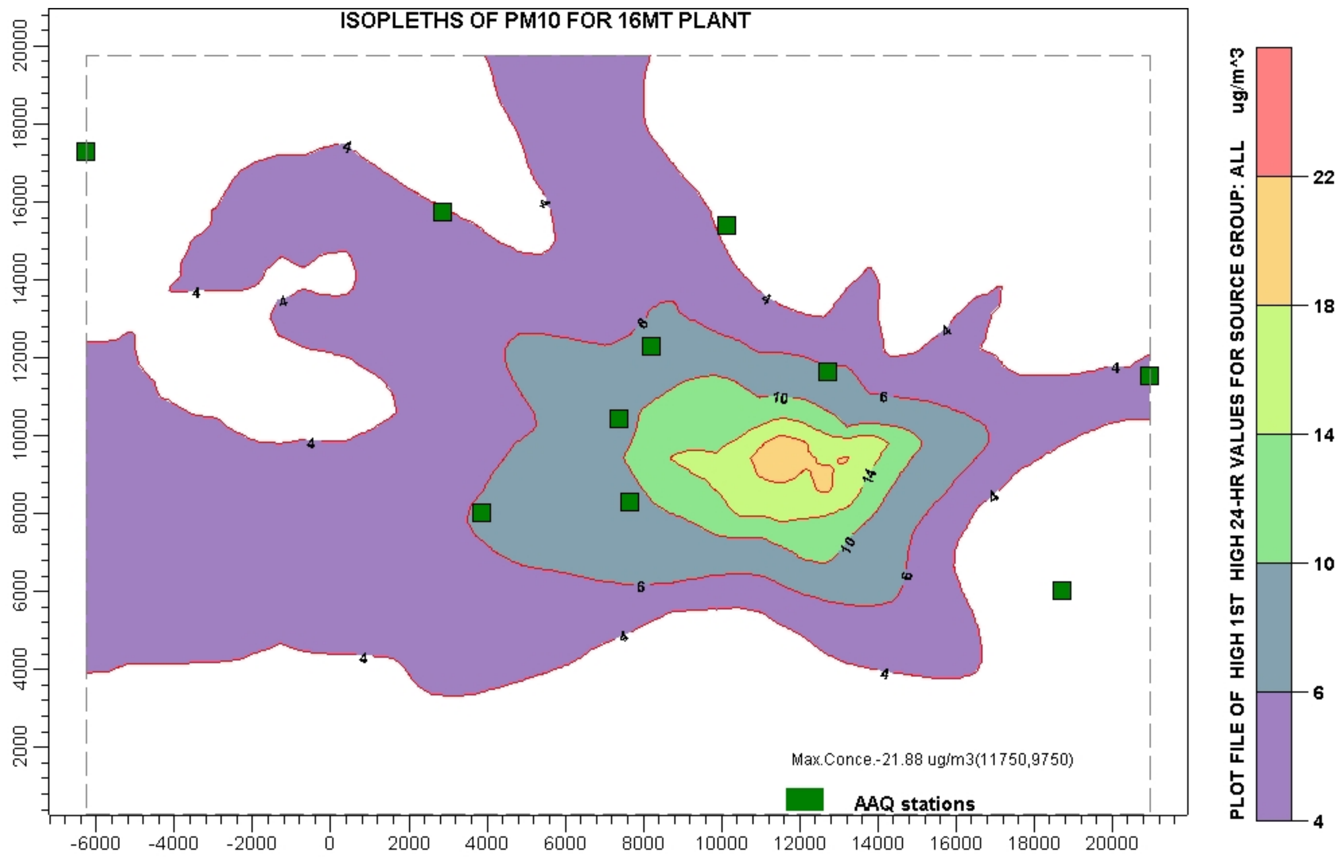
Table 4.3 Prediction of GLC's at 16 MTPA Expansion

All Values in ug / m3

Location Code	AAQM location	RPM (PM10)			
		Back Ground value	From stack prediction	Fugitive emission	Total
A1	Talur	82	6.1	1.3	89.4
A2	Township, Vidyanagar	80.3	8.9	6.7	95.9
A3	Vaddu	84	8.8	2.2	95.0
A4	Toranagallu	84.2	6.2	9.3	99.7
A5	Sultanpura	151	2.3	0	153.3
A6	Gadiganur	122	4.2	0.7	126.9
A7	Basapur	89.7	6.9	1.8	98.4
A8	Kurekuppa	115	3.7	3.6	122.3
A9	Kuditini	119	4.3	0	123.3
A10	Karadi Dhama	39	2.8	1.02	42.82
	Norm				100

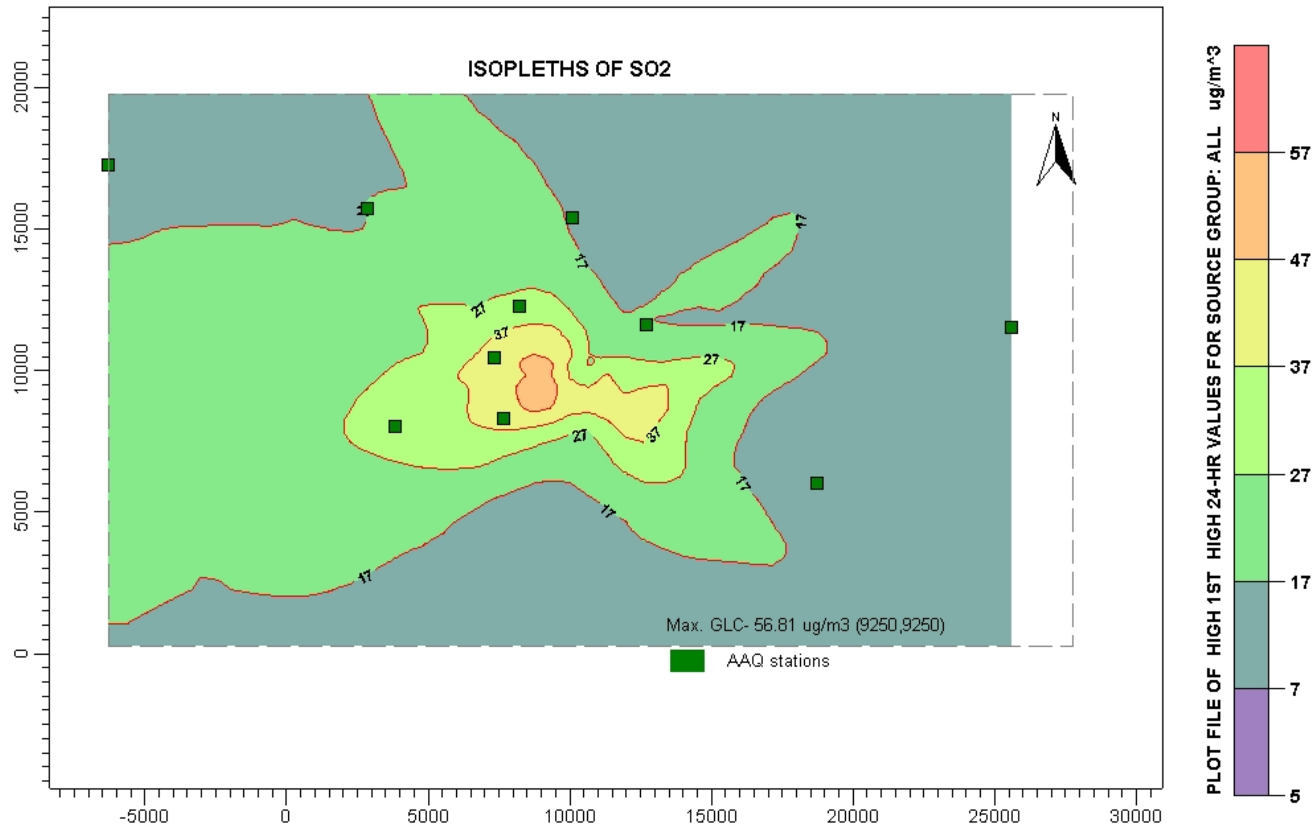
Location Code	AAQM location	RPM (PM 2.5)			
		Back Ground value	From stack prediction	Fugitive emission	Total
A1	Talur	16.4	4.5	0.11	21.01
A2	Township, Vidyanagar	14.7	6.2	0.44	21.34
A3	Vaddu	23.1	5.9	0.02	29.02
A4	Toranagallu	18.3	4.1	0.26	22.66
A5	Sultanpura	32.5	1.7	0.02	34.22
A6	Gadiganur	28.2	2.8	0	31.0
A7	Basapur	21.5	4.8	0.05	26.35
A8	Kurekuppa	24.8	2.6	0.10	27.5
A9	Kuditini	30.7	2.9	0	33.6
A10	Karadi Dhama	11.5	2.1	0.05	13.65
	Norm				60

Location Code	AAQM location	SO_2			NO_X		
		BG*	At 16 MTPA	Total	BG*	At 16 MTPA	Total
A1	Talur	13.4	30.4	43.8	16.6	22.0	38.6
A2	Township, Vidyanagar	13.9	41.3	55.2	17.4	30.0	47.4
A3	Vaddu	13.9	41.1	55.0	17.7	30.4	48.1
A4	Toranagallu	13.4	16.7	30.1	17.1	12.9	30.0
A5	Sultanpura	13.6	11.1	24.7	17.4	8.2	25.6
A6	Gadiganur	13.1	17.1	30.2	16.6	12.5	29.1
A7	Basapur	13.2	29.9	43.1	16.6	21.6	38.2
A8	Kurekuppa	13.3	16.12	29.42	16.6	11.7	28.3
A9	Kuditini	14.1	10.6	24.70	18.6	7.8	26.4
A10	Karadi Dhama	0	14.8	14.8	0	10.6	10.6
	Norm			80			80



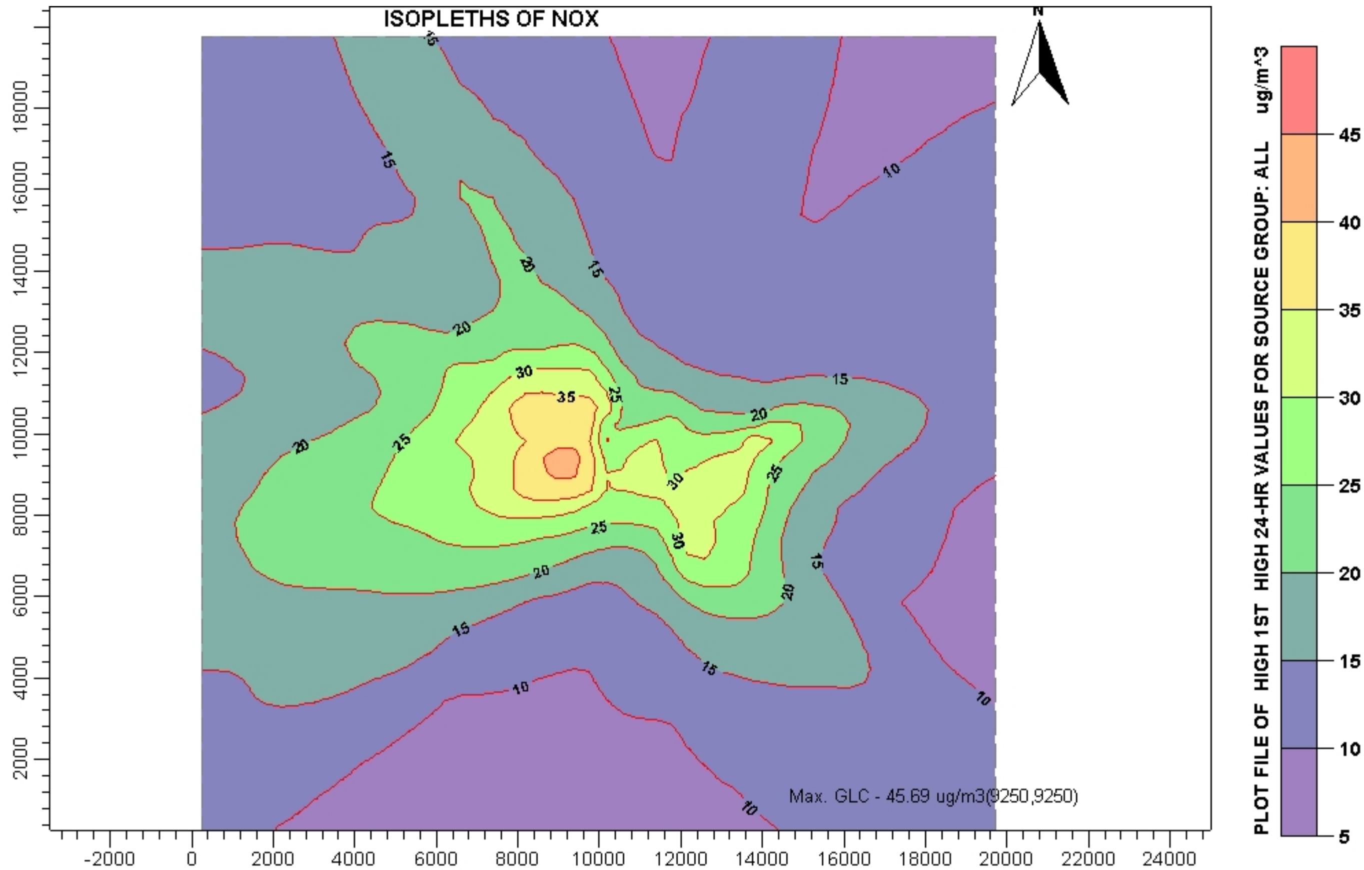
Maximum GLC: 21.88 µg/m^3 at (11700, 9700)

Fig. 4.1: Isopleths for SPM Concentration Due to expansion project



Maximum GLC: 56.81 µg/m^3 at (9200, 9200)

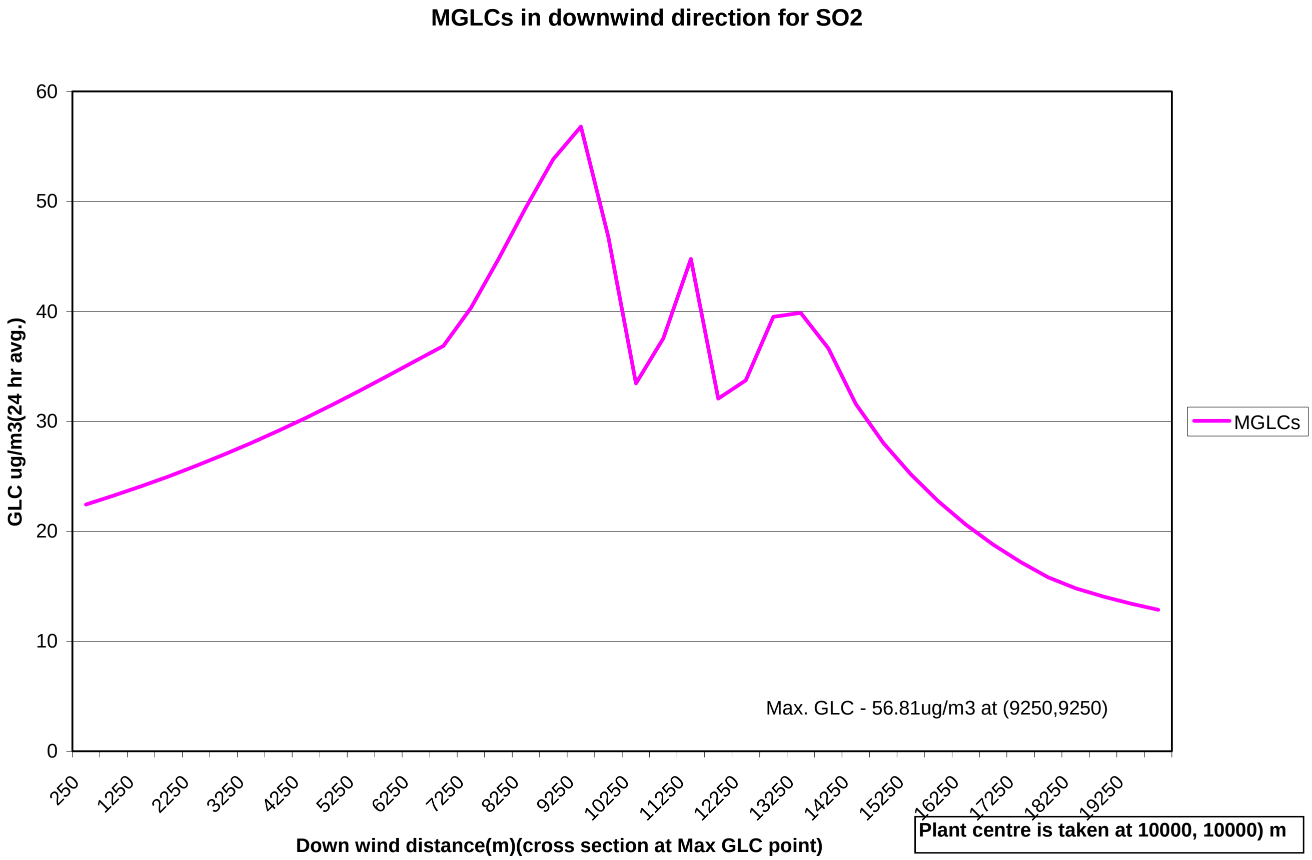
Fig. 4.2: Isopleths for SO_2 Concentration Due to expansion project



Maximum GLC: 45.69 µg/m^3 at (9200, 9200)

Fig. 4.3: Isopleths for NO_x Concentration Due to expansion project

A graph of daily average concentration (MGLC scenario) for SO2 has been plotted with downwind distance at every 500m interval covering the exact location of GLC.



Grid wise results of RSPM, SO2 and NOx is given in the annexure at the end of the chapter.

4.1.4.2.3 Mitigation Measures

During the design phase all efforts have been made to adopt latest state of art technology and to install adequate pollution control measures for different processes and de-dusting stacks and for different fugitive emission sources. During the construction phase of the proposed project appropriate mitigation measures will be implemented to ameliorate the anticipated air quality problems. The following mitigation measures will be employed during operation period to reduce the pollution level to acceptable limits:

- Bag filter based DE system in BF with gas cleaning plant.
- Bag filter based DE system for ground based pushing emission control in Coke Oven battery
- Dry fog type DS system for material handling junction points
- Fume Extraction system for BOF & LF along with gas cleaning plant.
- Dust extraction system in Sinter Plant.
- Dedusting System in lime & dolo plant
- Stack monitoring to ensure proper functioning of different major stacks.
- Air monitoring in the Work-zone to ensure proper functioning of fugitive emission control facilities.
- Adequate plantation in and around different units.
- Vehicles and machineries would be regularly maintained so that emissions confirm to the applicable standards.
- Monitoring of ambient air quality through online AAQ monitoring system at two locations.
- Workers will be provided with adequate protective measures to protect them from inhaling dust.

4.1.4.3 Impact of Transportation of Raw Materials and Finished Products by Road

Impact

The total annual external freight will be approximately **4.1 Mt** including **1.8 Mt** of incoming materials and **2.3 Mt** of outgoing finished products. The quantity of raw materials to be received and the finished products to be dispatched annually is shown in Table below:

Table below shows the transportation of raw materials and finished product to and from the plant. From the table it can be seen that the majority of bulk quantity of raw material / finished product is being transported from Rail and only small quantity of material is being transported from road. A total of maximum **713 trucks per day** will be running for the requirement of the Steel Plant. For traffic volume estimation, considering receipt of Raw Materials in three shifts (24hrs.) about **30 trucks per hour** will be additionally running on the NH 63 / SH 40 for the Steel Plant.

Transportation of Raw Materials and Finished Product

Sl. No.	Raw material	Source	Quantity (Mtpa)	Mode of transport	Number of Heavy Vehicles (16t)/day
1.	Iron ore fines	Bellary / Hospet area	13,375,000	Rail	0
2.	Coking coal	Imported / Blended	4,195,000	Rail	0
3.	Non-coking coal for BF	Imported / Blended	700,000	Rail	0
4.	Limestone fines for pellet plant	Bagalkot / Dronachalam region	84,000	Rail	0
5.	Limestone fines for sinter plant	Bagalkot / Dronachalam region	530,000	Rail	0
6.	Dolomite fines for sinter plant	Bagalkot / Dronachalam region	543,000	Rail	0
7.	Quartzite for BF	Belgaum region	78,000	Road	13
8.	Limestone for SMS	Imported / Bagalkot / Dronachalam region	1,029,000	Road	176
9.	Dolomite for SMS	Imported / Bagalkot / Dronachalam region	415,000	Road	71
10.	Bentonite for pellet plant	Belgaum region	30,000	Road	5
11.	Ferro-alloy for SMS	Local region	93,000	Road	16
12.	Iron ore for SMS	Bellary / Hospet area	124,000	Road	21
13.	Thermal Coal for Power plant (300 MW)	Indigenous coal linkages	1,750,000	Rail	0
			Sub Total		**302**
		Dispatch			
1	Steel		1500000	Road	275
2	Granulated Slag		600000	Road	102
3.	Cement		200000	Road	34
			Sub total		**411**
			Grand Total		**713**

Mitigation Measures

- To reduce the traffic on NH 63 and SH 40, JSW has already planned a by pass road from both ends of NH 63 (Gadiganur & Sultanpur Cross) which will join SH 40 at Banihatti. This will reduce the traffic substantially.

- JSW is also planning to have dedicated rail network for their operations by upgrading the Nandihalli – Sushilnagar - Banihatti project for which in principal approval from SE railway has already been taken.
- JSW is also planning to bring raw materials from mines through conveyers instead of trucks which will also reduce the traffic.

4.1.4.4 Water Environment

Water environment may be affected by industries in different ways depending upon the type of industries. The water environment may be surface or ground water or both. Water environment may be affected by the industry due to drawal of water, discharge of polluted water / waste water, and by contaminated leachate from land disposal / dumping of solid waste. The present activities are scrutinized in light of the above factors and its impact is predicted accordingly.

4.1.4.4.1 Effect of Water Drawal (Surface water)

Impacts

The expansion plant draws its requirement of raw water from reservoir which in turn receives water from the pumping station on river Krishna. Water is supplied to the plant from the reservoir after treating it in a water treatment plant. Government of Karnataka has sanctioned vide their G0 No. CI 29 SPI 94 dated 11.10.1994 22 MGD water from Tungabhadra Dam, G0 No. CI 121 SPI 2004 dated 17.02.2005 10.8 MGD water from Tungabhadra Dam , G0 No. CI 82 SPI 2005 dated 03.02.2007 45 MGD water from Almatti Dam and subsequently revised the 45 MGD water to 40 MGD vide G0 No. CI 82 SPI 2005 dated 09.11.2009. Hence Government of Karnataka has confirmed availability of water upto **72.8 MGD** to JSW for Industrial purposes.

No impact on ground water is also envisaged since no ground water will be drawn by the expansion plant.

Mitigation Measures

- No impact envisaged.
- Various water conservation schemes envisaged are :
  - Blow down water from power plant will be reused for Pig Casting Machines and Coke Quenching in Coke ovens.
  - Blow down water from BOF re-circulation system will be reused in SMS slag yards for spraying on hot slag.
  - Blown down water from Blast Furnace re-circulation system will be reused in Slag Granulation Plant as make-up water to SGP re-circulation Water System.

- In addition, rain water harvesting schemes are envisaged for the proposed project.

4.1.4.4.2 Water Usage

Background

In an integrated Steel plant wastewater may be generated from different units / shops. Some are being discharged after treatment; some are reused in the plant itself after treatment and only bleed off quantity are being discharged. Attempts will be made to achieve Zero discharge from plant.

Impacts

In an integrated steel plant water is generally used for purposes like:

- Material conditioning i.e. for slurrying, quenching, mill scale removal, rinsing etc.
- Air pollution control i.e. for wet scrubbing of air pollutants
- Heat transfer i.e. water used for protecting the equipment by cooling refractory and shell of equipment.

Overall approximately 75 % of water use is for heat transfer. Accordingly, a considerable portion of water supplied is lost by evaporation. Evaporation losses include slag quenching at blast furnaces and basic oxygen furnaces, Coke quenching, spray chamber cooling at casters and evaporation in cooling towers. However, wastewater discharges from any plant mainly depend upon the water usage, and type of use.

Wastewater discharges from an integrated steel plant can be broadly divided into two parts. Non-contact water discharges and contact water discharges. Water is used in a series of heat exchangers in coke oven gas treatment, blast furnaces, basic oxygen furnaces, and rolling operations and boilers. This non-contact water is generally contaminated with high dissolved solids comprising of salts of calcium and magnesium which were originally present in the raw / feed water. Due to repeated re-circulation and high temperature concentration of these salts starts to built up necessitating bleeding off of some part of circulating water. Water is also used for contact cooling e.g quenching, Coke oven gas treatment, slag handling etc. This contact water discharges may be contaminated with different pollutants and needs to be treated prior to discharges.

a) Sinter Plant

Wastewater may generate in Sinter plant if wet scrubbers are used for pollution control facilities. However in this project dry ESPs are used in the sinter plant for pollution control, which does not generate any effluent. Further the water requirement / consumption in sinter plant is very less and no water is required for process purposes and as such no wastewater is generated from the process.

b) Pellet Plant

In pellet plant is mainly used for wetting the ore additive mix before feeding in to balling mills for making balls. Further in the balling discs controlled water is used for adjusting final moisture content of the green balls. Further the water requirement / consumption in pellet plant is very less and as such no wastewater is generated from the process.

c) DR Plant

In DR plant water is required in the rotary kiln and cooler for cooling of the reduced material from the kiln indirectly in rotary coolers by an external water spray. The cooling water is collected in trough below the cooler and sent to cooling tower for cooling. The cooled water is re-circulated. Due to repeated re-circulation and high temperature concentration of dissolved salts starts getting built up necessitating bleeding off of some part of circulating water from the indirect cooling circuit.

d) Blast Furnace

Blast furnace requires a considerable quantity of water. Water required is mainly for direct contact water used in the gas coolers / wet scrubbers which cleans the blast furnace gas. This water is treated in settling tank / clarifier for removal of suspended solids and the overflows are recycled to the gas scrubbers.

Only the final blow down from the re circulated systems are being discharged. The blow down will conform to the following quality:

pH	6.5 - 8.5
Suspended Solids (mg/l)	100
Oil & Grease (mg/l)	10
Cyanide as CN^- (mg/l)	0.2
Ammoniacal Nitrogen as NH_3 – N (mg/l)	50

Therefore there is no possibility of any adverse impact of water pollution.

e) Steel Making and Primary Refining: Basic Oxygen Furnace (BOF)

The water requirement for BOF is not significant. The wastewater generated from Gas Cleaning Plant will be contaminated only with particulate matter and will be pumped to a sludge pond. Further any bleed off water from cooling circuit will be used for slag cooling and as such no wastewater is anticipated to be generated from cooling water circuit. Thus no adverse impact on water environment is anticipated.

f) Secondary Refining Facilities: Laddle Furnace

The other water usages indicated are mainly for refining and casting operations. The refining operation except vacuum degassing does not generates any effluent.

g) Continuous Casting Facilities and Rolling Mills

Continuous Caster usually requires water for cooling of different mechanical equipment, and for flushing of mill scale (generated during cutting) down the flume beneath the runout table. The principal pollutants are suspended solids oil and greases. This will be treated in scale pits for mill scale recovery and oil removal and the treated effluent will be discharged.

h) Coke Oven & By Product Plant

Waste waters are generated from the coke oven & bye product plant as waste ammonia liquor from moisture contaminated in the charged coal, steam used in distilling ammonia from the waste liquor, light oil recovery and other processes. Wastewaters are contaminated with oil & grease, ammonia, cyanides, thiocyanates, and phenols.

Further whatever wastewater is generated from the Coke Oven & By Product Plant area is collected and transported through pipeline to a wastewater treatment plant (BOD Plant). The wastewater after treatment is meeting the statutory norms for discharge of treated effluent but instead of discharging it outside, the wastewater is used for plantation and as such no water pollution is anticipated.

Treated effluent will conform to the following :

i)	pH of the treated effluent	-	Between 6.0 to 8.0
ii)	Suspended solids	-	Not more than 100mg/l
iii)	Phenol	-	Not more than 1.0 mg/l
iv)	Cyanide	-	Not more than 0.2 mg/l
v)	Ammonical Nitrogen	-	Not more than 50mg/l
vi)	Free ammonia	-	Not more than 5.0 mg/l
vii)	Oil & grease	-	Not more than 10 mg / l
viii)	Nitrate Nitrogen	-	Not more than 10mg/l
ix)	BOD (3 days, 27 ^{o}C)	-	Not more than 30 mg/l
x)	COD	-	Not more than 250 mg/l

i) Wastewater from Other Sources

In addition to the above some additional wastewater may be generated due to floor washings and also from the toilet blocks of the units envisaged during the expansion plant. The sewage generated from the toilet blocks will be very less in quantity and will be taken to the Sewage Treatment Plant.

Mitigation Measures

During the design phase all efforts have been made to adopt latest state of art technology and to install adequate effluent treatment facilities for different units expected to generate water pollutants. During the construction phase of the proposed project appropriate mitigation measures will be implemented to ameliorate the anticipated water /effluent quality problems. The following mitigation measures will be employed during operation period to reduce the pollution level to acceptable limits.

- Re-circulating water in the process whereby discharged volume is minimum.
- Clarifier and sludge pond for removal of suspended solids.
- Neutralisation of acidic water by lime.

- Removal of oil and grease from the contaminated water by means if oil traps, skimming devices, etc.
- Effluent quality monitoring at inlet and outlets of different effluent treatment plants to ensure proper functioning of different effluent treatment facilities.
- Use of treated wastewater in different shops and for plantation development as far as practicable.

The list of water pollution control systems envisaged are summarized below.

List of Water Pollution Control Systems

Source	Pollutants	Control System
Raw material handling yard	Suspended Solids	Catch Pits
Raw Water Treatment Plant	Suspended Solids	Clarifier, Thickener,
BF& BOF Gas Cleaning Plant	Suspended Solids	Clarifier, Thickener,
Coke Oven and by product plant	Oils, Suspended Solids, ammonia, phenols etc	Oil, organics and ammonia removal, in BOD Plant
Bloom Caster, Billet caster & Rolling mills	Suspended Solids, Oil & Grease	Settling Tanks fitted with Oil & Grease Trap
Soft and DM Water Plant	pH and dissolved solids	Neutralizing Pit
Cooling Tower and Boiler Blow-down	Temperature, Dissolved Solids	For re use
Canteens, Toilets	BOD, Suspended Solids	Sewage treatment plant

The new plant aims at zero discharge philosophy. In case of problem in water recovery/reuse system, during dry season maximum 200 m3/h, occasional discharge can be anticipated for a short period of time meeting the discharge norm. It is presumed that after completion of the project the water environment will improve significantly.

4.1.4.4.3 Ground Water

Impacts

The expansion plant does not envisage any ground water drawl and hence no impact on ground water availability around the plant is anticipated.

The waste disposal area around any industry is one of the major factors deteriorating ground water quality, if the water leached from the waste dumps contains toxic substances. At the expansion plant, some wastes are dumped in secured land fill sites and some inert wastes are dumped in low lying area. All other solid wastes are either re-used / recycled or sold out.

Mitigation Measures

- Periodical monitoring of ground water quality at up-gradient and down gradient of slag dump area.
- Disposal of waste generated from the proposed project will be done in a systematic /scientific manner as per guidelines to prevent any ground water pollution.

4.1.4.5 Solid Waste Generation and Disposal

4.1.4.5.1 General

Integrated Iron & steel plant generates solid wastes, some of which are hazardous while others are non-hazardous. Some of these wastes are reused / re-utilised and some are not. DSP is also not exception to that. Solid wastes are mainly generated from:

- Sinter Plant
- Blast Furnace
- DR plant
- BOF
- Coke Oven & By-product Plant
- Different Rolling Mills
- Lime & Dolomite Plant

In addition to above, wastes are also generated during operation / maintenance / annual maintenance of other units / shops etc, which are

- Flue dust from BF
- Blast Furnace Gas Cleaning Plant sludge
- BOF Gas Cleaning Plant sludge
- Waste Refractory materials
- Waste lubricant / oil etc. and Waste Lead – Acid Batteries
-

The characteristics of the generated solid wastes are presented in **Table 4.4a.** From the table it can be noticed that except some sludge generated from Coke Oven and By Product area none are hazardous. The generation quantity along with the reuse / recycle and disposal methodology for the solid waste is presented in **Table 4.4b.**

Table 4.4a: Source of Generation / Characterisation of Solid Wastes

Shop	Type of waste	Source of Generation	Typical Chemistry (%)	Waste Characterisation as per Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules, 2008 & its ammendments
DR Unit	Dolo / Char	DR Kiln operation	Ash: 60-70% C: 18-22% H_2O: 3.5% VM: 2% Calorific Value -- 1800 kCal/kg	Not Applicable
	DR Process Dust	DR Kiln Process from pollution control equipment of Kiln of Cooler discharge area and off gas system.	Ash: 70% C: 20 – 25% VM:2% Mithyle–Blue value 50-100	Not Applicable

Shop	Type of waste	Source of Generation	Typical Chemistry (%)	Waste Characterisation as per Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules, 2008 & its ammendments
	DR De-dusting Dust	De-dusting dust from pollution control equipment installed with Raw Material Handling, Coal Crusher, and Product processing & handling area unit.	Ash: 70% C: 20 – 25% VM:2% Mithyle–Blue value: 50-100	Not Applicable
BF Plant	BF Flue Dust	Flue dust of coarser particle is collected in dust catcher located before wet scrubbling	$Fe_{(t)}$: 37.00 C : 23.69 SiO_2 : 9.01 Al_2O_3 : 7.26, TiO_2 : 0.87, CaO : 6.37, MgO : 5.46, MnO : 2.02, P_2O_5 : 0.25, S : 0.27	Not Applicable
	BF Sludge	Flue dust of fine particles trapped by wet scrubbing and finally settled at sludge pond	$Fe_{(t)}$: 20-30 FeO : 7-12 Fe_2O_3 : 25-35 C : 30-40 S : 0.5-0.8 P : 0.09-0.12 Na_2O : 0.1-0.2 K_2O : 0.5-0.7 ZnO : 0.2-0.4 CaO : 8-10 SiO_2 : 5.0-7.0 MgO : 0.3-0.5 Al_2O_3 : 0.8-1.3 MnO : 0.5-0.8	Not Applicable
	BF Slag	BF operation	CaO : 30-31 SiO_2 : 32-33 Al_2O_3 : 18-22 MgO : 8-10 FeO : 0.2-0.6 MnO : 1.5-3.0 S : 1.5-1.7,	Not Applicable
	Spent Refractories	Bricks from BF, dismantled ladles / torpedo ladles, cast house runners, etc.		Not Applicable
Hot metal Pretreatment Unit	Hot Metal Pretreatment Dust	Dust collected in bag house filter of dust extraction system		Not Applicable
	Hot Metal Pretreatment Slag	Slag skimmed after pretreatment of hot metal		Not Applicable

Shop	Type of waste	Source of Generation	Typical Chemistry (%)	Waste Characterisation as per Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules, 2008 & its ammendments
BOF Shop	BOF Dust / Sludge	BOF flue dust collected in gas cleaning system either in dry form or as sludge	BOF dust : Fe(t) : 52.25 SiO_2 : 5.92, Al_2O_3 : 1.1 TiO_2 : 0.43 CaO : 18.26 MgO : 5.98 MnO : 2.59 P_2O_5 : 0.36 S : 0.18 BOF sludge : $Fe_{(t)}$: 50.84 CaO : 15.39 SiO_2 : 2.19 P : 0.17, MgO : 4.31 Al_2O_3 : 0.71 S : 0.29 Na_2O : 0.51, K_2O : 0.06 Zn : 1.10, C : 2.58	Not Applicable
	BOF Slag	BOF	CaO : 40-50 FeO : 20, SiO_2 : 15-17 P_2O_5 : 2.45 MgO : 3.9 - 4.5 MnO : 4.5 Al_2O_3 : 5.2-6.3	Not Applicable
	Spent Refractories	Bricks from dismantled converter		Not Applicable
Refractory Materials Plant	Limestone / Dolomite Fines	Screening of raw limestones / dolomite in raw materials handling yard / lime plant / dolomite calcination plant		Not Applicable
	Lime / Calcined Dolomite Fines	Screening of calcined lime / dolomite in lime /dolomite calcination plant		Not Applicable
	Spent Refractories	Bricks from dismantled kilns of refractory materials plant		Not Applicable
	RMP Sludge	Collected after scrubbing of kiln flue		Not Applicable

Shop	Type of waste	Source of Generation	Typical Chemistry (%)	Waste Characterisation as per Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules, 2008 & its ammendments
Continuous Casting Plant	Caster Scale	Caster Area	$Fe_{(t)}$: 62-68 FeO : 60-70 Fe_2O_3 : 15-25 C : 0.3-0.5, S : 0.12-0.25 P : 0.15-0.25 Na_2O : 0.05-0.1 K_2O : 0.01-0.03 ZnO : 0.04-0.06 CaO : 0.3-0.5 SiO_2 : 0.8-1.5, MgO : <0.01 Al_2O_3 : 0.1-0.2 MnO : 0.3-0.5	Not Applicable
	Caster Sludge	Sludge pit of continuous casting plant		Not Applicable
	Spent Refractories	Repair of tundishes and ladles		Not Applicable
Hot Rolling Mill	Mill Scales	Relatively coarse mill scale is collected from reheating furnaces and dry processing areas like cooling beds, straighteners, shears and saws	$Fe_{(t)}$: 62-68 FeO : 60-70 Fe_2O_3 : 15-25 C : 0.3-0.5, S : 0.12-0.25 P : 0.15-0.25 Na_2O : 0.05-0.1, K_2O : 0.01-0.03 ZnO : 0.04-0.06 CaO : 0.3-0.5 SiO_2 : 0.8-1.5, MgO : <0.01 Al_2O_3 : 0.1-0.2 MnO : 0.3-0.5	Not Applicable
	Mill Sludge	Fine mill scale contaminated with oil is collected in sludge pit	$Fe_{(t)}$: 64.4 CaO : 0.6, SiO_2 : 4.0 P : 0.085 MgO :0.22 MnO :0.44 Al_2O_3 : 1.85 TiO_2 : 0.07 Cr_2O_3 : 0.08 LOI : 0.4 Oil : 10-11	Not Applicable
	Spent Refractories	Bricks from dismantled reheating furnaces		Not Applicable
Coke Oven Plant	Spent Refractories	Rebuilding of coke ovens and miscellaneous repairs in coke ovens		Not Applicable

Shop	Type of waste	Source of Generation	Typical Chemistry (%)	Waste Characterisation as per Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules, 2008 & its ammendments
By-Products Plant	Decanter Tar Sludge	Decanter for separation of tarry sludge from ammonical liquor and tar		As per Category 13.3 of Schedule – I
	Tar Storage Tank Residues	Cleaning of Tar storage tank & Gas Traps & Seals		As per Category 1.2 & 13.4 of Schedule – I
	Acid Tar	Ammonium Sulphate Plant		As per Category 1.2 & 13.4 of Schedule – I
	Tarry & Acidic wastes	Coal Chemical Plant: Reactor / Electrostatic Tar Precipitator (ETP) Cleaning & Annual Maintenance		As per Category 1.2 & 17.1 of Schedule – I
	BOD Plant Sludge	Sludge from BOD Plant		As per Category 34.3 of Schedule – I
Mineral Oil/synthetic oil used as lubricants in hydraulic operations / other uses	Spent / Wash / Lubricant			As per Category 5.1 & 20.2 of Schedule – I
Batteries	Lead Acid Batteries	From various operations		Category B4 & E3 of Schedule – II

4.1.3.2 Impacts

Solid waste generated from different units and its re-utilisation and disposal is given in **Table 4.4b**.

Table 4.4b: Solid Waste Generation and Disposal

Sl. No	Solid waste	Generation Tpa @ 10 MTPA	Generation Tpa @ 16MTPA	Proposed disposal
1	Slag			
a.	Iron Making slag	4035000	6456000	98 % granulated and sold to Cement plants, 2% treated in dry pits and used for land fill
b.	Steel making slag	2210000	3536000	BOF slag is granulated , metalics separated and used in construction
2	Sludge			
a.	Iron making sludge	129000	207000	Used in Pellet plant after dewatering
b.	Steel making sludge	151000	242000	Used in Sinter plants after dewatering
3	Mill scales			

Sl. No	Solid waste	Generation Tpa @ 10 MTPA	Generation Tpa @ 16MTPA	Proposed disposal
a.	Steel making shop	38000	61000	Used in Sinter plants
b.	Rolling mills	149000	239000	Used in Sinter plants
4	Dusts			
a.	Flue dust from Blast furnace	106572	170515.2	Used in Sinter plants
b.	Dust from bag filter	343428	549485	Used in Sinter plants
5	Lime / Dolo dusts	38000	61000	Used in Sinter plants
6	Fly ash from boilers	42000	205286	Sold to Cement Plants and use for manufacturing fly ash bricks
7	Misc wastes & debris			
a.	Refractory waste	100000	160000	
b.	Misc waste	2400000	3840000	

4.1.3.3 Mitigation Measures

- All attempts to utilise solid waste as per the guidelines given in CREP.

4.1.4.6 Hazardous Waste Generation and Disposal

4.1.4.6.1 Impacts

Hazardous waste generation and its utilization for the expansion plant plan is given in **Table 4.5**.

Table 4.5: Net Increase Expected for Hazardous Waste Generation and its Disposal

Sl. No	Category	Quantity KL or t/yr @ 10mtpa	Quantity KL or t/yr @ 16mtpa	Proposed disposal
1	Waste oil & Used oil	2750 KL / Year	4400	Sold to authorised parties
2	Acid and alkali residue from CRM	450 t	720	Regenerated in ARP
3	Waste pickled liquor from CRM	73216000 KL	117145600	Regenerated in ARP
4	Tar sludge from Coke oven	315 t	505	Used back in Coke oven
5	Water treatment sludge	8172 t	12965	Sent to hazardous waste land fill
6	Spent activated carbon, catalyst & Oil soaked filter	8.7 t/y	14.3	Incinerated
7	Sludge from hazardous waste treatment process, incinerator & Waste sulphur	59 t/y	164	Sent to hazardous waste disposal site

Mitigation Measures

- All hazardous wastes to be disposed in secured landfill as per statutory norms.

4.1.1.6 Noise Levels

4.1.1.6.1 Impacts

During normal operations of the plant ambient noise levels may increase close to the compressors and blowers but this will be confined only within plant boundary and that too will be confined within shops. The level will be further minimised when the noise reaches the plant boundary and the nearest residential areas beyond the plant boundary.

4.1.1.6.2 Mitigation Measures

Various measures proposed to reduce noise pollution include reduction of noise at source, provision of acoustic lagging for the equipment and suction side silencers, vibration isolators, selection of low noise equipment, isolation of noisy equipment from working personnel. In some areas, personnel working will be provided with noise reduction aid such as ear muffs/ ear plugs and also the duration of exposure of the personnel will be limited as per the norms. The following measures will be undertaken:

<u>Technological Measures</u>

- Plugging leakages in high-pressure gas/air pipelines.
- Reducing vibration of high speed rotating machines by regular monitoring of vibration and taking necessary steps.
- Design of absorber system for the shift office and pulpit operator's cabin.
- Noise absorber systems in pump houses.
- Noise level at 1m from equipment will be limited to 85 dB (A).
- The fans and ductwork will be designed for minimum vibration.
- All the equipment in different new units and in units where capacity expansion is taking place will be designed/operated in such a way that the noise level shall not exceed 85 dB (A).
- Periodical monitoring of work zone noise and outside plant premises.

<u>Management Measures</u>

In a steel plant, with a variety of noise producing equipment, it may not be practicable to take technological control measures at all the places. In such cases the following administrative measures shall also be taken:

- Un-manned high noise zone will be marked as "High Noise Zone".
- In shops where measures are not feasible, attempts shall be made to provide

operators with soundproof enclosure to operate the system.

- Workers exposed to noise level will be provided with protection devices like earmuffs as per present practice and will be advised to use them regularly, while at work.
- Workers exposed to noisy work place shall be provided with rotational duties.
- All workers will be regularly checked medically for any noise related health problem and if detected, they will be provided with alternative duty.

Over and above all these adopted measures, trees and shrubs belts of substantial depths within and surrounding plant premises will further attenuate the sound levels reaching the receptors within and out side the plant premises.

4.1.1.7 <u>Ecological Features</u>

4.1.1.7.1 Impacts

- Erection and commissioning of the project may change the land-use pattern of the area and may cause significant loss of habitat, which is unavoidable. However, the proposed expansion is coming up within the existing plant premises of JSW – thus such changes are not of major concern.

- During construction some existing vegetation on the project site may be cut / damaged.

- The construction and operation of the project may cause direct impact to the wildlife present in the area. However, the proposed expansion is coming up within the existing plant premises of JSW - thus the impact on wild life is not envisaged.

- Emissions from plant operation may affect the natural vegetation and agricultural crops around the proposed plant expansion.

- The thresh-hold limit for continuous exposure of SO2 on plants is about 50 ug/m3 and that for NOx is 100 ug/m3 (Env. Engg., Chapter 7 by H. S. Pavy, D. R. Rowe, G.T. Chobanoglous. Mc.Graw-Hill Book Co.1986). The level of air pollutants due to operation of the proposed expansion will be much below the above said level. Moreover, the area is arid and the natural vegetation commonly found on hillocks and in plain areas are scrub types. All the plants naturally occurring are xerophytic with sunken stomata, thick and small leaves. All these adaptations are for water conservation. Side by side these features are also helpful in protecting plants from air pollutants. Thus it is expected that the natural vegetation in the area will not be affected. So far as agriculture crops are concerned, as they will remain in the field for three to six months only, the impact on the same is also not anticipated.

- Emissions from the proposed expansion may cause harm to the wild life and forests in the study area and more so to the animals residing in forests close to the project site in the forest areas falling within the study area. However, in forest areas the maximum predicted SO2 levels is 15ug/m3 and NOx level is 10ug/m3, which when added to the AAQ as observed during the study at the nearest AAQ station is well below the permissible level of SO2 levels for sensitive areas. Thus it is expected that the flora and fauna in the forests and else where in the study area will not get affected due to the proposed project.

- Noise generated due to the proposed project may cause disturbance to the faunal species.

- Strong light in the project premises during night may cause some disturbance to the fauna in the near by areas.

- The waste water from plant operation and domestic use may cause surface water pollution in the area.

Mitigation Measures

- The project site as of an Industrial land with operation industry and green belt, all care will be taken to avoid cutting of the same.

- All technological measures to limit air emissions, waste water discharge and noise generation are envisaged in the proposed plant expansion design and hence no further mitigation measures envisaged.

- An elaborate green belt / cover already exists which will further enhanced within and around the plant to ameliorate the fugitive emissions and noise from the project operation.

- The Narihalla water channel carrying water from Narihalla Dam to Daroji Tank passes at more than 500m from the project site on the western side. Whereas, High Level Canal from Tungabhadra dam flows near the project site on the northern side. The proposed project is designed for maximum re-circulation and no effluent will be allowed to discharge out of plant premises. The project and domestic waste water will be treated and after treatment the same will be re-used and recycled within the plant itself and the excess water will be used for gardening purpose and dust suppression of plant roads. Thus there will be no impact on the ecological components of surface water bodies in the area.

Mitigation Measures for Reducing Impacts on Faunal Species

- **Direct Disturbance:** Ten feet high fencing is erected all around the project so that no animals come to the project site. Further a green belt erected within the fencing (facing the proposed plant expansion) all around the proposed plant expansion area will further reduce the impact of direct disturbance.

- **Noise:** The maximum noise level reaching out side the proposed plant expansion project boundary will be below the statutory norms for residential area, and that reaching the forest areas will be below the statutory norm for silence zone. Further the green belt all along the project boundary will further reduce the noise level so as to cause any disturbance to the faunal species. Thus the animals in the study area will not get impacted due the noise from the proposed project activity.

- **Strong Light during Night:** The strong light in the project premises during night may cause some disturbance to the fauna in the near by forests. It is proposed that all the light posts erected along the boundary wall will face inwards and down wards (with reflectors facing the plant and downwards), so that the light do not spreads out side the plant boundary.

4.1.1.8 Occupational Safety and Health

Impact

Working operation of integrated steel plant is cumbersome and negligence in plant operations may cause risk to safety and health problems.

Mitigation Measures

For ensuring better occupational health and safety the following measures will be provided:

General Measures

- Proper control of fugitive dust from sources inside plant including open stockyards and to keep all de-dusting systems in prefect conditions. The de-dusting systems provided in shops will be regularly monitored and the level of dust in working zone will be reported to the management for necessary control action.
- Keeping plenum ventilation systems of premises in perfect working order to avoid accumulation of dust on equipment inside the pressurized room. Regular cleaning of air filters.
- Keeping air conditioning plants in perfect running condition for control / instrumentation rooms.
- Proper functioning of pollution control systems to minimise dust fall on plant and outside areas.
- Based on the environmental monitoring for dust, gases, toxic chemical, noise & vibration, the workers exposed to these will be regularly checked in medical unit and results will be intimated to management.
- Workers exposed to noise prone areas will be medically checked and proper noise protective equipment will be supplied to them and will be encouraged to use the same.
- Spot cooling facilities will be provided for workers exposed to high heat generating shops and will be checked periodically. If necessary, rotation of duties is advised.
- Proper attention is given to township water quality so that water borne disease may not affect residents.

- More doctors in township hospital and plant medical unit will be additionally trained in the field of occupational health as policy matter.

House Keeping Measures

Proper house keeping is the key to proper environmental management. This creates proper working environment for the work force and safe working conditions. However, for the proposed capacity expansion the following good house keeping measures will be adopted:

- Regular cleaning and watering of plant roads to avoid accumulation of dust/garbage.
- Regular cleaning of shop floors.
- Avoiding accumulation and dumping of wastes and damaged equipment and items anywhere inside the plant affecting aesthetics.
- Developing a positive outlook in the employees for keeping the work place, both in factory, office or laboratory, clean and well maintained.
- Maintaining hygienic conditions in areas like canteens, near drinking water sources and toilets.

4.1.1.9 Management Initiatives for Charter on Corporate Responsibilities for Environmental Protection (CREP)

The Charter on Corporate Responsibility (CREP) as laid down by Central Pollution Control Board (CPCB) for Integrated Iron and Steel Industry will guides the production in the proposed steel plant.

Management Initiatives for Charter of Corporate Responsibility as followed

SN	Unit / Item	Responsibilities	Extent of fulfillment
1.	Coke Oven	Meeting parameters related to PLD, PLL, PLO etc.	These criteria will be fulfilled
2.	SMS	To reduce fugitive emission by installing a secondary dedusting system	secondary dedusting facility envisaged to reduce the fugitive emission
3.	BF	Direct Injection of reducing agents	Coal Dust Injection (CDI) system for BF has been envisaged
4.	SMS / BF	Utilisation of SMS and BF Slag	100 % utilization will be explored
5.	Coke Oven	Charging of Tar sludge / ETP sludge to coke oven	Possibility will be explored
6.	Water conservation/ pollution	Reduce specific water consumption to 5 m^3/t for long products and 8 m^3/t for flat products. Operation of COBP Effluent Treatment Plant efficiently to achieve notified discharge standards	The statutory norms will be complied.

4.1.2 IMPACTS AND MITIGATION MEASURES BECAUSE OF ACCIDENTS

The major chemicals handled / stored in the expansion plant includes LPG .

In all the above listed chemicals (except LPG), any accident / mishap resulting in Fire or consequent to fire will not have any serious repercussions as that of a major hazard. Furthermore, the fire in such of these installations will be contained and confined to the installation / facility only and there are no chances of escalation.

Since LPG is used as fuel in the furnaces, any leakage of the same may lead to fire accidents which may cause damage to men, material and machinery in the nearby areas and are controllable. Whereas, once the `BLEVE' sets in, it is uncontrollable and it is a major disaster situation. The physical damage caused by a `BLEVE' cannot be controlled.

Mitigation Measures

Proper on-site / off-site emergency plans & Disaster Management Plan will be made. In addition, various fixed installations for Fire Detection, Alarm and Fire fighting will be available to effectively tackle the situation before the fire escalates into a conflagration. Regular mock drills will be conducted to check the effectiveness of the system

4.2 Measures for Minimizing and / or Offsetting Adverse Impact

The potential adverse environmental impacts possible verses the mitigation measures incorporated to minimize the possible impacts, in the expansion plant have been summarized in brief in **Table 4.6.**

Table 4.6: Potential Impacts Verses Mitigation Measures Adopted

SN.	Impact Topics	Impact On	Impact Due To	Adopted Measures
1	Physical Resources	Air environment	Release of air pollutants	Incorporation & installation of air pollution control systems and ensuring their effective functioning. Refer clause no. 4.1.4.2.3
		Water environment	Drawl of water & release of polluted waste water	Sufficiency of water availability assessed, maximum re-circulation of water envisaged, and Incorporation & installation of water pollution control systems and ensuring their effective functioning. Refer clause no. 4.1.4.3.2
		Soil	Release of polluted waste water, Deposition of SPM released, & Dumping of solid waste	Incorporation & installation of water and air pollution control systems, Handling & disposal of solid waste including hazardous waste in accordance with statutory norms.
2	Biological Resources	Vegetation	Release of polluted wastewater, Deposition of pollutants released.	Incorporation & installation of water and air pollution control systems
3	Land acquisition	Land environment, Aesthetics	Conversion of existing land use pattern	Land acquired is declared as Industrial land
4	Noise	Habitats	Use of equipment having operating sound level more than the statutory level.	Noise Control measures as required have been envisaged. All noise levels will be maintained within the permissible statutory limits. Refer clause no. 4.1.4.6.2
5	Hazardous Substance	Habitat, Surrounding environment	Release of hazardous chemicals	Incorporation of different process control systems, Safety features, Alarm arrangements, and follow up of Disaster management / Emergency response plan

SN.	Impact Topics	Impact On	Impact Due To	Adopted Measures
6	Transportation	Habitat, Surrounding environment	Release of pollutant, Improper traffic management.	Use of vehicles meeting the statutory norms related to emission, transport by railway freight, proper traffic management.
7	Social & Economic	Human, livelihood, Education etc	Influx of people, Settlement, Stress on existing infrastructure etc.	No negative impact envisaged since site is already a planned town. Moreover additional social improvement activities have also been planned by the project management in the region.
8	Cultural resources	Human	Influx of people, Settlement	No negative impact envisaged since site is already a planned town

However, the detailed technological aspects of mitigation measures are given in clause 4.5 of **Chapter 4**.

4.3 Irreversible and Irretrievable Commitments of Environmental Components

The project is not expected to create any irreversible and irretrievable impacts because of the following:

- The project is coming within the existing plant, hence there is no change in the land use pattern.
- No forest land is involved.
- No rehabilitation of site dwellers is required.
- All the impacts created by the project can be mitigated by adoption of suitable mitigation measures.

4.4 Assessment of Significance of Environmental Impacts

4.4.1 General

The assessment of effects of a particular action judgment must be made as to whether these effects are “Significant”. Significance is a relative concept, which reflects the degree of importance placed on the impact in question. Having identified the events associated with the proposed activity and their potential consequences, the next issue required to be addressed is the extent to which these make the proposed activity environmentally significant. In developing the criteria for determining this, the criteria outlined in the different guidelines for determining the level of environmental impact were considered.

These criteria entail an assessment of the level of certainty in the prediction of an activity’s potential environmental consequences **(Predictability Criterion),** combined with an assessment of the degree to which these consequences can be managed (**Manageability Criterion**).

The predictability criterion involves determining the level of certainty in the prediction of different issues for each of the events and their potential environmental consequences associated with the activity.

The manageability criterion focuses on the extent to which the potential environmental consequences can be either avoided or minimised in terms of size, scope and duration.

It is based on the recognition that minimising the environmental impact of an activity primarily entails managing the environmental consequence(s) of those activities by either avoiding them in the first place or by mitigating them to as low as reasonably practical. From the significance scores for the predictability and manageability criteria, the level of environmental significance for each of the potential events associated with the proposed activity can then be determined as either High, Medium or Low on the basis of environmental significance matrix.

The steps followed for assessing the significance are presented schematically in **Fig. 4.4** below. The aspect of environment and their environmental consequences considered are presented in **Table 4.7.**

Table 4.7: Events and their Environmental Consequences

Aspect of Environment	Category of Impact	Type of Event	Likely Consequences
Natural Environment	**Soil Impact**	Soil earthworks	Reduction in visual amenity of area.
	Air Impacts	Emissions to air (eg. dust, SO2, NOx gases etc)	Health risk to local community;
			Greenhouse effect.
	Surface & Ground Water Impacts	Water extraction	Water shortage to local community, agriculture and ecosystem.
		Spills into water bodies (eg. oil or chemical spills)	Inconsumable water to the local community and ecosystem.
		Altering drainage patterns	Reduced water capacity of natural water bodies. Increased soil erosion.
	Fauna Impacts	Disturbing terrestrial or aquatic species	Endangering species; Displacing species
	Flora Impacts	Disturbing native flora Clearing native vegetation	Threaten biological diversity Destroy fauna habitats; Threaten biodiversity
	Sensitive Area Impacts	Disturbance of National or Conservation Parks	Loss of conservation value
		Disturbance of World Heritage areas	Loss of world heritage value of area
		Disturbance of areas under national or international registers /conventions	Loss of register/convention values
Social Environment	**Community Resource Impacts**	Use of public resources	Degradation of public infrastructure (eg. roads)
		Change in land use	Disadvantage groups within the community; Loss of recreational amenity of a region
		Change visual attributes of area	Reduction in aesthetic and recreational value of area
	Cultural Impacts	Change demographic structure of an area	Changes to community make up;
			Changes in community cultural identity and values
	Heritage Impacts	Disturbance to natural or man made features of an area	Changes to aesthetic value of area;
			Changes to historical value of area
		Disturbance to aboriginal sites	Loss of aboriginal affiliation with an area
	Community Health Impacts	Air emissions	Health problems in the community
		Noise and vibration	Discomfort to local community;
		Water contamination	Health risk to local community
		Potentially hazardous operations (eg. high pressure pipelines, hazardous substance storage)	Health and safety risk to local community
Economic Environment	**Community Welfare**	Altering economy of a region	Changes to the standard of living in the region;

Aspect of Environment	Category of Impact	Type of Event	Likely Consequences
	Impacts	Altering employment rate within a community	Changes to the standard of living; Social instability/stability Changes in employment levels;
	Natural Resource Impacts	Disturbance of natural resources of other industries in the region	Changes in level of viability of other industries, Changes to industry types within Region
		Altering existing land use.	Changes to land value;

4.4.2 Criteria For Determining Significance

Issues considered under the predictability criterion are given in **Table 4.8**.

Table 4.8: Issues Considered under Predictability Criterion

a)	**Size of event(s) & consequence(s):**
	The accuracy of the predicted quantity of potential pollution discharge on a unit or total basis, the amount of population, land, fauna and flora disturbed, and the size of the potential consequences of such events.
b)	**Scope of consequence(s):**
	For example, the accuracy of the predicted extent to which the potential consequences extend beyond the confines of the area or region of direct disturbance.
c)	**Duration of event(s) & consequence(s):**
	This includes the accuracy of the predicted timeframe (i.e. short or long term) over which the event and their potential consequences are expected to last.
d)	**Likelihood of events**
	The likelihood at which the events that can potentially result in the consequences are estimated to occur.
e)	**Stakeholder Concerns of event(s) & consequence(s)**
	The extent to which the stakeholder perceptions, views and concerns of the events and their consequences associated with the activity is known.

As a first step, the level of certainty in the prediction of these issues has been determined and categorised as either Low, Medium or High as defined in **Table 4.9.**

Table 4.9: Level of Certainty in the Prediction of Activity Events and their Associated Consequences

Low	Extreme uncertainty in the prediction of the issue. Well-informed decision-making is very difficult to make.
Medium	Some uncertainty in the prediction of the issue. Sufficient confidence in the accuracy of the data to make informed decision-making possible.
High	Insignificant uncertainty in the prediction of the issue. Confidence in making an informed decision is very high.

The level of certainty for the above issues for each event is then determined. For ease of assessment, the results has been tabulated as shown below in **Table 4.10**

Identify events associated with the proposed activity and any potentially environmentally adverse consequences associated with these events

↓

Predictability Criterion
Assess the level of certainty in the prediction of the activity events and their associated adverse environmental consequences in relation to their :

- Size
- Scope,
- Duration,
- Likelihood and
- Stakeholder Concerns

↓

Manageability Criterion
Assess the level to which any adverse consequences for each event can be managed in relation to :

- Being avoided;
- Likelihood of occurring;
- Duration;
- Size and scope;
- Cumulative effects;
- Stakeholder concerns

↓

Determine the environmental significance scores for each event against the predictability and manageability criterion (Table 4.11 and 4.15 respectively).

↓

Ascertain the level of environmental significance (Low, Medium or High) for each event (environmental significance matrix : Table 4.16).

↓

Classify level of Environmental Impact of the overall proposed activity on the basis of the level of environmental significance of each event.

Fig. 4.4: Steps For Assessment of Significance of Environmental Impacts

4.4.3 Environmental Significance Against Predictability Criterion

Once the level of certainty of each of the issues is determined, it is then possible to assess the environmental significance of each of the events associated with the activity against the predictability criterion. The environmental significance is determined and assessed on a scale of 1 to 5 as described in **Table 4.10.**

The significance score can then be tabled into the “significance score” column of the predictability criterion **Table 4.11.**

Table 4.10: Predictability Criterion Significance Score

Significance Score	Predictability Criterion
1	All of the issues outlined in **Table 4.7** have been fully addressed; all events and their consequences associated with the activity have been accurately predicted to a high level of confidence.
2	There is a mixture of high and medium certainty of the issues. No issue is of low certainty.
3	All issues are of medium certainty.
4	There is low certainty in at least 1 of the issues for either the events or their potential environmental consequence(s).
5	There is low certainty in all of the issues for either the events or consequences.

Table 4.11: Predictability Criterion Table

Step 1 Each of the events of the proposed activity and their associated consequences are assessed against certainty (Low, Medium or High as described in **Table 4.9**) in the prediction of: •the size; •scope; •duration; •likelihood; and •stakeholder concerns Step 2 Significance Score of 1 to 5 is assigned for each event using **Tables 4.9 & 4.10**.		Size	Scope	Duration	Frequency	Stakeholder Concerns	Significance score
NATURAL ENVIRONMENTAL IMPACTS							
Impact on Soil	Earthworks	High	High	High	High	High	1
	Contamination (eg spills)	High	High	High	High	High	1
Air Impacts	Air emissions	Medium	Med.	Med	Med.	High	2
Surface/Ground Water Impacts	Water contamination	Medium	Med.	Med.	Med..	High	2
	Water extraction	High	High	High	High	High	1
	Altering drainage patterns	High	High	High	High	High	1
Fauna Impacts							
Disturbance to species		High	High	High	High	High	1
Disturbance to habitats		High	High	High	High	High	1
Flora Impacts							
Disturbing native flora species		High	High	High	High	High	1
Clearing extensive areas of native vegetation		High	High	High	High	High	1
Sensitive Area Impacts							
Disturbance to National Parks		High	High	High	High	High	1
Disturbance to World Heritage Areas		High	High	High	High	High	1
National and/or worldwide register or		High	High	High	High	High	1

Step 1 Each of the events of the proposed activity and their associated consequences are assessed against certainty (Low, Medium or High as described in **Table 4.9**) in the prediction of: •the size; •scope; •duration; •likelihood; and •stakeholder concerns Step 2 Significance Score of 1 to 5 is assigned for each event using **Tables 4.9 & 4.10**.	**Size**	**Scope**	**Duration**	**Frequency**	**Stakeholder Concerns**	**Significance score**
NATURAL ENVIRONMENTAL IMPACTS						
SOCIAL IMPACTS						
Community Resource Impacts						
Public infrastructure	High	High	High	High	High	1
Land use	High	High	High	High	High	1
Changes to visual attributes of area	High	High	High	High	High	1
Cultural Impacts						
Changes to demographic structure of area	High	High	High	High	High	1
Heritage Impacts						
Disturbance to natural features	High	High	High	High	High	1
Disturbance to man made features	High	High	High	High	High	1
Disturbance to aboriginal sites	High	High	High	High	High	1
Community Health Impacts						
Air quality changes	Medium	Med.	Med.	Med.	High	2
Noise and vibration	High	High	High	High	High	1
Changes to water quality	High	High	High	High	High	1
Hazardous operations introduced	Medium	Med.	Med.	Med.	High	2
ECONOMIC IMPACTS						
Community Welfare Impacts						
Wealth and employment	High	High	High	High	High	1
Natural Resource Impacts						
Disturbance of natural resources of other industries	High	High	High	High	High	1
Altering existing land use	High	High	High	High	High	1

4.4.4 Manageability Criterion

This criterion focuses on the extent to which the potential environmental consequences can be either avoided or minimised in terms of size, scope and duration. It is based on the recognition that minimising the environmental impact of an activity primarily entails managing the environmental consequence(s) of those activities by either avoiding them in the first place or by mitigating them to as low as reasonably practical. That is, any event will have an impact of some sort on the natural, social or economic aspects of the environment within which it occurs. However, the severity of the impact(s) depends on the extent to which the consequences to the environment can be eliminated or minimised. Therefore, the manageability criterion assesses the level to which the environmental consequences of each event can be either avoided or mitigated.

4.4.5 Issues Under Manageability Criterion

In assessing the level to which the environmental consequences can be managed the issues given in **Table 4.12** may need to be addressed.

Table 4.12: Issues Considered under Manageability Criterion

a)	**Avoidance of Consequences**
	The extent to which the associated consequences of the various activity events can be totally avoided.
b)	**Likelihood of Event Occurring**
	The likelihood or probability of an event occurring must also be addressed. If the likelihood of such an event or sequence of events occurring has been managed so as to be very low and acceptable to other stakeholders, then it could be said that this is being managed appropriately and therefore of low significance
	If the likelihood of such an event or sequence of events occurring has been managed so as to be very low and acceptable to other stakeholders, then it could be said that this is being managed appropriately and therefore of low significance
c)	**Duration of Consequences**
	Whether the consequences can be managed to be short-term needs to be addressed – short-term needs to be defined in the context of the environment within which the potential consequences are likely to occur. That is, concepts such as the resilience of the environment would come into consideration.
d)	**Size and Scope**
	Consideration should be given to the extent to which the size and scope of the consequences can be managed, for example area of land, amount of flora and fauna or number of people affected by an activity. Consideration should be given to the size and intensity of the impacted environment relative to the undisturbed surroundings. Also whether the consequences are potentially catastrophic in terms of human and environmental well being, for example wide scoping and irreversible consequences.
e)	**Cumulative Effects**
	This includes any cumulative effects of the consequences, for example, the number of individual activities, which individually may not pose a significant environmental risk but collectively their potential consequences may be very significant in a particular region.
f)	**Stakeholder Concerns**
	The level of severity of the environmental consequences perceived by stakeholders (e.g. the outrage effect).

Table 4.13 outlines some basic questions, which can be used to address the above issues.

Table 4.13: Questions for Addressing Issues under Manageability Criterion

Issues	Questions
Avoidance of consequences	Can the potential adverse environmental consequences be avoided; or are there is no such consequence? (Yes or No)
Likelihood of event	What is the probability of an event occurring, which may result in the adverse environmental consequence(s)? (Low, Medium or High on the basis of the results of the risk assessment carried out in accord with relevant standards)
Duration of consequences	Are the consequences likely to be Short, Medium or Long term?
Size and scope	Can the consequences be managed so as to be small or confined to a designated area? (Small or Confined?) If they are not small or confinable are the consequences potentially catastrophic? (wide Scoping and Irreversible).
Cumulative effects	Is it likely that the potential consequences of the proposal in conjunction with those of other existing activities are likely to pose a higher and unacceptable risk to the environment than if the individual activities where carried out on their own?
Stakeholder concerns	Is there any major concern of other stakeholders on any of the consequences of the proposed activity?

4.4.6 Environmental Significance Against Manageability Criterion

Once the potential environmental consequences have been addressed in relation to the above issues, the level of environmental significance of each of the events associated with the proposed activity can then be assessed against the manageability criterion. As with the predictability criterion, the environmental significance for the manageability criterion is assessed on a scale of 1 to 5 as described in **Table 4.14**.

Table 4.14: Manageability Criterion Significance score

Significance Score	Manageability Criterion
1	Adverse consequences of the various events associated with the proposed activity can be totally avoided, or it is highly unlikely that the events will ever occur.
2	Adverse consequences can be managed to be short-term. Short-term needs to be defined in the context of the environment within which the potential consequences are likely to occur.
3	Adverse consequences are not or cannot be managed to be short-term, but they can be confined so as to be insignificant in terms of size and scope relative to the surroundings.
4	Adverse consequences in conjunction with those of existing activities pose significant cumulative effects. Or Consequences are significant in terms of duration and/or size and scope relative to surroundings.
5	Consequences are potentially catastrophic. Or There is high stakeholder concern on the severity of the consequences. Catastrophic in this context means wide scope and long term or irreversible consequences such as death or serious injury to many individuals or permanent adverse change to the environment.

A step-by-step outline of the use of **Tables 4.13 & 4.14** to assess the level of environmental significance for each of the events associated with the proposed activity against the manageability criterion is suggested as follows.

Step1: Where potential adverse consequences can be totally avoided; or where there are no adverse consequences associated with the events of the activity; or where there is a low likelihood of an event occurring which would lead to adverse consequences being realised, then the event can be considered as being of low significance. In this case a significance score of 1 should be assigned.

Step 2: Where potentially adverse consequences cannot be totally avoided or where their likelihood of being realised is not low, consideration needs to be given to the duration of the consequences. If the consequences can be managed to occur only for short term in the context of the environment within which they will occur. In such cases a significance score of 2 should be assigned.

Step 3: If the consequences are not short term, then the question of whether or not they can be confined within a designated area, which is relatively small, compared to the surrounding environment needs to be addressed. If they can be confined to being small, then a significance score of 3 is assigned. If they cannot be confined to being small and are significant in terms of size and scope relative to surroundings and/or duration, then a significance score of 4 is assigned.

Step 4: Before assigning a 2 or 3 significance score, the question as to whether the consequences may pose a significant risk to the environment as a result of the cumulative effects with the consequences of other existing activities needs to be considered. If it is considered that the cumulative effects are a significant risk, a significance score of 4 should be assigned.

Step 5: In the case where the consequences are potentially catastrophic in terms of being wide scoping and irreversible, or where there are major concerns by other stakeholders of the consequences, then a significance score of 5 should be assigned.

The significance score can then be entered into the "significance score" column of the manageability criterion **Table 4.15**.

Table 4.15: Manageability Criterion Table

Step 1 The associated consequences of each of the impacts are assessed against the following issues: •the extent to which they can be avoided; •the likelihood of events occurring which result in the impacts being realised •their duration; •the size and scope the consequences; •the cumulative effects of the consequences; and •stakeholder concerns ***Step 2*** Each of these issues are addressed using the questions given in **Table 4.13**. ***Step 3*** Significance Score of 1 to 5 is assigned for each impact-using **Table 4.14**.	**Avoidance**	**Likelihood**	**Duration**	**Size & Scope**	**Cumulative Effects**	**Stakeholder Concerns**	**Significance Score**
NATURAL ENVIRONMENTAL IMPACTS							
Soil Impacts							
Earthworks	Yes	Low	Med.	Small	No	No	2
Contamination (eg spills)	Yes	Low	Med.	Small	No	No	2
Air Impacts							
Air emissions	Yes	Low	Med.	Small	No	No	2
Surface/Ground Water Impacts							
Water extraction	No	Low	Med.	Small	No	No	1
Water contamination	Yes	Low	Med.	Small	No	No	2
Altering drainage patterns	No	-	-	-	-	-	1
Fauna Impacts							
Disturbance to species	No	-	-	-	-	-	1
Disturbance to habitats	No	-	-	-	-	-	1
Flora Impacts							
Disturbing native flora species	No	-	-	-	-	-	1
Clearing extensive areas of native vegetation	No	-	-	-	-	-	1
Sensitive Area Impacts							
Disturbance to National Parks	No	-	-	-	-	-	1
Disturbance to World Heritage Areas	No	-	-	-	-	-	1
National and/or worldwide register or convention areas	No	-	-	-	-	-	1
SOCIAL IMPACTS							
Community Resource Impacts							
Sxe3Public infrastructure	No	-	-	-	-	-	1
Land use	No	-	-	-	-	-	1
Changes to visual attributes of area	No	-	-	-	-	-	1
Cultural Impacts							
Changes to demographic structure of area	No	-	-	-	-	-	1
Heritage Impacts							
Disturbance to natural features	No	-	-	-	-	-	1
Disturbance to man made features	No	-	-	-	-	-	1

Step 1 The associated consequences of each of the impacts are assessed against the following issues: •the extent to which they can be avoided; •the likelihood of events occurring which result in the impacts being realised •their duration; •the size and scope the consequences; •the cumulative effects of the consequences; and •stakeholder concerns ***Step 2*** Each of these issues are addressed using the questions given in **Table 4.13**. ***Step 3*** Significance Score of 1 to 5 is assigned for each impact-using **Table 4.14**.	**Avoidance**	**Likelihood**	**Duration**	**Size & Scope**	**Cumulative Effects**	**Stakeholder Concerns**	**Significance Score**
NATURAL ENVIRONMENTAL IMPACTS							
Disturbance to aboriginal sites	No	-	-	-	-	-	1
Community Health Impacts							
Air quality changes	Yes	Low	Med.	Small	No	No	2
Noise and vibration	No	-	-	-	-	-	1
Changes to water quality	Yes	Low	Med.	Small	No	No	2
Hazardous operations introduced	Yes	Low	Med.	Small	No	No	2
ECONOMIC IMPACTS							
Community Welfare Impacts							
Wealth and employment	No	-	-	-	-	-	1
Natural Resource Impacts							
Disturbance of natural resources of other industries	No	-	-	-	-	-	1
Altering existing land use	No	-	-	-	-	-	1

4.4.7 Environmental Significance

From the significance scores for the predictability and manageability criteria, the level of environmental significance for each of the potential events associated with the proposed activity can then be determined as either High, Medium or Low on the basis of environmental significance matrix presented in **Table 4.16**.

Table 4.16: Matrix for Determining Level of Environmental Significance

	Scores	**Manageability Criterion**				
		1	**2**	**3**	**4**	**5**
Predictability Criterion	1	L	L	L	M	H
	2	L	L	L	M	H
	3	L	M	M	H	H
	4	L	M	M	H	H
	5	L	M	M	H	H

H = High; M = Medium; L = Low

As observed in **Table 4.16**, it is proposed that where adverse environmental consequences can be avoided or where it is very unlikely that an event will occur which would result in such consequences (i.e a Score of 1 against the manageability criterion), then the significance of the individual event associated with the proposed activity can be considered to be low regardless of the predictability score.

The significance matrix provided in **Table 4.17** can be developed so as to set the three levels of significance at other positions within the matrix.

Table 4.17: Activity Environmental Significance Table

	Predictability Criterion Score 1-5 (Table 4.10)	Manageability Criterion Score 1-5 (Table 4.15)	Level of Environmental Significance H: High M: Medium L: Low (Table 4.16)
NATURAL ENVIRONMENTAL IMPACTS			
Soil Impacts			
Earthworks	1	2	**L**
Contamination (eg spills)	1	2	**L**
Air Impacts			
Air emissions	2	2	**L**
Surface/Ground Water Impacts			
Water extraction	1	1	**L**
Water contamination	2	2	**L**
Altering drainage patterns	1	1	**L**
Fauna Impacts			
Disturbance to species	1	1	**L**
Disturbance to habitats	1	1	**L**
Flora Impacts			
Disturbing native flora species	1	1	**L**
Clearing extensive areas of native vegetation	1	1	**L**
Sensitive Area Impacts			
Disturbance to National Parks	1	1	**L**
Disturbance to World Heritage Areas	1	1	**L**
National and/or worldwide register or convention areas	1	1	**L**
SOCIAL IMPACTS			
Community Resource Impacts			
Public infrastructure	1	1	**L**
Land use	1	1	**L**
Changes to visual attributes of area	1	1	**L**
Cultural Impacts			
Changes to demographic structure of area	1	1	**L**
Heritage Impacts			
Disturbance to natural features	1	1	**L**
Disturbance to man made features	1	1	**L**
Disturbance to aboriginal sites	1	1	**L**
Community Health Impacts			
Air quality changes	2	2	**L**
Noise and vibration	1	1	**L**
Changes to water quality	1	2	**L**
Hazardous operations introduced	2	2	**L**
ECONOMIC IMPACTS			
Community Welfare Impacts			
Wealth and employment	1	1	**L**
Natural Resource Impacts			
Disturbance of natural resources of other industries	1	1	**L**
Altering existing land use	1	1	**L**

4.5 Technological Details Of Environmental Mitigation Measures

4.5.1 Introduction

All new or expansion of any projects including expansion plant may be accompanied by certain undesirable consequences requiring mitigative measures. Since the objective of environmental impact assessment is to ensure that development proceeds hand in hand with ecological conservation so as to achieve sustained growth, it becomes imperative that a proper mitigative vis-à-vis environmental control measures are adopted at the planning and implementation stage itself. Environmental control measures are necessary for any major expansion projects to maintain environmental balance and to check possible harmful effects. These control measures are of multidisciplinary dimensions and varies with type of projects. Therefore, the measures described in this report are to be regarded as good beginning and depending upon the situations, continuing advice is to be updated. In this part of the report environmental management plan has been worked out based on present baseline status, and environmental impact assessment as presented in the environmental impact assessment part of the report. It has already been indicated earlier in the EIA part that a number of environmental factors needs to be considered covering ambient air quality, water pollution, solid waste management, social factors, etc. The environmental control measures thus envisaged for the proposed plant are described in following text.

It has been observed in the previous chapters that there will be very little negative impact in case control measures are undertaken. To ameliorate the adverse impacts of the project and for scientific development of the local environment, a comprehensive Environmental Management Plan (EMP) is necessary. This has been worked out based on present environmental conditions, environmental impact assessment and environmental prediction. The EMP has been made for formulation, implementation and monitoring of environmental protection measures during and after commissioning of the expansion plant-cum-modernization plan taking into consideration of the following:

- Mitigation of adverse impacts.
- House keeping.
- Occupational safety and health plan
- Green belt development plan.

4.5.2 <u>Carbon Credit Technology / Projects Envisaged</u>

Under Clean Development Mechanism (CDM) in steel sector the Green House Gases (GHG) reduction projects which can be taken through the CDM route to accrue carbon credits benefits as financial incentives for the efforts. Following are the areas which shall be developed as CDM project activity and have been identified for availing carbon credit in the proposed plant:

1. Top Pressure Recovery Turbine (TRT) in Blast Furnace
2. Coal dust injection in Blast Furnace
3. Sinter Plant: Waste Heat Utilisation

4. Waste Heat Recovery Boilers in DR Plant
5. CDQ in Coke Oven

Project Concept Note (PCN) and Project Design Document (PDD) will be prepared after detail engineering.

Top Pressure Recovery Turbine (TRT) in Blast Furnace

Top Pressure Recovery Turbine (TRT) is a power generation system, which converts the physical energy of high-pressure blast furnace top gas into electricity by using an expansion turbine. Although the pressure difference is low, the large gas volumes make the recovery economically feasible. The key technology of TRT is to secure the stable and high-efficiency operation of the expansion turbine in dusty blast gas conditions, without harming the blast furnace operation. Two types of system are available, Wet TRT system and Dry TRT system.

Benefits:

- Generates electric power for example in Japanese Integrated Steel Works : Generates more than 8% of electricity consumed in the ironworks.
- Excellent operational reliability, abrasion resistant.
- Suitable for larger furnaces and higher temperature gases.

Coal Dust Injection (CDI) in Blast Furnace

Pulverized coal injection in BF replaces part of the coke used to fuel the chemical reaction, reducing coke production, thus saving energy. The increased fuel injection requires energy from oxygen injection, coal, and electricity and equipment to grind coal. The maximum injection depends on the geometry of the BF and impact on the iron quality (e.g., sulfur).

Coal dust injection system will be introduced involving handling, screening, drying and pulverisation system for coal. CDI has an economic as well as an environmental advantage as it directs injection of coal into BF as reducing agent which reduces coke requirement (for every Kg of coal injected approximately 0.8 Kg. of coke requirement is reduced).

Benefits:

- Reduces emissions of coke ovens by reducing coke making, as required for without CDI.
- Increased costs of oxygen injection and maintenance of BF and coal grinding equipment offset by lower maintenance costs of existing coke batteries and/or reduced coke purchase costs, yielding a net decrease in operating and maintenance costs.
- Decreased frequency of BF relining
- Improved cost competitiveness with cost reduction of hot metal

- High reliability and easy operation
- Increased productivity

Sinter Plant Waste Heat Utilisation

Waste heat utilization has been envisaged preheating the sinter mix before feeding to sinter bed. For the same ignition furnace with post heat hood and pre heating (before ignition furnace) shall be installed just after the sinter mix drum feeder. Hot air from waste heat recovery system of sinter cooler shall also be used for preheating of raw material before ignition furnace and post heat hood after ignition furnace.

Approximately 250 to 350 deg C hot air for the combustion is supplied from waste heat recovery system of sinter cooler. De-dusting system shall be provided at inlet of combustion air fan to supply clean hot air from discharge of cooler. The hot air for combustion shall have control by having intake in cold air. The ignition temperature shall be 1200 – 1300 deg C. Pilot burners shall be provided for start up and safety.

Benefits:

- Fuel savings in terms of reduction in Coke consumption and steam
- Exhaust heat recovery.
- NOx, SOx and particulate emissions reduction
- Increased productivity, yield, and cold strength

Waste Heat Recovery Boilers in DR Plant

During DR kiln operation hot waste gases leave the rotary kiln at about 800 – 850^{o}C through kiln feed end and comes to after burning chamber (ABC) where combustibles are burnt completely by supplying excess air. The gases now at 950 – 1000^{o}C are led to a waste heat boiler to generate steam for power generation.

Benefits:

- Power generation from sensible heat which other wise would have lost.
- Particulate emissions reduction

Use of Continuous Casting Technology

Hundred percent of the steel production through continuous casting facilities saves considerable energy and protects environment. The major environmental advantages are:

- Elimination of Soaking pits resulting in reduction in consumption of fuels and Electricity.
- Considerable energy is saved vis-à-vis less energy generation and reduces pollutant emissions.
- Less scrap production resulting in improved yield and less solid waste handling.

CDQ in Coke Oven

Coke oven is the equipment to carbonize coal to make coke and discharge periodically coke at around 1000 deg. C. This coke is cooled by the inert gas instead of water. The major advantages are :

- Power generation from sensible heat
- Particulate emission

4.5.3 AIR POLLUTION : MITIGATION MEASURES

A number of environmental friendly features have been envisaged in the proposed plant design plan due to which the anticipated adverse environmental impacts are either avoided or minimized. JSW is taking a number of measures to control air pollution. The remedial and control measures planned to be adopted are discussed briefly in the following sections.

4.5.3.1 Fugitive Dust Emission Control

Coke Oven and By-Product Plant

To minimize fugitive emissions from the Coke Ovens during charging, High Pressure Ammonia Liquor Aspiration (HPLA) system has been considered for effective on-main charging. The oven doors would be provided with special type of sealing device. The coke side fugitive emission would be controlled by providing land based pushing emission control system, integrated with coke transfer car. **Computerised combustion Control System (CCS)** has been envisaged for the Coke Ovens to improve efficiency of combustion. The measures considered to control the fugitive or secondary emissions from the coke oven batteries for the proposed project is described below:

a. High Pressure Ammonia Liquor Aspiration (HPLA) System

To control charging emission from coke oven battery, high-pressure ammonia liquor aspiration system (HPLA) has been envisaged. It shall consist of high-pressure multistage booster pumps for ammonia liquor, spray nozzles and pipelines. The low pressure ammonia liquor shall be drawn from the liquor mains, pressurized to about 30 – 35 Kg / cm2 and injected into gooseneck while charging. The charging gasses evolved shall be sucked into the gas collecting mains, preventing emission of dust and smoke into the atmosphere. HPLA system will be complete with pumps, HP nozzles, LP nozzles, goosenecks, pipes, valves, valves & fittings, electric and instrumentation.

b. Coal Charging Cars

JSW has intended to provide charging cars fitted with screw feeders and hydraulically pressed sleeves. Feeding of coal into oven will be carried out with control speed by screw feeders. During charging hydraulically pressed sleeves will be helping to eliminate leakage around charging holes. The charging cars shall be of modern single spot type with hydraulic drives to cater to the needs. The charging cars shall be provided with PLC and air-conditioned operators cabin. The charging cars shall also be equipped with oven top vacuum cleaner which will help in proper up keeping of oven top.

c. Hydro Jet Door Cleaners

During the coking process in the Ovens, the bitumen separates out mainly at the bottom of the Oven and if there are any gaps in the door seal, Coal tar oozes out of the door. At times, it is impossible to get the door back onto the Oven because of a build up of bitumen in the faces. This results in leaking doors allowing Coal gas and sulphurous fumes to escape to the surrounding. It is therefore required to maintain clean door. JSW have envisaged to provide hydraulic door cleaner system to reduce the pollution and improved working environment. The system will be complete with high-pressure water pump, tank, hose, nozzles etc. with pressure and volume control arrangement. The hydro jet cleaning system will be used for door and the doorframe cleaning with facility of hydro pressure up to 600 Kg/cm^2.

d. Leak Proof Oven Door

Leak proof oven door will be installed the Coke Oven batteries. Doors shall be leak proof with flexible sealing strips and other modified features to ensure leak proof sealing. The doors shall be of heat resistant cast iron provided with spring-loaded latches and spring loaded sealing strips.

e. Pushing Emission Control (PEC)

Pushing emission control (PEC) system has been envisaged to capture the emission of hot coke dust and other pollutants when coke side door of a coke oven is opened and coke is pushed out of the oven and dropped into the coke car. In the PEC system the dust recovery hood unit /assembly will consists of two suction hoods and connecting duct piece. The coke car hood shall extend over the hot coke car and shall be open to the top face of the hot coke car as well as to the discharge face of the coke guide car. This hood will suck dust-laden gas when hot coke is dropped from coke guide car into the hot coke car during coke pushing operation and will be a part of the coke guide car machine. The other suction hood i.e the oven door hood shall be movable inside a telescopic sleeve and shall move /extend over oven door area to extract smoke and dust arising /emitting when the door is taken off the oven for coke pushing operation. The telescopic sleeve of the oven door hood and the coke car hood shall be joined into a connecting duct piece which shall be extended over stationary collecting duct positioned along the full length of the coke oven battery. The collecting duct shall be open on top for its full length. The opening shall be internally braced with grating to provide support for a special high temperature rubber belt. The actual connection between the moving dust recovery hood unit / assembly and the stationary collecting duct shall be achieved by means of belt raising tripper car movable on the collecting duct along the length of the collecting duct.

The pushing emission thus collected in the moving suction hoods and evacuated into the stationary collecting duct shall be taken into a dust control system (Wet Scrubber / Bag Filter) before discharging through a stack / chimney of suitable height.

f. Dry-fog Dust Suppression System in Coke Cutter / Coke Conveyor

When temperature of the Coke reaches normal, Dry fog type dust suppression system is proposed for the coke cutting house / coke conveyor transfer points to suppress the coke dust and other dust particles in the major areas like Transfer towers, Coke crushing station, Coke screening station, etc.

The Duel Fluid Dust Suppression "DFDS" (water atomization with compressed air) Dust Control System works on the **principle of agglomeration**. Dust particles released from a material handling or processing plant, which become air borne, are made to pass through a blanket of extremely fine fog. The dust particles and the micro-sized fog droplets collide and adhere to each other, thus increasing their mass. After a series of such collisions, the mass becomes heavy enough to cause settlement of the agglomerates on to the larger mass of the material being handled.

The "DFDS" (water atomization with compressed air) Dust Control System is envisaged for controlling the dust generated during Material Transfer at Junction Houses. This system has been envisaged based on the consideration that Micronic Fugitive Dust is generated during handling of material in these areas, which is hazardous for the people working in the work zone, and can best be controlled effectively by the "DFDS" Type Dust Control System.

Basic principle of the system is based on the fact that if water droplets of approximately the same size as the dust particles are produced, the probability of collision between the two is extremely high. On the other hand, if the droplets exceed the size of dust particles, possibility of collision decreases rapidly. The DFDS System uses an Air Driven Acoustic Oscillator Nozzle which is capable of producing super fine atomization of water droplets that greatly increase the dust particle to water droplet contact resulting in settlement of dust. The fine droplets evaporate before wetting anything but the dust. The water addition is 0.1% of the weight of material being handled. These atomized water droplets are best described as "**FOG**". Since it does not wet the product, the system is called "**DRY FOG**".

Coal Handling and Coke Sorting Plant

The following air pollution control system will be installed in coal handling and coke sorting plant:

- Water sprinklers for wagon tipplers
- Dust Extraction system (Bag Filter based) for coal crusher house
- Dust suppression system at crusher feeding point – Duel Fluid Dust Suppression (DFDS)
- DFDS Dust suppression system (compressed air and water) for coal handling plant
- Dust Extraction system with Bag Filter in coke sorting plant

Raw Materials Handling (RMHS) Section

To control the fugitive dust emissions at the stock piles on the ground, conveyor transfer points, vibrating screens, etc which would be major source of fugitive dusts, both water sprinkling and dry fogging (DFDS) would be adopted for dust suppression. The DFDS system generates a layer of fine water droplets (fog) that a dust particle cannot pass through without colliding with water droplet. It does not use any chemicals as dust suppressant agent. DF requires only compressed air and water pressure for atomization through specially designed nozzles. DF is applicable for coal dusts, coke dust, ore dust etc which are non-reactive with water – if the material is not hot.

For lime dust abatement, conventional dust extraction (DE) would be adopted. The Dust Extraction system will comprise of pulse jet type bag filter, centrifugal fan with motor and other accessories, suction hood, duct work, stack, etc. will be provided. The pollution Control Facility at RHMS can be summarized as:

- Stock Pile & Wagon Tripler – Plain water spray
- Rest all transfer point – DFDS
- All crusher House – Bag Filter based Dust Extraction.
- DE system with bagfilters in case of crusher house of lime/dolo handling plant.

Sinter Plant

There will be plant de-dusting system for different material transfer points in Sinter Plant Stock House and sinter screening and transport (to maintain proper work-zone condition). The ESP system will comprise of fan, ESP, suction hood, ducts and stacks.

Pellet Plant

There will be dust suppression system for raw material preparation, handling and different material transfer points in Pellet Plant.

DR Plant

The crushing and screening operation for raw material preparation will be carried out in enclosed area. Centralized de- dusting facility (collection hood and suction arrangements followed by suitable de-dusting units with bag filter or ESP and the emissions will be finally discharged through stack.

Water sprinkling arrangement will be provided at raw material heaps and on land around the crushing and screening units.

Belt conveyors and transfer points of belt conveyors will be provided with enclosures to control fugitive dust emission. Water sprays/ sprinklers will be provided at strategic locations for dust suppression during raw material transfer.

BF : Stock House and Cast House De-dusting System

The DE system based on fabric filter / electrostatic precipitator (ESP) would be provided for room air cleaning such as BF Stock House and BF Cast House fume extraction.

The fans will suck the air from the hoods of the working cast house and there will be no suction from hoods of the standby cast house except partial suction of air from tap hole. Pneumatic / Electrically operated dampers shall be provided in duct line to prevent idle suctions from non-working cast house. Variable inlet vane type pneumatic / electrically operated dampers are also to be provided at fan inlet.

Air laden with fumes of iron oxides will be cleaned in electrostatic precipitator before being discharged into atmosphere through stack with the help of centrifugal fans. The centrifugal fans are to be provided after ESP and before stack for sucking the air. The suction shall be taken from different points like tap hole, skimmer, slag runner, iron runner, tilting runners and from BF top charging conveyor discharge. Dust concentration of inlet air to ESP is 3-5 gm/ Nm3

Collected dust at ESP hoppers will be taken to storage hopper and from there dust will be disposed by truck. Clear height below storage hopper shall be 4.5 m to facilitate truck entry.

Dust concentration at stack outlet shall be less than 50 mg/Nm³. Work zone dust concentration shall not exceed 5mg/Nm³.

SMS

Material Handling Operations

The SMS would be one of the prime sources of fugitive dust emissions during material handling operations, charging / tapping / blowing, argon rinsing, steel pouring, de-slagging etc. Air pollution control system comprising of suction hood, duct and bag filters are provided in the SMS for bulk material charging system, mixer, desulphurization and LF.

Lime and Dolomite Plant

In Lime and Dolomite Plant - raw material bunker building, lime / dolo sizing plant, Dust extraction (plant de-dusting system) system will be provided. In lime / dolomite DE system will comprise of pulse jet type bag filter, centrifugal fan with motor and other accessories, suction hood, duct work, stack, etc.

4.5.3.2 Point Source Dust Emission Control

Wherever there is fuel gas fired combustion systems like coke oven batteries, BF stoves and reheating furnace of mills where cleaned fuel gases are used as fuel, no dust emission control devices are proposed.

Process Dust Emission Control

In case of BF, BOF top gas having calorific value and contains large amount of dust. To clean the gas wet scrubbing / ESP will be installed for cleaning fuel gases. However, as per process requirement at regular intervals fuel gases will be burnt in the flare stacks. All efforts will be made to utilize the fuel gases.

In case of Sinter plant and lime / dolo kilns, the waste gases contain large amount of dust and will require ESP/bag filter to arrest the particulates and emit the clean flues to the atmosphere. The ESP/Bag filters will be designed to limit the emissions to less than 50 mg/NM^3. However, in order to meet the statutory ground level concentration limits for

SO_2, NOx and other gaseous pollutants, suitable stack heights will be provided for proper dispersion. All stacks will be provided with port-hole and working platform so that stack monitoring can be done as per norms of statutory authority.

All bag filters shall have bags with non-adhesive coating to avoid blinding of bags and no air infiltration into bag house including ducting shall be ensured. However, the suitability of non-adhesive coating for specific application will be examined during detailed engineering. Pug mills shall be provided below dust silos to prevent secondary pollution / fugitive emission during unloading of dust. The collected dust from bag filters shall be transported to near by material handling system. In case this is not feasible, the same will be transported by trucks to consumer points such as sinter plant or the plant dump.

Sinter Plant

A centralized de-dusting system with dry type electrostatic precipitator (ESP) will be provided for raw material preparation and handling and sinter screening and transport area. ESP system will comprise of multiple fields, unit multiple cells, ESP and its accessories such as dust disposal system, electrics and control, instrumentation, interlock, supports etc.

Pellet Plant

- Mixed material drying unit (rotary kiln): Multicyclone-scrubber based de-dusting facility.
- Induration unit : ESP based De-dusting facility

DR Plant

- Off gas system including waste heat power generation (DR Kiln Feed end): Bag Filter/ESP based DE system.
- DR Kiln Product discharge end: Bag Filter/ESP based DE system.
- Raw Material Handling, Coal Crusher, Cooler Discharge and Product house unit: DE system : ESP based

Blast Furnace

A number of measures have been considered to control the emission from the blast furnaces:

Coal Dust Injection (CDI)

Coal dust Injection (CDI) in BF has been planned at the rate of about 150 Kg/t hot metal. The CDI has an economic as well as an environmental advantage. Direct injection of coal as reducing agent facilitates replacing part of the required coke. It is considered that for every Kg of coal dust injected approximately 0.8 Kg of coke requirement is reduced. Thus a considerable amount of coke production can be avoided. It is estimated the saving in coke requirement vis-a –vis coke production will be around 1138 t/day, based on total hot metal production of 9489t/day. Thus indirectly the CDI system will reduce the air emissions considerably.

Coal dust injection system will be introduced involving handling, screening and drying and pulverisation system for coal. During this handling and drying, dust will be generated. To control this dust, dust extraction system comprising of bag filter (pulse jet type), fan, suction hood, duct and stack have been envisaged.

Gas Cleaning System

A gas cleaning plant comprising of dust catcher, scrubber and wet ESP will be installed.

BOF – Convertors / LF

BOF Gas Cleaning System

The dust cleaning (of primary gases) system will be of venturi scrubber type.

Secondary Refining

During secondary refining process, the gases generated during mixing and de-sulphurisation process will be contaminated with dust. A centralised secondary dust and fume extraction system for Converters and LFs will comprise of Bag Filter suction hood, ducts and stacks.

Lime and Dolomite Plant

In Lime and Dolomite Plant, the waste gas cleaning will be conducted through dust extraction system comprising of pulse jet type bag filter, centrifugal fan with motor and other accessories, suction hood, duct work, stack etc.

4.5.3.3 Gaseous Emission Control

SO_2 Emission Control

The main sources of sulphur dioxides from the steel plant operations are the metallurgical coal used in the coke ovens. In consideration to this, it is proposed to use low sulphur blended coal (S < 0.5 w/w). A major portion of sulphur present in coal or coke would be fixed in BF and BOF slag. The balance sulphur in the form of H_2S is present in coke oven gas would be partly removed in the by products plant to 3 - 4gm/N cu m of H_2S. For power generation it is envisaged to use relatively sulphur free fuel gases hence no significant emissions from power plants are envisaged. The other source of sulphur dioxide emissions is from the sinter plant, where the sulphur present in coke is reflected as sulphur dioxide in the waste gases. The emissions can be reduced by using metallurgical coal with low sulphur (<0.5%) and also be incorporating waste heat recovery systems.

NO_X Emission Control

The source of NO_X is fixed nitrogen in coal. During coking, nitrogen is converted to ammonia and is present in coke oven gas. The ammonia is removed in the byproducts plant so that the generation of NO_X is reduced in furnaces where C.O Gas is used as fuel.

Other than this NO_X, there would be thermal NO_X during combustion of fuels. It is therefore proposed to have combustion control devices by adopting waste gas recirculation and introducing secondary air in the combustion process. For this using low NOx burners so as to minimize the formation of NO_X will be installed to limit combustion temperature in different units as feasible.

Carbon Monoxide Emission Control

The source of carbon monoxide generation is from the waste gases form the combustion operations. The control of air/fuel will be adjusted in such a way that formation of carbon monoxide is minimised in presence of excess oxygen in the flues.

4.5.3.4 Summary of Proposed Air Pollution Control (APC) Measures

In line with the above stated proposals for air pollution prevention and control of the emissions from proposed production facilities**,** a summarized list of required APC measures is presented in **Table 4.18**. Air pollution control measures envisaged above will be designed suitably so as to meet the air emission norms. The table indicates design target and control measures at respective sources.

Table 5.3: Emission Norms for Air Pollution Control (APC) Measures

S N.	Production Unit/ Facilities	Proposed Emission Control Devices		Design Target
		Non-Point Sources	Point Sources	
1.	Coal Handling / Coke Sorting Plant	- Dust suppression: water sprinkler & DFDS - DE system bag filter based: Coal crusher house / Coke sorting plant.	-	Dust outlet: $\leq$ 50 mg/N m^3 Work zone Dust level: < 5 mg/ m^3
2.	Raw Materials Handling Section	- Covered conveyor - Dry Fogging - Water sprinkling - Bag filter - DE system	DE Stacks	Dust outlet: $\leq$ 50 mg/N m^3 Work zone Dust level: < 5 mg/ m^3
3.	Coke Oven Battery	- On-main charging by HPLA - Coke side dust extraction		<u>Fugitive Emissions:</u> 5% PLD 1% PLL 4% PLO <u>BaP:</u> Work Zone (Battery Top) : $\leq$ 5 ug/m^3 Other Units in Coke Ovens

S N.	Production Unit/ Facilities	Proposed Emission Control Devices		Design Target
		Non-Point Sources	Point Sources	
			Combustion Stack	: ≤ 2 ug/m³ <u>Stack emissions:</u> SPM ≤ 50 mg/ m^3 SO_2 ≤ 800 mg/ m^3 NOx ≤ 500 mg/ m^3
4.	Sinter Plant	- Raw feed proportioning building, Sinter Cooler, Air Cleaning by DE System comprising of ESP	- Waste flue gas cleaning by ESP - Sinter Process De-dusting by ESP - Sinter process: low NOx burners	Dust outlet: ≤ 50 mg/N m^3 Work zone Dust level: < 5 mg/ m^3
5.	Pellet Plant	- Dust suppression system for Raw Material preparation & Handling.	- Multicyclone-scrubber based de-dusting for drying unit rotary kiln. - ESP for Induration unit.	Dust outlet: ≤ 50 mg/N m^3 Work zone Dust level: < 5 mg/ m^3
6.	DR Plant	- Raw material preparation & Handling centralized de- dusting facility bag filter/ ESP	- DR Kiln Feed end ESP. - DR Kiln Product discharge end Bag Filter/ESP	Dust outlet: ≤ 50 mg/N m^3 Work zone Dust level: < 5 mg/ m^3
7.	Blast Furnaces	- BF Stock House by DE system - BF Cast House by DE system: ESP	- BF Stove Stack - BF Stove : low NOx burners	Dust outlet ≤ 50 mg/N m^3 Work zone Dust level: < 5 mg/ m^3
8.	Steel Melting Shop	SMS Material Handling - DE system by Bag filter	- Centralised secondary fume extraction system for converters / LFs with Bag filter.	Dust outlet ≤ 50 mg/N m^3 Work zone Dust level: < 5 mg/ m^3
9.	Lime & Dolo Plant	- Lime Plant Raw Material Bunker Building - De-dusting by Bag Filter. - Lime sizing plant – De-dusting by Bag Filter.	Waste flue gas through Bag filter (fabric)	Dust outlet ≤ 50 mg/N m^3 Work zone Dust level: < 5 mg/ m^3
10	Bar & Rod Mill Reheating Furnace	-	Low NOx burners	Dust outlet ≤ 50 mg/N m^3
11	Power Plant	-	- Low NOx burners - ESP	Dust outlet ≤ 50 mg/N m^3 Work zone Dust level: < 5 mg/ m^3

4.5.4 WATER: MITIGATION MEASURES

Treatment of waste water generated from the proposed Integrated Steel Plant will be done as given in following sections. Further, several waste water recycling measures will be adopted as briefed in following sections to minimise fresh water intake.

Treatment of Coke Oven Effluent Stream

This would be the only toxic effluent stream, which requires physico-chemical as well as biological treatment. Raw coke oven effluent would be first stripped off in ammonia still by alkali addition in a stripping column. The effluent after bringing down the ammonia load below 100 mg/l would be stored in balancing reservoir. From the balancing tank, the effluent would require separation of floating and emulsified oil. Thereafter three-stage aeration with addition of nutrients and maintaining desired bacteriological population followed by clarification for removal of phenol and ammonia in waste. The treated effluent would be pumped to the settling pond for reuse within the plant in Coke quenching and greenbelt.

Gas Cleaning Plant Waste Water

The BF and BOF gas cleaning scheme would be of the conventional venturi type which have become the bench mark for similar application. The effluent coming out of the wet scrubber would be contaminated with high concentration of suspended solids. The slurry effluent would be clarified in the clarifier to recover clarified water for recycling to the wet gas scrubber after cooling in the cooling tower. The contaminated water coming from gas cleaning plant is collected in the flash mixer. Coagulants are added in the flash mixing tank and then water is supplied into thickeners (high rate type) for further treatment. The clean overflow water is collected in clean water sump and pumped back to gas cleaning plant. The settled sludge in the thickeners is pumped to sludge storage tanks and vacuum filter unit for drying and the cakes are disposed suitably.

Treatment of Caster Effluent and Mill Effluents

The wastewater is generated in the continuous casting units mainly due to machine / moulds cooling and may be contaminated with suspended solids and traces of oil. The effluent from the mill would be collected first in scale pit which is a large settling basin to separate out the floating oil and settable iron scales. The clean water is passed through sand filters to remove finer particles, after which the water is recycled in the process. The back wash from the filters is sent to the settling tank for removal of particulates. The settled sludge is sent to sinter plant for agglomeration. Quality of this discharged water will be continuously checked and as required will be treated to meet statutory norms.

Treatment of Plant Sanitary Wastewater

The sanitary wastewater would be treated in sewage treatment plant and the treated Septic Tanks and Soak Pits.

Treatment of Waste Water from Indirect Cooling Circuit Streams

In the proposed project the waste water generated from indirect cooling circuits of sinter plant, blast furnace, BOF and rolling mill are not normally contaminated with any major pollutants. However occasional discharges are made as bleed off when there is built up of dissolved solids in the circulating water due to repeated circulation. The dissolved solids are mainly different salt constituents of calcium and magnesium already present in water. Thus major portion of water will be re-circulated after necessary physical treatment e.g settling, cooling etc.

Cooling Tower Blow Downs from Direct Cooling Circuit Streams

It is noted that the re-circulating water in cooling towers gets contaminated with the dust & dissolved solids, necessitating blow down. It is proposed that all cooling towers be provided with side stream pressure filters to reduce the volume of blow down. The cooling towers shall be designed to operate at high cycles of concentrations to conserve water.

Summary of Proposed Wastewater Treatment Scheme

In view of the above stated proposals for wastewater treatment and disposal for various production facilities, a summarized list of the same is presented in below:

SN	Production Unit/ Facilities	Outlet Effluent Characteristics mg/l
1.	Coke Ovens By-Products Recovery Plant	pH 6.0 – 8.5 Suspended Solids <100 Phenol < 1.0 CN^- < 0.2 N_2 < 50 BOD, 3 days at 27^{o}C < 30 COD < 250 Oil & Grease < 10
2.	BF-Gas Cleaning Plant	TSS$\leq$ 100
3.	BOF-Gas Cleaning Plant	TSS$\leq$ 100
4.	Other Plants, such as Sinter Plant, BF & SMS	pH 6.0 – 9.0 Suspended Solids < 100 Oil & Grease < 10
5.	Plant Sanitary Effluent Treatment Plant	B.O.D$\leq$ 20 Coli-form $\leq$ 500 MPN/100 ml

Reuse of Waste Water

Some of the measures taken to reuse the wastewater generated in the plant will be:

- The wastewater generated from BF gas cleaning plant after physical treatment will be reused in the system.
- Cooling Tower blow downs of indirect cooling water system shall be used for slag quenching and as make up to direct contaminated cooling water circuits and surplus

if any would be stored in the treated wastewater lagoon for in-plant use (eg. Green belt, floor washing, plant road dust suppression etc).

- Blown down water from Blast Furnace re-circulation system will be reused in Slag Granulation Plant as make-up water to SGP re-circulation water system.
- Blow down water from BOF re-circulation system will be reused in SMS slag yard for spraying on hot slag.
- Blow down water from power plant will be reused for Pig Casting Machines.

Through cascaded reuse of blow-down, the water scheme ensures practically zero-discharge from the industrial water circuit. However, in such huge operation of ISP some water will be discharged, which will meet the statutory norm.

4.6 RAIN WATER HARVESTING

While developing the Plant General Layout for plant commissioning, it will be ensured that rain water is harvested from building rooftops. Run-off water from the office areas & shop roofs will be collected and stored for future use. Proper functioning of the systems provided will be ensured by regular monitoring.

4.7 ENERGY CONSERVATION MEASURES

Energy conservation measures will be implemented so as to bring energy saving and also possible CDM benefits. This will include providing VVVF drives for higher capacity motors, CFL lamps etc.

4.8 SOLID WASTE: MITIGATION MEASURES

Different types of solid wastes are generated from Integrated Steel Plant. The source of solid waste generation along with their re-use, re-cycle, utilization and disposal methodology are presented below:

Solid Waste Generation their Re-Use, Re-Cycle, Utilization and Disposal

SN	Type of Solid Waste	Re-utilisation			Dumped for Future Use
		Recycle	Re-use		
			Within Plant	Sold	
1	DRI Char	Used in AFBC Boilers in PP.		Sold for making coal briquettes to be used as fuel & to Brick Kilns for making briquettes with coal fines for use in Brick Kilns @ Rs 200/t	
2	BF slag		-	Sold to Cement manufacturers / glass manufactures	

S N	Type of Solid Waste	Re-utilisation			Dumped for Future Use
		Recycle	Re-use		
			Within Plant	Sold	
3	BOF Slag		- Granulated and partly used in plant - Balance will be crushed &used for making roads, civil works, etc.	- Will be sold to parties for building roads (aggregate for road making, Rail Track ballast, land filling, after conditioning as it contains lime which if used before conditioning then it swells), civil engineering works, etc. - Soil conditioner as it contains P2O5, especially at places where PH is acidic as in heavily leached soils of Ranchi region.. - Used in sinter @of 3% only due to high P2O5.	
4	BOF Scales & Scrap	Reued in sinter plant as sinter mix.	-	-	
5	Mill Scrap	Used in BF	-	-	
6	Fly ash		-	Sold to Cement manufacturers	
7	Bottom Ash		-	-	Ash Dump
8	Waste Refractory		- Used in Plant for making refractory mortars in captive mortar shops - Making / repairing plant roads	Sold as material for making road embankment or for filling low lying areas	
9	Lime/dolomite Fines		Re-used in Sinter Plant		
10	Mill scale		- Reused in Sinter Plant (Oil content from 1 - 3%). - Reused as a reductant input material in BF (Oil content up to 15%)		
11	DRI Flue Dust	Reused in sinter plant as sinter mix.	Used in Sinter Plant		

S N	Type of Solid Waste	Re-utilisation			Dumped for Future Use
		Recycle	Re-use		
			Within Plant	Sold	
12	DRI De-dusting Dust	Reused in sinter plant as sinter mix. Unused quantity sold to parties for brick making & Land filling.	Used in Sinter Plant		
13	BF Flue Dust	Reused in sinter plant as sinter mix.	Used in pellet plant	-	
14	BF GCP Sludge	- Reued in sinter plant as sinter mix after pelitisation	Used in Sinter Plant after pelletisation	-	
15	BOF Sludge	Reued in sinter plant & BF	Used in Sinter Plant	-	
16	Sinter ESP Dust	Recycled in Sinter plant	-	-	-

- Recycle of waste means utilization of waste in the same process from which it has been generated
- R-use of waste means utilization of the waste in any process other than the process from which the waste has been generated. The process utilizing the waste may be within the plant or out side the plant. In case of utilization outside plant, the waste is sold to firm utilizing the waste
- Disposal means dumping of waste in designated areas.

The following shop wise specific management measures will be adopted for solid waste:

Sinter Plants

- 100% recycling of LD sludge, Mill scale, Lime and Dolomite dust, SP sludge, and ESP dust.
- 100% recycling of return sinter fines
- Complete utilization of 10 mm LD slag
- BF Flue dust utilization in Sinter Plant.

DR Plant

- DRI Process Dust 100% used - Reused in sinter plant as sinter mix. Unused quantity sold to parties for brick making, Land filling and to Oil refineries as replacement of activated carbon.
- DRI De-dusting Dust 100% used - Reused in sinter plant as sinter mix. Unused quantity sold to parties for brick making & Land filling.

Blast Furnaces

- 100% Cast House slag granulation for sale to Cement Plants Recycling of LD slag (10-40 mm size) for its lime content
- Recovery of iron scraps at BF slag dump.

- Use of cast-able material in Cast House runners, in place of ramming mass, which will reduce scrap generation by 1%.
- Recycling of BF flue dust in sinter plant and sold.
- Recycling of used refractory.

Steel Melting Shops

- Recycling of LD sludge will be explored.
- LD slag – after granulation partly used in Sinter Plants, Blast Furnaces and Steel Melting shop for conserving limestone & dolomite. Balance used for making roads, civil works etc

Refractory Material Plant

- Under size limestone, dolomite & lime fines recycled 100% to Sinter Plant.
- Utilisation of refractory grog made from used refractory bricks for mortar manufacturing of different grades (25% raw material input is from grog)
- Ladle covering compound in SMS using LD Slag
- Waste Mg-C bricks for production of new bricks for converter bottom, coating and patching materials for converter vessels
- Reduction of refractory consumption

Rolling Mills

- 100% recycling of mill scales.

Coal Based Power Plant

- 100% Used in Fly-ash Brick making plant and Sold to Cement Plants.

4.9 Green Belt Development: Mitigation Measures

Green belt, is an important sink for air pollutants, it also absorbs noise. Enhancing green cover not only mitigates pollutants but also improves the ecological conditions / aesthetics and reduces the adversities of extreme weather conditions. Trees also have major long-term impacts on soil quality and the ground water table. By using suitable plant species, green belts can be developed in strategic zones to provide protection from emitted pollutants and noise.

Plant species suitable for green belts should not only be able to flourish in the area but must also have rapid growth rate, evergreen habit, large crown volume and small / pendulous leaves with smooth surfaces. All these traits are difficult to get in a single species. Therefore a combination of these is sought while selecting trees for green belt.

The green belt should be planted close to the source or to the area to be protected to optimize the attenuation within physical limitations.

The green belt / cover will serve the following purposes:

- Compensate the damage to vegetation due to setting up and operation of the proposed plant expansion.

- Prevent the spread of fugitive dust generated due to project and allied activities.
- Attenuate noise generated by the project.
- Reduce soil erosion
- Help stabilise the slope of project site.
- Increases green cover and improve aesthetics.
- Attract animals to re-colonise the area.

Selection of Species

The species for plantation have been selected on the basis of soil quality, place of plantation, chances of survival, commercial value (timber value, ornamental value, etc.), etc. It is to be noted that only indigenous species will be planted. Exotic species like Eucalyptus and Australian acacia will not be planted. The species for green belt / vegetation cover development will be selected in consultation with State Forest Department and State Soil Conservation Department. Mixed plantations will be done keeping optimum spacing between the saplings. However, the species suitable for planting in the area as recommended by Central Pollution Control Board in their publication "Guidelines for Developing Greenbelts" (PROBES/75/1999-2000) are given under various heads here under.

Plantation Scheme

Plant saplings will be planted in pits at about 2.0 m to 3.0 intervals so that the tree density is about 1600 trees per ha. The pits will be filled with a mixture of good quality soil and organic manure (cow dung, agricultural waste, kitchen waste) and insecticide. The saplings / trees will be watered using the effluent from the sewage treatment plant and treated discharges from project. They will be manured using sludge from the sewage treatment plant. In addition kitchen waste from plant canteen can be used as manure either after composting or by directly burying the manure at the base of the plants. Since, tests have shown that availability of phosphorus, a limiting nutrient, is low, phosphoric fertilisers will also be added. The saplings will be planted just after the commencement of the monsoons to ensure maximum survival. The species selected for plantation will be locally growing varieties with fast growth rate and ability to flourish even in poor quality soils.

A total of about **33%** of the project area will be developed as green belt or green cover in project area (including water bodies), township and other areas. The widths of the belt around the plant will be erected all around the project boundary, depending on the availability of space.

Vegetation/ Plantations

In JSW already extensive plantation programme has been carried out since its inception and a good green cover within the plant premises and the town ship already exists. Total existing green belt cover is about **1264 acres (511.5ha)** and it has been further planned to develop green belt / green cover in additional **680 acres (275.3 ha)** of land. The existing and planned greenbelt / green cover will cover most of the possible areas within the plant boundary and in the township. The existing and proposed Green belt / cover development is shown in **Fig. 4.1**.

A very elaborate green belt development plan has been drawn for the proposed plant expansion. The areas, which need special attention regarding green belt development in the industrial area, are:

1. Steel Plant Area - Around Various Shops
2. Areas Around Waste Dumps and Plant Boundary
3. Vacant Areas in Plant
4. Around Office Buildings, Garage, Stores etc. and Along Road Sides
5. Township

1. Steel Plant Area

Winds in the study area are mainly from NW, SE, W and E. During winter season South Easterlies and Easterlies are predominant, during winter season. South Easterly component is predominant till summer and during monsoon season the predominant winds are from West and NW. The predominant winds except monsoon (when scavenging of pollutants are more in the atmosphere), are from SE and E, which may carry the pollutants from the plant to the nearby population settlements.

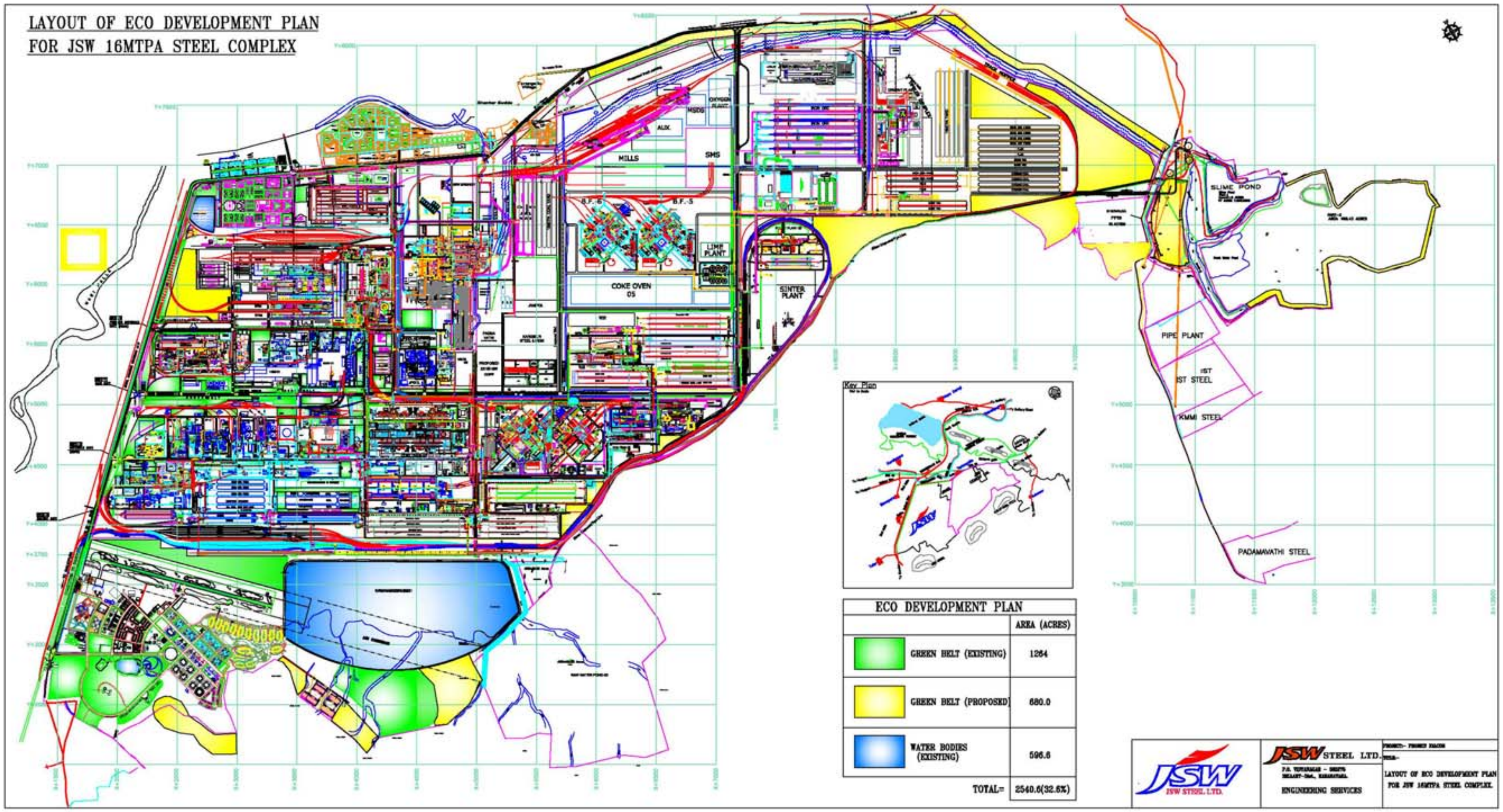


Fig. 4.1: Existing Green Belt / Cover and Proposed Green Belt / Cover Development Plan

Inside the steel plant works area, the region with high pollution load are areas around Raw Material Yards, Coal Handling Yards, Lime / Dolo Calcination Plant, Blast Furnace, Sinter Plant, Pellet Plant, Coke Ovens, Steel Melting Shop etc.

To arrest the fugitive emissions emitted from such polluting units, a two pronged approach will be adopted as described below and as shown in **Fig. 4.2**.

- Plantation all around the concerned units close to the source in available spaces to arrest fugitive emissions at the source.
- Plantation on NW and W of the concerned units: By taking the concerned unit as centre and planting trees in a “V” in NW and W direction [i.e down wind (D/W) of predominant wind SE and E] at staggered distances in available spaces to arrest fugitive emissions which have not been arrested by the green belt at the source.

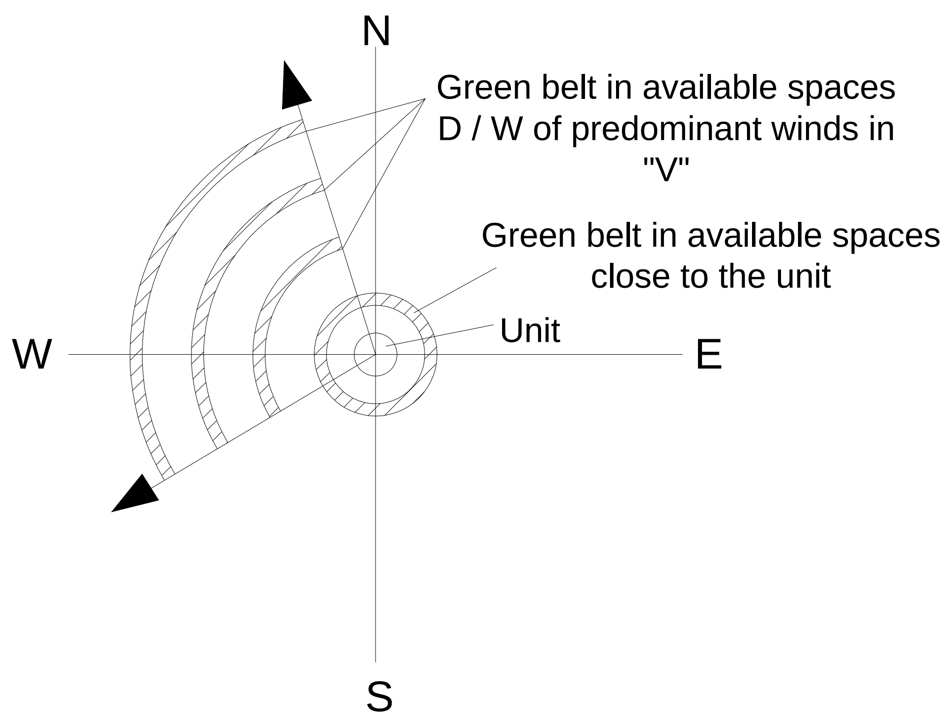


Fig. 4.2: Schematic Diagram of Greenbelt Development in and around Polluting Units.

As there will be limited space (in height) due to various over head pipelines, thus small and medium sized species are suggested and they should be planted depending on the vertical height and lateral space available for the plant growth. The above-mentioned areas / direction should be covered with pollution tolerant species (in the space available around) as mentioned below:

Scientific Name	Common Name
Acacia mangium	Mangium
Acacia nilotica	Babool
Annona squamosa	Sharifa
Bougainvillea spp.	Bougainvellea
Cassia auriculata	Cassia
Duranta sp.	Duranta
Ficus religiosa	Peepal
Murraya exotica	Kamayani
Nerium sp	Pink Kaner
Pithecolobium dulce	Sweet Tamarind
Pongamia pinnata	Karanj
Saraca indica	Ashok
Thevieta peruviana	Yellow Kaneer
Zizyphus mauritiana	Indian jujube

The sensitive varieties like Gulmohar, Amaltas, Kachnar, Kadamb should not be planted in the works area. The plants in the steel plant works area should be periodically washed with water spray, especially during dry and dusty seasons.

2. Areas Around Waste Dumps and along Plant Boundary

Green belt is to be developed in the vacant spaces around waste dump areas and along the plant boundary. The proposed plant expansion should be in three concentric orbits:

(i) Curtain belt on the outermost boundary comprising tall trees with conical canopy.
(i) Middle belt of large size trees with globose and spreading canopy and
(i) Inner belt with medium size trees with spreading or trailing canopy. The desired minimum thickness of these belts should be as follows:

Location	Width (m)
Outer belt (pollution attenuation)	30
Middle belt (pollution attenuation)	50
Inner belt (pollution attenuation and training of winds to middle & outer belt)	20

However, the above-mentioned thickness of each belt may be proportionately reduced or increased in view of the total space available for plantation work. The list of plants to be used in each belt is given in the following paragraphs.

In the curtain belt the following species of trees be planted keeping a space of 2.5m from plant to plant as well as from row to row:

Scientific Name	Common Name
Acacia mangium	Mangium
Albizzia lebbek	Siris
Artocarpus heterophyllus	Kathal
Azadirachta indica	Neem
Butea spp.	Palas
Dalbergia sissoo	Shisham
Leucaena leucocephala	Subabool
Pithecolobium dulce	Junglee jilebi
Polyalthia longifolia	Druping Ashok
Pongamia pinnata	Karanj
Syzygium cuminii	Jamun
Tectona grandis	Teak

In the middle belt - the following species of trees to be planted 3 m apart, from tree to tree as well as from row to row:

Scientific Name	Common Name
Anthocephalus cadamba	Kadamb
Azadirachta indica	Neem
Cassia siamea	Cassia
Ficus bengalensis	Bargad
Ficus religiosa	Peepal
Lagerstroemia parviflora	Lagerstroemia
Pongamia pinnata	Karanj
Tamarindus indica	Imli

In the inner belt - the following species of trees and shrubs to be planted 2.0 m apart from tree to tree as well as from row to row:

Scientific Name	Common Name
Acacia arabica	Babool
Acacia mangium	Mangium
Bougainvillia spectabilis	Baganvileas
Murriya exocitica	Kamayani
Nerium sp	Kaneer
Sarca indica	Ashok
Zizyphus spp	Ber

3. Vacant Areas in Plant

Plantation in vacant areas will be selected from among the following species. Plantation will be done in staggered trench manner 3.0 apart.

Scientific Name	Common Name
Artocarpus heterophyllus	Kathal
Azadirachta indica	Neem
Ficus bengalensis	Bargad
Ficus religiosa	Peepal
Lagerstroemia parviflora	Lagerstroemia
Mangifera indica	Mango
Pongamia pinnata	Karanj
Syzygium cuminii	Jamun
Tectona grandis	Teak

Plantation around Office Buildings, Stores, Garage etc.

The species recommended for plantation around various buildings will include:

Scientific Name	Common Name
Anthocephalus cadamba	Kadamb
Azadirachta indica	Neem
Bougainvillea spp.	Bougainvellea
Cassia auriculata	Cassia
Cassia fistula	Amaltas
Cassia javanica	Java-ki-rani
Cassia siamea	Kassod Tree
Dalbergia latifolia	Sisham
Delonix regia	Gul mohar
Duranta sp.	Duranta
Ficus bengalensis	Bargad
Ficus religiosa`	Peepal
Lagerstroemia parviflora	Lagerstroemia
Mangifera indica	Mango
Nerium sp	Pink Kaner
Polyalthia longifolia	Ashok
Thevieta peruviana	Yellow Kaneer

5.Avenue Plantation

Double rows of avenue trees on the outer side of the footpaths are recommended; an outer row of shade trees and an inner row of ornamental flowering trees will be planted.

(a) <u>Foliage Trees for Outer Avenue:</u>

Scientific Name	Common Name
Anthocephalus cadamba	Kadamb
Azadirachta indica	Neem
Dalbergia latifolia	Sisham

Scientific Name	Common Name
Mimusops elengi	Mimusops
Samanea saman	Rain Tree
Syzigium cumnii	Jamun
Tamarindus indica	Imli
Tectona grandis	Teak

(b) Flowering / Ornamental Trees for Inner Avenue:

Scientific Name	Common Name
Anthocephalus cadamba	Kadamb
Bougainvillea spp.	Bougainvellea
Cassia auriculata	Cassia
Cassia fistula	Amaltas
Cassia javanica	Java-ki-rani
Cassia siamea	Kassod Tree
Delonix regia	Gul mohar
Duranta sp.	Duranta
Lagerstroemia parviflora	Lagerstroemia
Nerium sp	Pink Kaner
Polyalthia longifolia	Ashok
Thevieta peruviana	Yellow Kaneer

Post Plantation Care

Immediately after planting the seedlings, watering will be done. The wastewater discharges from different outfalls will be used for watering the plants during non-monsoon period. Further watering will depend on the rainfall. In the dry seasons watering will be regularly done especially during February to June. Watering of younger saplings will be more frequent. Manuring will be done using organic manure (animal dung, agricultural waste, kitchen waste etc.). Younger saplings will be surrounded with tree guards. Diseased and dead plants will be uprooted and destroyed and replaced by fresh saplings. Growth / health and survival rate of saplings will be regularly monitored and remedial actions will be undertaken as required.

Phase Wise Green Belt / Cover Development Plan

Green belt will be developed in a phase wise manner right from the construction phase of the proposed project. In the first phase along with the start of the construction activity the plant boundary, the township boundary, around the proposed waste dumps, and the major roads will be planted. In the second phase the office building area will be planted. In the third phase when all the construction activity is complete plantation will be taken up in the plant area, in stretch of open land, along other roads and in the township.

Annexure

CONC OF RSPM IN MICROGRAMS/M³

Y-COORD (METERS)	X-COORD (METERS)				
	250	750	1250	1750	2250
19750	2.70809	2.84594	3.042	3.25697	3.36716
19250	2.60267	2.71216	2.86209	3.05568	3.2718
18750	2.67345	2.69351	2.7205	2.89099	3.087
18250	3.29127	2.77545	2.80164	2.8024	2.935
17750	3.94496	3.5115	2.97367	2.91793	2.9237
17250	4.34614	4.11671	3.73071	3.21125	3.04331
16750	4.50431	4.42795	4.25741	3.93585	3.45084
16250	4.51826	4.55283	4.50019	4.36622	4.11292
15750	4.36573	4.53	4.60032	4.57456	4.4643
15250	4.09961	4.35556	4.54934	4.65134	4.65528
14750	3.85399	4.12127	4.38829	4.60108	4.72306
14250	3.88818	3.93517	4.1911	4.47345	4.71698
13750	3.91831	4.04192	4.135	4.32234	4.61238
13250	4.0268	4.11094	4.21158	4.34639	4.54327
12750	4.13718	4.25602	4.37905	4.51035	4.66165
12250	4.08679	4.24313	4.40856	4.585	4.77243
11750	3.84392	4.02858	4.22585	4.43766	4.66772
11250	3.46069	3.62515	3.83076	4.05688	4.30598
10750	3.54921	3.66114	3.78379	3.91914	4.06959
10250	3.7377	3.85851	3.98644	4.12201	4.26582
9750	4.00975	4.14932	4.29805	4.4568	4.62656
9250	4.25385	4.4089	4.57463	4.75212	4.94255
8750	4.45995	4.62573	4.80286	4.9924	5.19553
8250	4.61948	4.79002	4.97153	5.1648	5.37067
7750	4.72586	4.89446	5.07246	5.26018	5.45783
7250	4.77478	4.93448	5.10096	5.27388	5.4526
6750	4.76462	4.90883	5.05633	5.20606	5.3565
6250	4.6964	4.81941	4.94173	5.0616	5.17671
5750	4.57378	4.67116	4.76376	4.84929	4.92497
5250	4.40232	4.47122	4.53163	4.58098	4.61628
4750	4.18935	4.22887	4.25686	4.27072	4.26763
4250	3.94396	3.95483	3.95201	3.93321	4.04426
3750	3.67547	3.65988	3.78503	3.92171	4.04316
3250	3.55261	3.67929	3.79533	3.89566	3.97416

2750	3.56976	3.66833	3.75116	3.81286	3.84732
2250	3.54299	3.6113	3.65935	3.6818	3.67305
1750	3.47707	3.51397	3.52689	3.51097	3.46146
1250	3.37673	3.38201	3.36065	3.30857	3.22225
750	3.24656	3.22102	3.16735	3.08261	2.96471
250	3.09115	3.0366	2.95377	2.84098	2.69763

Y-COORD (METERS)	X-COORD (METERS)				
	2750	3250	3750	4250	4750
19750	3.28692	3.56282	3.90151	4.18221	4.33922
19250	3.38935	3.38008	3.76194	4.10972	4.36699
18750	3.3015	3.41658	3.57461	3.97771	4.32404
18250	3.13596	3.34902	3.45383	3.78903	4.2085
17750	2.99407	3.20506	3.41796	3.55414	4.02396
17250	3.05514	3.07262	3.29518	3.50944	3.78238
16750	3.17885	3.19804	3.17851	3.40994	3.62484
16250	3.68555	3.3257	3.35396	3.33847	3.55569
15750	4.26453	3.90541	3.48519	3.5248	3.51464
15250	4.56776	4.40269	4.10966	3.6592	3.71298
14750	4.74961	4.68358	4.54473	4.30802	3.88693
14250	4.85531	4.88135	4.82527	4.70342	4.51172
13750	4.90044	5.08878	5.1114	5.02302	4.89976
13250	4.82096	5.14582	5.41712	5.50114	5.37014
12750	4.85465	5.12086	5.46695	5.8223	6.03435
12250	4.97406	5.20369	5.48824	5.86089	6.30141
11750	4.91954	5.19358	5.49255	5.8342	6.25676
11250	4.58087	4.88628	5.22815	5.60927	6.03371
10750	4.238	4.42781	4.64289	5.02981	5.47733
10250	4.41855	4.58089	4.81158	5.11353	5.45297
9750	4.80844	5.00373	5.30702	5.67445	6.09077
9250	5.14732	5.36807	5.60674	5.86578	6.14849
8750	5.41358	5.64807	5.90074	6.17371	6.46973
8250	5.59	5.82367	6.07253	6.33747	6.61943
7750	5.66546	5.88283	6.10938	6.34411	6.58549
7250	5.63613	5.8229	6.01078	6.19678	6.37698
6750	5.50557	5.65053	5.78784	5.91302	6.02063
6250	5.28416	5.38036	5.46092	5.52073	5.55403
5750	4.9874	5.03264	5.05622	5.05325	5.08978
5250	4.63411	4.63073	4.6022	4.67565	4.84845

4750	4.24455	4.33684	4.49521	4.62377	4.71078
4250	4.19129	4.31681	4.41181	4.46613	4.46913
3750	4.14255	4.21197	4.24265	4.22556	4.15215
3250	4.02391	4.03736	4.00681	3.92515	3.78658
2750	3.84805	3.80851	3.72273	3.58597	3.39554
2250	3.62751	3.54017	3.40719	3.22648	2.99843
1750	3.37416	3.24591	3.07516	2.86247	2.611
1250	3.09914	2.93807	2.73972	2.50702	2.24541
750	2.81281	2.62765	2.41193	2.17044	1.97172
250	2.52451	2.32408	2.10059	1.88357	1.93109

Y-COORD (METERS)	X-COORD (METERS)				
	5250	5750	6250	6750	7250
19750	4.31432	4.07378	4.35831	4.63265	4.52114
19250	4.46164	4.337	3.98827	4.48937	4.48775
18750	4.53841	4.5469	4.30367	4.19977	4.43764
18250	4.53642	4.68465	4.57925	4.2058	4.29883
17750	4.44967	4.73643	4.78918	4.54331	4.04053
17250	4.2785	4.69262	4.91016	4.83154	4.42768
16750	4.036	4.54889	4.92495	5.03682	4.78884
16250	3.76961	4.31478	4.82499	5.12925	5.08729
15750	3.74042	4.00673	4.61699	5.09493	5.28188
15250	3.71004	3.96985	4.31608	4.93799	5.34347
14750	3.92209	3.92902	4.25346	4.66775	5.2693
14250	4.16695	4.15781	4.25095	4.60366	5.06512
13750	4.7436	4.46809	4.42973	4.6736	5.0448
13250	5.17694	5.0259	4.82175	4.75584	5.23398
12750	5.95698	5.66931	5.42576	5.25338	5.40589
12250	6.67867	6.77051	6.49833	6.13703	5.90513
11750	6.79228	7.37368	7.75897	7.69589	7.35241
11250	6.52756	7.14738	7.92376	8.71676	9.11375
10750	5.99178	6.57918	7.27251	8.13818	9.19097
10250	5.83663	6.27238	6.76596	7.40133	8.33343
9750	6.56402	7.10451	7.72369	8.42778	9.20194
9250	6.54688	7.07774	7.70802	8.47829	9.4612
8750	6.79255	7.14762	7.54348	7.99372	8.51999
8250	6.91961	7.23959	7.58158	7.94894	8.34451
7750	6.8313	7.07857	7.3231	7.55938	8.00341
7250	6.54637	6.69871	6.82659	7.13129	7.4248

6750	6.10429	6.17961	6.36993	6.52877	6.64589
6250	5.60164	5.71096	5.78374	5.8535	6.01924
5750	5.14459	5.28207	5.42347	5.49521	5.48486
5250	4.98079	5.05797	5.06577	4.99209	4.82679
4750	4.74371	4.71042	4.60053	4.40593	4.11952
4250	4.4106	4.28194	4.07691	3.79189	3.42576
3750	4.01539	3.81055	3.53593	3.1933	2.78889
3250	3.58756	3.32746	3.00925	2.64024	2.61781
2750	3.15143	2.85699	2.51948	2.45008	2.48561
2250	2.72634	2.417	2.30605	2.34526	2.33675
1750	2.32685	2.18055	2.22258	2.22328	2.18239
1250	2.07003	2.1143	2.12179	2.09464	2.02671
750	2.01777	2.03041	2.01381	1.96197	1.87558
250	1.94765	1.93901	1.90027	1.82975	1.73304

Y-COORD (METERS)	X-COORD (METERS)				
	7750	8250	8750	9250	9750
19750	4.3103	3.99749	3.482	2.91623	2.9689
19250	4.26452	3.92159	3.59247	2.97053	2.94667
18750	4.26284	3.86768	3.56142	3.10264	2.9451
18250	4.27009	3.89491	3.5208	3.20386	2.96517
17750	4.23242	3.98384	3.7532	3.369	3.00779
17250	4.11107	4.14134	3.9766	3.62608	3.1556
16750	4.22927	4.26521	4.18329	3.87948	3.4248
16250	4.64346	4.34397	4.36268	4.12076	3.69416
15750	5.03372	4.4078	4.50215	4.34062	3.95479
15250	5.3535	4.86122	4.58647	4.52687	4.19486
14750	5.54974	5.30733	4.59578	4.66441	4.39942
14250	5.59958	5.68162	5.12101	4.73408	4.5538
13750	5.50623	5.91609	5.69587	4.85461	4.64092
13250	5.61431	5.98623	6.2098	5.54696	5.13856
12750	5.98382	6.36625	6.51882	6.45134	5.86454
12250	6.41085	6.9892	7.39677	7.26224	7.12841
11750	7.09674	7.79635	8.31318	8.97043	8.72739
11250	9.09071	9.09431	9.6408	10.32127	11.49534
10750	10.08523	10.36748	11.4191	12.14015	13.3907
10250	9.55344	10.95633	11.7413	12.00703	11.69185
9750	9.96929	11.00073	13.3004	13.33418	12.95806
9250	10.79374	12.66261	14.8602	16.13531	14.0605

8750	9.15933	10.24851	11.7306	13.22254	14.15935
8250	9.00899	9.81459	10.6478	11.47811	12.52026
7750	8.49883	9.00269	9.53287	10.1817	11.17083
7250	7.69542	7.94049	8.1681	8.71791	9.72434
6750	6.71143	6.91911	7.19065	7.42314	7.27862
6250	6.11377	6.13614	6.05033	5.72144	4.98376
5750	5.38203	5.16411	4.77551	4.16236	4.40573
5250	4.5565	4.15838	3.62696	3.79725	3.79303
4750	3.73327	3.24542	3.37453	3.38802	3.23488
4250	2.98105	3.06155	3.08238	2.98767	2.76109
3750	2.81725	2.84339	2.78307	2.62379	2.43909
3250	2.64896	2.6117	2.49738	2.30614	2.33856
2750	2.46488	2.38242	2.23564	2.04912	2.24542
2250	2.27787	2.1643	2.00261	1.99176	2.15917
1750	2.09434	1.96364	1.79818	1.93583	2.07917
1250	1.92069	1.78242	1.73799	1.88149	2.00471
750	1.76	1.62056	1.70248	1.8288	1.93511
250	1.61323	1.54205	1.66637	1.77775	1.86978

Y-COORD (METERS)	X-COORD (METERS)				
	10250	10750	11250	11750	12250
19750	2.97289	3.00091	2.76413	2.49894	2.3396
19250	2.90749	2.94954	2.71854	2.46534	2.37542
18750	2.86484	2.90245	2.68165	2.43422	2.41002
18250	2.85202	2.86413	2.65605	2.45693	2.51478
17750	2.87403	2.84135	2.7112	2.52648	2.65933
17250	2.9338	2.86389	2.77034	2.59913	2.80568
16750	3.0319	2.93464	2.83538	2.67583	2.93679
16250	3.16938	3.0108	2.90877	2.75851	3.03317
15750	3.44668	3.09521	2.99278	2.85027	3.0767
15250	3.71552	3.24052	3.08987	2.95535	3.08039
14750	3.96052	3.46545	3.20389	3.11818	3.07472
14250	4.1634	3.74377	3.34285	3.23681	3.0776
13750	4.53559	4.08309	3.64758	3.46848	3.24752
13250	5.03843	4.49498	4.11628	3.99509	3.72988
12750	5.73037	4.98295	4.74132	4.74123	4.39875
12250	6.7534	5.53384	5.56831	5.79795	5.3153
11750	8.4799	6.52213	6.65123	7.31134	6.57863
11250	10.95781	8.83592	8.33194	9.46629	8.40724

10750	13.62262	10.2644	12.1638	12.47952	11.24922
10250	11.84511	12.55559	14.774	16.43247	14.13305
9750	13.5087	15.94657	20.0953	21.88067	18.67501
9250	16.6846	19.56396	21.1065	21.84119	16.79482
8750	13.86633	15.77196	18.8169	18.01611	17.42074
8250	14.75974	19.13155	13.5277	14.12269	14.6628
7750	13.76563	13.99117	12.5724	16.10056	13.51572
7250	9.96428	8.84149	8.79478	12.05548	14.38193
6750	6.37158	6.77907	6.55498	8.33423	9.88887
6250	5.33239	5.0928	5.35772	6.24467	7.26483
5750	4.34501	4.09551	4.54011	4.98864	5.72814
5250	3.53208	3.68363	3.96399	4.1734	4.74816
4750	3.03728	3.35258	3.53869	3.60446	4.07015
4250	2.84803	3.084	3.21258	3.21068	3.5746
3750	2.68199	2.86275	2.95438	2.94423	3.1991
3250	2.53621	2.67717	2.7437	2.72886	2.90589
2750	2.40779	2.51925	2.56796	2.5502	2.67004
2250	2.29365	2.38276	2.41847	2.39896	2.47533
1750	2.19134	2.26313	2.28908	2.26849	2.31076
1250	2.09883	2.15698	2.17546	2.15427	2.16899
750	2.01447	2.06176	2.07445	2.05299	2.045
250	1.93699	1.97552	1.98369	1.9622	1.93522

Y-COORD (METERS)	X-COORD (METERS)				
	12750	13250	13750	14250	14750
19750	2.70592	3.2065	3.50005	3.68131	3.84447
19250	2.80579	3.23925	3.48074	3.68143	3.84064
18750	2.9	3.25549	3.46534	3.69012	3.83442
18250	2.97999	3.25767	3.45969	3.70333	3.82888
17750	3.03802	3.25467	3.46462	3.72242	3.82336
17250	3.06977	3.25616	3.4789	3.75394	3.81192
16750	3.0794	3.26254	3.50583	3.8014	3.78616
16250	3.08585	3.27519	3.55698	3.85604	3.73151
15750	3.09844	3.30395	3.64996	3.90662	3.64065
15250	3.11804	3.36921	3.78383	3.94062	3.50556
14750	3.15807	3.50237	3.94123	3.94578	3.33102
14250	3.24785	3.71701	4.10384	3.90537	3.13536
13750	3.42459	3.99931	4.26819	3.82075	2.94616
13250	3.72464	4.34279	4.43507	3.71188	2.99135

12750	4.17778	4.76141	4.61308	3.62057	3.317
12250	4.85232	5.27855	4.81978	3.59538	3.75304
11750	5.84531	5.9638	5.07292	4.28432	4.26755
11250	7.22657	6.91161	5.28814	5.21822	5.16329
10750	9.43542	8.6038	6.66502	7.24841	6.79004
10250	12.30234	9.74719	10.8323	10.24146	9.75576
9750	15.64531	15.60598	17.5313	14.35337	11.4912
9250	17.87753	19.41597	15.9693	12.24856	9.76991
8750	20.54324	16.88553	13.1497	10.21449	8.86078
8250	15.88409	14.48012	11.7677	8.7943	7.28098
7750	13.42881	11.90128	10.0686	8.06582	6.5145
7250	12.51401	9.60494	8.36518	7.41114	6.20753
6750	10.17156	9.40834	7.90579	6.77868	6.00213
6250	7.73769	7.85521	7.48423	6.61075	5.79292
5750	6.1712	6.39361	6.46765	6.24256	5.70365
5250	5.13741	5.36142	5.48939	5.53884	5.40206
4750	4.4124	4.63037	4.75732	4.84447	4.88918
4250	3.87932	4.09111	4.2217	4.3033	4.3735
3750	3.47323	3.67796	3.81447	3.89692	3.95599
3250	3.15429	3.35054	3.49097	3.57975	3.63347
2750	2.89614	3.08272	3.22408	3.31957	3.37612
2250	2.68167	2.85782	2.99745	3.09771	3.16034
1750	2.49946	2.66494	2.80097	2.90372	2.97236
1250	2.34181	2.49676	2.62798	2.73129	2.80463
750	2.2035	2.34829	2.474	2.57642	2.65291
250	2.08081	2.21594	2.3358	2.43631	2.51456

Y-COORD (METERS)	X-COORD (METERS)				
	15250	15750	16250	16750	17250
19750	3.79923	3.51626	3.16295	2.64936	2.0444
19250	3.75019	3.42406	3.0477	2.47209	1.85198
18750	3.69062	3.32906	2.91378	2.27284	1.66822
18250	3.6171	3.22916	2.75013	2.05464	1.82137
17750	3.52739	3.11463	2.54919	1.83357	2.01458
17250	3.42134	2.97494	2.31364	2.00618	2.20849
16750	3.29662	2.80057	2.05849	2.20788	2.34278
16250	3.14903	2.58611	2.19815	2.34988	2.4544
15750	2.98045	2.33533	2.34624	2.48689	2.80173
15250	2.79011	2.33102	2.52051	2.8759	3.20536

14750	2.57512	2.56975	2.93814	3.29627	3.58811
14250	2.61425	2.98191	3.36719	3.69824	3.90338
13750	3.00069	3.40471	3.78458	4.03029	4.08317
13250	3.39247	3.83071	4.13656	4.2063	4.04671
12750	3.81781	4.21171	4.30981	4.11668	3.73662
12250	4.25297	4.39082	4.14624	3.77307	3.933
11750	4.45591	4.14591	4.38456	4.30805	4.02485
11250	5.36407	5.13418	4.63365	4.36361	4.15577
10750	6.02162	5.83591	5.60618	5.34936	5.11679
10250	8.72033	7.63702	6.77081	6.13608	5.65648
9750	9.36424	8.07127	7.15228	6.32768	5.59755
9250	9.90138	7.79865	6.42737	5.49496	4.79467
8750	7.25473	6.08058	5.17089	4.48421	3.95646
8250	5.98758	4.95321	4.28136	3.80881	3.4572
7750	5.48354	4.67248	4.08915	3.66746	3.34782
7250	4.83502	4.25453	3.80526	3.46036	3.18973
6750	5.15911	4.11133	3.47558	3.21081	2.99809
6250	5.16658	4.52145	3.74441	2.97566	2.80603
5750	5.12553	4.62617	4.10893	3.49665	2.84352
5250	5.0603	4.65139	4.25449	3.82632	3.32208
4750	4.81196	4.59172	4.29941	3.98209	3.62001
4250	4.4187	4.37984	4.23698	4.02445	3.76758
3750	4.01687	4.06208	4.04732	3.95462	3.79784
3250	3.67961	3.73342	3.77741	3.77861	3.7201
2750	3.41182	3.44941	3.49753	3.54063	3.5532
2250	3.19479	3.21893	3.25081	3.29486	3.33772
1750	3.01092	3.03044	3.04734	3.07555	3.117
1250	2.84903	2.87033	2.88006	2.89266	2.91876
750	2.70289	2.72899	2.73823	2.74182	2.75214
250	2.56913	2.60078	2.61338	2.61444	2.61446

Y-COORD (METERS)	X-COORD (METERS)				
	17750	18250	18750	19250	19750
19750	1.54114	1.68031	1.83795	1.988	2.11482
19250	1.66711	1.83794	2.00168	2.14296	2.20177
18750	1.83252	2.01139	2.1673	2.23822	2.23061
18250	2.01607	2.18697	2.27223	2.27718	2.38891
17750	2.20106	2.30223	2.32431	2.46974	2.6882
17250	2.32635	2.37073	2.55278	2.78862	2.97131

16750	2.4148	2.63703	2.89247	3.08981	3.21464
16250	2.72086	2.99838	3.213	3.34624	3.39056
15750	3.10399	3.33929	3.48321	3.52552	3.47017
15250	3.4659	3.62392	3.66488	3.59358	3.4285
14750	3.76554	3.80669	3.71721	3.52149	3.25177
14250	3.94774	3.83778	3.60638	3.29558	3.13204
13750	3.95016	3.67713	3.31993	3.37851	3.6399
13250	3.72483	3.32903	3.59754	3.69871	3.6641
12750	3.62852	3.74553	3.69952	3.57969	3.40056
12250	3.88724	3.71153	3.46514	3.1887	3.22076
11750	3.65841	3.60498	3.5534	3.78209	4.016
11250	4.17844	4.24655	4.32225	4.37086	4.37308
10750	4.93598	4.7744	4.62682	4.48994	4.33299
10250	5.27782	4.92334	4.57319	4.23902	3.92744
9750	4.97935	4.46445	4.03368	3.67088	3.36446
9250	4.24454	3.80513	3.45017	3.15976	2.91894
8750	3.58489	3.30556	3.07824	2.89057	2.7336
8250	3.18365	2.96311	2.78048	2.62595	2.49302
7750	3.09611	2.89164	2.72115	2.57582	2.44988
7250	2.97046	2.78757	2.63141	2.49569	2.37628
6750	2.82062	2.6675	2.53206	2.4104	2.3002
6250	2.66465	2.54107	2.42903	2.32521	2.22803
5750	2.51269	2.41341	2.32307	2.23793	2.15619
5250	2.77255	2.28318	2.21161	2.14417	2.0785
4750	3.19094	2.71651	2.24445	2.04142	1.99088
4250	3.45763	3.08539	2.66837	2.24262	1.8937
3750	3.58822	3.32129	2.99473	2.62376	2.23705
3250	3.60363	3.43164	3.20101	2.91266	2.58016
2750	3.51889	3.43242	3.29092	3.09126	2.83568
2250	3.35881	3.34216	3.27858	3.16203	2.98902
1750	3.16021	3.18781	3.18433	3.13855	3.04263
1250	2.95876	3.00266	3.03527	3.04175	3.00999
750	2.77725	2.81663	2.86133	2.89777	2.91184
250	2.62387	2.64879	2.68805	2.7335	2.77284

CONC OF SO2 IN MICROGRAMS/M³

Y-COORD (METERS)	X-COORD (METERS)				
	250	750	1250	1750	2250
19750	12.88103	12.73376	12.47133	13.11421	14.89218
19250	13.41054	13.38676	13.24275	12.96991	13.76201
18750	13.82206	13.93564	13.9297	13.79032	13.50617
18250	14.09758	14.35166	14.49817	14.51379	14.38065
17750	14.22605	14.61481	14.91624	15.10173	15.14343
17250	14.20346	14.71397	15.16196	15.51858	15.75033
16750	14.03667	14.64726	15.22451	15.74043	16.16158
16250	14.55616	14.42588	15.10521	15.75754	16.35152
15750	15.15742	15.29417	15.20602	15.57581	16.31251
15250	17.30359	16.51616	16.14747	16.12461	16.05708
14750	19.1608	18.9129	18.36555	17.484	17.19776
14250	19.9661	20.30276	20.39638	20.1855	19.607
13750	19.60898	20.43464	21.13089	21.63011	21.85301
13250	20.03168	20.35845	20.65924	21.53385	22.4723
12750	20.16113	20.76746	21.35701	21.92154	22.46002
12250	19.17574	19.97477	20.80853	21.67185	22.54913
11750	17.18988	18.03746	18.95024	19.93275	20.98963
11250	17.73819	18.23294	18.76229	19.33046	19.94176
10750	18.67896	19.23781	19.82212	20.4321	21.06727
10250	20.09077	20.74826	21.44202	22.17387	22.94533
9750	21.36421	22.10437	22.88909	23.7213	24.60372
9250	22.44585	23.24445	24.09157	24.99014	25.94298
8750	23.28959	24.11565	24.98847	25.90985	26.88083
8250	23.85925	24.6772	25.53399	26.42867	27.35899
7750	24.13047	24.90307	25.70049	26.51817	27.34918
7250	24.09256	24.78398	25.48142	26.1762	26.85638
6750	23.74918	24.32831	24.89183	25.4273	25.91857
6250	23.11828	23.56142	23.96711	24.32014	24.60185
5750	22.23084	22.5238	22.75963	22.92207	22.99215
5250	21.12798	21.26659	21.33283	21.31114	21.18453
4750	19.85737	19.84761	19.756	19.56924	20.10769
4250	18.47126	18.34291	18.98299	19.54657	19.9991
3750	17.93512	18.48559	18.95833	19.32266	19.54268
3250	17.96395	18.35953	18.65079	18.80662	18.79298
2750	17.76232	17.99281	18.09678	18.04525	17.80927

2250	17.35503	17.41689	17.33607	17.08825	16.65199
1750	16.76891	16.66538	16.41028	15.98581	15.37933
1250	16.03237	15.77327	15.36137	14.78633	14.04454
750	15.17495	14.77587	14.22998	13.53452	12.69405
250	14.22664	13.70768	13.05402	12.26982	11.36636

Y-COORD (METERS)	X-COORD (METERS)				
	2750	3250	3750	4250	4750
19750	16.71578	18.50863	20.1434	21.39126	21.90553
19250	15.67061	17.62029	19.50968	21.15917	22.25431
18750	14.46956	16.52246	18.60607	20.579	22.18728
18250	14.08416	15.24461	17.45651	19.67673	21.70373
17750	15.01859	14.70845	16.09612	18.48131	20.83067
17250	15.82368	15.7096	15.3842	17.03415	19.60345
16750	16.44837	16.56017	16.46003	16.11732	18.06976
16250	16.8482	17.20078	17.35955	17.27728	16.91466
15750	16.99613	17.5816	18.01319	18.22964	18.17046
15250	16.88836	17.67506	18.36519	18.89229	19.18035
14750	16.95164	17.48377	18.38911	19.20328	19.84702
14250	18.6171	18.28975	18.0978	19.14011	20.10256
13750	21.70943	21.10835	19.98607	19.38957	19.93319
13250	23.20708	23.62717	23.59718	22.9809	21.66724
12750	22.98258	24.06338	25.13527	25.84229	25.97824
12250	23.42137	24.27616	25.108	25.97327	27.49129
11750	22.11862	23.30149	24.50868	25.71676	26.91416
11250	20.6967	21.79038	22.97665	24.44203	26.09431
10750	21.72626	22.40648	23.10371	24.24172	26.06801
10250	23.77546	25.13223	26.63521	28.2916	30.10793
9750	25.53894	26.57722	28.14287	29.84949	31.69602
9250	26.95245	28.02023	29.14689	30.33134	31.57004
8750	27.90137	28.96995	30.08259	31.23192	32.40568
8250	28.32043	29.30544	30.30239	31.29364	32.25359
7750	28.18316	29.00533	29.79497	30.52357	31.1526
7250	27.50582	28.10295	28.61959	29.01943	29.25717
6750	26.34508	26.68085	26.89419	26.94726	27.48297
6250	24.78973	24.85713	24.7738	25.13836	25.40449
5750	22.94832	22.81183	23.05864	23.16952	23.11132
5250	21.09674	21.30919	21.83701	22.13654	22.13183
4750	20.66706	21.06752	21.25306	21.16215	20.73406

4250	20.29909	20.39928	20.24918	19.80057	19.0158
3750	19.57833	19.38787	18.93245	18.18246	17.12568
3250	18.57523	18.12169	17.40873	16.42677	15.18629
2750	17.36288	16.68695	15.77397	14.63235	13.28957
2250	16.01179	15.16171	14.10867	12.87495	11.49858
1750	14.58618	13.61222	12.47585	11.20838	10.28068
1250	13.14113	12.09148	10.92172	9.81106	10.03816
750	11.72166	10.63939	9.47762	9.61827	9.73237
250	10.36241	9.2839	9.23162	9.36555	9.37567

Y-COORD (METERS)	X-COORD (METERS)				
	5250	5750	6250	6750	7250
19750	21.35746	19.56147	16.70282	15.97766	15.68731
19250	22.38929	21.22921	18.72682	16.43156	16.45612
18750	23.0175	22.61643	20.69814	17.48066	17.14356
18250	23.18042	23.5951	22.4677	19.68502	17.70741
17750	22.85464	24.06601	23.86448	21.81421	18.16566
17250	22.05639	23.97705	24.73522	23.66749	20.54944
16750	20.82501	23.32388	24.97511	25.01907	22.80916
16250	19.21278	22.12702	24.54608	25.68876	24.66996
15750	17.78472	20.46313	23.48054	25.61881	25.89733
15250	19.15141	18.73886	21.83684	24.82924	26.36968
14750	20.22539	20.23742	19.79486	23.33067	26.05697
14250	20.891	21.38674	21.45792	21.21869	24.90802
13750	21.0758	22.04904	22.70494	22.87	22.92422
13250	20.78199	22.15064	23.37139	24.2614	24.58746
12750	25.31593	23.66335	23.57331	25.2385	26.28631
12250	28.56637	28.88671	28.09809	26.56124	28.92568
11750	28.15853	30.18977	31.71284	32.26918	31.26313
11250	27.95713	30.04098	32.31564	34.6209	36.43464
10750	28.00857	30.36872	33.30912	36.67395	40.42023
10250	32.09456	34.25564	36.56661	38.91206	40.97182
9750	33.68322	35.80622	38.0328	40.2304	42.02108
9250	32.85618	34.17847	35.52117	36.85883	40.31962
8750	33.58469	34.73931	35.82707	38.78445	42.02902
8250	33.14538	33.91725	35.98665	38.09562	40.02015
7750	31.63088	32.97211	34.30133	35.37451	36.0355
7250	30.10133	30.92522	31.49442	31.71072	31.46853
6750	27.974	28.23547	28.20084	27.80423	26.99096

6250	25.47228	25.29279	24.82131	24.02146	22.87565
5750	23.16681	22.85076	22.00937	20.60214	19.24402
5250	21.74495	20.911	19.60122	17.8498	16.13915
4750	19.92001	18.69885	17.09449	15.1856	14.12823
4250	17.87903	16.40766	14.65969	13.20334	13.48493
3750	15.77544	14.17589	12.40057	12.71058	12.75583
3250	13.72177	12.09141	12.00821	12.12192	11.97875
2750	11.79235	11.37294	11.53454	11.47378	11.1845
2250	10.79911	10.99293	10.99596	10.79552	10.39834
1750	10.49516	10.54635	10.41774	10.11168	9.64033
1250	10.12544	10.054	9.82358	9.44129	8.92037
750	9.70632	9.53805	9.2317	8.7946	8.24632
250	9.25805	9.01597	8.65217	8.17873	7.62432

Y-COORD (METERS)	X-COORD (METERS)				
	7750	8250	8750	9250	9750
19750	14.70946	14.78034	14.0762	12.55351	12.94942
19250	15.68721	15.06483	14.58789	13.07656	13.24438
18750	16.65336	15.3573	15.08064	13.66891	13.54573
18250	17.57789	16.48675	15.53666	14.28017	13.85503
17750	18.41989	17.62069	15.93189	14.90379	14.17294
17250	19.12404	18.72578	17.17084	15.52485	14.49879
16750	19.61648	19.75472	18.46978	16.17673	14.83158
16250	21.12416	20.63393	19.74426	17.50466	15.17143
15750	23.46597	21.22342	20.92149	18.84463	15.90951
15250	25.34638	21.35392	21.89163	20.14648	17.08927
14750	26.53951	23.76487	22.46282	21.3187	18.19283
14250	26.94194	25.77336	22.36024	22.19619	19.3585
13750	26.42042	27.12463	23.79776	22.46571	21.49055
13250	24.81592	27.51585	26.17989	24.08035	23.77083
12750	26.81702	26.56825	27.90626	28.10703	26.11934
12250	30.45161	29.90849	29.55591	31.99909	28.96979
11750	33.44519	35.71149	34.36295	34.52006	34.36776
11250	37.15149	38.79144	42.00779	40.96996	40.19824
10750	44.26571	46.8997	46.60949	45.51538	47.10952
10250	42.95001	47.95251	51.584	49.37261	44.80493
9750	42.57101	45.14223	47.87033	48.26361	43.20846
9250	44.75106	49.4417	53.83397	56.81863	46.78752
8750	45.31546	48.27707	50.34012	50.39007	45.69713

8250	41.49497	42.11305	41.3812	38.88007	34.98908
7750	36.08337	35.30323	33.57483	31.0833	28.52789
7250	30.67193	29.27266	27.34658	25.15908	23.05864
6750	25.73644	24.07398	22.11575	20.02232	18.61938
6250	21.39975	19.65409	17.73612	17.38855	16.99063
5750	17.70691	16.35109	16.2877	15.88119	15.20604
5250	15.17428	15.27033	14.97461	14.36231	14.20103
4750	14.33629	14.17247	13.67624	12.87641	13.52664
4250	13.43758	13.07059	12.41358	11.77407	12.90488
3750	12.50981	11.989	11.22182	11.37925	12.33249
3250	11.58214	10.95422	10.12779	11.00202	11.8064
2750	10.68015	9.98782	9.81557	10.64244	11.32293
2250	9.824	9.10072	9.58195	10.30012	10.87767
1750	9.02414	8.6318	9.34926	9.97428	10.46612
1250	8.28824	8.4818	9.11876	9.66387	10.08409
750	7.70002	8.32533	8.89147	9.36789	9.72799
250	7.59985	8.16448	8.66816	9.08543	9.39485

Y-COORD (METERS)	X-COORD (METERS)				
	10250	10750	11250	11750	12250
19750	12.71798	11.94514	10.8036	11.32842	11.38724
19250	13.03843	12.23495	11.0569	11.51663	11.48599
18750	13.36995	12.52976	11.30843	11.69163	11.90726
18250	13.71239	12.83057	11.55593	11.84966	12.77746
17750	14.06627	13.13888	11.79771	11.98652	13.68636
17250	14.43417	13.45688	12.0336	12.0973	14.60077
16750	14.82093	13.78742	12.26582	12.4357	15.46918
16250	15.2319	14.13475	12.49979	13.41446	16.22096
15750	15.6713	14.50494	12.74435	14.41489	16.73366
15250	16.14211	14.90525	13.01175	15.36459	16.89581
14750	16.64838	15.34188	13.31855	16.16721	16.66121
14250	17.20531	15.82625	13.76221	16.70677	16.09285
13750	18.04371	16.40764	14.91795	16.89704	15.40057
13250	20.2362	17.19016	16.12868	16.78303	14.84205
12750	22.62874	18.40854	17.39018	16.5546	14.47741
12250	24.89412	20.29729	18.57253	16.22378	14.2957
11750	26.87277	22.83318	19.81591	18.32595	16.39589
11250	31.47459	25.26284	22.33449	22.18958	18.82518
10750	39.21402	24.40939	24.93112	26.85834	22.84416

10250	27.89306	25.14617	29.20982	30.79975	29.36852
9750	28.38286	31.96438	39.49973	31.73642	29.86347
9250	33.43688	37.56252	44.78205	32.08608	33.72785
8750	37.11932	40.28456	42.85906	39.49883	45.83923
8250	31.94572	32.34121	36.24879	41.31103	46.77
7750	26.72153	25.69068	32.2732	38.18573	40.44791
7250	21.04919	22.56342	27.2256	34.39275	38.91396
6750	19.03366	20.86049	23.63495	29.00872	33.01458
6250	17.69327	19.3036	20.64068	24.61418	27.63082
5750	16.56116	17.81558	18.451	21.29035	23.70623
5250	15.54042	16.48271	16.84534	18.79519	20.82642
4750	14.61682	15.32199	15.52466	16.86578	18.61801
4250	13.78796	14.31936	14.42563	15.33149	16.86953
3750	13.04931	13.45332	13.49884	14.08427	15.45254
3250	12.39089	12.70006	12.70594	13.05119	14.28051
2750	11.80179	12.03912	12.01812	12.17891	13.29114
2250	11.27178	11.45377	11.41408	11.42975	12.44086
1750	10.79171	10.93053	10.87769	10.77671	11.69904
1250	10.35391	10.45868	10.39658	10.20019	11.04383
750	9.95208	10.02978	9.96127	9.75707	10.45929
250	9.5812	9.63723	9.5644	9.3725	9.93343

Y-COORD (METERS)	X-COORD (METERS)				
	12750	13250	13750	14250	14750
19750	12.79346	14.66141	15.33858	15.10587	14.48529
19250	13.58927	15.20686	15.4973	15.0213	14.30814
18750	14.37371	15.63771	15.51874	14.85706	14.10049
18250	15.1087	15.91587	15.40225	14.63521	13.87739
17750	15.74494	16.00849	15.16423	14.38569	13.64721
17250	16.22364	15.89775	14.84129	14.13948	13.40609
16750	16.48283	15.59441	14.48867	13.91751	13.13421
16250	16.47482	15.14545	14.16263	13.71838	12.79811
15750	16.15384	14.63698	13.90514	13.50892	12.3569
15250	15.57761	14.197	13.72626	13.24336	11.76644
14750	14.9249	13.92982	13.57631	12.87823	13.24832
14250	14.41371	13.82846	13.38799	13.78558	15.84173
13750	14.17238	13.80115	14.28543	16.58741	17.86039
13250	14.16625	14.60825	17.34681	18.44225	18.72374
12750	14.52455	17.97369	18.92814	18.49266	18.24906

12250	18.00442	19.07193	17.84334	16.70716	16.97574
11750	17.85764	16.34273	14.76166	15.24362	15.53637
11250	18.22268	18.94078	18.38426	17.56869	17.62482
10750	21.95287	22.78061	22.55217	22.92793	24.41418
10250	29.14149	27.81105	28.33442	31.45321	31.75235
9750	31.15679	32.61094	37.58478	37.32001	34.14978
9250	39.50408	39.87358	36.63081	31.58988	28.03054
8750	42.20405	40.27594	35.30828	29.06085	24.36149
8250	42.38707	36.03277	32.52294	27.60135	23.52012
7750	38.33308	35.86963	29.93347	25.78034	22.43859
7250	36.95019	33.4999	30.79309	26.35335	20.74935
6750	33.53486	31.68696	29.44805	27.19353	23.77563
6250	28.95629	28.76616	27.66335	26.27497	24.55786
5750	25.11362	25.59433	25.37709	24.73728	23.87979
5250	22.16974	22.85044	23.02912	22.88095	22.55501
4750	19.87891	20.63073	20.97095	21.04391	20.99653
4250	18.04945	18.83318	19.26242	19.43577	19.48942
3750	16.55513	17.34807	17.83867	18.07966	18.17144
3250	15.30967	16.09479	16.62558	16.9238	17.04979
2750	14.25087	15.01655	15.56966	15.91432	16.0814
2250	13.335	14.07388	14.63534	15.01411	15.22318
1750	12.53141	13.23921	13.79899	14.20036	14.44634
1250	11.81833	12.49283	13.04399	13.45859	13.73394
750	11.17981	11.82022	12.35812	12.77875	13.07595
250	10.60386	11.21035	11.73192	12.15317	12.46572

Y-COORD (METERS)	X-COORD (METERS)				
	15250	15750	16250	16750	17250
19750	13.61066	12.4371	10.85952	9.04199	8.14728
19250	13.3826	12.09532	10.37817	8.48115	8.91938
18750	13.12561	11.6992	9.83559	8.89349	9.64697
18250	12.83368	11.23574	9.23083	9.68192	10.28367
17750	12.49168	10.69097	9.6888	10.37728	10.78042
17250	12.07637	10.05727	10.44679	10.92235	11.10143
16750	11.56228	10.49118	11.04046	11.37723	12.81283
16250	10.93259	11.13628	11.80031	13.34873	14.62716
15750	11.21481	12.25031	13.91464	15.27144	16.26099
15250	12.7322	14.51343	15.93073	16.95275	17.53306
14750	15.15199	16.59165	17.61048	18.1862	18.26298

14250	17.23894	18.18053	18.72438	18.78555	18.29351
13750	18.5846	19.03648	19.1052	18.60326	17.50741
13250	18.95421	19.06929	18.64863	17.52563	15.85436
12750	18.47298	18.2851	17.24488	15.49293	14.51606
12250	17.36385	16.57045	14.78901	14.18699	14.24676
11750	15.79751	15.99279	15.95921	15.67452	15.16316
11250	17.78737	18.3121	18.8394	19.02027	18.91641
10750	24.93728	24.62604	23.75585	22.63177	21.41196
10250	29.85773	27.51103	25.19038	23.06469	21.17464
9750	30.28679	26.77926	23.855	21.48092	19.51944
9250	25.1768	22.74796	20.61999	18.77566	17.1851
8750	21.18159	18.89814	17.36314	16.00581	14.82041
8250	20.62013	18.53466	16.9315	15.64405	14.58809
7750	19.8351	17.9089	16.44653	15.28317	14.31678
7250	18.67125	17.04471	15.78155	14.77037	13.92385
6750	19.44798	15.95907	14.92134	14.08853	13.38977
6250	21.90187	18.4931	15.1026	13.30782	12.74229
5750	22.57974	20.4892	17.76881	14.93146	12.33522
5250	22.03617	21.05619	19.39486	17.18457	14.77492
4750	20.88371	20.58085	19.83717	18.50206	16.67392
4250	19.53205	19.55175	19.38571	18.81526	17.73012
3750	18.23649	18.34404	18.44091	18.362	17.92387
3250	17.10396	17.18774	17.33659	17.4789	17.46078
2750	16.1378	16.17761	16.28005	16.45599	16.62638
2250	15.30141	15.31827	15.35739	15.47696	15.67078
1750	14.55723	14.57764	14.57528	14.62114	14.75566
1250	13.87936	13.92101	13.9062	13.89786	13.95416
750	13.25262	13.32315	13.31778	13.28389	13.27779
250	12.66852	12.76881	12.78491	12.74933	12.70748

Y-COORD (METERS)	X-COORD (METERS)				
	17750	18250	18750	19250	19750
19750	8.91717	9.5051	9.88048	10.03312	9.96155
19250	9.58702	10.03218	10.23853	10.20956	10.54691
18750	10.16771	10.43435	10.45159	10.94827	11.8412
18250	10.6165	10.68391	11.37434	12.33412	13.07092
17750	10.90223	11.82643	12.85916	13.64373	14.14815
17250	12.30564	13.41705	14.25257	14.77569	14.97498
16750	14.00721	14.89592	15.43728	15.61769	15.45289

16250	15.56888	16.12715	16.28462	16.05833	15.49617
15750	16.83329	16.96425	16.66928	16.00307	15.0475
15250	17.63571	17.26778	16.48812	15.39329	14.09465
14750	17.82463	16.92699	15.68276	14.2267	13.52797
14250	17.28395	15.88586	14.2651	14.20355	14.39157
13750	15.96144	14.39875	14.56768	14.5046	14.20023
13250	14.64868	14.5753	14.29167	13.75295	12.96148
12750	14.27769	13.79115	13.0704	13.40828	13.56399
12250	14.11097	13.95441	14.06411	13.97811	13.73196
11750	14.58129	14.92857	15.12049	15.17671	15.11486
11250	18.60271	18.14653	17.59788	16.99292	16.3595
10750	20.19044	19.01977	17.92743	16.92085	16.0002
10250	19.52972	18.10302	16.86321	15.78905	14.85312
9750	17.88083	16.5049	15.32886	14.31159	13.58397
9250	15.82164	14.81498	14.06648	13.42686	12.87237
8750	13.79742	13.08195	12.48599	11.98253	11.55063
8250	13.71345	12.98096	12.35838	11.82047	11.34905
7750	13.49332	12.78122	12.15957	11.61299	11.12987
7250	13.18818	12.5333	11.94275	11.40772	10.92285
6750	12.77454	12.2131	11.69035	11.20013	10.7407
6250	12.24863	11.79491	11.3632	10.94565	10.54058
5750	11.64358	11.28738	10.9482	10.61433	10.28116
5250	12.44004	10.7186	10.45839	10.20331	9.94506
4750	14.59958	12.49436	10.47986	9.73043	9.53863
4250	16.19905	14.39695	12.49536	10.61576	9.08396
3750	17.03644	15.74198	14.16592	12.44655	10.699
3250	17.12645	16.39722	15.29496	13.90992	12.35455
2750	16.65251	16.40083	15.79973	14.85591	13.63435
2250	15.85912	15.91863	15.73344	15.23698	14.42526
1750	14.9614	15.16157	15.24679	15.11534	14.70495
1250	14.10134	14.31503	14.52295	14.62805	14.54019
750	13.34596	13.50357	13.72239	13.93523	14.05568
250	12.70847	12.78851	12.95458	13.17643	13.39209

CONC OF NOX IN MICROGRAMS/M^3

Y-COORD (METERS)	X-COORD (METERS)				
	250	750	1250	1750	2250
19750	10.17361	10.05053	9.84265	10.4558	11.8502
19250	10.595	10.56665	10.44609	10.2299	10.97053

18750	10.92314	11.00383	10.98854	10.87136	10.64605
18250	11.14772	11.33712	11.4418	11.44231	11.32951
17750	11.26123	11.5541	11.77866	11.91178	11.93137
17250	11.25875	11.64693	11.98446	12.25	12.41696
16750	12.24224	11.61213	12.05127	12.4401	12.7536
16250	13.07156	12.87914	12.29336	12.47454	12.92235
15750	13.40147	13.61076	13.53943	13.07377	12.91669
15250	13.61384	13.98577	14.22984	14.25473	13.90049
14750	14.82786	14.58047	14.71292	14.99495	15.07539
14250	15.58512	15.76541	15.76078	15.58184	15.94911
13750	15.48989	16.04621	16.49301	16.78274	16.86245
13250	15.80372	16.08202	16.36996	16.9304	17.54684
12750	15.96478	16.43266	16.89742	17.35709	17.82853
12250	15.35829	15.95505	16.58622	17.25299	17.94236
11750	14.01462	14.66418	15.36012	16.10876	16.92154
11250	13.93557	14.32037	14.73507	15.18427	15.67303
10750	14.52112	14.94488	15.38777	15.85009	16.33168
10250	15.64192	16.1429	16.67128	17.22853	17.81598
9750	16.66699	17.23463	17.83634	18.47447	19.1514
9250	17.55453	18.17177	18.82672	19.52194	20.25996
8750	18.26776	18.91211	19.59377	20.31452	21.07576
8250	18.77679	19.422	20.09945	20.80913	21.55009
7750	19.06066	19.67864	20.31925	20.97985	21.65615
7250	19.10838	19.67164	20.24413	20.8202	21.39188
6750	18.91985	19.40389	19.88141	20.34382	20.78004
6250	18.5058	18.89129	19.25387	19.58283	19.86492
5750	17.8872	18.16151	18.3977	18.58404	18.70673
5250	17.09279	17.25033	17.35752	17.40285	17.37353
4750	16.15615	16.19934	16.18385	16.09955	15.93614
4250	15.1166	15.05394	14.92863	15.3857	15.8105
3750	14.07758	14.55376	14.97941	15.33225	15.5859
3250	14.19058	14.5537	14.84543	15.04267	15.11983
2750	14.11938	14.35923	14.50973	14.54894	14.45439
2250	13.8805	13.99225	14.001	13.88775	13.63496
1750	13.49364	13.47791	13.35073	13.09738	12.70635
1250	12.98051	12.84304	12.59117	12.21524	11.70998
750	12.3639	12.11486	11.75366	11.27594	10.68223
250	11.66687	11.31981	10.86739	10.31023	9.65384

Y-COORD (METERS)	X-COORD (METERS)				
	2750	3250	3750	4250	4750
19750	13.26096	14.66121	15.95178	16.94391	17.34472
19250	12.46249	13.97268	15.45042	16.74959	17.61284
18750	11.53274	13.13377	14.75048	16.29141	17.55556
18250	11.09414	12.14909	13.87177	15.59604	17.17595
17750	11.82423	11.57772	12.82742	14.684	16.50696
17250	12.45961	12.35972	12.10068	13.57687	15.57588
16750	12.96091	13.0315	12.94085	12.66754	14.40768
16250	13.29213	13.5477	13.65223	13.57339	13.28362
15750	13.43241	13.86842	14.18201	14.3281	14.26444
15250	13.37745	13.97152	14.48579	14.86961	15.06717
14750	14.8182	14.10017	14.54114	15.14852	15.61825
14250	16.07419	15.88696	15.23711	15.14381	15.8631
13750	17.07617	17.31626	17.18467	16.58811	15.78501
13250	17.99854	18.31754	18.78286	18.78166	18.22056
12750	18.3454	18.96005	19.66187	20.31662	20.62447
12250	18.64287	19.36453	20.13973	21.00925	21.87134
11750	17.80511	18.74497	19.72042	20.73928	21.84825
11250	16.20691	17.06173	18.041	19.13938	20.37812
10750	16.83176	17.349	17.88139	18.80981	20.20218
10250	18.43477	19.0857	20.17482	21.38588	22.72713
9750	19.86947	20.6309	21.57062	22.85616	24.25504
9250	21.04312	21.87359	22.75311	23.68277	24.66299
8750	21.87832	22.72212	23.60577	24.52591	25.47643
8250	22.32	23.11457	23.9268	24.74591	25.55577
7750	22.34163	23.02665	23.69759	24.33547	24.91444
7250	21.94831	22.47476	22.95189	23.3546	23.65128
6750	21.17561	21.51242	21.76795	21.91525	21.99049
6250	20.08398	20.22083	20.25336	20.27569	20.61232
5750	18.74988	18.69598	18.71394	18.91276	18.99776
5250	17.25587	17.30317	17.40129	17.55536	17.70529
4750	16.26868	16.67357	16.93317	17.00221	16.83479
4250	16.13242	16.31668	16.32552	16.12176	15.67436
3750	15.71052	15.67451	15.44735	15.00406	14.33063
3250	15.05032	14.80893	14.37531	13.73798	12.89866
2750	14.20513	13.78442	13.18283	12.40142	11.45399
2250	13.22879	12.66146	11.93369	11.0565	10.05169
1750	12.17121	11.49252	10.67928	9.74945	8.7293

1250	11.07589	10.32048	9.45874	8.51284	7.9637
750	9.97893	9.17872	8.30045	7.62353	7.77843
250	8.90909	8.09218	7.31172	7.47437	7.54214

Y-COORD (METERS)	X-COORD (METERS)				
	5250	5750	6250	6750	7250
19750	16.93445	15.59791	13.47753	12.8567	12.6999
19250	17.71725	16.85128	14.99557	13.17276	13.25888
18750	18.1997	17.89883	16.47204	14.0931	13.74996
18250	18.32836	18.64507	17.80265	15.74179	14.14298
17750	18.0805	19.01278	18.86133	17.33682	14.64471
17250	17.47504	18.9584	19.53268	18.73447	16.42757
16750	16.54868	18.47672	19.73686	19.76868	18.12741
16250	15.32962	17.58943	19.44468	20.30449	19.54619
15750	13.95551	16.34568	18.67576	20.29912	20.50708
15250	15.02337	14.84351	17.46837	19.76287	20.91912
14750	15.88065	15.86392	15.9143	18.69506	20.76407
14250	16.43986	16.78664	16.80946	17.16128	19.99782
13750	16.64151	17.35588	17.81835	17.90489	18.61323
13250	17.12718	17.5084	18.40895	19.0416	19.23913
12750	20.21052	19.07401	18.51508	19.72077	20.63945
12250	22.48247	22.47351	21.53378	20.82026	22.69847
11750	23.05682	24.14874	24.71431	25.06894	24.49202
11250	21.7697	23.31418	25.02212	26.85863	28.4459
10750	21.82793	23.73665	25.98309	28.62494	31.76147
10250	24.21703	25.87495	27.70554	29.65809	31.53648
9750	25.77296	27.41411	29.16567	30.94752	32.51543
9250	25.6933	26.77218	27.89788	29.06429	30.48774
8750	26.44723	27.4223	28.37811	29.60953	32.17964
8250	26.33307	27.04463	27.81557	29.54968	31.21135
7750	25.39984	25.81532	26.9782	27.99851	28.77147
7250	23.84712	24.63229	25.26564	25.68192	25.81104
6750	22.51474	22.89607	23.08917	23.04907	22.73844
6250	20.82045	20.86518	20.71371	20.33782	19.72051
5750	18.9432	18.72286	18.31399	17.70213	16.88412
5250	17.59186	17.16449	16.39549	15.29882	14.33222
4750	16.39177	15.65144	14.62169	13.3466	12.11898
4250	14.96606	14.00135	12.81148	11.45164	10.66633
3750	13.42982	12.32473	11.05787	10.03732	10.22616

3250	11.87496	10.7004	9.47192	9.68565	9.72375
2750	10.36738	9.17925	9.19313	9.26918	9.17871
2250	8.95063	8.7445	8.85014	8.80666	8.61207
1750	8.33604	8.46363	8.45817	8.31856	8.0446
1250	8.10729	8.13194	8.03766	7.82346	7.48601
750	7.82699	7.7694	7.60572	7.32941	6.94781
250	7.51378	7.39244	7.16921	6.84396	6.4423

Y-COORD (METERS)	X-COORD (METERS)				
	7750	8250	8750	9250	9750
19750	12.01738	11.68497	11.25061	10.15126	10.20358
19250	12.74495	11.88437	11.62633	10.57759	10.41007
18750	13.45458	12.54677	11.98843	11.01826	10.6231
18250	14.1241	13.38402	12.32154	11.47308	10.84711
17750	14.72417	14.21351	13.00349	11.93992	11.08479
17250	15.21567	15.01096	13.94556	12.40779	11.33602
16750	15.54682	15.74289	14.89305	13.28211	11.59956
16250	16.92484	16.35797	15.81178	14.26729	12.26774
15750	18.70753	16.76025	16.65203	15.24852	13.18352
15250	20.16591	17.18107	17.33355	16.19122	14.06658
14750	21.12674	19.0894	17.73477	17.03712	14.89481
14250	21.52401	20.68243	17.66174	17.67657	15.63411
13750	21.27363	21.79946	19.39568	17.89613	17.02852
13250	20.24151	22.27349	21.33869	19.10049	18.85601
12750	20.97519	21.856	22.55828	22.209	20.82645
12250	23.96827	23.39819	23.18934	25.38537	23.41313
11750	26.58722	28.24768	27.19258	27.80199	28.00202
11250	29.83758	32.01697	33.92706	32.55996	32.28818
10750	35.55346	39.99662	37.58255	37.44294	38.76504
10250	34.20951	37.78396	40.33337	39.5847	37.16916
9750	33.32729	34.76972	37.54783	39.04418	34.86503
9250	33.92598	37.7434	41.82083	45.69617	38.94027
8750	34.89333	37.56543	39.85741	40.78943	37.35377
8250	32.6243	33.49879	33.43946	31.99362	29.23532
7750	29.15929	29.00953	28.23015	26.94337	25.71346
7250	25.59164	24.99642	24.08618	23.05947	22.17819
6750	22.13982	21.27448	20.21088	19.03572	17.73775
6250	18.86447	17.79841	16.567	15.19169	14.20856
5750	15.87371	14.70067	13.39886	13.10495	13.11146

5250	13.2645	12.14653	12.22797	12.13949	11.81083
4750	11.36642	11.48096	11.38958	11.07988	10.52465
4250	10.8208	10.76566	10.50062	10.00012	10.11077
3750	10.21877	10.0119	9.59954	8.96929	9.71482
3250	9.57762	9.24548	8.72729	8.60402	9.33899
2750	8.91971	8.49509	7.91114	8.35711	8.98515
2250	8.26832	7.77938	7.48715	8.11613	8.65351
1750	7.6367	7.11459	7.33013	7.88218	8.34296
1250	7.0394	6.62701	7.17081	7.65573	8.05183
750	6.48563	6.52359	7.01051	7.43691	7.77832
250	5.97739	6.41436	6.85028	7.22577	7.5208

Y-COORD (METERS)	X-COORD (METERS)				
	10250	10750	11250	11750	12250
19750	10.06985	9.60795	8.85075	8.79992	8.95578
19250	10.31	9.82654	9.05918	8.94405	9.04882
18750	10.56003	10.04903	9.26613	9.07935	9.12481
18250	10.81836	10.2775	9.46929	9.20347	9.71474
17750	11.0842	10.51419	9.66701	9.31386	10.38507
17250	11.3603	10.76111	9.85947	9.40753	11.06581
16750	11.65293	11.0198	10.04967	9.49814	11.71595
16250	11.96904	11.2923	10.24386	10.24024	12.28301
15750	12.31414	11.58342	10.45096	11.01305	12.68008
15250	12.69405	11.9016	10.68151	11.76482	12.82786
14750	13.11835	12.25649	10.94803	12.4232	12.6928
14250	13.60706	12.66279	11.2776	12.89756	12.32284
13750	14.91276	13.1646	11.72802	13.10981	11.8751
13250	16.69935	13.84797	12.80754	13.07377	11.54865
12750	18.71521	14.88933	13.94193	12.93112	11.40699
12250	20.84301	16.46612	14.93787	13.60068	12.10721
11750	23.13808	18.60224	16.46764	15.72408	14.14526
11250	26.25397	20.94107	18.69168	18.87515	16.9133
10750	35.54836	21.84526	21.72628	23.00409	20.55468
10250	24.82692	22.91839	25.3868	27.52778	24.47581
9750	24.20758	27.54407	32.03555	27.21754	26.26529
9250	26.85947	30.62749	35.39619	25.18609	27.27139
8750	29.5774	31.73861	33.74931	30.00266	34.87553
8250	27.04777	26.20556	28.03099	30.60187	33.96829
7750	25.32278	25.58091	25.63943	28.81582	31.7087

7250	21.39321	19.86733	20.92536	27.11114	34.31266
6750	16.07636	16.50469	18.40493	23.46394	28.84966
6250	14.48056	15.23913	16.90655	20.01918	23.58925
5750	12.87742	14.26243	15.35082	17.27092	19.87256
5250	12.21352	13.29977	13.99901	15.1909	17.24042
4750	11.57962	12.41212	12.86622	13.58227	15.26715
4250	10.98241	11.62021	11.91961	12.30494	13.72956
3750	10.43149	10.92377	11.12252	11.27039	12.5018
3250	9.92892	10.31221	10.44329	10.41856	11.50145
2750	9.47239	9.77303	9.85701	9.71796	10.66916
2250	9.05763	9.29466	9.34488	9.20724	9.96294
1750	8.67956	8.86701	8.89248	8.75798	9.35324
1250	8.33326	8.4816	8.48869	8.35818	8.81919
750	8.01442	8.13159	8.12489	7.99882	8.34575
250	7.71939	7.81151	7.79443	7.67298	7.9219

Y-COORD (METERS)	X-COORD (METERS)				
	12750	13250	13750	14250	14750
19750	9.71867	11.09772	11.72461	11.83998	11.68215
19250	10.28812	11.50098	11.87205	11.84558	11.62121
18750	10.85651	11.82714	11.93214	11.80679	11.54455
18250	11.39259	12.0505	11.90812	11.73774	11.46139
17750	11.86034	12.15004	11.8145	11.65731	11.37636
17250	12.21892	12.11646	11.67835	11.58422	11.28634
16750	12.42604	11.96096	11.53793	11.52984	11.1777
16250	12.45082	11.7225	11.43034	11.49098	11.02692
15750	12.26585	11.46366	11.38319	11.44529	10.798
15250	11.91706	11.27382	11.39942	11.367	10.46206
14750	11.53569	11.2238	11.44482	11.22728	10.02314
14250	11.27995	11.308	11.47914	11.01599	11.52065
13750	11.24336	11.46565	11.49523	12.05845	13.00572
13250	11.40671	11.67882	12.63295	13.42758	13.7348
12750	11.76237	13.15144	13.82301	13.5963	13.61397
12250	13.30862	14.03021	13.23222	12.58149	13.06358
11750	13.73723	13.34464	12.76227	11.9502	12.56175
11250	15.44161	15.28769	14.95071	14.30772	14.72945
10750	17.76397	17.52325	16.94945	18.28663	20.73226
10250	23.34571	23.24341	23.46626	26.49648	26.81202
9750	25.9348	26.81209	33.81262	31.2452	27.25455

9250	30.64464	33.69192	30.39113	25.76496	23.20836
8750	33.04281	32.60814	29.1393	24.32693	21.57018
8250	32.19193	29.35433	28.60503	23.93735	20.06723
7750	29.59228	28.84753	26.7393	22.88426	19.516
7250	32.62236	27.93134	25.16682	21.54562	18.08975
6750	29.98734	27.70328	24.78612	22.11292	19.07524
6250	25.29151	25.07204	23.7515	21.93793	19.88111
5750	21.468	22.0011	21.72825	20.94047	19.77515
5250	18.65122	19.36294	19.52923	19.32508	18.87686
4750	16.51699	17.26184	17.59154	17.63818	17.54446
4250	14.84821	15.59324	15.99957	16.15746	16.19107
3750	13.51314	14.24487	14.6986	14.92319	15.00682
3250	12.423	13.13213	13.61437	13.88954	14.01017
2750	11.51349	12.19402	12.68964	13.0032	13.16152
2250	10.73922	11.38765	11.88505	12.22526	12.41923
1750	10.06855	10.68326	11.17427	11.53081	11.75479
1250	9.4793	10.05999	10.53919	10.90387	11.15085
750	8.9557	9.5029	9.96685	10.3336	10.59692
250	8.4862	9.001	9.44767	9.81205	10.0861

Y-COORD (METERS)	X-COORD (METERS)				
	15250	15750	16250	16750	17250
19750	11.2283	10.53717	9.44288	8.01123	6.49667
19250	11.13525	10.34742	9.109	7.56466	6.78562
18750	11.02372	10.11183	8.71425	7.07686	7.45071
18250	10.8874	9.81798	8.25441	7.45064	7.95164
17750	10.71337	9.4511	7.73292	7.97582	8.28922
17250	10.48216	8.99993	7.98245	8.34231	8.57889
16750	10.17167	8.46388	8.37882	8.66015	9.49277
16250	9.76418	8.40262	8.71958	9.84479	10.88715
15750	9.25188	8.9624	10.2161	11.30962	12.19751
15250	9.29416	10.61179	11.73718	12.6523	13.30588
14750	11.04174	12.16367	13.07333	13.74169	14.08846
14250	12.58545	13.42551	14.08312	14.45376	14.42229
13750	13.66299	14.25314	14.66233	14.67174	14.18818
13250	14.14242	14.60596	14.72516	14.26736	13.28801
12750	14.14784	14.47972	14.12965	13.11337	11.7126
12250	13.82598	13.71466	12.68354	11.51778	11.3223
11750	12.86111	12.87563	13.04091	12.89463	12.51515

11250	15.21577	14.8098	14.98874	14.99863	14.7918
10750	20.76602	19.97715	18.921	17.82176	16.76745
10250	24.64039	22.20024	20.08219	18.3243	16.86737
9750	23.97359	21.38196	19.32352	17.68379	16.28728
9250	21.47629	19.79165	18.11942	16.5635	15.15596
8750	19.58712	17.69003	16.00813	14.55854	13.32184
8250	17.32848	15.37325	13.91009	12.7733	11.86381
7750	16.99549	15.14515	13.75778	12.68197	11.81469
7250	16.04386	14.47887	13.27226	12.32022	11.54348
6750	15.70663	13.52997	12.5283	11.73602	11.08587
6250	17.44563	14.75202	12.14069	11.08217	10.54204
5750	18.22452	16.27802	14.08548	11.88163	9.9763
5250	18.12446	16.96232	15.40313	13.58658	11.69111
4750	17.32811	16.84294	15.96681	14.70767	13.17816
4250	16.19737	16.12569	15.81395	15.14387	14.11458
3750	15.06108	15.13603	15.1491	14.94884	14.43088
3250	14.06464	14.14225	14.25698	14.31957	14.19725
2750	13.22188	13.26708	13.36253	13.50101	13.59529
2250	12.49971	12.52647	12.57215	12.68156	12.83465
1750	11.86302	11.89307	11.90341	11.95458	12.07494
1250	11.28745	11.3353	11.33458	11.33951	11.39848
750	10.7586	10.83027	10.83707	10.81946	10.82567
250	10.26828	10.36411	10.38854	10.36882	10.34387

Y-COORD (METERS)	X-COORD (METERS)				
	17750	18250	18750	19250	19750
19750	6.80569	7.39912	7.77653	7.92754	7.93499
19250	7.43349	7.85064	8.03532	8.08787	7.98699
18750	7.90975	8.13351	8.23064	8.24631	8.99618
18250	8.21897	8.36127	8.53505	9.33828	9.99788
17750	8.47811	8.83869	9.69922	10.40261	10.91557
17250	9.15775	10.07868	10.82862	11.36912	11.6776
16750	10.47549	11.27366	11.8431	12.15639	12.20769
16250	11.73294	12.33209	12.65031	12.6782	12.4332
15750	12.82575	13.14987	13.1532	12.85312	12.29564
15250	13.63858	13.61906	13.26099	12.61745	11.76374
14750	14.05371	13.63909	12.9044	11.94152	10.8477
14250	13.96099	13.13439	12.05663	10.84813	11.01542
13750	13.27638	12.08236	11.14654	11.25489	11.18513

13250	11.98303	11.34978	11.29804	11.04025	10.57421
12750	11.38786	11.15347	10.67758	10.16306	10.33351
12250	11.27326	11.1507	10.88285	10.77134	10.65533
11750	11.99196	11.4849	11.64975	11.72317	11.71483
11250	14.46563	14.07638	13.6522	13.20887	12.75663
10750	15.79188	14.90586	14.10867	13.38737	12.73196
10250	15.66146	14.63694	13.74443	12.96917	12.28729
9750	15.06863	14.00771	13.05893	12.20296	11.44308
9250	13.91197	12.83735	11.91818	11.13136	10.45405
8750	12.27078	11.37727	10.61578	9.96356	9.5487
8250	11.12039	10.50137	9.97649	9.52411	9.12863
7750	11.09396	10.48144	9.95214	9.48933	9.08126
7250	10.88818	10.31976	9.81686	9.36674	8.96151
6750	10.53004	10.03781	9.59115	9.18018	8.79983
6250	10.08289	9.67413	9.29726	8.94226	8.60465
5750	9.59709	9.26277	8.95431	8.66019	8.37462
5250	9.85835	8.8171	8.57012	8.3348	8.10372
4750	11.52277	9.86435	8.28655	7.96799	7.78844
4250	12.81284	11.35507	9.84823	8.3754	7.43511
3750	13.58353	12.46828	11.17801	9.80619	8.43287
3250	13.79554	13.09396	12.13367	10.98809	9.73843
2750	13.52939	13.21815	12.6348	11.80485	10.78569
2250	12.9501	12.9265	12.68686	12.20042	11.48095
1750	12.2374	12.36758	12.37648	12.19413	11.78776
1250	11.52752	11.69615	11.83683	11.87094	11.73487
750	10.89327	11.02927	11.20187	11.34999	11.40382
250	10.35527	10.43143	10.57286	10.74787	10.90117

5.0 ENVIRONMENTAL MONITORING PROGRAMME

5.1 INTRODUCTION

The monitoring and evaluation of the management measures envisaged are critical activities in implementation of the Project. Monitoring involves periodic checking to ascertain whether activities are going according to the plan. It provides the necessary feedback for project management to keep the program on schedule. The purpose of the environmental monitoring plan is to ensure that the envisaged purpose of the project is achieved and results in desired benefits.

To ensure the effective implementation of the proposed mitigation measures, the broad objectives of monitoring plan are:

- To evaluate the performance of mitigation measures proposed in the EMP.
- To evaluate the adequacy of Environmental Impact Assessment
- To suggest improvements in environmental management plan, if required
- To enhance environmental quality.
- To implement and manage the mitigative measures defined in EMP.
- To undertake compliance monitoring of proposed project operation and evaluation of mitigative measure.

5.2 ENVIRONMENTAL ASPECTS TO BE MONITORED

5.2.1 General

Several measures have been proposed in the environmental mitigation measures for mitigation of adverse environmental impacts. These shall be implemented as per proposal and monitored regularly to ensure compliance to environmental regulation and also to maintain a healthy environmental conditions around the steel works.

A major part of the sampling and measurement activity shall be concerned with long term monitoring aimed at providing an early warning of any undesirable changes or trends in the natural environment that could be associated with the plant activity. This is essential to determine whether the changes are in response to a cycle of climatic conditions or are due to impact of the plant activities. In particular, a monitoring strategy shall be ensured that all environmental resources, which may be subject to contamination, are kept under review and hence monitoring of the individual elements of the environment shall be done. During the operation phase Environmental Management Department (EMD) shall undertake all the monitoring work to ensure the effectiveness of environmental mitigation measures. The suggestions given in the Environmental Monitoring Programme shall be implemented by the EMD by following an implementation schedule.

In case of any alarming variation in, ground level concentration in ambient air, stack emission, work zone air and noise monitoring results, performance of effluent treatment facilities, wastewater discharge from outfalls, etc. shall be discussed in the EMD and any variance from norms shall be reported for immediate rectification action at higher management level. In addition to the monitoring programme the following shall also be done to further ensure the effectiveness of mitigation measures:

- Quarterly internal environmental audits shall be carried out to check for compliance with standards / applicable norms by in-house experts.
- Third party environmental audits shall be carried out once every year.
- In addition to the above, all necessary steps to have been taken to implement the measures suggested by Central Pollution Control Board (CPCB) in the Charter on Corporate Responsibility for Environmental Protection (CREP) for Integrated Iron and Steel Industry. These measures have already been included in the plant design, for example:
- Direct injection of reducing agents for example, pulverized coal into the Blast Furnaces.
- 100% utilisation of Blast Furnace and Steel Melting Slag.
- Hazardous wastes to be handled and disposed off strictly in accordance with Hazardous Wastes (Management and Handling) Rules, 2003.
- Specific water consumption to be brought down to less than 8 m3/t of crude steel.
- Promotion of Energy Optimization Technology including periodic energy audits.
- All new stacks to be provided with continuous stack monitoring facilities.

The environmental aspects to be monitored to ensure proper implementation and effectiveness of various mitigative measures envisaged / adopted during the design and commissioning stage of the proposed expansion plan are described here under.

5.2.2 Maintenance of Drainage System

The effectiveness of the drainage system depends on proper cleaning of all drainage pipes/channels. Regular checking will be done to see that none of the drains are clogged due to accumulation of sludge/sediments. The catch-pits linked to the storm water drainage system from the raw material handling areas will be regularly checked and cleaned to ensure their effectiveness. This checking and cleaning will be rigorous during the monsoon season, especially if heavy rains are forecast.

5.2.3 Meteorology

It is necessary to monitor the meteorological parameters regularly for assessment and interpretation of air quality data. The continuous monitoring will also help in emergency planning and disaster management. The proposed plant shall have a designated automatic weather monitoring station. The following data shall be recorded and archived:

- Wind speed and direction
- Rainfall
- Temperature and humidity
- Solar Radiation

5.2.4 Plant Stack Emissions Monitoring

Periodical monitoring of stacks for PM, SO_2, NOx in case of process stacks shall be done to assess the performance of pollution control facilities installed for the unit. In case emissions are found to exceed the norms, the 'on duty' personnel shall check the relevant process parameters and take appropriate corrective action.

All major stacks for the proposed plant will be provided with on-line monitoring system.

After the implementation of project, the stacks will be monitored as per plan given in **Table 5.1** *.

Table 5.1: Stacks to be Monitored after the Implementation of the Project

Shop / Unit	Nos. of Stacks (Working)	Monitoring Frequency Per Month
1. Sinter Plants Process	One (in rotation)	2
2. Coke Ovens	One (in rotation)	2
3. Pellet Plant	One (in rotation)	2
4. DRI Plant	One (in rotation)	2
5. Blast Furnaces Process	One (in rotation)	2
6. Steel Melting Shop Process	One (in rotation)	2
7. Hot Strip Mill	One (in rotation)	2
8. Dolo Plant Process	One (in rotation)	2
9. Lime Calcination Plant Process	One (in rotation)	2
10. Power Plants Process	One (in rotation)	2
*** Parameters = TPM, SO_2, NO_X & CO**		

Further for the units / facilities commissioned during the proposed plant the following shall be followed:

- Along with the performance and guarantee test of main plant equipment, performance and guarantee test of pollution control equipment will be made before taking over the various units. EMD shall also be a party in preliminary and final acceptance tests.
- A detailed maintenance schedule shall be drawn for all pollution control systems. The maintenance shall be done strictly as per schedule and guidelines furnished by plant manufacturer.

5.2.5 Solid / Hazardous Waste Generation & Utilisation

Maximum re-cycling and utilization of generated waste as per guidelines shall be done. Hazardous waste shall be disposed off as per applicable statutory conditions.

5.2.6 Green Belt Development

The following plan has been made for implementation:

- Annual plans for tree plantation with specific number of trees to be planted shall be made. The fulfillment of the plan shall be monitored by the EMD every six months.
- A plan for post plantation care will be reviewed in every monthly meeting. Any abnormal death rate of planted trees shall be investigated.
- Watering of the plants, manuring, weeding, hoeing will be carried out for minimum 3 years.

5.2.7 House Keeping

The Safety Department will keeping a very close monitoring of house keeping activities and organising regular meetings of joint forum at the shop level (monthly), zonal level – (once in two months) and apex level (quarterly). The individual shop concern will be taking care for the house keeping of shops.

5.2.8 Occupational Health and Safety

Routine medical examination of personnel will be carried out in a systematic programme at plant medical unit. A systematic programme for medical check-up at regular intervals shall be followed for all workers to ascertain any changes in health condition due to the working conditions.

5.2.9 Socio-Economic Development

The setting up of the steel plant will improve the infra-structure & economic conditions thus will improve the socio economic development. The communities, which are benefited by the steel plant, are thus one of the key stakeholders for the steel plant. It is suggested that the plant management should have structured interactions with the community to disseminate the measures taken by the steel plant and also to elicit suggestions for overall improvement for the development of the area.

5.2.10 Effluent Quality

Effluent characteristics at inlet and out let of Effluent Treatment Plant (ETP) dedicated to different units shall be regularly monitored* (as per **Table 5.2)** to assess the performance of different effluent treatment facilities**.**

Table 5.2: Monitoring of Effluent Outlet & Inlet of ETP

Description	Nos. of Locations	Monitoring Frequency
In let and out let of ETP of different units	6X2	Once a month
*** Parameters = pH, SS, Phenol, Cyanide, COD, BOD, DO, NH3-N, Temp., O & G**		

5.2.11 Work Zone Air Quality

Work zone air quality will be monitored as per directives of KSPCB to assess the levels of Particulate matter, NO_x and SO_2 in the work zone.

5.2.12 Work Zone Noise

Noise levels shall be measured at the source of generation. The noise attenuation measures have been taken at the design stage of the plant itself. However in case of high noise generating equipment which are not frequented by the plant personnel, the area shall be cleanly marked as 'High Noise" area and the employees be provided with personal protective equipment like ear plugs/ear muffs.

After the implementation of the project, the noise level shall be monitored* as given in **Table 5.3** and all preventive measures shall be followed. Work zone noise shall be monitored at all units to cover all shift operations once in a year.

Table 5.3: Noise Level to be Monitored after Expansion

Description	Nos. of Locations	Monitoring Frequency
Work zone Noise	At all shops eight hours per shift continuous to cover all shift operations once in a year	Once in a year to cover all shifts
***Noise Level in Leq (A)**		

5.2.13 Ambient Air Quality

It is necessary to monitor the air quality at the boundary of the steel works specifically with respect to particulates. It is proposed that continuous particulate matter monitoring stations be established at two locations of the steel works. The equipment shall have facilities to monitor both PM 10 and PM 2.5 particulates.

After the implementation of the expansion plan the ambient air shall be regularly monitored* as given in **Table 5.4.**

Table 5.4: Ambient Air to be Monitored

Description	Number of AAQ Stations	Monitoring Frequency
1. Ambient Air Quality	4	Once (for 8 hours continuous) per month
2. Online Particulate Matter Monitoring at Steel Plant Boundary	2	Continuous
*** Parameters = $PM_{2.5}$, PM_{10}, SO_2, NO_X, CO, O_3, NH_3, Benzene, BaP, Pb, As and Ni**		

5.2.14 Wastewater Discharge from Plant Outfalls

A small quantity of wastewater will be discharged from the plant after treatment. Majority of the treated wastewater will be utilized with in the plant area for dust suppression and afforestation.

5.2.15 Ambient Noise

Ambient noise shall be monitored at six locations all along the boundary once in a month.

5.2.16 Ground Water Monitoring

Ground water shall be sampled from up gradient and down gradient of the plant including slag dump area to check for possible contamination and to ascertain the trend of variation in the water quality, if any. In case any adverse trend is noticed, immediate remedial measures shall be taken. A total of nine samples (two inside the plant area & seven out side) shall be monitored once in a month for the critical parameters.

5.3 MONITORING PLAN

5.3.1 General

The target of the Environmental Control Department implementing the environmental monitoring plan on a short-term basis would be to:

- Prepare specific unit operation plan for different shops along with Human Resource Department ;
- Interpret requirements of the EIA documentation into an environmental education plan;
- Assist engineering team with the incorporation of EMP requirements in contract specifications and contract terms and conditions;
- Undertake and/or co-ordinate all internal compliance monitoring and evaluation and external monitoring through suitable outside consulting firm;
- Advice the top management on all matters related to environmental requirements of the project;
- Provide all necessary specialized environmental expertise as needed during the project period.

The long-term objective of EMD would be to build environmental awareness and support, both within and outside the plant premises. The other long-term tasks would be to develop environmental training programme for the target groups of different units of the plant.

The environmental monitoring plan contains:

- Performance indicators
- Environmental monitoring programme
- Progress of Monitoring and Reporting Arrangements
- Budgetary provisions
- Procurement Schedules

5.3.2 Performance Indicators

The physical, biological and social components identified to be particularly significant in affecting the environment at critical locations have been suggested as Performance Indicators (PIs). The performance indicators will be evaluated under two heads:

a) Environmental condition indicators to determine efficiency of environmental management measures in control of air, noise and water pollution and solid waste disposal.
b) Environmental management indicators to determine compliance with the suggested environmental management measures.

The Performance Indicators and monitoring plans will be prepared for the project for effective monitoring.

5.3.3 Environmental Monitoring Programme

The Environmental Monitoring Plan during construction and operation stages envisaged for the proposed project, for each of the environmental condition indicator is given in **Table 5.5A & B**.

The monitoring plan specifies:

- Parameters to be monitored
- Location of the monitoring sites
- Frequency and duration of monitoring
- Special guidance
- Applicable standards
- Institutional responsibilities for implementation and supervision

Table 5.5: Part A - Environmental Monitoring Programme

Environmental Issue/ Impacts	Mitigation Measure	Reference to Contract Documents	Approximate Location	Time Frame	Mitigation Cost	Institutional Responsibility	
						Implemen-tation	Super-vision
Construction Stage							
1. Dust Generation	All possible measures will be done to minimize dust generation during construction, like water spraying, etc.	Project Requirement	Construction site within plant	During construction stage	Project preparation cost	Contractor	Projects
2. Solid Waste disposal	Solid waste generated during construction will be disposed in pre-identified dumping area.	-Do-	Construction site within plant and dumping area.	-Do-	-Do-	-Do-	-Do-
3. Air Quality at construction site	Air Quality with respect to various pollutants shall be monitored.	-Do-	At construction site	-Do-	-Do-	-Do-	-Do-
4. Environmental Protection Measures	Implementation/Installation of all Environmental Protection Measures as envisaged in **Chapter 3 & 4** for controlling/abating pollution.	-Do-	Different units under expansion	-Do-	-Do-	-Do-	-Do-
Operation Stage							
1. Environmental Protection Measures	Proper functioning of all Environmental Protection Measures as envisaged in **Chapter 3 & 4** for controlling/abating pollution.	Project/Statutory requirement	Different units under expansion	Continuousl y	Production cost	Concerned Plant Units/EMD	Top Manageme nt
2. Maintenance of Storm Water Drainage System	The drains will be periodically cleared to maintain storm water flow within the Plant.	-Do-	Entire drainage network of the plant.	Beginning and end of each monsoon.	Productionc ost	Contractor	Civil Maint.Depa rtment
3. Meteorology	Meteorological parameters through a continuously monitoring system.	-Do-	Suitable location within plant premises	Continuousl y	environmen tal monitoringc ost	EMD /Pollution Monitoring Agency,	Top Manageme nt
4. Stack emissions / Performance of stack emissions pollution control facilities	Out let of all process & de-dusting (major) stacks in different units.	-Do-	All units of the proposed expansion plan	Through out operation stage	-Do-	-Do-	-Do-
5. Particulate Monitoring inside Plant Boundary	Online SPM Monitoring at two locations.	-Do-	Inside the plant	Continuousl y	-Do-	-Do-	-Do-
6. Solid waste/Hazardous Waste generation and utilisation	Maximum re-cycling and utilization of generated solid waste as per EMP	-Do-	All units of the expansion plant generating & utilization solid wastes	-Do-	-Do-	Concerned Plant Units/EMD	-Do-

Environmental Issue/ Impacts	Mitigation Measure	Reference to Contract Documents	Approximate Location	Time Frame	Mitigation Cost	Institutional Responsibility	
						Implemen-tation	Super-vision
7. Green Belt	Already good green cover exists, efforts to further strengthen the green cover	-Do-	Planting trees in the open area	-Do-	-Do-	Horticulture Department/EMD	-Do-
8. House Keeping	Cleanliness of work place	Corporate responsibility	All units of the expansion plant	-Do-	-Do-	All responsible units/safety Dept./EMD	-Do-
9. Occupational Health	Health of workers / Staff	-Do-	-Do-	-Do-	-Do-	Plant Medical Unit	-Do-
10. Socio-economic Development	Structured interactions with the community to disseminate the measures taken by the steel plant and also to elicit suggestions for overall improvement for the development of the area	-Do-	Stake Holders	-Do-	CSR cost	Personnel Dept. / EMD	-Do-
11. Performance of Effluent Treatment Facilities	Effluent Treatment facilities installed at different units	Statutory requirement	All units of the expansion plant	-Do-	Environmental Cost	Concerned plant units/ EMD	-Do-
12. Work zone Air Quality	At all units of the plant	-Do-	-Do-	-Do-	-Do-	Safety Dept.	-Do-
13. Work zone Noise levels	At all units of the plant	-Do-	-Do-	-Do-	-Do-	Safety Dept.	-Do-
14. Atmospheric Pollution (AAQ)	Ambient Air Quality with respect to various pollutants shall be monitored as envisaged in the pollution-monitoring plan.	-Do-	As per specified AAQ monitoring programme	-Do-	-Do-	EMD	-Do-
15. Ambient Noise	Noise pollution will be monitored.	-Do-	As per the noise pollution monitoring programme	-Do-	-Do-	-Do-	-Do-
16. Ground Water Quality	Changes in ground water quality will be monitored in the up-gradient and down gradient of the plant including slag dump will be monitored	-Do-	As per ground water monitoring programme	-Do-	Env. Cost	-Do-	-Do-

Note: EMP = environmental management plan, EMD = Environmental Management Department , CSR= Corporate Social Responsibility, RPM = Respirable particulate matter, SO2 = sulphur di-oxide, NOx = nitrogen oxides, CO = carbon mono-oxide, HC = hydrocarbons, Pb = lead, CSR – Corporate Social Responsibility.

Table 5.5: Part B: Environmental Monitoring Plan for the Performance Indicators

Environmental component	Project Stage	Parameters	Location	Frequency	Standards	Approximate cost (Rs)	Implemen-tation	Supervision
Effluent Quality	Operation stage	All the parameters as specified by statutory agencies	At outlet of different effluent treatment plants	Once in a month	IS :2490 IS:3025	2X1X12x7000 =Rs168000	EMD and / or through approved monitoring agency	EMD
Work zone Air Quality	Operation stage	As per applicable statutory standards	All units of the plant	8 hr per shift continuous (to cover all shifts of operation in a year for each unit) per year.	Factories Act	20x3X12x8000 =Rs576000	-Do-	-Do-
Ambient Air Quality	Operation stage	$PM_{2.5}$, PM_{10}, SO_2, NO_X, CO, O_3, NH_3, Benzene, BaP, Pb, As and Ni	4 locations	Once for 24 hr continuous, over the project period (once in a month per year except in monsoon) per year.	NAAQ Standards IS:5182	4X12X50,000 =Rs2400000	-Do-	-Do-
Ambient Noise levels	Operation stage	As per National Ambient Noise Standard as per Environmental Protection Act, 1986 amended 2002	All along the boundary	Once in a month during the operation period.	Noise Pollution Control Rules, 2000	6x12 x4,000 =Rs 288000	-Do-	-Do-
Ground Water Quality	Operation stage	Critical parameters as per IS 10500	5 wells (2 inside + 3 outside)	Once in a month	IS:10500	5X12x8,000 = Rs 480000	-Do-	-Do-
Stack émission monitoring	Operation stage	PM,SO2, NOx	All process stacks of plant in rotation	5 stacks in a month in rotation	IS:11255	5x12x10000 = Rs. 600,000	-Do-	-Do-
					Total	**45,12,000**	**Say 46,00,000**	

Total Monitoring Costs = Rs 46,00,000 per year during the operation year of the proposed plant

Note: CO - Carbon Monoxide; Cr - Chromium; EMD = Environmental Control Department, HC - Hydrocarbon; IS - Indian Standard; NOx - Nitrogen Oxide; Pb - Plumbum (lead); RPM - Respirable Particulate Matter; SO_2 - Sulfur Dioxide; SPM - Suspended Particulate Matter, PM - Particulate Matter

5.3.4 Progress Monitoring and Reporting Arrangements

The rational for a reporting system is based on accountability to ensure that the measures proposed as part of the Environmental Monitoring Plan get implemented in the project. The monitoring and evaluation of the management measures are critical activities in implementation of the project. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. It provides the necessary feedback for the project management to keep the programme on schedule. The rational for a reporting system is based on accountability to ensure that the measures proposed as part of Environmental Management Plan get implemented in the project.

A reporting system for environmental monitoring plan is given in **Table 5.6.**

Table 5.6: Reporting System for Environmental Monitoring Plan

S.N	Details	Indicators	Stage	Responsibility
A.	**Pre-Construction Stage: Environmental Management Indicators and Monitoring Plan**			
1	Suitable location for dumping of wastes has to be identified.	Dumping locations	Pre-construction	Projects
2	Suitable location for construction worker camps have to be identified (if applicable) and parameters indicative of environment in the area has to be reported	Construction camps	Pre-construction	Projects
B.	**Construction Stage: Environmental Condition Indicators and Monitoring Plan**			
1.	Dust suppression at construction site	Construction site	Construction	Projects
2	The parameters to be monitored as per frequency, duration & locations of monitoring specified in the Environmental Monitoring Programme	Air quality	Construction	Projects through approved monitoring agency
C.	**Operation Stage: Management & Operational Performance Indicators**			
1	Solid waste generation, utilization and dumping	As per guidelines of statutory bodies	Operation	Concerned Plant Units / EMD
2	Hazardous waste re-utilisation and dumping in designated pits as specified by statutory authorities.	As per the notifications / guidelines specified by statutory authorities.	Operation	-Do-
3	Stack Emissions from Process & de-dusting stacks	All parameters as specified for stacks of different units by Statutory Authorities	Operation	Concerned Plant Units / EMD
4	Meteorology, Ambient air quality, Waste water discharge through plant outfalls and Noise levels.	All parameters as specified by Statutory Authorities	Operation	-Do-

5.3.5 Emergency Procedures

Suitable emergency procedures will be formulated and implemented at design stage itself for tackling of emergency situations arising out of the proposed operations.

- Emergency situations arising out of non-functioning of the air pollution control systems and inter-locking of the systems.
- Emergency situations arising out of non-functioning of effluent treatment plant and suitable storage facilities for effluent generation.

- To contain oil spillage, proper system will be provided around the storage facilities to collect & use them later.

5.3.6 Budgetary Provisions for Environmental Monitoring Plan

The break-up of equipment cost for monitoring is given in **Table 5.7.** A capital cost provision of about **Rs.57,000,000/-** has been kept towards the cost of monitoring equipments for environmental laboratory in the EMP. The budgetary cost estimate for implementation of the environmental monitoring measures is elaborated in **Table 5.5 (Part B**) and the environmental protection and enhancement measures included in the project cost is given in **Table 5.5 (Part A**). The summary of the cost of environmental budgetary provisions for environmental monitoring programme is given in **Table 5.8.**

Table 5.7: Estimated Cost of Monitoring Equipments

SN.	Monitoring Equipments	Nos Required	Unit Cost (Rs)	Total Cost (Rs)
1	High Volume Sampler (HVS)	4	70,000	280,000
2	PM2.5 & PM10 Analyser	4	200,000	800,000
3	Stack Monitoring Kit (manual)	2	100,000	200,000
4	On line stack monitoring along with accessories for monitoring SO_2, NOx, CO_2, CO & PM	19	100,000	1,900,000
5	On Line AAQ Monitoring Station	3	12,500,000	37,500,000
6	Flue Gas Analyser	1	300,000	300,000
7	Sound Level Meter	1	100,000	100,000
8	Automatic Weather Monitoring Station	1	400,000	400,000
9	Ion Analyser with Autotitrator	1	350,000	350,000
10	Hot Air Oven	1	25,000	25,000
11	Hot Plate	2	10,000	20,000
12	Muffle Furnace	1	70,000	70,000
13	BOD Incubator	1	70,000	70,000
14	BOD Apparatus, Oxitop	1 set of 6	50,000	50,000
15	DO Meter	1	60,000	60,000
16	Spectrophotometer with COD Digestion Assembly	1	300,000	300,000
17	pH meter	2	35,000	70,000
18	Conductivity Meter	1	25,000	25,000
19	AAS along with Graphite furnace, Hydride Generator and Cold Vapour Technique	1	2,000,000	200,0000
20	CO Analyser (NDIR)	1	1,000,000	1,000,000
21	Gas Chromatograph	1	1,000,000	1,000,000
22	High Pressure Liquid Chromatograph (HPLC)	1	1,500,000	1,500,000
	Digital Micro-Balance	1	125,000	125,000
23	Digital Top Load Balance (Range 1 to 500g)	1	30,000	30,000

SN.	Monitoring Equipments	Nos Required	Unit Cost (Rs)	Total Cost (Rs)
24	Filtration Apparatus	2	20,000	20,000
25	Heating mental	2	2,500	2,500
26	Refrigerator	1	20,000	20,000
27	Fuming Chamber	1	200,000	200,000
28	Water Bath	1	20,000	20,000
29	Vacuum pump	1	25,000	25,000
30	Turbidity Meter	1	30,000	30,000
31	Filter Papers, Glassware, Plastic wares, Chemicals	In Lot	-	1,000,000
			Total	**56,815,000/- Say Rs.57,000,000/-**

Table 5.8: Summary of Cost of Environmental Monitoring Plan

SN.	Item	Cost in Rs.
A.	**Capital Cost**	
1.	Cost of Environmental Monitoring Equipments	**Rs. 57,000,000/-**
	Total Capital Cost	**Rs. 57,000,000/-**
B.	**Operation Phase**	**Recurring Cost in Rs./yr.**
1	**Environmental Monitoring Plan**	
	Monitoring during operation @ **Rs 46,00,000/yr** for the operation phase of the proposed Integrated Steel Plant	**46,00,000**
	Total	**46,00,000**
2	Contingency @ 5% of Monitoring during operation	**230000**
	Total Recurring Cost	**48,30,000/-**

***Note: estimates are on the basis of present cost (2010)**

5.3.7 Budgetary Provisions for Environmental Protection Measures

Total capital cost of the project will be around **Rs. 16,000 Crores.** The environmental protection and enhancement measures (as mentioned in **Chapters 4.0)** included in the project cost in **Table 5.5 (Part A),** as estimated are given in **Table 5.9**.

Table 5.9: Cost of Environmental Protection Measures (Rs. Crores)

SN	Environmental Protection Measures	Recurring Cost per annum	Capital Cost (Rs. Crores)
1	Air Pollution Control	50	400
2	Water Pollution Control	15	80
3	Noise Pollution Control	Included in item no.1	Included in 1
4	Environment Monitoring Programme	0.46	5.0
5	Green Belt	0.10	8.0
6	Others (Solid waste management, ventilation / air conditioning, fire fighting etc.)	42	307.0
	Total	**107.56**	**800**

Note: estimates are on the basis of present cost (2010)

5.3.8 Procurement Schedule

The construction phase of the proposed expansion will be complete in 48 months. Thus the procurement of different equipments (**Table 5.7**) shall be planned in phased manner in 48 months so as to ensure environmental enhancement measures are implemented before the commissioning of the project as planned in the EMP.

5.4 UPDATING OF EMP

The directives from MOEF and the regulations in force at any time shall govern the periodicity of monitoring. However it is suggested that the implementation of various measures recommended in the Environmental Monitoring Programme be taken as EMPs to effectively implement the measures for continual improvement in environmental performance.

6.0 ADDITIONAL STUDIES

6.1 PUBLIC CONSULTATION

Socio-economic survey was carried out covering all the villages / towns of the study area to record awareness, opinion, apprehensions, quality of life and expectations of the local people about the proposed expansion plant. The opinion of local people about the expansion plan was obtained through socio-economy survey of the villages in the study area.

The survey has been conducted through specially designed questionnaire covering every aspect of the present study. In addition to the field data, secondary data / information collected, compiled and published by different Governmental agencies / departments were also collected and utilized appropriately.

For selection of respondents from the study area, **Two Stage Random Sampling** has been adopted. In the first stage, villages are selected and in the second stage, households/ respondents are selected. From each selected village, the respondents are selected randomly to account intra-village variability among the respondents for the character under study. As the variability of the characters under in each strata study do not vary widely among the households, a smaller sample size is expected to represent the population.

A sample of 60 respondents is drawn from the study area. The sample covers an estimated 300 persons.

Peoples' perception regarding the project is a very important factor because it is the people on whom the major part of the impact will fall. To this end, an opinion poll was conducted as a part of field survey. With a view to cover the peoples perception in the study area, an effort was made to collect the detailed information on this aspect during the field survey. People of the area are mostly aware of the activities of the project, specifically, the developmental ones. They are also quite aware of the its likely advantages and disadvantages.

The results of the poll are analysed and furnished in **Table 6.1.** It is observed that 77% of them have identified job opportunity in the plants as the main advantage. This is quite natural because any steel plant has tremendous employment potential which can fulfill the aspirations of local people of this agriculturally backward area. CSR activities of JSW were highly praised by people (about 63% of the respondents). Mid-day meals introduced by JSW is pointed out by 20% of the respondents. Pollution and toilets & water are the major disadvantages identified by the respondents

Table 6.1 : Peoples' Perception on the Project

Perception	No of respondents	Distribution (%)
ADVANTAGES		
Employment opportunity	46	76.7
Mid-day meals	12	20.0
CSR activities as a whole	38	63.3
Afforestation	27	45.0
DIS-ADVANTAGES		
Pollution	32	53.3
Toilets and water	28	46.7
Suitable jobs not given to the locals	15	25.0

Conclusions

On the basis of the overall results of the present impact assessment the following conclusions are drawn:

Overall peoples' perception on the project is good. However, few people have opinions, which are not based on scientific / technical backing. However, based on the extensive mitigation measures being adopted in the proposed expansion project, there will be more advantages.

6.2 RISK ASSESMENT

6.2.1 INTRODUCTION

Industrial activities, which produce, treat, store and handle hazardous substances, have a high hazard potential endangering the safety of man and environment at work place and outside. Recognizing the need to control and minimize the risks posed by such activities, the Ministry of Environment & Forests have notified the "Manufacture Storage & Import of Hazardous Chemicals Rules "in the year 1989 and subsequently modified, inserted and added different clauses in the said rule to make it more stringent. For effective implementation of the rule, Ministry of Environment & Forests has provided a set of guidelines. The guidelines, in addition to other aspects, set out the duties required to be performed by the occupier along with the procedure. The rule also lists out the industrial activities and chemicals, which are required to be considered as hazardous.

The proposed expansion project is engaged in the production of Steel from iron ore and other required raw materials. During the process of manufacture of steel and other associated materials hazardous gases are generated which are stored and used in the plant. In addition to this also some other hazardous chemicals, which are required in the manufacture of steel or produced as a bye product also, being stored and handled by the plant. The major chemicals handled / stored by the plant includes coke oven gas (COG), blast furnace gas (BF gas), basic oxygen furnace gas (BOF gas), LPG, different acids etc. In view of this, proposed activities are being scrutinized in line of the above referred "Manufacture, storage and import of hazardous chemicals rules" and observations / findings are presented in this chapter.

The assessment has been made in a systematic manner covering the requirements of the above-mentioned rules. Accordingly subsequent sections have been divided as follows:

- i) Process description
- ii) Applicability of the rule
- iii) Description of hazardous chemicals
- iv) Hazard identification & risk analysis (HIRA)
- v) Hazard assessment
- vi) Consequence analysis including MCACA
- vii) Brief description of the measures taken and
- viii) On site emergency plan

Accordingly next sections are elaborated.

6.2.2 PROCESS DESCRIPTION

The proposed expansion plant is following the BF- BOF-Continuous Casting Route of steel making. Iron ore lumps, sinters and, coke (made from cooking coal) and fluxes such as limestone, dolomite are the major raw materials. The main steps in manufacturing process are as follows:

<u>Coke Making - Coal Carbonisation</u>

Coking coals are the coals which when heated in the absence of air, first melt, go in the plastic state, swell and re-solidify to produce a solid coherent mass called coke. When coking coal is heated in absence of air, a series of physical and chemical changes take place with the evolution of gases and vapours, and the solid residue left behind is called coke. Coke is used in Blast Furnace (BF) both as a reductant and as a source of thermal energy. It involves reduction of ore to liquid metal in the blast furnace and refining in convertor to form steel. The various stages of the steel plant is described below

<u>Sintering</u>

Sintering is a technology for agglomeration of iron ore fines into useful Blast Furnace burden material. The raw materials used are as follows - Iron ore fines (-10 mm), coke breeze (-3 mm), Lime stone & dolomite fines (-3mm) and other metallurgical wastes. The proportioned raw materials are mixed and moistened in a mixing drum. The mix is loaded on sinter machine through a feeder onto a moving grate (pallet) and then the mix is rolled through segregation plate so that the coarse materials settle at the bottom and fines onto the top.

The top surface of the mix is ignited through stationary burners at 1200^oC. As the pallet moves forward, the air is sucked through wind box situated under the grate. A high temperature combustion zone is created in the charge -bed due to combustion of solid fuel of the mix and regeneration of heat of incandescent sinter and outgoing gases. Due to forward movement of pallet, the sintering process travels vertically down. Sinter is produced as a combined result of locally limited melting, grain boundary diffusion and recrystallisation of iron oxides.

On the completion of sintering process, finished sinter cake is crushed and cooled. The cooled sinter is screened and is dispatched to blast furnace.

Blast Furnace

The Blast furnace iron making process basically consists of the conversion of iron oxide to iron in liquid form. This requires reductant for reduction of iron oxide and heat for the above reduction reaction to take place and for melting the products of smelting. The primary source to fulfill both these requirements is carbon (in the form of coke).The blast furnace is a vertical counter-current heat exchanger as well as a chemical reactor in which burden material charged from the top descend downward and the gasses generated at the tuyere level ascend upward.

The top gas containing the flue dust is routed from the furnace top to the gas purifiers and then to the consumption zones. The hot air for combustion is injected through water-cooled tuyeres into the blast furnace. Hot metal is tapped through the tap hole, which is opened by power driven drills into a train of ladles kept below the runner of the cast house. Slag comes along with the metal and is skimmed off with the help of skimmer plate towards slag runner and is collected in slag thimbles. Raw material (ore, sinter, coke) are screened before being charged into the blast furnace through conveyors or skip. Air for combustion in the blast furnace is blown from turbo blowers, which are preheated in hot blast stoves to temperatures around 1300^oC, which is then blown through tuyers into the blast furnace. Each blast furnace is equipped with two or more stoves, which operate alternatively. Preheating of air helps in reducing fuel consumption in the furnace.

Hot metal produced in the blast furnace is sent to Basic oxygen Furnace for steel making or to Pig casting machines.

Pre-Treatment Of Hot Metal

Hot metal from blast furnaces is treated to remove undesired elements like sulphur, silicon or phosphorous before being transformed to steel. Desulphurising agents are applied to reduce sulphur content of the metal.

Basic Oxygen Furnace

The basic oxygen furnace (LD convertor) is a pear shaped vessel lined inside with refractory bricks. The vessel lining consists of tar bonded dolomite /magnesia carbon bricks or other refractories. The vessel can be rotated 360 degree on its axis. Oxygen is blown into the vessel with the help of water-cooled lance.

The 'heat' begins with the addition of scrap into the slightly tilted convertor, hot metal is then added after straightening the convertor, and Oxygen is blown into the bath through the lance .The necessary fluxes are added during blowing. Flux addition is done automatically and precisely through bunkers situated above the convertor. A sample is taken after blowing for 16-18 minutes and temperature is measured using a thermocouple. The steel is tapped by tilting the convertor to the tapping side and alloying elements are added via chutes while metal is being tapped The convertor is tilted to the charging side in order to remove the floating slag.

Reaction

During blowing operation, oxygen oxidises iron into iron oxide and carbon into carbon monoxide. The iron oxide immediately transfers the oxygen to the tramp elements. The center of the reaction has temperatures of around 2000^o-2500^{o}C. The development of carbon monoxide during refining process promotes agitation within the molten bath. The reaction of the tramp elements with the oxygen and the iron oxide developed in the center of reaction leads to formation of reactive slag. As blowing continues, there is a continuous decrease of carbon, phosphorous, manganese and silicon within the melt. Phosphorous is removed by inducing early slag formation by adding powder lime with oxygen. The refining process is completed when the desired carbon content is attained. The steel produced in the basic oxygen furnace is sent to continuous casting or for ingot teeming.

Continuous Casting

During continuous casting, the liquid steel passes from the pouring ladle, with the exclusion of air, via a tundish with an adjustable discharge device into the short, water-cooled copper mould. The shape of the mould defines the shape of the steel. Before casting, the bottom of the mould is sealed with a so-called dummy bar. As soon as the bath reaches its intended steel level, the mould starts to oscillate vertically in order to prevent the strand adhering to its walls. The red-hot strand, solidified at the surface zones, is drawn from the mould, first with the aid of a dummy bar, and later by driving rolls. Because of its liquid core, the strand must be carefully sprayed and cooled down with water. Rolls on all sides must also support it until it has completely solidified. This prevents the still thin rim zone from disintegrating. Once it has completely solidified, mobile cutting torches or shears can divide the strand. Intensive cooling leads to a homogeneous solidification microstructure with favourable technological properties.

From the process description it can be noticed that the process of manufacture requires considerable thermal energy. This thermal energy is supplied through fuel gasses generated in the plant e.g. Coke oven gas, Blast Furnace gas and BOF gas. If there is any shortfall of these generated gasses then fuel gas is also supplied from outside source also. In plant generation of fuel gasses will not meet the requirement of proposed capacity. Therefore use of LPG has been considered. Further Oxygen is also required. Therefore to run the plant, it is required to store all these chemicals along with their distribution arrangement.

6.2.3 APPLICABILITY OF THE RULE

From the above description of the process, it is observed that the chemicals handled and involved are:

(i) Blast furnace gas (ii) Coke Oven gas (iii) BOF Gas (iv) LPG

To decide whether the above mentioned industrial activities are likely to come within the scope of the above mentioned "Manufacture Storage and Import of Hazardous Chemicals Rules" and the threshold quantities mentioned in the rules are used for comparison as given in **Table 6.2.**

Table: 6.2: Threshold Quantity & the Chemicals Stored and Handled

SN	Chemical Stored / Handled	Qty. Stored / Handled (In Tonne) And Storage / Handling Conditions	Whether Included in The List of Hazardous & Toxic Chemicals	Lower Threshold Qty. (In Tonne)	Upper Threshold Qty. (In Tonne)
1	Blast Furnace Gas (Major Constituents Carbon Monoxide)	100,000 m^3 Gaseous, Ambient temp & Press.	Yes	15	200
2	Coke Oven Gas (Major Constituents Hydrogen & Methane)	2X50,000 m^3 Gaseous Ambient temp & Press.	Yes	15	200
3	BOF Gas (Major Constituents Carbon Monoxide)	40,000 m^3 Ambient temp &Press.	Yes	15	200
4	LPG	2x50 t Liquid & pressurized	Yes	25	200

After comparison of the stored / handled and threshold quantities, it can be noticed that majority of the chemicals are crossing the lower threshold quantities but are below the upper threshold quantities. Accordingly, rule nos. 7,8,9,13,14, and 15 will be applicable, whereas for the other chemical, the stored / handled quantities are less than the lower threshold quantity. Accordingly only rule 17 i.e. preparation and maintenance of material safety data sheets for these chemicals are required. Rule -7 i.e. notification of site requires submission of a written report containing among other information the followings:

a) Identification of major accident hazards
b) The conditions or events which could be significant in bringing one about
c) Brief descriptions of the measures taken
d) Area likely to be affected by the major accident etc.

6.2.4 DESCRIPTION OF HAZARDOUS CHEMICALS

The chemicals which are expected to be handled, are presented in **Table 6.2.** The Material Safety data sheets of different chemicals are presented below.

DATA SHEET

Carbon monoxide	**CAS : 630-08-0**
CO	**RTECS : FG3500000**
Synonyms & Trade Names	**DOT ID & Guide :1016 119**
Carbon oxide, Flue gas, Monoxide	**9202 168 (cryogenic liquid)**
Exposure	***NIOSH REL**: TWA 35 ppm (40 mg/m^3) C 200 ppm (229 mg/m^3)*
Limits	**OSHA PEL†: TWA 50 ppm (55 mg/m^3)**
IDLH	***Conversion***
1200 ppm See: 630080	1 ppm = 1.15 mg/m^3

Physical Description	Colorless, odorless gas. [Note: Shipped as a nonliquefied or liquefied compressed gas.]		
MW: 28.0	BP: -313°F	MLT: -337°F	Sol: 2%
VP: >35 atm	IP: 14.01 eV	RGasD: 0.97	
Fl.P: NA (Gas)	UEL: 74%	LEL: 12.5%	
Flammable Gas			

Incompatibilities & Reactivities	Strong oxidizers, bromine trifluoride, chlorine trifluoride, lithium

Measurement Methods	NIOSH 6604; OSHA ID209, ID210 See: NMAM or OSHA Methods
Personal Protection & Sanitation (See protection) Skin: Frostbite Eyes: Frostbite Wash skin: No recommendation Remove: When wet (flammable) Change: No recommendation Provide: Frostbite wash	First Aid (See procedures) Eye: Frostbite Skin: Frostbite Breathing: Respiratory support
Respirator Recommendations	NIOSH
Up to 350 ppm	(APF = 10) Any supplied-air respirator
Up to 875 ppm	(APF = 25) Any supplied-air respirator operated in a continuous-flow mode
Up to 1200 ppm:	(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern† (APF = 50) Any self-contained breathing apparatus with a full facepiece (APF = 50) Any supplied-air respirator with a full facepiece

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions

(APF = 10,000) Any self-contained breathing apparatus that has a full face-piece and is operated in a pressure-demand or other positive-pressure mode (APF = 10,000) Any supplied-air respirator that has a full face-piece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus.

Escape

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern†/Any appropriate escape-type, self-contained breathing apparatus

Important Additional Information About Respirator Selection

Exposure Routes

Inhalation, skin and/or eye contact (liquid)

Symptoms

Headache, tachypnea, nausea, lassitude (weakness, exhaustion), dizziness, confusion, hallucinations; cyanosis; depressed S-T segment of electrocardiogram, angina, syncope

Target Organs

Cardiovascular system, lungs, blood, central nervous system

DATA SHEET

METHANE	**ICSC: 0291** **October 2000**
Methyl hydride	
CAS No: 74-82-8 RTECS No: PA1490000 UN No: 1971 EC No: 601-001-00-4	(cylinder) CH_4 Molecular mass: 16.0

Types of Hazard / Exposure	Acute Hazards / Symptoms	Prevention	First Aid / Fire Fighting
FIRE	Extremely flammable.	NO open flames, NO sparks, and NO smoking.	Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out; in other cases extinguish with water spray, powder, carbon dioxide.
EXPLOSION	Gas/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools.	In case of fire: keep cylinder cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE			
Inhalation	Suffocation. See Notes.	Ventilation. Breathing protection if high concentration.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
Skin	ON CONTACT WITH LIQUID:	Cold-insulating gloves.	ON FROSTBITE: rinse with plenty of water, do NOT

Types of Hazard / Exposure	Acute Hazards / Symptoms	Prevention	First Aid / Fire Fighting
	FROSTBITE.		remove clothes. Refer for medical attention.
Eyes	ON CONTACT WITH LIQUID: FROSTBITE.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion			

SPILLAGE DISPOSAL	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Ventilation. Remove all ignition sources. Personal protection: self-contained breathing apparatus. NEVER direct water jet on liquid.	F+ Symbol R: 12 S: (2-)9-16-33 UN Hazard Class: 2.1

EMERGENCY RESPONSE	SAFE STORAGE
Transport Emergency Card: TEC (R)-20G1F NFPA Code: H 1; F 4; R 0	Fireproof. Cool. Ventilation along the floor and ceiling.

IMPORTANT DATA	
Physical State; Appearance COLOURLESS, COMPRESSED LIQUEFIED GAS, WITH NO ODOUR. **Physical dangers** The gas is lighter than air. **Occupational exposure limits** TLV: Simple asphyxiant (ACGIH 2000). MAK not established.	**Routes of exposure** The substance can be absorbed into the body by inhalation. **Inhalation risk** On loss of containment this gas can cause suffocation by lowering the oxygen content of the air in confined areas. **Effects of short-term exposure** Rapid evaporation of the liquid may cause frostbite.

Physical Properties	Environmental Data
Boiling point: -161°C Melting point: -183°C Solubility in water, ml/100 ml at 20°C: 3.3 Relative vapour density (air = 1): 0.6 Flash point: Flammable Gas Auto-ignition temperature: 537°C Explosive limits, vol% in air: 5-15 Octanol/water partition coefficient as log Pow:	

Physical Properties	Environmental Data
1.09	
Notes: Density of the liquid at boiling point: 0.42 kg/l. High concentrations in the air cause a deficiency of oxygen with the risk of unconsciousness or death. Check oxygen content before entering area. Turn leaking cylinder with the leak up to prevent escape of gas in liquid state. After use for welding, turn valve off; regularly check tubing, etc., and test for leaks with soap and water. The measures mentioned in section PREVENTION are applicable to production, filling of cylinders, and storage of the gas. Other UN number: 1972 (refridgerated liquid), Hazard class: 2.1. Card has been partly updated in October 2005. See section Emergency Response.	

DATA SHEET

LPG	**CAS : 68476-85-7**
$C_3H_8/C_3H_6/C_4H_{10}/C_4H_8$	**RTECS : SE7545000**
Synonyms & Trade Names	**DOT ID & Guide : 1075 115**
	Bottled gas, Compressed petroleum gas, Liquefied hydrocarbon gas, Liquefied petroleum gas, LPG [Note: A fuel mixture of LPG, propylene, butanes & butylenes.]
Exposure	**NIOSH REL**: TWA 1000 ppm (1800 mg/m^3)
Limits	**OSHA PEL**: TWA 1000 ppm (1800 mg/m^3)
IDLH	**Conversion**
1 ppm = 1.72-2.37 mg/m^3	2000 ppm [10%LEL] See: 68476857

Physical Description	Colorless, non-corrosive, odorless gas when pure. [Note: A foul-smelling odorant is usually added. Shipped as a liquefied compressed gas.]		
MW: 42-58	BP: >-44°F	FRZ: ?	Sol: Insoluble
VP: >1 atm	IP: 10.95 eV	RGasD: 1.45-2.00	
Fl.P: NA (Gas)	UEL: 9.5% (LPG) 8.5% (Butane)	LEL: 2.1% (LPG) 1.9% (Butane)	
Flammable Gas			
Incompatibilities & Reactivities	Strong oxidizers, chlorine dioxide		
Measurement Methods	NIOSH S93 (II-2) ; See: NMAM or OSHA Methods		

Personal Protection & Sanitation	First Aid
Skin: Frostbite , Eyes: Frostbite Wash skin: No recommendation Remove: When wet (flammable) Change: No recommendation Provide: Frostbite wash	Eye: Irrigate immediately (liquid) Skin: Water flush immediately (liquid) Breathing: Respiratory support
Respirator Recommendations	NIOSH/OSHA
Up to 2000 ppm	(APF = 10) Any supplied-air respirator(APF = 50) Any self-contained breathing apparatus with a full face-piece

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus.

Escape

Any appropriate escape-type, self-contained breathing apparatus

Important Additional Information About Respirator Selection

Exposure Routes

Inhalation, skin and/or eye contact (liquid)

Symptoms

Dizziness, drowsiness, asphyxia; liquid: frostbite

Target Organs

Respiratory system, central nervous system

6.2.5 HAZARD IDENTIFICATION

Hazards associated with the above mentioned chemicals are presented in **Table 6.3.** .

Table 6.3: Type Of Hazards

Name of the Chemical	Type of Hazard	Hazard Rating			IDLH Value	Vap. Press @ latm.	Remarks
		Health	Flammability	Reactivity			
LPG	1, 9	1	4	0	--	--	Liquified under pressure & stored at ambient temp.
Hydrogen	1, 6, 9	0	4	0	--	--	Gas stored under pressure at ambient temp.
Carbon monoxide	1,3,9	2	4	0			Gas stored under pressure at ambient temp.
Methane		1	4	0			Gas stored under pressure at ambient temp.

<u>Note:</u>

Type of Hazard

1. Flammable substance
2. Oxidising substance, reacts with reducing agents
3. Emits a toxic gas or vapour
4. Emits an irritating gas or vapour
5. Emits a narcotic gas or vapour
6. Gas or vapour not dangerous other than displacing air
7. Causes skin irritation or burns
8. Toxic substance
9. Explosive material under certain conditions

Hazard Rating

a. <u>Health</u>

1 None
2 Minor
3 Moderate, could cause temporary incapacitation or injury
4 Severe, short exposure may cause serious injury
5 Extreme, short exposure may cause death

b. Flammability

1 None, Material does not burn
2 Minor, material must be preheated to ignite
3 Moderate, moderate heating is required for ignition and volatile vapours are released
4 Severe, material ignites at normal temperature
5 Extreme, very flammable substance that readily forms explosive mixtures

c. Reactivity

1 None, stable when exposed to fire
2 Minor, unstable at high temp. or press and may react with water
3 Moderate, unstable but does not explode, may form explosive mixture with water
4 Severe, Explodes if heated or water added
5 Extreme, readily explosives under normal condition

From the above table it can be observed that LPG, BF, BOF and CO gas are most `dangerous' materials since all these are gaseous under ambient condition except these chemicals, all others are liquid at ambient condition. Further, among LPG, BF, BOF and CO gas, except LPG, all are stored more or less under ambient temperature and pressure. The catastrophic potential of a hazardous substance depends both on toxicity and volatility. The ambient temperature vapour pressure of a substance is used as a measure of the ability to become air borne. Since LPG is gaseous at ambient temperature and pressure and are stored in pressurised condition to keep it in liquid form, the catastrophic potential of this chemical is maximum. Accordingly, the consequence analysis carried out subsequently covers analysis of LPG only since the release of this quantity and in case of any eventuality it may affect the maximum area.

6.2.6 HAZARD ASSESSMENT

In the earlier section, type of hazard associated with different type of chemicals and the event of release of these chemicals is being identified. It has also been identified the category of hazard associated with different chemicals. LPG is stored under pressurised condition with elaborate arrangement for controlling storage pressure and distribution facilities whereas all other chemicals are stored under ambient temperature and pressure or in liquid condition.

Hazardous situation arising due to:

- Failure in the monitoring of crucial process parameters e.g. pressure, temperature, flow quantity etc.
- Failure in the utilities e.g. cooling water
- Failure control elements e.g. pressure, temperature level, flow controllers etc.
- Failure of components such as pumps, compressor etc.

- Failure of safety systems, safety valves / relief valves, sprinkler systems, alarm etc.
- Mechanical failure of vessels or pipe work due to excessive stress, over pressure, corrosion etc.
- Wrong operation, failing to adhere to the safety norms etc.

It has been mentioned that release of LPG may lead to hazardous situation in case of accidental release of large quantity. Such situation is possible from the storage area where bulk quantities are being stored. It is unlikely that small leakage through pipes, gaskets, glands or any other means within the plant proper itself (user points) will create a hazardous situation unless allowed to be released for a long time. It is expected that during such small leakage preventive steps will be taken within a specified time span.

EFFECTS OF THE ABOVE HAZARDS

The effect of accidents in these areas will be confined to the facilities only and can be controlled within the areas by the operating personnel themselves.

At the extreme it may require the resources of the whole facility to control the effects but these are not at all expected to spill over to the community.

EXPLOSION RISK

Liquefied Petroleum Gas at LPG Complex	`BLEVE' / Unconfined Vapour cloud explosion risk

6.2.7 HAZOP Study

It is suggested to have HAZOP Study for the fuel distribution network handling facilities prior to commissioning, for last minute corrections in the design of the systems from fail safe angle. The HAZOP analysis for the fuel handling system will be carried out and suitable measures will be implemented for safe operations.

Electrical safety: Adequately rated and quick response circuit breakers, aided by reliable and selective digital or microprocessor based electro-magnetic protective relays would be incorporated in the electrical system design for the proposed project. The metering and instruments would be of proper accuracy class and scale dimensions.

6.2.8 CONSEQUENCE ANALYSIS

In this section, accident consequence analysis to determine the consequence of a potential major accident on the installation, the neighbourhood and the environment are being discussed by evaluating the consequence of incidence involving hazardous materials vis-a-vis LPG. Consequence analysis also involves assessment of release quantity which is again dependent upon chemical, storing condition, type of release, duration etc. Catastrophic flammable material normally involves the air borne release of these materials. A potential catastrophic release of flammable material would involve air borne release and subsequent explosion or fire i.e. a sufficiently large fuel – air mixture within flammable mix rapidly developed and finds a source of ignition. However LPG will be stored under pressurized condition in liquid form and is expected to be distributed to the user points in gaseous form.

When a pressurised liquified gas is released from containment, a portion flashes off. Following flash off, residual liquid is at its boiling point and the vapourisation continues as a rate limit process. The second stage of rate limit vapourisation is usually regarded as relatively less important compared with the initial flash off. Fraction flash off is approximately 17% at 15°C as Butane. From the above it is clear that release of liquid LPG is potentially more catastrophic than release of vapour.

Flammable releases cause harms as a results of fire or explosion. Flammable vapour cloud resulting from rapid, release of LPG is being calculated. Since the cloud center cannot be predicted, a conservation approach has been followed and it has been assumed that the cloud drift towards downwind from the point of release when the danger of ignition occurs. Assuming that the cloud would drift in any direction, the “Hazard Area” around LPG storage area has been established by drawing a circle of radius equal to the distance, which may be affected due to heat intensity, if **BLEVE** occurs. A `BLEVE’ can occur, if a pressure vessel becomes completely filled with liquid. The temperature, rises and pressure relief capacity is insufficient to keep the internal pressure from exceeding tank strength. One of the hazards of a `BLEVE’ of a pressurized tank containing liquefied gas is the fireball created by combustion of the mixture of vapour liquid that is explosively dispersed by the sudden rupture. The sudden expansion of compressed vapour and the large quantities of vapour suddenly produced by liquid flashing combine to create a large ball of liquid droplets and vapour. The heat created by the burning of the dispersed liquid and vapour causes a powerful thermal updraft. As already explained, sudden release of a liquid stored at a temperature above its boiling point will result in the instantaneous and adiabatic vaporization of a fraction of the liquid. It is usually taken as half the tank capacity while calculating the radiative flux incident, on a target some distance away from the LPG tank. However, as the storage quantities along with its details have not yet been finalized, the assessments have been made on the assumption that maximum instantaneous release of total 50 tonne release.

Unconfined vapoour cloud explosion is one of the most serious hazards of LPG. A vapour cloud explosion may cause harm by direct or indirect blast effects. The peak incident pressure at different distance due to explosion of various quantities of vapour cloud are being calculated and is presented in **Table 6.4**. The effect of this over pressure is presented in **Table 6.5.**

Table 6.4: Over Pressure generation from vapour cloud explosion

Over Pressure (bar)	Distance in meter
0.09	200
0.06	300

Over Pressure (bar)	Distance in meter
0.04	400
0.35	500
0.03	600
0.026	700
0.022	800

Table 6.5: Effect of Different Overpressure

Over Pressure (Milibar)	Type of Damage
10 – 15	Typical window glass breakage
35 – 75	Windows shattered, Plaster cracked, Minor damage to some building
70 – 100	Personnel knocked down
75 -125	Panels of sheet metal buckled
125 -200	Failure of walls constructed of concrete blocks or cinder blocks
200 - 300	Oil storage tank ruptured
400 - 600	RCC Structure severely damaged
350 - 1000	Ear drum rupture
2000 - 5000	Lung damage
7000 - 10,000	Lethal

The heat radiation intensity at different distances for different quantities of releases are presented in **Table 6.6.** The effect of thermal radiation on unprotected skin is also presented below in **Table 6.7.**

Table 6.6 : Heat radiation intensity at different distances for 50 t

Distance in meter	Thermal load (Kw/m2)
120	117.3
130.9	92.6
141.8	76.1
152.7	63.9
163.6	54.6
218.1	28.9
327.2	12.0
436.3	6.5
545.4	4.1
1090.7	0.9
1636.1	0.4
2181.4	0.2

Table 6.7: Relation Between Heat Radiation Intensity, Time and Effect on Man

Heat Radiation Level (Kw / m2)	Duration (Secs)	Effect
2.5	65	Blistering Starts
5	25	Do
8	13.5	Do
11	8.5	Do
18	4.5	Do
22	3	Do
10.2	45.2	Lethal (1%)
33.1	10.1	Do
146	1.43	Do

6.2.9 ON-SITE EMERGENCY PLAN / DISASTER MANAGEMENT PLAN

The on-site emergency plan relates to the laid-down and well-practiced procedure after taking care of all design based precautionary measures for risk control. This plan is aimed for tackling any emergency situation, if arises.

Objective of the Plan

The emergency plan has been prepared to ensure the smooth working of the steel plant complex. The main objectives of the plan are to take immediate actions to meet any emergency situation making maximum use of combined in-plant and allied resources for the most effective, speedy and efficient rescue and relief operations. These are briefly enumerated below:

1. Cordon and isolate the affected area for smooth rescue operation
2. Rescue and treat casualties and safeguard the rest
3. Minimize damage to persons, property and surroundings
4. Contain and ultimately bring the situation under control
5. Secure and safe rehabilitation of the affected area
6. Provide necessary information to statutory agencies
7. Provide authoritative information to the news media.
8. Ward off unsocial elements and prying onlookers.
9. Counter rumor mongering and panic by relevant accurate information.

Methodology

Keeping in mind the detailed information on the proposed steel plant, the plan is formed on the following basis:

- identification of possible hazards in various units and their impact on the surroundings
- detailed information on the available resources and control measures.

6.2.10 INDUSTRIAL SAFETY AND FIRE FIGHTING

As detailed above, some of the working premises of the plant have hazardous and fire-prone environment. To protect the working personnel and equipment from any damage or loss and to ensure uninterrupted production, adequate safety and fire fighting measures have been proposed for the project.

6.2.11 SAFETY OF PERSONNEL

All workmen employed in hazardous working conditions will be provided with adequate personal safety appliance as applicable to the work like;

- Industrial safety boots
- Industrial helmets
- Hand gloves
- Ear muffs
- Welder's screens and aprons
- Gas masks
- Respirators
- Resuscitators

6.2.12 FIRE PROTECTION FACILITIES

Keeping in view the nature of fire and vulnerability of the equipment and the premises, the following fire protection facilities have been proposed for the plant.

Portable Fire Extinguishers

All plant units, office buildings, stores, laboratories, MCCs etc. will be provided with adequate number of portable fire extinguishers. The distribution and selection of extinguishers will be done as per IS:2190.

Hydrant System

Hydrants will be provided at suitable locations and in different levels inside the plant buildings. Yard hydrants will be provided in the vicinity to meet the additional requirement of water to extinguish fire. Sprinkler system for LPG, MRSS, Oil cellars also have been provided.

Automatic Fire Detection System

Unattended vulnerable premises like electrical control rooms, cable tunnels, MCC, oil cellars, etc. will be provided with automatic fire detection and alarm systems.

Manual Call Point Systems

All major units and welfare/administrative building will be provided with manual call points for summoning the fire fighting crew from the fire station for necessary assistance.

Fire Station

The Fire station will be centrally located with adequate communication facilities and trained man power. There will be one central fire station with fire tenders to extend the necessary assistance required for fighting fire in any of the plant units and associate premises. The following equipment will be provided in fire station/fire posts.

- Water tender
- Foam tender
- Portable pump
- Wireless set
- Hoses

6.2.13 PLANT DISASTER CONTROL

The On Site Emergency Plan will be made available considering all the different units of the proposed steel plant complex.

Organisation

A Central Disaster Control Cell will be set up under the direct charge of the GM I/c (works). He will be the person nominated to declare any major emergency and would be in-charge of all operations in such situations. In his absence, GM (HRM & Maint.) would be the in-charge. He will be supported by the other nominated members of cell, e.g., General Manager for Plant operations and service agencies , Personnel, Security, Fire and safety, Administration and Medical Officer. In case of any major emergency, the Disaster Control Cell would operate from Disaster Control Room. At the shop level, Deputy General Managers, have been nominated as Controllers who will be assisted by Manager, Shift-in-charges and trained key workers to deal with any minor emergencies arising at the shop.

Information Flow

The following guidelines will be observed by any person after noticing a gas leak, fire, etc. till help is made available from Central Disaster Control Cell or Shop level Disaster Control Cell.

- Raise alarm
- Communicate to the control room about the incident/emergency.
- Communicate to fire station for relief in case telephone is available otherwise try to attract attention by any available means.

- Attempts to close doors, windows or ventilators of the room to prevent any contaminated air getting in.

6.2.13.1 CENTRAL DISASTER CONTROL ROOM

Upon receiving information from any site regarding emergency, the person operating from the Disaster Control room will :

- Depute a person to rush to site and assess the situation.
- Inform fire, transport, safety, medical and concerned control room.
- Organise operating personnel and arrange for control over the situation.
- Keep the management informed about the gravity of the situation from time to time.
- On receiving the call, the Disaster Control room would immediately direct the different supporting service agencies as enumerated below :
- Security and Administration services : responsible for safety of the plant against trespassers, saboteurs, any crowd, information to Government authorities and in the neighbourhood (if required), provision of transport facilities, telecommunication facilities and fire service facilities.
- Safety service: responsible for implementation of safety measures at work place and occupational safety.
- Medical service: responsible for providing medical care to the injured or the affected in an event of emergency.
- Stores: responsible for providing adequate number of tools, tackles and accessories for proper emergency control.
- Preservation of evidence and taking of photographs, if necessary, for future enquiries to determine the cause and taking further preventive actions.
- Welfare: Provide food, clothes, shelter etc., as per requirements.
- Power and water supply : To ensure supply of fire fighting water requirement and provisions of power supply.

Alerted by news, all key personnel will arrive immediately at the respective reporting place during emergency.

6.2.13.2 SHOP LEVEL DISASTER CONTROL CELL

The Controller at the shop level would take immediate charge of any emergency situation and would assume full responsibility regarding mobilisation of resources, guide and help service agencies in properly carrying out their assigned duties. Being from the operations side of the plant, he has full knowledge of the process aspects and he would decide whether to stop the plant/process. He will be responsible for overall co-ordination.

In his absence, his Deputy would be Controller of the operations. The duties of the Shop level Controller are enumerated below:

- Assess the scale of emergency and decide, if any possibility of major emergency exists and inform the Central Control Room, if necessary.

- Direct Safe close down of plant or any operation, if necessary.

- Direct evacuation of areas in the vicinity, which may be endangered.

- Ensure key personnel are called in immediately and they start carrying out their assigned duties.

- Direct rescue and fire fighting operations from safe operation point of view.

- Direct the shop personnel to the designated places for safe assembly.

- Control rehabilitation of affected areas and any victim on emergency.

- Ensure complete safety before restarting the plant/ operation.

At Shop floor, teams of workers will be trained, who will be present at the incident site for doing the needful. They will assist and extend help to the following :

- Fire brigade team in controlling fire.

- Operational staff in shutting down plant to make it safe.

- Search, evacuation, rescue team.

- Movement of vehicles for emergency control.

- Plant pollution monitoring staff for carrying out atmospheric tests.

- Medical team for providing necessary help.

- Any other special operation.

6.2.13.3 CONTINGENCY PLAN

It has been based on the following considerations :

- The plant general layout.
- The available resources.
- The analysis of hazards.

And is aimed at the

- Pre-emergency activities.
- Emergency time activities.
- Post-emergency activities.

In the event of an emergency, the people from affected pockets would be directed to move to safe assembly places nearby the units.

The following facilities will be provided.

- Security service
- Fire fighting service
- Medical service
- Pollution control service
- Public relation service
- Telecommunication service
- Transport service
- Evacuation service
- Welfare service

An alarm system will be provided with a wailing type siren at a centralised place and actuators at the strategic locations in the plant. Adequate number of telephones will be provided in each unit at Shop floor so that a person can either directly raise the alarm or ring up disaster control room from where the alarm can be raised directly. The wailing siren will mark the beginning of the emergency while a continuous note will mark the end meaning all clear signal.

All fire fighting equipment like valves, fire hydrants, pumps, monitors, etc., will be checked periodically to detect defective parts and such parts would be immediately replaced. Mock drills will be conducted for training the persons and to check the performance of men and equipment and also to keep them fit for any emergency. The plant will be equipped with a separate Medical Centre with necessary instrument/appliances, medicines and trained manpower. The Medical Officer will maintain close liaison with different hospitals in the nearby city.

6.2.13.4 RESCUE AND REPAIR SERVICES

The responsibility of effective working of Rescue and Repair Services will be with the incident controller.

Rescue Services

- To extricate persons from the debris of collapsed building/structure and save human lives.

- To hand over the extricated persons to first aid parties.

- To take immediate steps as may be necessary for the temporary supports or demolition of buildings and structures, the collapse of which is likely to endanger life or obstruct traffic.
- To cut off supplies of water, gas, electricity to damaged buildings.

Trained Rescue parties shall be formed at Shop levels, who will be provided with the following equipment :

1. Self contained oxygen breathing apparatus
2. Blower type gas mask
3. Resuscitators
4. Petromax lamp / Torches
5. Axe/hand saw
6. Bamboo ladder
7. Necessary Safety appliances
8. First aid box
9. Blankets

On-site emergency planning rehearsals need to be carried out from time to time. It requires monitoring by experienced persons from other similar factories or by senior officials from the State Inspectorate of Factories and/or the Directorate of Fire Services, who can help in updating the emergency plan procedure.

6.2.14 OFF-SITE EMERGENCY PLANNING

Off-site emergency planning is normally under the jurisdiction of the district administration. The designated official of the Steel Plant is required to have co-ordination with the district administration for responsive action in off-site emergency planning.

6.2.15 FIRE FIGHTING ORGANISATION AND PROCEDURE

There will be trained fire fighting personnel and a Fire Officer under the Fire & Safety Department. The following important instructions will be given for fire prevention and tackling of any fire in the plant.

- Overall control of the Fire fighting operations will rest with the senior most officer present at the scene of fire, who will be assisted by the operational and fire staff. Close co-ordination and planning for fire protection will be done between Plant Operations and Fire Service.

- While turning out for fire calls, the fire staff will be guided to the correct location immediately on their arrival.

- In-charge of the section at Shop floor will explain special risks involved and guide the In-charge of the Fire fighting crew. He will, however, not interfere in the method of fire fighting operations.

- No one would tamper with the sources of water supply/ fire hydrants or misuse them in any manner. The passages/approach to/from fire hydrants to the fire appliances would always be kept clear.

Fire drills would be held in each, zone periodically under the direction of the Fire Officer.

The organisation and brief procedure for fighting small, major and simultaneous fire is given below :

Degree of fire emergency	Fire chief	Siren code	Persons attending
Small fire	Functional head in charge of affected area	No siren	CISF/Fire
Major fire/Disaster	Head of the works department	Double Wailings	On site emergency plan
Simultaneous fire	In-charge of affected area	Single wailing	Persons already present at the scene of fire, operators
BLEVE	Head of works	Triple wailing	As per on site emergency plan

Definitions :

Small fire : A fire in its incipient stage which is controlled by the first line fire fighting team.

Major fire : The fire is spreading to other equipment or areas and which threatens to go beyond the control of first line and second line fire fighting teams.

Simultaneous fire : More than one fire occurring at the same time.

Fire Control Office : The Fire Control Officer will be in-charge at the scene of fire. In case of small fire, Section Head/ Functional Head of affected area will be fire Officer.

In major fire, Head of works will be Fire Control Officer.

In simultaneous fires, in-charges of the respective affected areas will be Fire Control Officers.

Fire call : Fire call will be received at the fire station regarding occurrence of fire and its location. The message will be conveyed either by telephone or fire alarm or in person.

While giving Fire call message on telephone, the person will

- Give his name, Section & Department.
- Exact location of Fire and if possible, nature of fire.
- Confirm that the Fire call message is repeated by the Control room attendant.

When the call message is given by the Fire alarm, the person would stand rear the Fire alarm to guide the Fire fighting team to the location of the fire.

Fire Siren Code :	For small fire	: No siren will be sounded.
	For major fire	: Double Wailing
	For all clear	: Steady siren for one minute.

Fire Fighting for Small Fire

The small fire will be tackled by the first line team which would comprise of the persons already present at the scene of fire. However, the second line fire fighting team whose composition is given below will also report at the scene of fire immediately after receiving the Fire Call of affected area at the time of fire. The team will consist of the following :

Fire Control Officer

First line Fire Fighting team:
Operational / maintenance staff and/or other plant personnel working in the area.

Second line Fire Fighting team :

- Fire station shift-in-charge and trained fire fighting personnel.
- Ambulance driver with ambulance.
- Functional head of affected area.
- Shift Officer production.
- Security personnel.

Third line Fire Fighting team :

- Fire Officer & Auxiliary Fire Fighting personnel.
- All Departmental & Functional Heads.
- Local Fire Brigade from Govt., if necessary.

Fire Fighting for Major Fire :

The major fire will be tackled by the first line, second line and the third line fire fighting teams. The fire chief in this case is the Head of works. The fire chief for small fire will judge the nature of fire and in case of major fire, he will inform Fire Officer (either himself or through responsible persons) to sound the fire sirens (double wailing type). The team will consist of the following who will immediately report at the scene of the fire.

1. Fire Officer
2. First, Second and Third line Fire Fighting team.
3. Auxiliary Fire Fighting personal

All the members of the auxiliary fire fighting crew will have thorough training on the job.

Responsibilities of Fire Control Room Operator :

During fire Call :

- To take correct message regarding location, type of fire etc., from the caller.

- To repeat the message.

- To inform fire fighting personnel on duty immediately for turn out by hearing the bell.

- To ask the pump house operator to maintain adequate head in the fire water line.

- To inform Telephone Exchange.

- To inform first aid centre.

Responsibilities of Fire Fighting Personnel :

- To report immediately at the scene of fire.

- To take instructions from Fire Officer.

Responsibilities of Fire Officer :

- To direct the deployment of Fire fighting personnel and fire fighting appliances.

- To organise additional fire fighting crew, if required, depending upon gravity of the situation.

- To guide plant employees in fire fighting.

- To co-ordinate between different groups of fire fighting personnel & team of trained workers from the department.

- To control the spread of fire and rescue operation, if necessary.
- To extinguish the fire.

- To replenish the required fire fighting material/ equipment.

- To arrange relievers wherever necessary.

- To assess the situation and arrange additional help if necessary in co-ordination with Disaster Control room.

- To advice for all clear siren to be blown after the major fire emergency is over.

Responsibilities of Ambulance Driver:

- To report to the scene of fire with ambulance immediately.

- To carry the casualties, if any, to the medical centre as directed by Medical Officer/Fire Officer at the earliest.

- To park the ambulance without obstructing the fire fighting operations and traffic.

Responsibilities of Security personnel at the manned gate :

- To prevent entry of unauthorized persons.

- To keep the gate open for emergency vehicles and officers and staff concerned with fire fighting and allied operations.

Responsibilities of Telephone Operator :

- To receive fire call messages.

- To inform Shift Officer for all fires.

Responsibilities of Medical Officer during major fire :

- To be available at the first aid centre for necessary medical advice.

- To depute one of the medical staff to the scene of fire to render any medical assistance, required at site.

Responsibilities of Head of the Personnel and Welfare Department during major fire :

- To arrange the transport of the fire fighting personnel with minimum loss of time in consultation with the Fire Control/Fire Officer.

- To make arrangements for the refreshment/meals for persons engaged in fire fighting.

- To inform the Fire Officer regarding the actions taken.

Responsibilities of Head of the Maintenance Department during major fire:

- To report to Fire Chief and render all help that may be required from Maintenance Department.

Responsibilities of Head of the Electrical Maintenance Department during major fire :

- To report to Fire Officer and render assistance to be required from Electrical Department such as installation of equipment, provision of temporary lighting etc.

Responsibilities of Head of the Materials Procurement Department during major fire :

- To arrange to man the stores for emergency issue of materials. If the materials are not available in the stores or are likely to be exhausted during fire fighting operations, he would arrange for the same from other sources.

6.2.16 CLOUD BURST / LIGHTNING

Cloud burst / lightning may at times lead to minor to major emergency. In such an emergency, actions indicated under fire and explosion will be undertaken.

6.2.17 FOOD POISONING

In case of food poisoning in plant canteens, the following will be done :

- Disaster Controller will inform Medical Officer for immediate first aid.

- Medical Officer will contact other hospitals and seek their help, if necessary.

- Security will help in evacuating the affected people to various hospitals, in co-ordination with the Medical Officer.

6.2.18 MUTUAL-AID SYSTEM

At times the possibility of a major emergency (a situation out of control of plant authority) cannot be ruled out. In such a case, the plant authority would declare it to be a major emergency and total control would be transferred to the district level office of contingency plan committee.

Necessary help would also be sought from Government sources having necessary infrastructure for dealing with disaster.

6.3 SOCIAL IMPACT ASSESSMENT

6.3.1 Introduction

Social and economic development of a region is closely linked with the growth of industrialization. Industrialization creates forward and backward linkages which lead to multi-dimensional development. Jindal South West's (JSW) integrated steel plant at Toranagallu, Bellary district, Karnataka, is a step towards achieving such a developmental goal. Torana indicates a welcome arch and the area gets its name because of the fact that it was once the gateway to the historic city of Vijayanagar. In recognition of its historical association with prosperity and also because of the locational advantages it enjoys, a steel plant is installed here and the plant is in operation. Existence of the plant already led to a Bubble Effect in the vicinity of the plant. At the same time, extensive activities under the Corporate Social Responsibility (CSR) led to a holistic development of the area. Now, JSW is going for an expansion of the plant from the existing 10Mtpa to 16.0Mtpa. The `expansion project' as such, indicates a significant beak in investment which is likely to have widespread impact on the socio-economy of the area surrounding it, through multiplier and linkage effects. Further development of the area is expected due to the project.

6.3.2 Objectives

The proposed expansion project will have a widespread impact on the social and economic conditions of the people of the region in terms of direct and indirect employment, skill diversification, infrastructure development, business development etc. On this backdrop, the present study is directed towards the following objectives :

i) To assess the impact of the project on agricultural situation;
ii) To examine the employment and income effects of the project;
iii) To explore the possibility of local industrialization as an impact of the project;
iv) To assess the impact of the project on health situation
v) To assess the Corporate Social Responsibility of JSW
vi) To judge peoples' perception regarding the project;

vii) To examine the impact of the project on tourism.

6.3.3 Methodology adopted for the study

The methodology adopted for the study is based on the following:

Review of Secondary Data

Review of secondary data, such as District Census Statistical Handbooks 2001 for the parameters of demography, occupational structure of people within the general study area of 10km radius around the proposed plant site. The secondary data supplemented the primary data collected through direct field survey.

Field Survey

Baseline data on socio-economic parameters were generated using information available with Govt. agencies, census data etc.

Socio-economic survey was carried out covering all the villages / towns of the study area to record awareness, opinion, apprehensions, quality of life and expectations of the local people about the proposed plant. The opinion of local people about the proposed expansion plan was obtained through socio-economy survey of the villages / towns in the study area.

A brief about the sampling design adopted for the field survey is described below. The survey has been conducted through specially designed questionnaire covering every aspect of the present study. In addition to the field data, secondary data / information collected, compiled and published by different Governmental agencies / departments were also collected and utilized appropriately.

Sampling

For selection of respondents from the study area, **Two Stage Random Sampling** has been adopted. In the first stage, villages are selected and in the second stage, households/ respondents are selected. From each selected village, the respondents are selected randomly to account intra-village variability among the respondents for the character under study. As the variability of the characters under in each strata study does not vary widely among the households, a smaller sample size is expected to represent the population.

Samples of 60 respondents were dawn from the study area. The sample covers an estimated 300 persons.

Composition of the Questionnaire

Households/respondents were interviewed with the structured questionnaire specifically designed for this study keeping in view the objectives of the study. The questionnaire consists of following major sections:

a) Demographic profile of the households
a) Educational status
b) Information on agricultural situation
c) Employment (sources of employment)
d) Income (income from various sources)
e) Information on family budget
f) Consumption and saving
g) Respondents' perception about the project

Analytical Framework / Methodology for Compilation & Analysis

The major methods used as tools of analysis in this study are as given below :

1. Regression:

   Simple linear regression of the following type in considered

   $Y_i = a + b X_i + U_i$

   Where, Y is dependent variable, X is explanatory variable and U is the stochastic error term having its usual properties.

   The model is fitted to data applying Least Square (LS) technique to obtain estimated demand and consumption functions.

2. Fitted regression models are used to work out

   i) Elasticity of demand with respect to disposable income (e) in case of demand functions:
   $e = (dy / dx) . (x/y)$

   ii) Marginal propensity to consume (MPC) from consumption function:
   $MPC = dC / dY$

3. Frequency distribution of demographic parameters, peoples' perception, educational status, agricultural status etc.

6.3.4 Profile of Bellary District

Bellary district covers an area of about 8446 square kms and is situated in the central region of the eastern sector of the state. Situated in an arid zone, Bellary district has a scanty rainfall, and such shortage of rains produces immense and extensive distress among the people. Prior to the major irrigation project at Tungabhadra, the district was prone to frequent famines. Severe and protracted famines have been the marked feature of the district.

The district is endowed with the major economic resource of mineral deposits such as iron ore, manganese, magnesite, copper, gypsum, gold etc. Among these, iron and manganese ores are the important ones. The iron ore reserves here are estimated to be of the order of 1250 million tonnes.

The district has some large-scale industries along with a large number of medium and small scale units. At the household level, cotton handloom weaving, weaving of woolen rug, manufacture and repair of leather foot-wear, pottery are of considerable importance. Trading and commercial activities also have considerable significance.

Population and occupational pattern of the district are presented below:

POPULATION OF BELLARY DISTRICT

Sl No	Item	Unit	Bellary district
1.0	Population (2001)	No	
1.1	Total		2027140
1.2	Male		1029714
1.3	Female		997426
1.4	Rural		1320290
1.5	Urban		706850
2.0	Population density	No/sq kms	238
3.0	Sex ratio	Female/1000male	970
4.0	Literates	No	980483
5.0	Occupational pattern	No	
5.1	Main workers		801369
5.2	Marginal workers		119452

Source : Census 2001

According to 2001 census, the total population of the district is about 2027140. The population density is only 238 persons per square kms. The high growth of population may be attributed to some of the economic developments achieved by the district during this period, especially in the spheres of mineral exploration and exploitation, industries, trade and commerce and anticipated further industrialisation.

6.3.5 The Study Area

In the present investigation, the study area is considered as the 10 km radius circle with centre at Torangallu, the plant/project site. The impact assessment of this project has been done mostly on the study area, but in some cases, certain areas such as Hampi are also included. Table-2 depicts the demographic profile of the study area. There are 210 villages in the study area. Of these Kurekappa is the largest one followed by Vaddu. Vaddu is hardly 1.5 km from the existing JSW plant. At present there are around 12746 households and total population of the study area is around 63730. Of this about 51% are male and the rest are female. Population density is 203 persons per sq km. Share of SC population is around 14% while the share of ST population is 20.9% of the total population. These two categories together constitutes about 35% of the total population.

DEMOGRAPHIC PATTERN OF THE STUDY AREA

(2001)

Sl No	Name of the village	Population			Households
		Total	Male	Female	
1	**Population**				
2	Anantpur	2661	1373	1288	532
3	Avinamagadu	402	190	212	80
4	Ayanahalli	1964	986	978	393
5	Bannihati	1528	746	782	306
6	Bhujaganagar	4672	2386	2286	934
7	Bevinahalli	1337	670	667	267
8	Gadiganur	4513	2240	2273	903
9	Chikkantapura	1094	538	556	219
10	Gangalpur	672	343	329	134
11	Kodalu	1616	820	796	323
12	Kurekappa	10817	5658	5159	2163
13	Lingadahalli	1137	571	566	227
14	Madapura	439	216	223	88
15	Muraripur	1138	587	551	228
16	Talur	4343	2162	2181	869
17	Nagalpura	1684	855	829	337
18	Taranagar	5377	2747	2630	1075
19	Torangal	6324	3390	2934	1265
20	Vaddu	5652	3107	2545	1130
21	Yelebenchi	3860	1922	1938	772
	Total population	**63730**	**32707**	**31023**	**12746**
2.0	Area (sq kms)	314.3			
3.0	Population density (persons / sq km)	203			
4.0	Share of SC population in total	13.9%			

5.0	Share of St population in total	20.9%

Land use of the study area is given below. Forest constitutes about 22% of the area. Around 22 % of the are is not available for cultivation. Current fallow constitutes about 15% of the area. Net are sown of 39.3%.

LAND USE OF THE STUDY AREA

Sl No	Land use	Area (Sq km)	Distribution (%)
1	Forest	70.4	22.4
2	Land not available for cultivation	68.5	21.8
3	Culturable waste	5.7	1.8
4	Current fallow	45.9	14.6
5	Other fallow	0.3	0.1
6	Net area sown	123.5	39.3
	TOTAL	324.3	100.0

6.3.6 Prediction of Impacts

Agricultural situation

Agriculture was the major source from which people of the area derive their income. The climatic condition and the quality of soil, however, are not suitable for developed agriculture. This gets reflected in the cropping pattern presented below. From the table it is amply evident that cotton and sunflower are the most important crops produced. While cotton is produced on 57.7% of GCA, sunflower is cultivated on 19.3% of GCA. Jowar is also found to be an important crop which is produced on 8.5% of GCA. The area under paddy cultivation is only 3.6% of GCA.

CROPPING PATTERN & CROPPING INTENSITY

Sl No	Item	Cropping pattern (area in GCA%)		Impact	
		2005	2010	Impact (I)	Impact (IP)
1	Cotton	56.8	57.7	0.9	This trend is likely to continue in future which indicates more or less similar cropping pattern in the study area
2	Sunflower	18.2	19.3	1.1	
3	Jowar	8.9	8.5	-0.4	
4	Paddy	3.6	3.0	-0.6	
5	Onion	1.5	1.9	0.4	
6	Others	11.0	9.6	-1.4	
	TOTAL	**100.0**	**100.0**	**100.0**	

Table below depicts the impact of the project on crop productivity. The productivity figures for most of the crops are found to lie much below state averages. Productivity of cotton, Jowar and sunflower has increased in 2010 compared to 2005. In case of cotton and sunflower, the increase is substantial. Productivity of paddy and onion have declined substantially.

CROP PRODUCTIVITY

Sl No	Item	Crop productivity (qtl/ac)		Impact	
		2005	2010	Impact (I)	Impact (IP)
1	Cotton	9.5	10.3	0.8	This trend is likely to continue in future which indicates increase in productivity of cash crops and decrease in case of food crops in the study area
2	Sunflower	5.0	6.2	1.2	
3	Jowar	14.6	15.7	1.1	
4	Paddy	9.0	8.6	-0.4	
5	Onion	46.0	45.0	1.0	

Table below depicts the impact of the project on net return from agriculture. Despite low crop productivity, agriculture is found to be profitable in the study area. It is observed that net return from all the crops increased substantially after the project. In case of the main crops in the study area, i.e., cotton and sunflower, net return increased by 50% and 108% respectively. For the food crops too increase in net return is found to be substantial. A part of this increase is due to the local inflation in primary articles. Nevertheless, the increase in net return from crops is significant.

NET RETURN FROM AGRICULTURE

Sl No	Item	Crop productivity (qtl/ac)		Impact	
		2005	2010	Impact (I)	Impact (IP)
1	Cotton	4500	5700	1200	This trend is likely to continue in future which indicates increase in net return from all the crops in the study area
2	Sunflower	2600	3300	700	
3	Jowar	780	1250	470	
4	Paddy	4300	5050	750	
5	Onion	12700	14000	1300	

Overall assessment of the agricultural situation of the area reveals that agriculture is still very backward in this area. Constraints of such backwardness reported by the farmers are scanty rainfall, lack of irrigation water and unproductive soil. In addition to these, scarcity of capital (for investment) is also one of the major constraint. Majority of the farmers opined that unproductive land is the most important among these constraints. Keeping this in mind it can be ascertained that even if some irrigation facilities are provided / extended in this region, agriculture will still continue to be traditional.

Given the persistent nature of backwardness of agriculture and impact of the project observed so far, it can reasonably be said that the present expansion of JSW is not going to cause significant damage to it. Hence, the project will not have much of adverse impact on the existing agricultural situation of this area. Instead, the industrial project is likely to provide the farmers with supplementary income which appears to be essential for raising the standard of living of the people of the study area.

Employment and income effects

Employment and income generation are the most important aspects that need detailed investigation in case of any industrial project. The present project has some positive employment and income effect. A sizable number of persons for the locality are involved in different activities of the plant. For execution of the 16.0 MT expansion project, a large number of people will be required directly and indirectly. This will create a huge employment and income effect on the socio-economy of the study area. So far indirect employment is concerned the effect is very strong and widespread. The project is expected to generate indirect employment and income which is 4 - 5 times higher than the direct employment.

In view of this, it can be justifiably concluded that the present project has tremendous positive employment and income effects.

Industrialisation Around the Project

Industrial status of Bellary district has a few large and medium scale industries and large number of small units. Table-7 presents summary of large and medium scale industrial units, investment and employment in Bellary district. It is evident that there are 45 working units with investment of Rs 3569 crores which provided employment to 24784 persons.

Summary of large and medium scale industrial units, investment and employment in Bellary district (as on 31.03.2010)

Sl No	Item	No. of units	Investment (Rs crores)	Employment (No)
1	Working	45	35699.22	24784
2	Under implementation	17	7802.12	7612
3	Yet to implement	22	3232.32	4289
	TOTAL	**84**	**46733.66**	**36700**

Source : District Industry Centre (DIC), Bellary

The distribution of type-wise large and medium industries in Bellary district is given below. It is observed that there are maximum engineering industry. Among the industries under implementation stage there are several Iron and Steel units. Besides these, there about 22 proposed units.

Distribution of industries in Bellary district (No)

Sl No	Type of industries	Working units	Under implementation
1	Engineering	26	5
2	Engineering and Power	2	
3	Power / Energy	4	2
4	Iron and Steel	4	5
5	Chemical	2	
6	Others	7	5
	TOTAL	**45**	**17**

Source : DIC, Bellary

Steel plants by nature serve as the nuclei for development of small scale industries in the areas around them. These small scale units usually have input-output linkages with the steel plants. The demand for spares, assemblies and sub-assemblies by steel plants are generally met through the supply (of these items) from small scale units located nearly. The small scale units, in turn, get necessary steel products from the steel plants. In the vicinity of major Indian steel plants e.g. Rourkela Steel Plant, TISCO, Bhilai Steel Plant etc. similar type of small-scale industries are visible. This brings forth mutual advantages with one acting as complementary to another. The advantages to steel plants as well as small scale units are listed below :

<u>Advantages to steel plants</u>

i) Assurance of a reliable source of supply of spares and consumables;
ii) Supply on short-delivery schedules enabling maintenance of lower inventory;
iii) Saving foreign exchange through import substitution;
iv) Lower freight element in comparison to materials supplied by firm located far away;
v) Better service facilities

<u>Advantages to small scale units</u>

i) Availability of ready market;
ii) Availability of raw material source for steel/by-product consuming industries;
iii) Getting price preference over distant suppliers;
iv) Availability of facilities from government;
v) Availability of infrastructure support from the steel plant

Proper utilisation of these mutual advantages is expected to play a catalytic role in the development of the region where the present project is proposed to be implemented.

The small scale industries that are likely to come in the vicinity of the steel plant can be grouped into three - spares, metal based and chemical based. These will be complemented by the service units.

At present there are a few small scale units established in the vicinity of JSW plant. These are JAMIPOL, owned by Tata Group, Bhuwalka Pipie Limited, Padmavati Ferro Alloys etc.

The proposed project is expected to serve as center of significant small-scale industrial economy around it complemented by the services sector. This is expected to play a major role in the future economic and social development of this area.

Health status

Health care has always been a priority of JSW. Table below depicts the health care activities undertaken by JSW during 2008 and 2009. It is observed that 24580 persons were treated in 2008. This has increased to 25796 in 2009. Major physical problems in this area are related to ENT, eye etc.

Health care activities of JSW during 2008 and 2009

Sl No	Name of the examination	2008	2009
1	Periodical medical examination (PFT & AUDIO) JSW employees and A Es	16952	21445
2	PME / Physical fitness	201	109
3	OPD cases treated	608	858
4	Crane operators' vision test	648	878
5	Canteen workers' physical test	434	94
6	Hydro operators' vision test	282	16
7	First aid training	1559	556
8	Free medical camp in labour colonies	3116	601
9	ENT OPD	268	613
	Physical fitness certificate, New cement plant employees		77
10	Physical fitness certificate, others	48	96
	TOTAL	24580	25796

Besides this, JSW is also spending good amount of money on health care through CSR. Therefore, impact of the project on health status is quite good.

Impact on tourism

Hampi is situated on the bank of river Tungabhadra and is a small village which covers the ruins of Vijayanagar, the renowned capital of Vijayanagar Empire that flourished during the 14th,15th and 16th centuries. The ruins of Hampi cover about 9 square miles. It is famous all over the world as a tourist spot. Economic activities of this small village are mostly determined by tourism because it is the only major source of income for the people of Hampi. Obviously, it can be said that tourism is the major determinant of socio-economic conditions of the people of Hampi. A survey is conducted at Hampi to assess the impact of the project on tourism. Most of the economic transactions take place at the small Hampi bazar. Tourist frequency of Hampi bazar are depicted in Table given below. Tourist frequency has increased in all the three seasons and there is about 1.99 times increase in 2010 compared to 2005t. The expansion project is going to have further positive impact on tourist frequency. Accordingly, monthly income generated in Hampi has increased manifold which is likely to increase further after the expansion of JSW plant.

Impact of the project on tourism

(No)

	2005	2010	Impact
November – January	267000	560700	293700
February – April	745000	130450	55949
May – October	154000	20020	4620
TOTAL	**356900**	**711170**	**354269** (increase of about 1.99 times)

6.3.7 Conclusions

On the basis of the overall results of the present impact assessment the following conclusions are drawn:

i) The project is not going to cause significant damage to the existing agricultural situation. Instead, it is likely to provide the farmers with supplementary income.

ii) The project has very strong positive employment and income effects.

iii) There is a great possibility of industrialisation in the vicinity of the proposed steel plants. This is likely to bring dramatic changes by transforming this backward area into an industrially developed one.

iv) The project has good impact on health situation / status of the people

v) JSW has been doing huge social development in the area through its CSR providing benefits to a large number of stakeholders.

vi) Overall peoples' perception on the expansion project is a mix of advantages and disadvantages. On one hand, they expect job opportunities, market expansion etc. as advantages and on the other hand they are worried about the damage to agriculture.

vii) The project has very strong positive impact on tourism at Hampi which is likely to result in improvement of the existing poor economic situation of this historically important place

6.3.8 Corporate Social Responsibility

Corporate Social Responsibility (**CSR**), is a form of corporate self-regulation integrated into a business model. CSR refers to strategies of corporations or firms to conduct their business in a way that is ethical, society friendly and beneficial to community in terms of development. CSR is the deliberate inclusion of public interest into corporate decision-making, and the honoring of a triple bottom line: People, Planet, Profit.

Community Development (CD) refers to initiatives undertaken by community with partnership with external organizations or corporation to empower individuals and groups of people by providing these groups with the skills they need to effect change in their own communities. These skills are often concentrated around making use of local resources and building political power through the formation of large social groups working for a common agenda.

The role of CSR in CD is any direct and indirect benefits received by the community as results of social commitment of corporations to the overall community and social system. The common roles of CSR in CD are as follows:

- To share the negative consequences as a result of industrialization.
- Closer ties between corporations and community.
- Helping to get local talents as an attractive employer for potential candidates.

Community development activities (including that for its employees) are very important aspects for any organization like JSW. JSW has been implementing a large number of social development activities under its CSR. JSW has very clear CSR policy :

"JSW cherishes people and believes in inclusive growth to facilitate creation of a value based and empowered society through continuous and purposeful engagement of all stakeholders. In partnership with external development agencies, JSW would strive to achieve sustainable development in all spheres of the life including integrated community development, promotion of arts and culture, environment protection, and sports. As a responsible corporate, JSW would integrate its environment, HR, and ethical business policies with appropriate community engagement and gender equality. JSW is committed for allocation of exclusive budget in its annual business plan to pursue its CSR policy"

JSW's social initiatives are as follows :

- Education
- Women empowerment
- Vocational training
- Health
- Environment
- Infrastructure development
- Sports
- Art, culture and heritage

Education

Activities and status in area of education are presented below:

Activities in the area of education

Activity	Status
Computer Aided Learning Centres (CALs)	25 schools, 10000 students, 107 computers
Balwadis	14 Centres, 11 villages, 500 children
Accelerated Learning Programme (ALPs)	19 School, 1237 students
Mobile libraries	25 Centres, 20 villages, 1062 members
Village Learning Centre (VLC)	20 Centres, 20 villages
Out of school children admitted to schools	295 children
Visit of village children to JSW plant	1747 children for 7 schools
Summer camp for village children	20 villages, 785 children
Mid-day-Meal	1,20000 children from 445 villages

Women empowerment

Activities and number of beneficiaries in this area are given below:

Activities in the area of women empowerment

Activity	No of beneficiaries
Data Halli – Rural BPO	400
Heavy machine operation	19
Pump and power tiller operators	8
Drivers trained	8
Women facilitated to join associate companies	46
Support to MDDG / SHG members	360
SHG promoted	26
Tailoring training	250

Health care

Health care activities of JSW are given below:

Activities in the area of health care

Activity	No of beneficiaries
General health check up camps	2 camps/month – 4152 patients
Eye camps	1 camp/month – 1165 screened & 383 operated
STI camps	1 camp/month – 497 women covered
HIV / AIDS awareness programme	1 street play/month

Infrastructure development

JSW's activities in the area of infrastructure development are given below:

Activities in the area of infrastructure development

Activity	Status
Roads	Bellary, Hospet, Sandur, Toranagallu, Vaddu, Taranagar,Bannihati
Compound walks to school	Sutanpura, Talur, Joga, Toranagallu & Tngl RS
Additional rooms for schools	Talur, Totanagallu
Drinking water supply	Vaddu, Basapura, Kurekuppa, Banihatti & Sultanpura

Art, Culture and Heritage

- Formation of Hampi Foundation in 2000
- Restoration of 15th century Chandramauleshwara temple in co-ordination with Global Heritage Fund
- Restoration of Soumya Someshwara and Krishna temple
- Sponsoring the Hampi Utsav every year

Environment

JSW's activities in the area of environment are given below:

Activities in the area of environment

Activity	Coverage
Ago-eco system improvement programme	60 farmers from 6 villages
Development of perks	Bellary town
Garbage management	5 villages

JSW used to spend good amount of money on CSR. It is observed from the table given below that expenditure on CSR as a % of distributable profit increased from 0.27 to 2.4.

Expenditure on CSR by JSW

Year	Expenditure of CSR (Rs crores)	Distributable profit (Rs crores)	Expenditure on CSR as % of distributable profit
2005-06	2.3	856.5	0.27
2006-07	8.6	1292	0.67
2007-08	20.9	1728	1.21
2008-09	11.0	458.5	2.4

7.0 PROJECT BENEFITS

7.1 INTRODUCTION

The development of industrial projects plays a key role in the economic growth of any country. The growth of the steel industry significantly contributes to economic growth as it generates employment both directly and also due to development of downstream industries. Peripheral development takes place and due to more influx of money through the area, overall importance of the area increases and overall the infrastructure improves.

7.2 EMPLOYMENT POTENTIAL

7.2.1 Skilled and Semi-skilled

Skilled and Semi-skilled employment potential in terms of indirect employment of the area will be non-marginal and will usually remain widespread across a long region. As the proposed project takes place indirect employment is likely to grow further. The project is expected to generate substantial indirect employment in other sectors such as metal-based industries, chemical-based industries, small rolling units, scrap dealing units, service units etc. Overall assessment of the employment and income effects indicates that the project has strong positive direct as well as indirect impact on employment and income generation of the area.

7.2.2 Un-skilled

Unemployment for un-skilled workers is quite common in the study area. The proposed project has employment generation potential by way of recruiting local people directly for different activities of the project, specifically at the construction phase. It is expected that substantial portion of the investment in this project will trickle down to the local people in the form of employment and income.

7.3 OTHER TANGIBLE BENEFITS

7.3.1 Education

- The local peoples' interest towards education will increase due to the expectation of getting jobs, especially from non-agricultural sources such as the industries in the area.
- The project is expected to increase such aspirations by bringing opportunities of some direct & indirect employment for the local people.
- The general awareness towards the importance of education is expected to increase as a result of the new project.
- The project will have positive impact on the level of education of the people of the study area.

7.3.2 Industrialisation Around the Project

Steel plants by nature serve as the nuclei for development of small-scale industries in the areas around them. These small-scale units usually have input-output linkages with the steel plants. The demand for spares, assemblies and sub-assemblies by steel plants are generally met through the supply (of these items) from small-scale units located nearby.

The present project is likely to accelerate such industrialization through "Bubble Effects" in the study area. It is important to note that the small-scale units are usually labour-intensive and high-priority industries from social point of view.

The proposed project is expected to serve as centre of significant small-scale industrial economy around it complemented by the services sector. This is expected to play a major role in the future economic and social development of this area.

7.3.3 Pattern of Demand

The socio-economic survey questionnaire reveals that the respondents spend major portion of their disposable income on food items. However, the respondents are heavily influenced by the changing demand pattern of fast growing Indian consumer society. There has been a tendency among the respondents of allocating higher expenditure on non-food items although their basket of consumption has only few items other than food.

With the implementation of the project and development of the locality, existing demand pattern is likely to continue which indicates more importance on consumer goods and quality products. This will increase the local consumer goods market, thus creating more income opportunities to the local people.

7.3.4 Consumption Behaviour

The proposed project is going to have positive income effect and consequently, the multiplier effect is expected to lead to an overall increase in average consumption of the people of the study area.

7.3.5 Revenue to Govt.

The project will contribute huge amount of money to Government in terms of taxes which will be utilized for various social developments.

8.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP) : ADMINISTRATIVE ASPECTS

8.1 ORGANIZATION POLICY

The importance of environmental control has been recognised by project proponent and it has taken necessary steps to identify and control pollution in the plant, respond to impacts on its own captive population and also in the peripheral areas.

"Environment Management" is one of the thrust areas of operation. It has already adopted a two-pronged strategy to abate pollution, as follows:

- Installation of new state of art pollution control equipment at the design stage itself.
- By developing a very strong monitoring/analysis and inspection setup for compliance.

The above objective has been intended to be achieved through the following:

i) Improvement in the quality of raw materials.
ii) Using automation & Computer control to have improvement on technology and on working condition,
iii) Pollution Monitoring and Control,
iv) Implementation of occupational health set up including regular medical monitoring of employees,
v) A well developed safety management system,
vi) Preparation of Emergency/Disaster Control plan and a properly trained group to meet the emergency situations,
vii) Green belt development inside the plant and township.
viii) Development of awareness in employees and public including student population towards environmental preservation,
ix) R & D activities in regard to specific pollution problems.

Project proponent has given maximum importance for adopting latest technologies for keeping the pollution to minimum levels. A separate Environment Management Department will be set up with an Environmental Laboratory with latest monitoring instruments.

8.2 IMPLEMENTATION OF MITIGATIVE MEASURES

Mitigative measures for air, water & noise pollution control, solid /hazardous waste management have already been envisaged in the expansion project. Various proposed mitigation measures are given in Clause 4.1.4 (Impact & mitigation measures during operation phase). Environmental mitigation measures are also a part of equipment and will be commissioned along with the main equipment. Also, critical emission parameters have been covered under the performance guarantee clause so that to ensure compliance.

8.3 ORGANISATIONAL SET UP

8.3.1 Administrative Set Up

A senior officer, of the rank of General Manager will be the head of the EMD. In his day to day work he is assisted by two Sr. Managers / DGMS. GM (EMD) reports to the Executive Director (ED)/ Director (Incharge). The organizational chart of EMD (proposed setup) is given in **Fig. 8.1.** A laboratory have been proposed to carry out the environmental monitoring and surveillance programme of the plant.

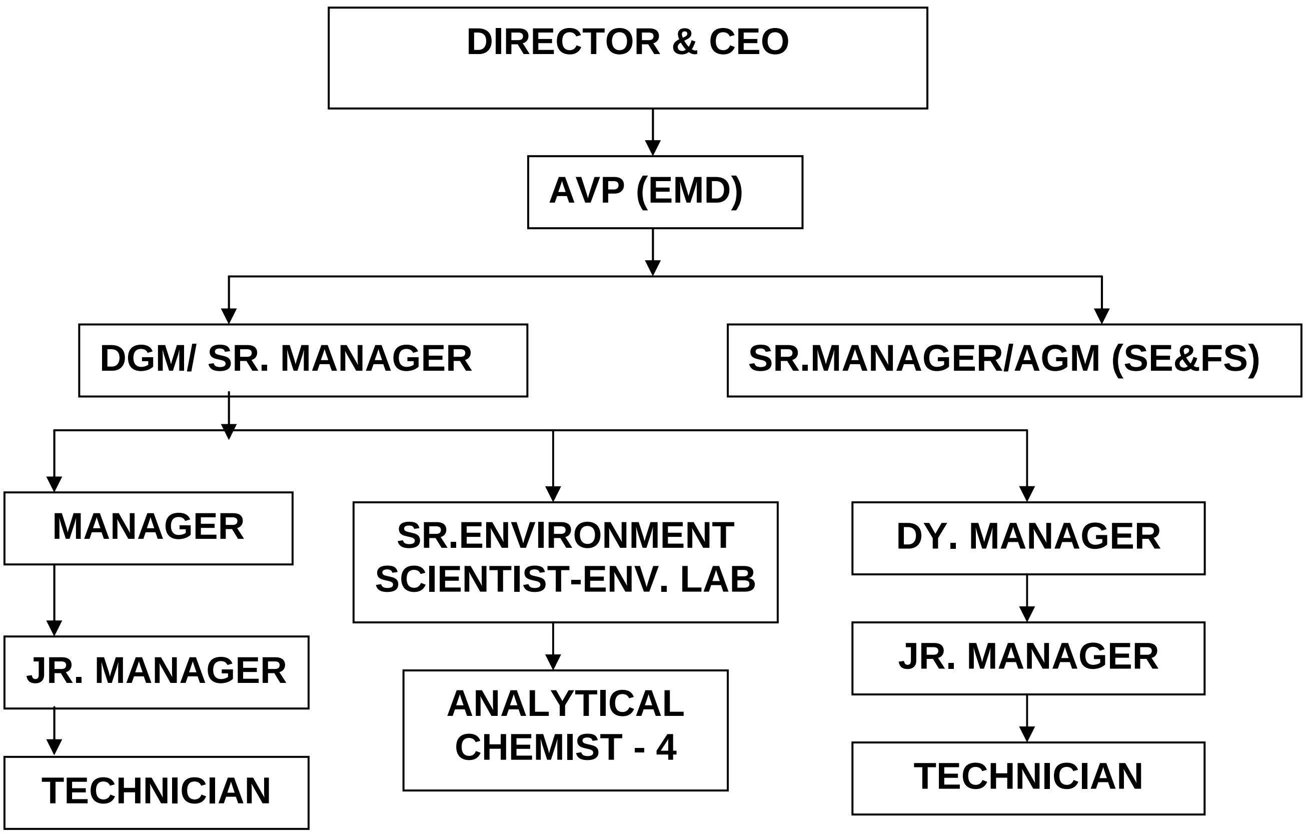


Fig. 8.1: Organisation Chart (Proposed) of Environment Management Department

8.3.2 Laboratory Set Up

A well-equipped environmental laboratory will be set up inside the plant premises. All the personnel deployed in the laboratory will be given training to carry out necessary environmental monitoring as well as analysis also. The requirement of equipments for carrying out environmental monitoring and frequency of the use of different equipments (as required for the environmental requirements of proposed plant) are given in **Table 8.1.**

Table 8.1: Monitoring / Analytical Equipments / Usage for proposed plant

SN.	Monitoring Equipments		Parameter / Function	Frequency	Ambient air Fugitive Emission	Stack Gas Source Emission
	Equipments	Nos Required				
Air / Stack / Noise Monitoring						
1.	High Volume Air Samplers (HVAS)	4	SO_2, NO_X, O_3 NH_3, As, Ni & Benzo-a-pyrine (BaP) - sampling	24 hr continuous; Once per month	Yes	-
2.	PM 2.5 & PM10 Sampler	4	PM2.5 & PM10	24 hr continuous; Once per month	Yes	-
3.	Stack Monitoring Kit (manual)	2	SPM	All stack Once per month	No	Yes
4.	On line stack monitoring along with accessories for monitoring SO_2, NOx, CO_2, CO & PM	3	Particulate Matter, SO2, NOx, CO2 & CO	Continuous	No	Yes
5.	On Line AAQ Monitoring Station	3	PM 10, PM2.5	Continuous	Yes	No
6.	Flue Gas Analyser	1	O_2% CO% SO_2 mg/m^3 NO_X mg/m^3 NO mg/m^3 C_XH_Y PPM Ambient temp	Once per month for coke oven battery stacks	No	Yes
7.	Sound Level Meter	1	Noise Level	As and when required	-	-
8.	CO Analyser (NDIR)	1	CO	Once per month	Yes	-
9.	Gas Chromatograph	1	Benzene (C_6H_6)	Once per month	Yes	-
10.	High Pressure Liquid Chromatograph (HPLC)	1	Benzo-a-pyrine (BaP) – particulate phase only	Once per month	Yes	-
Meteorological Monitoring						
11.	Automatic Weather Monitoring Station	1	Meteorological parameters	Continuous	-	-
Water Monitoring & Chemical Analysis						
12.	Ion Analyser with auto-titrate	1	NH_3, CN, F	Daily	-	-
13.	Hot Air Oven	1	Moisture content & drying of samples glassware	Regularly	-	-
14.	Hot Plate	2	O&G Iron & various purpose like boiling &	Regularly	-	-

SN.	Monitoring Equipments		Parameter / Function	Frequency	Ambient air Fugitive Emission	Stack Gas Source Emission
	Equipments	Nos Required				
			digestion of sample			
15.	Muffle Furnace	1	Digestion at higher temp, up to 1000°C	As and when required	-	-
16.	BOD Incubator	1	BOD	Twice in a week	-	-
17.	BOD Apparatus, Oxitop	1 set of 6	BOD	Twice in a week	-	-
18.	DO Meter	1	BOD	As and when required	-	-
19.	Spectrophotometer with COD Digestion Assembly	1	COD, Phenol NO_3 – N PO_4 - P	Daily	-	-
20.	pH meter	2	pH	Daily	-	-
21.	Conductivity Meter	1	TDS	Daily		
22.	AAS along with Graphite furnace, Hydride Generator and Cold Vapour Technique	1	Heavy metals in water & As & Ni analysis in ambient air.	As and when required	-	-
23.	Digital Micro-Balance	1	Weighing	Daily	-	-
24.	Digital Top Load Balance (Range 1 to 500g)	1	Weighing	Daily	-	-
25.	Filtration Apparatus	2	SS / MLSS	Daily	-	-
26.	Heating mental	2	Distillation	Daily	-	-
27.	Refrigerator	1	Preservation of chemicals and samples	Regularly	-	-
28.	Fuming Chamber	1	For exhaust	As and when required	-	-
29.	Water Bath	1	Evaporation of sample	As when required	-	-
30.	Vacuum pump	1	Hardness alkalinity etc.	As and when required	-	-
31.	Turbidity Meter	1	Turbidity	As and when required	-	-
32.	Filter Papers, Glassware, Plastic wares, Chemicals	In Lot				

8.3.3 <u>Functioning</u>

Environmental monitoring programme and its reporting has been designed to provide a close watch on the surrounding natural environment and provide early warnings of any adverse changes that may be related to some dimension of the plant's operations.

A separate department "Environmental Management Department" (EMD) will be formed for environmental monitoring of the plant and for development and maintenance jobs like drainage, settling tanks etc. assistance from the Projects, Civil engineering department are taken.

EMD will functioning in the plant to look after all environmental aspects, carry out day to day environmental monitoring / inspection requirements and maintain records. Part of the environmental monitoring programme is carried out through external agencies on a part time basis. However, casual labourers etc. is employed for plantation, drain cleaning etc as and when required.

The EMD carries out complete Air Monitoring, Noise Level Monitoring, Special monitoring on water and air, effluent, special surveys, solid waste management etc. Safety management & Occupational health aspects will be dealt by Safety Engineering & Fire Services / Factory Medical Officer (FMO). Green belt development aspects will be dealt by horticulture department. Community welfare & peripheral development aspects will be dealt by Personnel Department. The officers of EMD shall frequently analyse the data and periodically assess the progress of the EMP.

8.4 IMPLEMENTATION ARRANGEMENT

8.4.1 Institutional Implementation Arrangements

The proposed plant will be responsible for implementation of all the mitigation and management measures suggested in Environmental Monitoring Programme. A separate department "Environmental Management Department" (EMD) will be formed to look after all environmental related matters of the plant. In addition higher Management will also monitor the smooth implementation of Environment Management Plan. The in-charge of EMD (Dy. General Manager) will report all the environmental matters to higher management as per the reporting schedule on prescribed formats. The higher management will supervise the reported activity from time to time for smooth implementation of Environmental Mitigation and Management measures and will take necessary actions, if required.

For successful implementation of the environmental management plan other agencies of the State may also be involved, if required (for regulatory requirement or technical support). The coordinating agencies, which may be involved for specific environmental related activities, are given in **Table 8.2**.

Table 8.2: List of Coordinating Agencies, which may be involved for specific Environmental Activities

State Level Agency	**SFD**	**KPCB**	**DOH**	**TC**
		Chairman	**Chief Engineer**	**Chief Engineer**
District Level	**DFO**	**D.E.E**	**Ex. Engr.**	**Ex.Engr.**
Project Area: Plantation Programme	✔			
Study Area: Air, noise, water quality, waste water discharge quality monitoring.		✔		

State Level Agency	SFD	KPCB	DOH	TC
		Chairman	Chief Engineer	Chief Engineer
District Level	**DFO**	**D.E.E**	**Ex. Engr.**	**Ex.Engr.**
Project Area: Stack monitoring, work-zone air, work-zone noise, effluents from outlet of effluent treatment plants, fugitive emissions		✔		
Project Area: Solid / Hazardous Waste Utilisation & Dumping		✔		
Project Area: Human Health			✔	✔
Study Area / Project Area Interface: Road safety measures				✔

Index:

SFD	–	State Forest Department
KPCB	–	Karnataka Pollution Control Board
DOH	–	Department of Health
TC	–	Tornagallu Corporation
DFO	–	District Forest Officer
DEE	–	District Environmental Engineer

Local NGOs will also be identified at the district and block level to provide help and advice for implementation of EMP especially on matters related to community development programmes.

8.4.2 Co-ordination with Other Departments

The Environment Management Department (EMD) also co-ordinates with other departments like Occupational Health, Safety Management, Project Engineering, Horticulture, CSR, Town administration, Water Supply Department etc. and also do the liaison work with external agencies like State & Central Pollution Control Boards.

8.4.3 Interaction with State Pollution Control Board /CPCB / MoEF

EMD shall be in regular touch with MPCB and shall send them monthly progress reports in the prescribed format, as per the prevailing practice. Any new regulations considered by State/Central Pollution Control Board for the Industry shall be taken care of by EMD of the plant. Also, half yearly compliance reports will be sent to MoEF as per the guidelines in the prescribed format.

8.4.4 Training

The EMD, who would be responsible for the implementation of the EMP, needs to be trained on the effective implementation of the environmental issues. To ensure the success of the implementation set up proposed, there is a high requirement of training and skill up-gradation. For the proposed project, training facilities will be developed for environmental control. For proper implementation of the EMP, the officials responsible for EMP implementation will be trained accordingly.

To achieve the overall objective of pollution control it is essential not only to provide latest pollution control and monitoring systems but also to provide trained man power resources to operate and maintain the same. So far, the practice with many plants is to utilize the plant operations and maintenance crew for operation of systems. This has shown adverse results due to lack of specialized knowledge in addition to priority selection. Therefore apart from the EMD, specific training will be provided to personnel handling the operation and maintenance of different pollution control equipments. In-plant training facilities will be developed for environmental control. Specialised courses at various Research / Educational institutes will be organised.

The training will be given to employees to cover the following fields:

- Awareness of pollution control and environmental protection to all.
- Operation and maintenance of specialised pollution control equipment.
- Field monitoring, maintenance and calibration of pollution monitoring instruments.
- Laboratory testing of pollutants.
- Repair of pollution monitoring instruments.
- Occupational health/safety.
- Environmental management.
- Afforestation / plantation and post care of plants.
- Knowledge of norms, regulations and procedures.
- Risk assessment and Disaster Management.

8.5 ENVIRONMENTAL AUDITING

The proposed project will be audited by third party after commissioning in phases. This will help in identifying any non-compliance through structured internal /external audits in the area of environment and occupational safety & health areas and to take corrective action.

8.6 WATER AND ENERGY CONSERVATION MEASURES

Rain water harvesting measures will be implemented for the proposed project to reuse the rain water or to recharge the ground water as part of water conservation measures. Proper functioning of the systems provided will be ensured by regular monitoring.

Energy conservation measures as per the design plan will be implemented so as to bring energy saving and also possible CDM benefits. This will include providing VVVF drives for higher capacity motors, CFL lamps etc.

8.7 OTHER MEASURES

The following activities will be carried out in a structured way for the benefit of the surrounding people through close co-ordination with Personnel Department:

- Improvement of social infrastructure through CSR activities like school buildings, drinking water facilities, street lights, roads, sanitary facilities etc.
- Community education & training.
- Medical welfare.
- Sports activities.

9.0 SUMMARY AND CONCLUSION

Executive summary of the entire EIA study is being submitted as a separate report. However in this chapter the brief summary and conclusion of the study is being highlighted.

In the design phase of the Project Environmental Impact Assessment (EIA) was done to assess the possible impacts of the proposed plant. In the plant design itself latest state of art technology has been envisaged so as to achieve the desired air emissions and noise levels from plant operation levels and the effluent quality at the outlet below statutory norms. Further, maximum re-use and re-utilisation of generated solid waste has been envisaged.

Primary and secondary data were used to assess the environmental impacts of the proposed project. The potential environmental impacts were assessed in a comprehensive manner. All the potential environmental impacts associated with different phases (i.e, during design or pre-construction, construction and operation) of the Project were assessed.

The EIA report has thoroughly assessed all the potential environmental impacts associated with the project. The environmental impacts identified by the study are manageable. The implementation of environmental mitigation measurers recommended in the report will bring the anticipated impacts to minimum.

Site specific and practically suitable mitigation measures are recommended to mitigate the impacts. Further, a suitable monitoring plan has been designed to monitor the effectiveness of envisaged mitigation measures during the operation phase.

The introduction of state of art technology (including the technological mitigation measures) during the design has limited the environmental impacts related with the Project. The implementation and monitoring of effectiveness of the environmental mitigation measures during the operation phase will be assigned to the Environmental Management Department. An Environmental Management Unit, comprising of senior management level officers will periodically assess and monitor the implementation of mitigation measures, and will tackle the management bottle necks of implementation of mitigation measures and environmental monitoring programme.

10.0 DISCLOSURE OF CONSULTANT ENGAGED

The EIA report has been prepared by M/s MECON Limited, Ranchi, a Public Sector undertaking under the Ministry of Steel, Government of India, is a premier multi disciplinary planning, design, engineering and consultancy organisation in the country in the field of ferrous, non-ferrous, thermal, petrochemical, defense and other related projects and in the field of environment. MECON's Head Office is at Ranchi and site offices in Bangalore, New Delhi, Bhubaneshwar, Pune, Vizag, Bhilai, Durgapur, Rourkela, Bokaro and many other places in the country. The Environmental Engineering Division of MECON has provided services for more than 200 numbers of Environmental projects.

MECON's Environmental Engineering Division is a multi-disciplinary group of engineers, specialists and scientists whose services are backed up by a sophisticated Environmental Engineering Laboratory recognized by Ministry of Environment & Forest and several State Pollution Control Boards. There are specialists in the field of hydrogeology, geology, ecology, forestry, agricultural statistics, microbiology, soil sciences, biotechnology, audit & socio–economics and engineers from different disciplines. MECON has been preparing regularly EIA / EMP reports for different projects. Besides, rendering services for rehabilitation action plan for affected people, MECON also does inspection and audit including environmental audit.

MOE&F vide circular No. J-11013/77/2004-IA II(I) dated 28th June 2010 has extended the time for accreditation till December,2010 for 157 listed consultant with Quality Council of India (QCI). MECON serial number is 47 in the list of 157 consultants.

11

<u>ಅನುಬಂಧ – 1</u>

ಪರಿಸರ ಸಾರ್ವಜನಿಕ ಸಭೆಯಲ್ಲಿ ಭಾಗವಹಿಸಿದ ಅಧಿಕಾರಿಗಳು

1 ಶ್ರೀ ಆರ್‌ವೆಂಕಟೇಶ್	:	ಸಹಾಯಕ ಆಯುಕ್ತರು ಉಪವಿಭಾಗ ಬಳ್ಳಾರಿ
2. ಶ್ರೀ ಸಿ.ಎಂ.ಸತೀಶ	:	ಹಿರಿಯ ಪರಿಸರ ಅಧಿಕಾರಿಗಳು, ಕರಾಮಾನಿಮಂ, ಬಳ್ಳಾರಿ
3. ಶ್ರೀ ಕೆ.ಬಿ.ಕೋಟ್ರೇಶ	:	ಪರಿಸರ ಅಧಿಕಾರಿಗಳು, ಕರಾಮಾನಿಮಂ, ಬಳ್ಳಾರಿ

<u>ಅನುಬಂಧ – 2</u>

ಪರಿಸರ ಸಾರ್ವಜನಿಕ ಸಭೆಯಲ್ಲಿ ಭಾಗವಹಿಸಿದ ಯೋಜನೆಯ ಪ್ರತಿನಿಧಿಗಳು

1) ಶ್ರೀ ವಿಕಾಶ ಶರ್ಮಾ :	;	ಸಿನಿಯರ್ ವಿಪಿ(ಸಿ& ಎಸ್)
2) ಶ್ರೀ ಯೆಚ್ಚ್ ಆರ್ ಲಾಲ್:	:	ಪಿ.ಪಿ(ಹೆಹಚ್ ಆರ್)
3) ಶ್ರೀ ಪಿ.ಕೆ ಸಿಂಗ್	:	ವಿ.ಪಿ(ಸಿ&ಈ ಎಸ್)
4) ಶ್ರೀಎಸ್ ಎಮ್ ಆರ್ ಪ್ರಸಾದ	:	ಎ.ವಿ.ಪಿ (ಈ.ಎಮ್.ಡಿ)
5) ಶ್ರೀ ಆರ್.ಟಿ ಶ್ರೀನಿವಾಸ	:	ಡಿ.ಜಿ.ಎಮ್.(ಈ.ಎಮ್.ಡಿ)
6) ಶ್ರೀ ಬ್ರಿಗೆಡಿಯರ್ ಇನಾಯತ;	:	ಜೆ ಎಚ್ ಎಸ್
7) ಶ್ರೀಶ್ರೀ ಜೊಸೆಫ್ ರೆಡ್ಡಿ	:	ಡಿ ಎಮ್.ಜಿ (ಎಲ್&ಎಲ್)
8) ಶ್ರೀ ಪಿ ನಾರಾಯಣ್	:	ಎ.ಜಿ.ಎಮ್(ಹಚ್.ಆರ್)
9) ಶ್ರೀ ಎಮ್ ನಾಗರಾಜ	:	;ಪಿ.ಆರ್.ಒ
10) ಶ್ರೀ ಜೆ.ಎನ್. ಈಶ್ವರ್	:	ಡೆಪ್ಯೂಟಿ ಮ್ಯಾನೆಜರ
11) ಡಾ. ಜೈನ್	:	ಮೆಕಾನ್ ಲಿಮಿಟೆಡ್ ರಾಂಚಿ
12) ಡಾ.ವಿ.ಜಿ.ನಾಥನ್	:	:ಮೆಕಾನ್ ಲಿಮಿಟೆಡ್ ರಾಂಚಿ

<u>ಅನುಭಂದ – 3</u>

ಸಾರ್ವಜನಿಕ ಸಭೆಯಲ್ಲಿ ಭಾಗವಹಿಸಿದಂತಹ ನಾಗರಿಕರು. (ಪಟ್ಟಿಯನ್ನು ಲಗತ್ತಿಸಿದೆ)

ANNEXURE-1

OFFICIALS PRESEN IN THE MEETING

1. Shri R Venktesh	:	Assistant Commissioner Sub Divin Bellary
2. Shri CM Sathesh	:	Senior Environmental Officer Karnataka State Pollution Control Board Bellary
3 Shri K B Kotresh	:	Environmental Officer (Karnataka State Pollution Control Board Bellary

ANNEXURE- 2

REPRESENTATIVE OF THE PROJECT PRESENT IN THE MEETING

1) Shri Vikas Sharma,	:	Sr.V.P (C & S)
2) Shri H.R.Lal,V.	:	VP(HR),
3) Shri .A.K.Singh,	:	V.P (C & ES)
4) Shri .S.M.R.Prasad,	:	A V.P(EMD)
5) Shri. R.T.Srinivasa Rao,	:	DGM (EMD),
6) Shri Brig. Enayat,	;	JSH,
7) Shri Joseph Reddy,	:	DGM (L & L)
8) Shri P.Narayana,	:	AGM (H R)
9) Shri M.Nagaraj,	:	PRO,
10)Shri J,N.Eshwar	:	DEPUTY MANAGER
11) Dr.Jain	:	AGM MECON, Ltd RANCHI
12) Dr. VG Nadhan	:	AGM MECON LTD RANCHI

ANNEXURE -03

PUBLICS PARTCIPATED IN THE MEETING(List Enclosed)

JSW	**EIA & EMP FOR THE PROPOSED EXPANSION FROM 10.0 MTPA TO 16.0 MTPA STEEL PLANT**	MECON मेकॉन ISO 9001 Company

1

ಬಳ್ಳಾರಿ ಜಿ. ಜೆ.ಎಸ್.ಡಬ್ಲ್ಯೂ ಸ್ಟೀಲ್ಸ್ ಲಿ. ಇವರು ~~[illegible]~~ ತೋರಣಗಲ್ಲು ಗ್ರಾಮ ಸಮೀಪದಲ್ಲಿ [illegible] ಇಲ್ಲಿ ಈಗ ಇರುವ ಇಂಟಿಗ್ರೇಟೆಡ್ ಸ್ಟೀಲ್ ಪ್ಲಾಂಟಿನ ಸಾಮರ್ಥ್ಯವನ್ನು ವಾರ್ಷಿಕ 10 ದಶಲಕ್ಷ ಟನ್ನಿಂದ 16 ದ.ಲ. ಟನ್ನುಗಳಿಗೆ ಹೆಚ್ಚಿಸುವ ಸಂಬಂಧ ದಿನಾಂಕ 5.10.10 ರಂದು ಜೆ.ಎಸ್.ಡಬ್ಲ್ಯೂ ಕಾಲೋನಿ ತೋರಣಗಲ್ಲು ಇಲ್ಲಿ ಜರುಗಿದ [illegible] ಹಾಜರಾದ [illegible]

ಅನುಬಂಧ-I

ಕ್ರ.	ಹೆಸರು / ವಿಳಾಸ	ಸಹಿ
1	[illegible]	
2	[illegible]	5/10
3	[illegible]	K.B. [illegible]

-2-

ಮೆ॥ ಜೆ.ಎಸ್.ಡಬ್ಲ್ಯು [illegible]
[illegible]
[illegible] 10.0 [illegible] 16.0 [illegible] 5.10.10
[illegible] 11.00 [illegible]
[illegible]

: ಅನುಬಂಧ :

H R Lal	VP (HR) JSW	
Vikas Sharma	Sr VP (CA) JSW	
SMA Prasad	Asst GM	
A.K. Singh	V.P C&ES	
R.T. Srinivasa Rao	DGM (EMD)	
Enneyalt	JSH	
M Joseph Reddy	DGM (LSL)	
P. NARAYANA	Army	
M. Nagaraja	PRO	
J.N. Eshwar	Dy. Mgr	

-3

ಮೆ|| ಜೆ.ಎಸ್.ಡಬ್ಲ್ಯೂ ಸ್ಟೀಲ್ಸ್ ಲಿ. ಇವರು ತೋರಣಗಲ್ಲು ಗ್ರಾಮ, ಸಂಡೂರು ತಾ. ಬಳ್ಳಾರಿ ಜಿಲ್ಲೆ ಇಲ್ಲಿ ಸ್ಥಾಪಿಸಿರುವ ~~10 ದಶಲಕ್ಷ ಟನ್ನಿನಿಂದ 16 ದ.ಲ. ಟನ್ನಿಗೆ ಹೆಚ್ಚಿಸುವ ಕು.~~ ಇಂಟಿಗ್ರೇಟೆಡ್ ಸ್ಟೀಲ್ ಪ್ಲಾಂಟಿನ ಸಾಮರ್ಥ್ಯವನ್ನು ವಾರ್ಷಿಕವಾಗಿ 10 ದಶಲಕ್ಷ ಟನ್ನಿನಿಂದ 16 ದಶಲಕ್ಷ ಟನ್ನಿಗೆ ಹೆಚ್ಚಿಸುವ ಕುರಿತು ದಿನಾಂಕ 5.10.10 ರಂದು ಬೆಳಗ್ಗೆ 11 ಗಂ. ಜೆ.ವಿ.ಎಸ್ ತೋರಣಗಲ್ಲು ಇಲ್ಲಿ ಜರುಗಿದ ಪ.ಸಾ. ಸಭೆಯಲ್ಲಿ ಹಾಜರಿದ್ದ ಸಾರ್ವಜನಿಕರು.

-ಅನುಬಂಧ-:

ಕ್ರ.ಸಂ	ಹೆಸರು	ಊರು	ರುಜು
(1)	Trilochan Sahu	~~[illegible]~~ Sly colley	T sahu
(2)	Raghu Raj Singh	Surcay	[illegible]
(3)	Mallikarjun	Yeroor	[illegible]
4)	Dattatraya. P. P	9	[illegible]
5)	A. Bug	K.U.R.KOPP	[illegible]
6)	Jayashree V Kulkarni	YTNGL	[illegible]
7)	Vishwanath P	TNGL	[illegible]
8)	Sridhar Rao	TNGL	[illegible]
9)	Mohan Kumar	Vaddu	[illegible]
10)	NAGARAJ	vaddu	[illegible]
11)	MANJUNATH. H	vaddu	[illegible]
12)	KM. Mahesh	Vaddu	[illegible]
13	ರಮೇಶ	Vaddu	[illegible]
14	VENKATESH	Vaddu	[illegible]
15)	Praveen Kumar	Toranagallu	[illegible]
16)	ಗೌಸ್	B [illegible]	[illegible]
17	Moinuddin	[illegible]	Moinuddin
18)	MUSTAFA	TNGL	MUSTAFA
19	ಎರ್ರಿಸ್ವಾಮಿ	~~[illegible]~~ TNGL	[illegible]
20	ಕೆ. ಶಿವರಾಜ್ ಬಾಬು	ವಡ್ಡು	[illegible]
21	MAHAMOOD BASHA	Bellary	Mahamood
22	Sri Ram	ವಡ್ಡು	Sri Ram
23	B. Ursu	Talluru	B. Ursu
24)	Muttappa. H. Yankanchi	BaDami	[illegible]
25)	Srinivasa. C	Toranagallu	[illegible]
26	[illegible]	Taluru	[illegible]
27	GOPAL. V	Toranagallu (R)	Gopal V
28)	Shiva Kumar	Sandur	[illegible]
29)	Shiva raja	Vaddu	[illegible]
30)	B. Mohammed Dimran	Krishnanagar	[illegible]

7

Sl. No	NAME	Place	Sign
31)	A. Srikumar Shastry	Sandur	[illegible]
32)	A. Murali Krishna	Old Daroji	A. Murali
33)	Raghavendra Kulkarni	Taranagar	Kulkarni
34	T. Mallikarjuna	Voorakonda	T. Mallik
35	Shivashankar. K.M.	Bellary	[illegible]
36	RAJESH. T	Sandur	Rajesh. T
37	A. Gangadhar patil	Taluk	[illegible]
38.	Ramesh Ghorpade.	Sandur	[illegible]
39	M. [illegible]	[illegible]	M. [illegible]
40	V. [illegible]	[illegible]	V. [illegible] -do-
41	Angadi Mallikarjuna.	Taranagar	A. Mallik
42	Gali Eshwarappa.	Toranagallu	[illegible]
43	N. Ravikumar BJP president (Sandur)	Toranagallu	[illegible]
44	M. Shabbir Sab	Vaddu	M. Shabbir
45	[illegible]	[illegible]	[illegible] (Girish)
46	H. [illegible]		H. Basu
47	K. M. Mulla	Vaddu	K. M. Mulla
48	K. J. Allappa	Vaddu	K. J. Allappa
49	A. Rudresh	Vaddu	A. Rudresh
50	U. Shankanna	Toranagallu	U. [illegible]

JSW Steel Limited

Vijayanagar Works :
P. O. Vidyanagar, Toranagallu,
Dist. Bellary - 583 275, Karnataka, India

Phone : 08395 - 250 120 - 130
Fax : 08395 - 250 138/250 665
Website : www.jsw.in

07.10.10

To,
Environmental Officer,
KSPCB, Regional Office,
 # 7, Ward No. 1, KHB Colony,
Near SP Circle, Parvathi Nagar,
Bellary 583 103

Dear Sir

Ref: Letter of President, Bharata Prajasattada Yuvajana Federation, Toranagallu dated : 5th Oct 2010.

This has reference to the above letter, mentioning some points against setting up of the expansion project of JSW Steel. We wish to comment on the concerns raised in the letter as under;

1. Air & Water Pollution from the steel plant:. The concern is general in nature. The air quality in term of chemical pollutants like SO2, NOx, and other chemicals is well within the specified limits. The pollution due to dust is mainly from the local fugitive sources, as evidenced by low value of PM-2.5.

2. Water Pollution from the steel plant: The quality of water at the two guard ponds are being monitored daily and the same is furnished to the Board. These are well within the norms.

3. Effect of health on human beings & crops.
    a. JSW foundation carries out regular health check ups and inspections in the surrounding 25 villages. Similarly regular health check up is also being conducted for the employees. No adverse health effects have been noticed. The health issues in villages are more due to poor sanitation.
    b. The survey of the area carried out by MECON for the EIA has not shown such trend. In fact there has been marginal increase in the yield due to better availability of water as explained in the EIA report

Yours truly,
For JSW Steel Limited,

SMR Prasad
AVP (Environment)

Part of O. P. Jindal Group

Regd. Office : Jindal Mansion,
5 A, Dr. G. Deshmukh Marg,
Mumbai - 400 026
Phone : 022-2351 3000
Fax : 022-2352 6400

JSW Steel Limited
Vijayanagar Works :
P. O. Vidyanagar, Toranagallu,
Dist. Bellary - 583 275, Karnataka, India.
Phone : 08395 - 250 120 - 130
Fax : 08395 - 250 138/250 665
Website : www.jsw.in

07.10.10

To,
Environmental Officer,
KSPCB, Regional Office,
 # 7, Ward No. 1, KHB Colony,
Near SP Circle, Parvathi Nagar,
Bellary 583 103

Dear Sir

Ref: Letter of President, Raitara Bhoo Horata Samithi dated: 5th Oct 2010.

This has reference to the above letter, mentioning some points against setting up of the expansion project of JSW Steel. We wish to comment on the concerns raised in the letter as under;

1. Increased pollution due to local terrain: The surrounding hillocks are relatively short and the area experiences fairly high wind speed. The accumulation of pollution due to the hillocks is not based on facts.

2. SO2 emissions from the Coke ovens-4: We have installed a desulphurization plant which can reduce the sulphur content in the coke oven gas from 500 mg/nm3 to less than 200 mg/Nm3. This technology and the unit is the first desulphurization plant installed in the country. The concern expressed is not based on facts as the SO2 levels in the ambient air surrounding the steel works is very well within the norms for ambient air quality.

3. Reduction of agricultural yield. The survey of the area carried out by MECON for the EIA has not shown such trend. In fact there has been marginal increase in the yield due to better availability of water as explained in the EIA report

4. Employment to local youth: Providing employment in our organization is in line with the recommendation of the "Sarojini Maharshi Committee Report ". Company is committed to give more employment opportunities to locals and this will be continued

Yours truly,
For JSW Steel Limited,

SMR Prasad
AVP (Environment)

Regd. Office : Jindal Mansion,
5 A, Dr. G. Deshmukh Marg,
Mumbai - 400 026
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P. O. Vidyanagar, Toranagallu,
Dist. Bellary - 583 275, Karnataka, India

Phone : 08395 - 250 120 - 130
Fax : 08395 - 250 138/250 665
Website : www.jsw.in

07.10.10

To,
Environmental Officer,
KSPCB, Regional Office,
 # 7, Ward No. 1, KHB Colony,
Near SP Circle, Parvathi Nagar,
Bellary 583 103

Dear Sir

Ref: Letter of President, Bellary District Parisara Samrakshana Vedike, dated: 5th Oct 2010.

This has reference to the above letter, mentioning some points against setting up of the expansion project of JSW Steel. We wish to comment on the concerns raised in the letter as under;

1. Raw material handling: JSW Steel purchases major quantity of iron ore from mining agencies in the nearby Sandur area. The road connecting Sandur to Toranagallu along the steel plant is the major route for transportation of iron ore from the Sandur by trucks. A large number of trucks carrying iron ore to areas other than JSW Steel also traverse through this route. The major portion of iron ore for our consumption is received through railways, for which we have a dedicated railway line. This is further being strengthened. However, due to non availability of railway siding and low volumes, some iron ore is being received by trucks.

   The road along the steel plant is made of concrete, is being cleaned daily to ensure cleanliness. You would appreciate that this stretch of road is one of the best maintained road in the area. The raw material for the expansion of the steel plant is located far away from the plant. The health related issues cited are not based on facts.

2. Underpass for railway track: As a part of the overall development of the area, KRDCL is executing the State Highway road #40 project, connecting Toranagallu to Sandur. This will totally eliminate the movement of traffic on the existing road by passing all railway tracks The existing road is a private road maintained by us.

3. Increased ambient temperature: The maximum ambient temperature recorded in Toranagallu is 43 deg C, as against 48 deg C at Bellary, located 25 K away from the plant site. The concern is not based on facts

4. Infrastructure for Sandur and other villages:
   As a part of our CSR activity, we have taken up supporting the development of infrastructure and other facilities in villages surrounding the steel plant.

Yours truly,
For JSW Steel Limited,

SMR Prasad
AVP (Environment)

JSW Steel Limited

Vijayanagar Works :
P. O. Vidyanagar, Toranagallu,
Dist. Bellary - 583 275, Karnataka, India.

Phone : 08395 - 250 120 - 130
Fax : 08395 - 250 138/250 665
Website : www.jsw.in

Received By C. R. Unit
Min. of Environment & Forests
Govt. of India
CGO Complex, Lodhi Road
New Delhi-110510

Date; 09.10.2009

~~Dr. P.L.Ahuja Rai~~
Director
IA Division,
Ministry of Environment & Forests,
Paryavaran Bhavan,
CGO Complex,
Lodhi Road,
New Delhi 110003

11/10/10

Dear Madam,

Sub: Expansion of the integrated steel plant from (10 Mtpa to 16 mtpa) along with captive power plant (600 MW) near village Toranagallu, Dist. Bellary, Karnataka.

Ref: F. No. J-11011 / 489 / 2009- IA II (I) dt. 09.10.2009

1. Subsequent to the issue of above TOR for expansion of steel plant from 10 Mtpa to 16 Mtpa, MECON, Ranchi to carry out the Environment Impact assessment for the above project. A copy of the final EIA report is enclosed.

2. Karnataka State Pollution Control Board has conducted the Public Consultation process on 05.10.2010 in connected with the above expansion activity. The proceedings of the Public Consultation along with our comments on the various concerns raised in the meeting, has been prepared as a separate document and is enclosed.

3. We are hereby submitting one copy of the following documents;
   a. Final EIA report prepared by MECON
   b. Addendum to EIA report, containing the proceedings of the public consultation,
   c. One CD containing the photographs and video coverage of the public consultation.
   d. Photo album containing phographs of public consultation

We request you to kindly permit us to make our presentation to the expert appraisal committee about our project.

Thanking you

For JSW Steel Limited

SMR Prasad
Associate Vice President
Environment