JSW Steel Limited

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JSWSL/Pellet 9 MTPA/MoEF&CC/2019 July 4, 2019

To

The Member Secretary,
Expert Appraisal Committee,
Ministry of Environment, Forest & Climate Change,
Indira Paryavaran Bhawan, Jor Bagh Road, Aliganj,
New Delhi- -110 003

Sub. Proposal to obtain modernization on Environment Clearance for changes in plant configuration for Proposed Expansion of Integrated Steel Plant from 5.0 MTPA to 10 MTPA at Village Dolvi, Raigad District, Maharashtra

Ref.: Environmental Clearance letter no - J-11011/76/2013-IA.II (I) dated 25th August 2015 for expansion of integrated steel plant capacity from 5 to 10 MTPA at JSW Steel Ltd., Dolvi, Tehsil, Maharashtra. **Proposal No.**: IA/MH/IND/78340/2018 dated 2.11.2018

Dear Sir,

This has reference to our on line application no IA/MH/IND/78340/2018 dated 2.11.2018 seeking modification in the environment clearance for changing in plant configuration under the clause 7.ii of the EIA notification at integrated steel plant capacity from 5 to 10 MTPA at JSW Steel Ltd., Dolvi, Tehsil, Maharashtra.

We have proposed for amendment in existing Environment Clearance vide letter no - J-11011/76/2013-IA II (I) dated 25th Aug, 2015 for change in configuration of Pellet Plant II from 4.0 MTPA to 9.0 MTPA and Sinter Plant III from 8.0 MTPA to 4.0 MTPA under integrated steel plant capacity from 5 to 10 MTPA at JSW Steel Ltd., Dolvi, Tehsil, Maharashtra. There are no changes in all other facilities originally mentioned in Environment clearances. As directed by Expert Appraisal Committee (EAC), Environment Impact Assessment (EIA) was carried out by NEERI, Nagpur

As per ToR letter FNo. IA-J-11011 /76/2013 IA(II) I dated 21.12.2018, all requisite documents / reports are prepared and annexed. Please find herewith the copy of Certificate of latest Environmental Clearance Compliance report from the regional Office, MoEF&CC, Nagpur.

We request you to kindly consider our proposal and for inclusion in the agenda for discussion with the Expert Appraisal Committee at the earliest.

Thanking you,

Yours faithfully,
For JSW Steel Ltd

V M Waghchaure
(General Manager – Environment).

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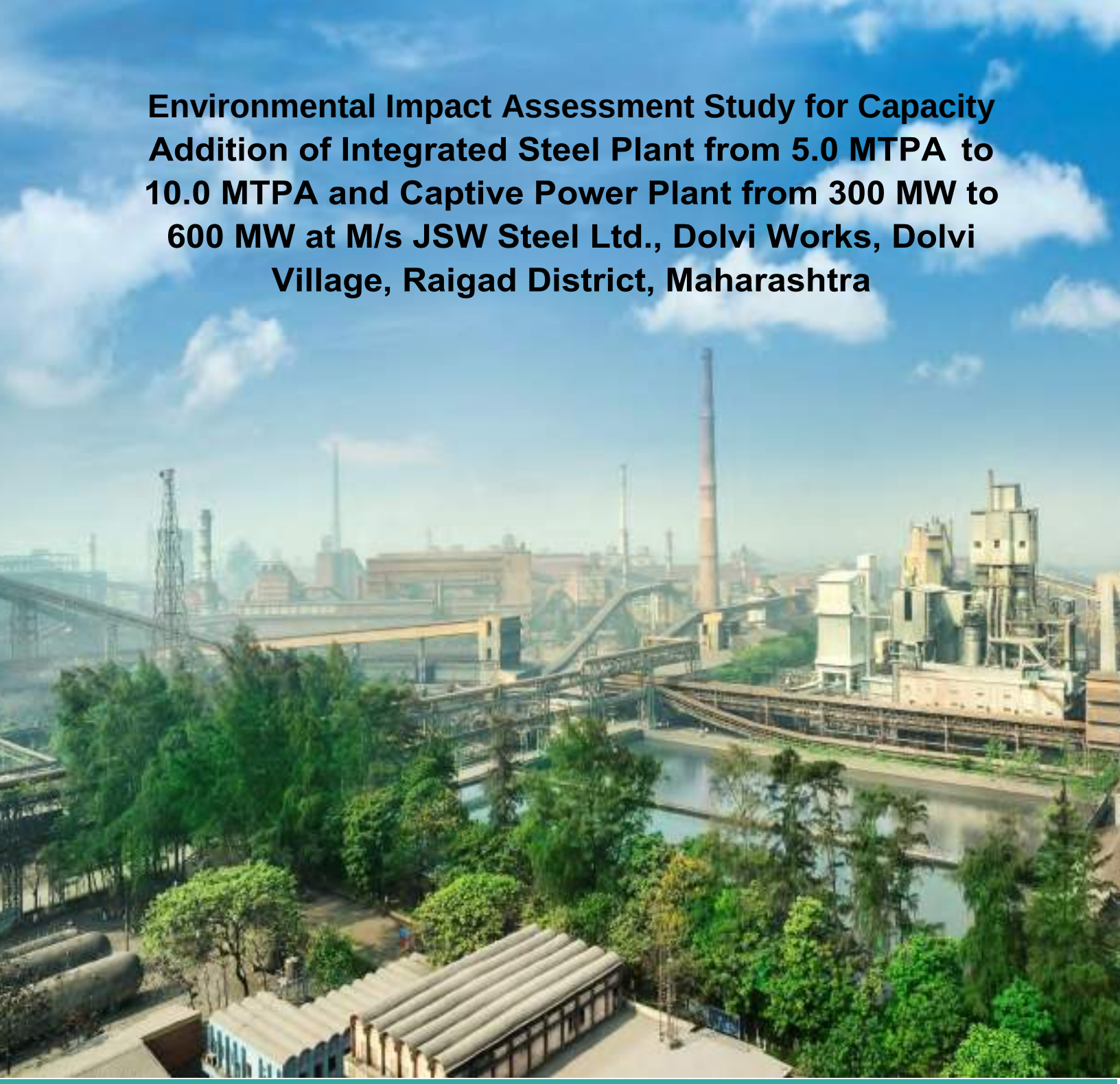
Environmental Impact Assessment Study for Capacity Addition of Integrated Steel Plant from 5.0 MTPA to 10.0 MTPA and Captive Power Plant from 300 MW to 600 MW at M/s JSW Steel Ltd., Dolvi Works, Dolvi Village, Raigad District, Maharashtra



Sponsor

JSW Steel Ltd., Dolvi Works

CSIR-National Environmental Engineering Research Institute
Nehru Marg, Nagpur

July 2019

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	Environment, Forest and Climate Change as per circular dated 30th May, 2012 on the status of compliance of conditions stipulated in all the existing environmental clearances including Amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing /existing operation of the project from SPCB/PCC shall be attached with the EIA-EMP report.	
	b. In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA Notification 1994 and/or EIA Notification 2006 shall be provided. Copies of Consent to Establish/No Objection Certificate and Consent to Operate (in case of units operating prior to EIA Notification 2006, CTE and CTO of FY 2005- 2006) obtained from the SPCB shall be submitted. Further, compliance report to the conditions of consents from the SPCB shall be submitted.	Chapter 2 Table 2.2
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	vi. Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular.	Chapter 10.3.5
	vii. Landuse break-up of total land of the project site (identified and acquired), government/private - agricultural, forest, wasteland, water bodies, settlements, etc shall be included. (not required for industrial area)	Chapter 3.4.2 Table 3.4.13Fig 3.4.5
	viii. A list of major industries with name and type within study area (10km radius) shall be incorporated. Land use details of the study area	NA
	ix. Geological features and Geo-hydrological status of the study area shall be included.	Chapter 3.4.3
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	xi. Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.	NA
	xii. R&R details in respect of land in line with state Government policy	NA
5.	Forest and Wildlife related issues (if applicable)	
	i. Permission and approval for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department. (if applicable).	NA
	ii. Land use map based on High resolution satellite imagery (GPS) of the proposed site delineating the forestland (*in case of projects involving forest land more than 40 ha).*	Chapter 3 Section 3.4.2
	iii. Status of Application submitted for obtaining the stage I forestry clearance along with latest status shall be submitted.	NA
	iv. The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere	NA

Sr. No.	ToR	Compliance
	Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden-thereon.	
	v. Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State Government for conservation of Schedule I fauna, if any exists in the study area.	NA
	vi. Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972, to the Standing Committee of the National Board for Wildlife	NA
6.	Environmental Status	
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	ii. AAQ data (except monsoon) at 8 locations for PM_{10}, $PM_{2.5}$, SO_2, NO_X, CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.	Chapter 3.1.4
	iii. Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAQQM Notification of Nov. 2009 along with – min., max., average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report.	Table 3.1.3, 3.1.4, 3.1.5
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Sr. No.	ToR	Compliance
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	viii. Soil Characteristic as per CPCB guidelines.	Chapter 3.4.1.3
	ix. Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.	Chapter 4
	x. Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule-I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished.	Chapter 3.5
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7.	Impact Assessment and Environmental Management Plan	
	i. Assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features. In case the project is located on a hilly terrain, the AQIP Modelling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be well assessed. Details of the model used and the input data used for modelling shall also be provided. The air quality contours shall be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any.	Chapter 3.1
	ii. Water Quality modelling – in case, if the effluent is proposed to be discharged in to the local drain, then Water Quality Modelling study should be conducted for the drain water taking into consideration the upstream and downstream quality of water of the drain.	NA
	iii. Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided. In this regard, options for	Chapter 4

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	transport of raw materials and finished products and wastes (large quantities) by rail or rail- cum road transport or conveyor-cum-rail transport shall be examined.	
	iv. A note on treatment of wastewater from different plant operations, extent recycled and reused for different purposes shall be included. Complete scheme of effluent treatment. Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) Rules.	Chapter 4
	v. Details of stack emission and action plan for control of emissions to meet standards.	Chapter 4
	vi. Measures for fugitive emission control	Chapter 4
	vii. Details of hazardous waste generation and their storage, utilization and disposal. Copies of MOU regarding utilization of solid and hazardous waste shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/ recover techniques, Energy conservation, and natural resource conservation.	Chapter 4 and Chapter 10 Section 4.1.3
	viii. Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided.	NA
	ix. Action plan for the green belt development plan in 33 % area i.e. land with not less than 1,500 trees per ha. Giving details of species, width of plantation, planning schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.	Chapter 10.3.5
	x. Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources.	Chapter 10
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	monitoring shall be submitted.	
	xiii. Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and damage control. Disaster management plan should be linked with District Disaster Management Plan.	Please refer Chapter 7 Additional Studies- Risk Assessment
8.	Occupational Health	
	i. Details of existing Occupational & Safety Hazards. What are the exposure levels of above mentioned hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved,	Please refer Chapter 7 Additional Studies- Risk Assessment, Section 7.5.2.3 Personal Protective Equipment (PPE), 7.5.2.4 Occupational Health Hazards, and 7.5.2.5Falling Objects
	ii. Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre-designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre-placement and periodical examinations give the details of the same. Details regarding last month analysed data of abovementioned parameters as per age, sex, duration of exposure and department wise.	Chapter 10
	iii. Annual report of health status of workers with special reference to Occupational Health and Safety.	Chapter 10
	iv. Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers.	Please refer Chapter 8 Project benefits, Section 8.4 Social and Environmental Benefits (Proposed Under Corporate Social Responsibility (CSR) of PPT)
9.	Corporate Environment Policy	
	i. Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.	Please refer Chapter 10 Environmental management Plan, Section 10.4 Environmental Management Cell
	ii. Does the Environment Policy prescribe for	Please refer Chapter 10

Sr. No.	ToR	Compliance
	standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.	Environmental management Plan, Section 10.4 Environmental Management Cell
	iii. What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given.	Please refer Chapter 10 Environmental management Plan, Section 10.4 Environmental Management Cell
	iv. Does the company have system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report	Chapter 10
10.	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.	Chapter 8 Project benefits, Section 8.4 Social and Environmental Benefits (Proposed Under Corporate Social Responsibility (CSR) of PPT)
11.	Corporate Environment Responsibility (CER)	
`	i. To address the Public Hearing issues, an amount as specified under Ministry's Office Memorandum vide F.No. 22-65/2017-IA.III dated 1st May 2018 amounting to Rs. .....crores, shall be earmarked by the project proponent, towards Corporate Environment Responsibility (CER). Distinct CER projects shall be carved out based on the local public hearing issues. Project estimate shall be prepared based on PWD schedule of rates for each distinct Item and schedule for time bound action plan shall be prepared. These CER projects as indicated by the project proponent shall be implemented along with the main project. Implementation of such program shall be ensured by constituting a Committee comprising of the project proponent, representatives of village	Please refer Chapter 8 Project benefits, Section 8.4 Social and Environmental Benefits (Proposed Under Corporate Social Responsibility (CSR) of PPT)

Sr. No.	ToR	Compliance
	Panchayat & District Administration. Action taken report in this regard shall be submitted to the Ministry's Regional Office. No free distribution/donations and or free camps shall be included in the above CER budget	
12.	Any litigation pending against the project and/or any direction/order passed by any Court of Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance/ATR to the notice(s) and present status of the case.	Please refer Chapter 1: Introduction, Section 1.5: Brief Description of Nature of the Project and Regulatory Requirements

Additional ToR for Integrated Steel Plant

Sr. No.	ToR	Compliance
1.	Iron ore/coal linkage documents along with the status of environmental clearance of iron ore and coal mines	NA
2.	Quantum of production of coal and iron ore from coal & iron ore mines and the projects they cater to. Mode of transportation to the plant and its impact	NA
3.	For Large ISPs, a 3-D view i.e. DEM (Digital Elevation Model) for the area in 10 km radius from the proposal site. MRL details of project site and RL of nearby sources of water shall be indicated.	Provision of satellite imagery for topographic details in Chapter 3 Baseline Environmental Status Section 3.4 Land Environment Subsection 3.4.2 Land use/ Land Cover using Remote sensing.
4.	Recent land-use map 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 10 Km radius area from proposed site. The same shall be used for land used/land-cover mapping of the area.	Please refer Chapter 3 Baseline Environmental Status, Section 3.4 Land Environment, sub-section 3.4.2 Land Use / Land Cover using Remote Sensing
5.	PM (PM_{10} and $P_{2.5}$) present in the ambient air must be analysed for source analysis – natural dust/RSPM generated from plant operations	Please refer Chapter 3 Baseline Environmental Status, Section 3.1

Sr. No.	ToR	Compliance
	(trace elements) of PM_{10} to be carried over	Ambient Air Quality
6.	All stock piles will have to be on top of a stable liner to avoid leaching of materials to ground water.	Please refer Chapter 2: Project description, Section 2.3.3 Iron ore concentrate and additives storage unit, Sub- section 2.3.6.3 Stock House
7.	Plan for the implementation of the recommendations made for the steel plants in the CREP guidelines.	Chapter 10 Page 10.16
8.	Plan for slag utilization	Please refer Chapter 3: Baseline Environmental Status, Sub-section: 3.4.4.1 Sources of Solid and Hazardous Wastes
9.	Plan for utilization of energy in off gases (coke oven, blast furnace)	Please refer Chapter 2: Project description, Section 2.3.7 Captive Power Plant Process Description, Sub-section 2.3.7.1 Fuel
10.	System of coke quenching adopted with justification.	Chapter 4
11.	Trace metals Mercury, arsenic and fluoride emissions in the raw material.	Chapter 4
12.	Trace metals in waste material especially slag.	Chapter 4
13.	Trace metals in water	Chapter 3
14.	Details of proposed layout clearly demarcating various units within the plant.	Please refer Chapter 1: Introduction, Section 1.5 Brief Description of Nature of the Project and Regulatory Requirements
15.	Complete process flow diagram describing each unit, its processes and operations, along with material and energy inputs and outputs (material and energy balance).	Please refer Chapter 2 Process description, Section 2.3 Existing project description & 2.4 Proposed project description, Figure 2.2
16	Details on design and manufacturing process for all the units.	Please refer Chapter 2: Project description, Section 2.3: Existing Project Description
17.	Details on environmentally sound technologies for recycling of hazardous materials, as per CPCB Guidelines, may be	Chapter 10

Sr. No.	ToR	Compliance
	mentioned in case of handling scrap and other recycled materials.	
18.	Details on requirement of energy and water along with its source and authorization from the concerned department. Location of water intake and outfall points (with coordinates).	Please refer Chapter 2: Project description, Section: 2.3.7 Captive Power Plant Process Description
19,	Details on toxic metal content in the waste material and its composition and end use (particularly of slag).	Chapter 3 Table 3.4.15 and 3.5.16
20.	Details on toxic content (TCLP), composition and end use of slag.	Chapter 4

Chapter 1
Introduction

The National Steel Policy (NSP) of Ministry of Steel has projected a demand of steel products of 300 Million tonnes by 2030. In line with this policy of Nation Development, JSW steel Ltd (JSWSL) is expanding its capacity through Brown field and Green field expansion projects. The Dolvi unit of JSWSL is currently operating at a capacity of 5 MTPA. The Engineering for the expansion of the crude steel capacity to 10 MTPA has been carried out and construction of some of the units are currently in progress. In view of the changes in sourcing of Iron Ore and its deteriorating quality, it has become necessary to modify the burden for the blast furnace by increasing the portion of pellets as compared to sinter.

In view of the above, it is proposed to increase the capacity of the pellet plant from 4 MTPA to 9 MTPA and reducing the capacity of the Sinter plant from 8 MTPA to 4 MTPA. This change requires amendment to the Environment Clearance issued by MoEF&CC, earlier for the expansion of capacity of Steel plant from 5 MTPA to 10 MTPA.

1.1 Purpose of the Project

JSW Steel Ltd, Dolvi Works had obtained Environmental Clearance from MoEF&CC for their expansion of its integrated steel plant from 5 MTPA to 10 MTPA (vide Letter No. J-11011/76/2013/IA II(I) dated 25th August 2015). This EC was issued after deliberation in the 35th meeting of the Expert Appraisal Committee of MoEFCC. In the present expansion, it was proposed to install two sinter plants of 360 m^2 bed area each having production capacity of 4 MTPA and a pellet plant of 464 m2 bed area and with a production capacity of 4 MTPA.

Now, JSW steel is proposing to install a pellet plant of capacity 9 MPTA instead of 4 MTPA capacity and this change in configuration is mainly due to raw material availability, capital and operational costs as well as technological advancements in charging of burden to the blast furnace. At the same time, JSW Steel also proposed to reduce the sinter plant capacity from 8 MTPA to 4 MTPA. Thus, the agglomerate feed to the Blast Furnaces will be met by increasing the pellet pant capacity from 4 MTPA to 13 MTPA and 6 MTPA sinter plant to 10 MTPA. However, there will be no change in the configuration and capacities of other production facilities.

As per the requirement of Environmental Impact Assessment (EIA) notification of MoEF&CC, dated 3rd March, 2016, the proposed activity of Steel Industry, which falls under Category - 3 a, of the Schedule and is necessary to obtain amendment to the environmental clearance issued vide letter No. J-11011/76/2013/IA II(I) dated 25th August 2015. In this regard M/s JSW Steel approached MoEFCC with a request for an amendment to the Environment Clearance under category 7 (ii) as the proposed change involves no increase in crude steel capacity and overall pollution. The

reconstituted Expert Appraisal Committee in its 2nd meeting held on 10th December 2018, observed that there is a need to reassess the environment impacts. The committee recommended to issue TOR without fresh Public Hearing, considering the fresh base line data. The TOR was subsequently issued vide F. No IA-J-11011/76/2013-IA .II (I) dated 21st December 2018.

JSWSL approached CSIR-National Environmental Engineering Research Institute (CSIR-NEERI), Nagpur to undertake an Environmental quality monitoring and carryout the Environment Impact Assessment and Environment Management Plan (EIA/EMP) report for their proposed expansion of Integrated Steel plant, Dolvi, Raigad in Maharashtra. The present report is an Environmental Impact Assessment & Environmental Management Plan (EIA/EMP) report for expansion of existing integrated steel plant from 5.0 to 10 MTPA & gas based CPP from 300 MW to 600 MW. The report is prepared to ensure environmental soundness of the expansion project and includes JSWSL's commitment towards environmental protection. The purpose of this study report is to take stock of the prevailing quality of existing environment, and to plan appropriate environmental control measures to minimize adverse impacts. The following major objectives have been considered:

- Assess the existing status of environmental quality surrounding steel plant.
- Assess the impacts due to the environmental improvements being carried out in the existing 5 MTPA steel plant.
- Assess emissions from new units under expansion of integrated steel project.
- Suggest appropriate Environment control mechanisms for the existing and new units and corrective measures.
- Prepare an action plan for implementation.
- Suggest a monitoring programme to assess the impact of the various adopted environmental control measures.
- Assess financial considerations for environmental control plans and maintenance of environmental quality.

For carrying out the Environmental Impact Assessment (EIA) study, the area falling within 10 km radius of project site at Geetapuram, Dolvi, Raigad (MS) area has been considered for generation of base line data with respect to present air quality, water quality, noise level, soil quality, ecology, meteorology etc. The environmental baseline studies were carried out during winter season of November 2018 – January 2019. The baseline environmental data was collected by actual field monitoring and from various secondary sources for identifying and predicting the probable environmental impacts from the expansion project. An in-depth analysis of the data was carried out. Wherever data was found lacking, reasonable assumptions have been made for impact assessment. A suitable environmental management plan has been suggested based on the findings.

1.2 Information about Project Proponent

Amongst the leading conglomerates in India, JSW Group is a $13 billion company. It is an integral part of the O. P. Jindal Group, and has been a part of major projects that have played a key role in India's growth. Ranked among India's top business houses, JSW's innovative and sustainable ideas cater to the core sectors of Steel, Energy, Cement and Infrastructure. The Group continues to strive for excellence with its strength, differentiated product mix, state-of-the-art technology, excellence in execution and focus on sustainability.

From its humble beginnings in steel, the JSW Group has expanded its presence across India, South America, South Africa & Europe. Through its CSR projects, it also continues to participate in and initiate activities that assist in improving those areas of our country that lack resources. JSW is known to be the "strategic first mover" to venture away from status quo, have the conviction to make fundamental changes and drive operational excellence on its quest to become better everyday.

JSW Steel is a flagship company of the JSW Group. JSW Steel is a leading integrated steel manufacturer (**Figure 1.1**). Currently one of the fastest growing companies in India, JSW Steel have a presence in over 100 countries. JSW is also the first company to manufacture high-strength and advanced high-end steel products for its automotive segments.

With the largest product portfolio in steel, JSW is India's largest steel exporter, shipping to over 100 countries across 5 continents. Starting with a single plant in 1982, JSW steel is now India's leading manufacturer of value-added and high-grade steel products. With plants in Karnataka, Tamil Nadu and Maharashtra, JSW steel have the capacity to produce 18 million tons per annum (MTPA). Over the last 35 years, JSW steel have been at the forefront of science and cutting-edge technology.

JSW Steel Limited (JSWSL), a leading steel maker of India, is in a position to fulfill its role in the nation's quest for higher growth and development in the new millennium. JSWSL is a dominant player in specialty steel production in the country having its plants at Dolvi, Vasind, Tarapur and Kalmeshwar in Maharashtra.

1.3 Nature, Size & Location of the Project

The nature of proposed expansion project is ferrous metallurgical operations and falls under the category of primary metallurgical industry to manufacturing steel and further processing to secondary metallurgical industry for HR & CR coil products in flat category and Bar & Rebar in long category.

The size of the project is addition of 5.0 MTPA over and above the existing crude steel capacity of 5.0 MTPA, resulting in a total of 10.0 MTPA steel products in the form of flat & long products along with slag cement as by product. In addition, a CPP of 300 MW from surplus gases of BF, Coke oven and balance from RLNG will also be installed. The location of the plant site within the district is shown in **Figure 1.2**, while major infrastructural facilities in close proximity are depicted in **Figure 1.3**.

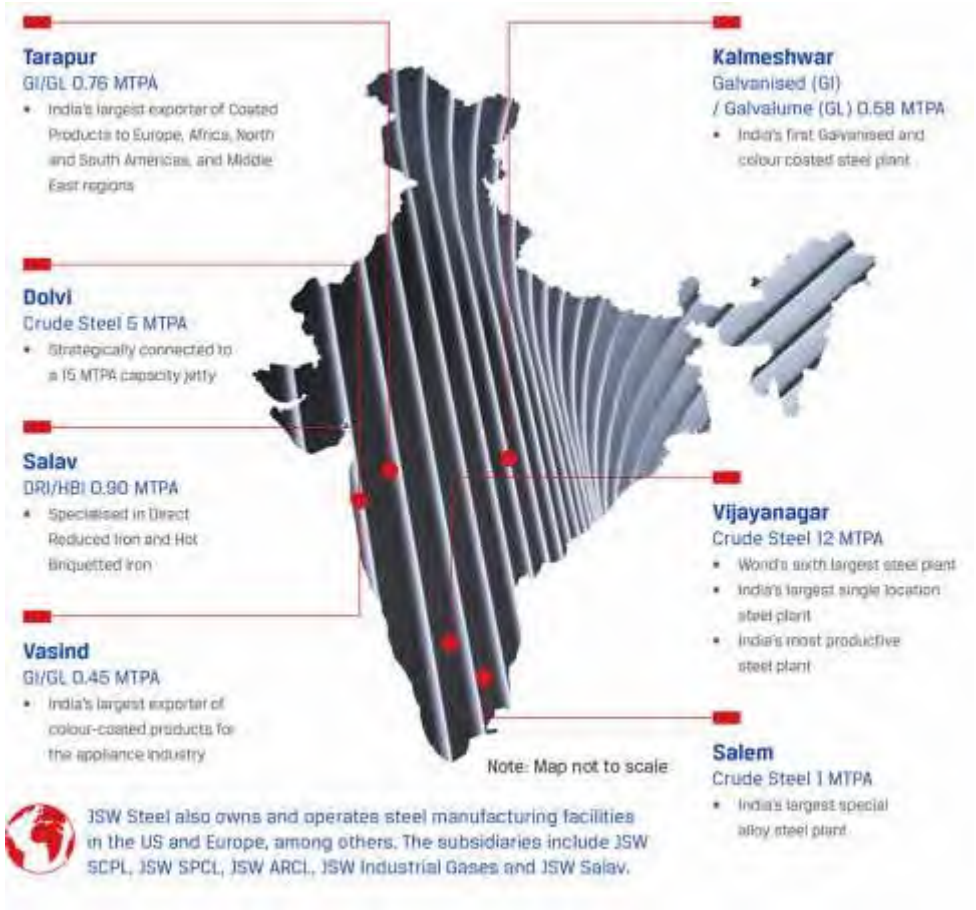


Figure 1.1: Plant locations of JSW Steel (Source: https://www.jsw.in/jsw-steel-2018/images/map.jpg)

The integrated steel plant is located between latitude 18°40'00" to 18°45'00" N and longitude 73°00'00" to 73°05'00" E at Geetapuram, Dolvi of Raigad district of Maharashtra. Land measuring about 1800 (1200 existing+600 additional) acres (which is falling under villages Dolvi, Khar, Karavi & Jui Bapuji in Taluka Pen district Raigad in Maharashtra) is under possession of JSWSL. All proposed expansion will be located in additional land & inside the existing plant boundary as depicted in Lay out of the project **Figure 1.4** .

1.4 Details of EIA Consultant and NABET Accreditation

The EIA consultant for the proposed project is National Environmental Engineering Research Institute (NEERI), which is a Constituent Laboratory of Council of Scientific & Industrial Research (CSIR), India (Website: www.neeri.res.in) was established in 1958. The details about the CSIR-NEERI and NABET Accreditation are given in **Chapter 12**.

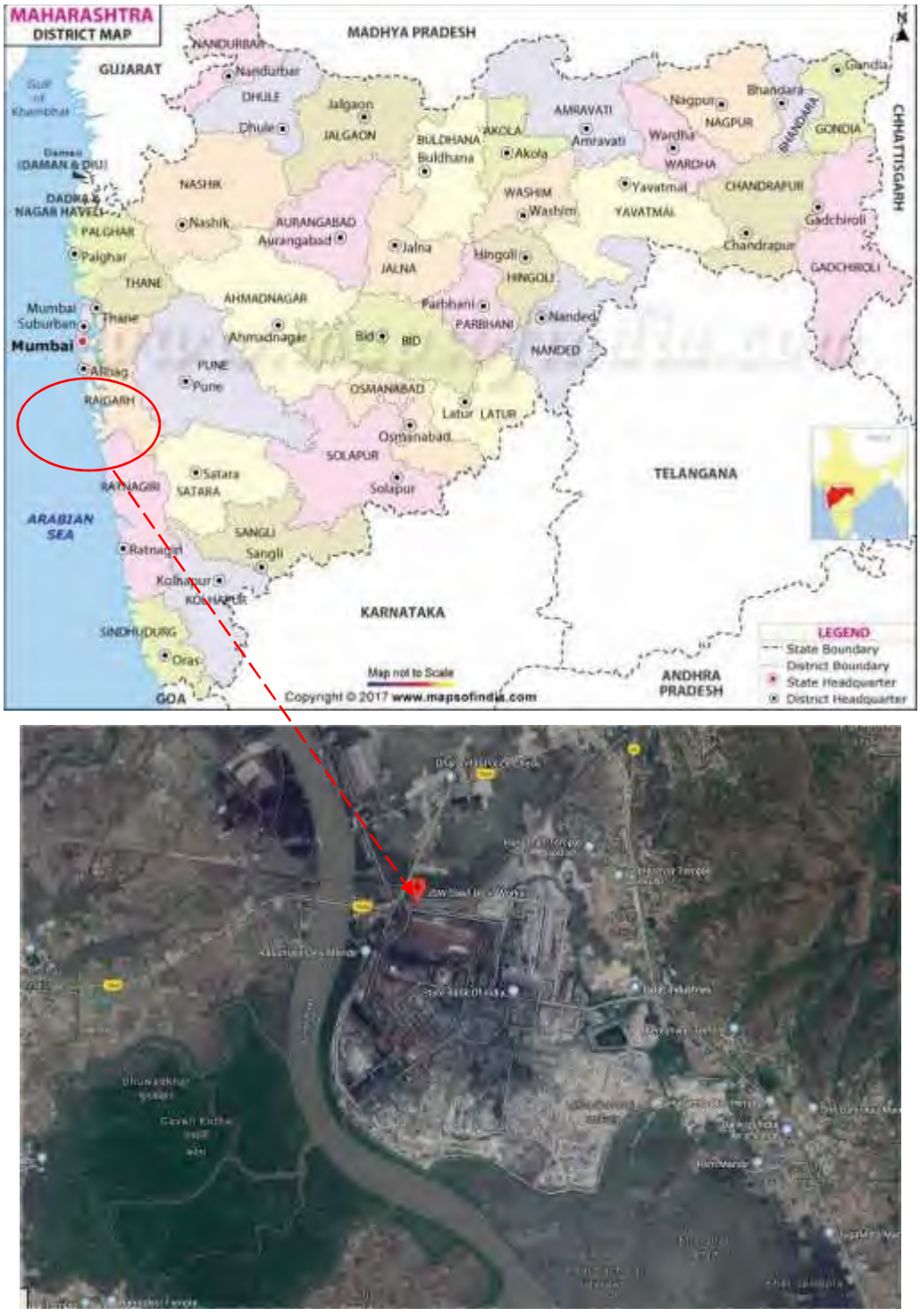


Figure 1.2 : Location Map of JSW Steel Plant

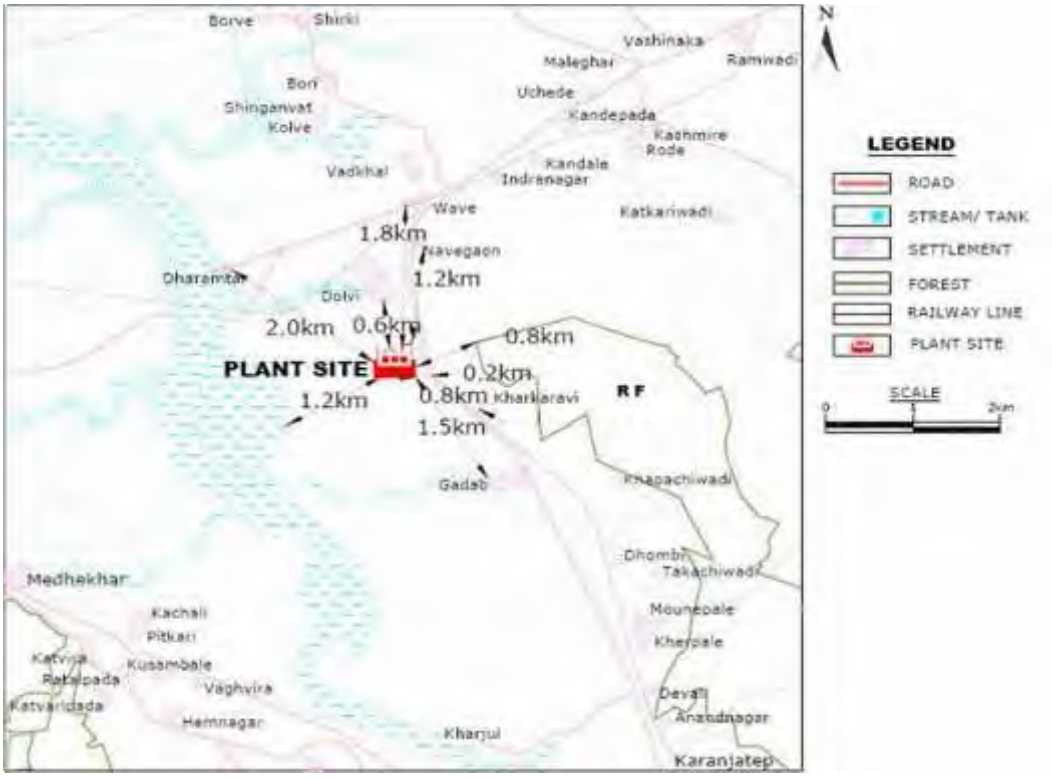


Figure 1.3: Infrastructure Facilities near the JSW Steel Plant

1.5 Brief Description of Nature of the Project and Regulatory Requirements

JSW Steel Ltd, Dolvi Works had been granted Environmental Clearance (EC) for expansion of its integrated steel plant from 5 MTPA to 10 MTPA of finished product vide letter no J-11011/76/2013-IA II (I) dated 25th Aug, 2015. The EC letter was further amended to exclude the proposed 1.0 MTPA & 2.5 MTPA coke oven units and transfer of the same to Dolvi Coke Projects Limited (A Sister Company) and 10 MTPA Slag and clinker grinding unit to JSW Cement Limited (A Sister Company). The plant's current annual production capacity is **5 MTPA** of steel.

Located on the west coast of India, the plant has a jetty with a capacity of 10 million tonnes per annum. This provides the unit with logistical advantages in importing raw materials and savings on freight cost. Production capacity of various units after the proposed Expansion from 5 MTPA to 10 MTPA as per existing revised EC are given in **Table 1.1.**

JSW is submitting the compliance status of the steel plant periodically to MSPCB and MoEFCC's Regional Office, Nagpur. The latest certified compliance status report vide letter no 5-71/2015(Env)/4529 dated 26/10/2018 by the Regional Office-MoEF&CC, Nagpur has been submitted along with EC application.

In the earlier proposal for expansion of steel production capacity from 5 MTPA to 10 MTPA, JSW Steel has proposed setting up of two identical sinter plants of 4 MTPA sinter production capacity each and one pellet plant of 4 MTPA production

capacity. As part of the present proposal, JSW is proposing to remove one of the proposed sinter plants and in place of proposed 4 MTPA pellet plant, to install a bigger pellet plant of 9 MTPA capacity. Revised plant configuration after proposed changes is shown in **Table 1.1**.

Table 1.1: Revised Plant Configuration after Proposed Changes

Sl No	Unit Name	Existing Capacity at 5 MTPA Stage (A)	Addl. Proposed Capacity under 5 to 10 MTPA Expansion as per previous EC (B)	Revised Unit Capacity under 5 to 10 MTPA Expansion (C)	Total Plant Capacity at 10 MTPA after present proposal (A+C)	Remarks
1	DRI (Gas based Mega Module)	2.0 MTPA	2.0 MTPA	2.0 MTPA	4.0 MTPA	No change
2	**Pellet Plant**	**4.0 MTPA**	**4.0 MTPA**	**9.0 MTPA**	**13.0 MTPA**	**Increase by 5 MTPA**
3	Coke Oven including By- product plant	1.0 MTPA	-	-	1.0 MTPA	No change
4	**Sinter Plant**	**6.0 MTPA**	**8.0 MTPA**	**4.0 MTPA**	**10.0 MTPA**	**Decrease by 4 MTPA**
5	Blast furnace including pig casting	3.6 MTPA	4.5 MTPA	4.5 MTPA	8.1 MTPA	No change
6	SMS(CONA RC)	5.2 MTPA	-	-	5.2 MTPA	No change
7	SMS(BOF)	-	6.0 MTPA	6.0 MTPA	6.0 MTPA	No change
8	Ladle Furnace(LF)	2X200+250t	2 X 300 T	2 X 300 T	2X200t+ 250t + 2 X 300 T	No change
9	VD/VOD & RH-TP	1X200t+ 1X205t	2 X 300 T	2 X 300 T	1X200t+ 1X205t + 2 X 300 T	No change
10	CSP(HRC Coil) Thin Caster-cum- Hot Strip Finishing Train	3.5 MTPA	-	-	3.5 MTPA	No change
11	Conventional Slab Caster	2X1 Strand 3.68 MTPA	2X2 Slab Casters 5.73 MTPA	2X2 Slab Casters 5.73 MTPA	9.41 MTPA	No change
12	Billet Caster	-	1X6 Strands	1X6 Strands	1X6 Strands	No change
13	Plate Mill	1.5 MTPA	-	-	1.5 MTPA	No change
14	Hot Rolling Mill with Shearing and Slitting	-	5.0 MTPA	5.0 MTPA	5.0 MTPA	No change
15	Bar Mill	-	1.4 MTPA	1.4 MTPA	1.4 MTPA	No change
16	CRM	1 MTPA	1.5 MTPA	1.5 MTPA	2.5 MTPA	No change
17	Galvanizing Line	0.6 MTPA	-	-	0.6 MTPA	No change
18	Electrical Steel CRGO Line	0.4 MTPA	-	-	0.4 MTPA	No change
19	Tin Plate Mill	0.4 MTPA	-	-	0.4 MTPA	No change
20	Colour Coating line	0.5 MTPA	-	-	0.5 MTPA	No change
21	Lime/dolo Plant	1800 tpd	3X600 TPD	3X600 TPD	3600 TPD	No change
22	Oxygen Plant	4100 tpd	3500 TPD	3500 TPD	7600 TPD	No change
23	Captive Power Plant	300 MW	300 MW	300 MW	600 MW	No change
24	Township	-	150 acres township of 7500 dwellings	150 acres township of 7500 dwellings	150 acres township of 7500 dwellings	No change

As per the EIA notification published by MOEF, Government of India, dated 14th September 2006, this project falls under sector 3(a), Category "A" of the Projects or Activities requiring prior environmental Clearance of MOEF&CC. Further any changes made in the approved Environmental Clearance also requires the amendment to the EC. The summary of applicable statutory legislations for this sector listed in **Table 1.2**.

Table 1.2 : Applicable Statutory Legislations

Legislation/Acts	Objective
Environment (Protection) Act 1986 and its subsequent amendments	To protect and improve the overall environment
EIA Notification dated September 14th , 2006 and its subsequent amendments	Requirement of environmental clearance before establishment of or modernization / expansion of identified developmental projects.
Forest (Conservation) Act,1980 and its subsequent amendments	To protect forests.
Wildlife (Protection) Act, 1972 and its subsequent amendments	To protect wildlife
Water (Prevention and Control of Pollution) Act, 1974 and its subsequent amendments	For the prevention and control of water pollution and also maintaining or restoring the wholesomeness of water.
Air (Prevention and Control of Pollution) Act 1981 and its amendments	For the prevention, control and abatement of air pollution.
The Noise (Regulation and Control) Rules, 2000 The Environment (Protection) Second Amendment Rules, 2002 (Noise Limits for New Generator Sets)	For the prevention and control of noise pollution
Construction & Demolition Rule, 2016	Every waste resulting from construction, re-modelling, repair and demolition of any civil structure that generates construction and demolition waste such as building materials, debris, rubble.
Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 and its subsequent amendments.	For Management & Handling of the hazardous wastes in environment friendly manner.
The Public Liability Insurance Act and Rules 1991	It provides strict liability for damages arising out of any accident occurring while handling any hazardous substance and for the establishment of a National Environment Tribunal for effective and

Legislation/Acts	Objective
	expeditious disposal of cases arising from such accident, with a view to giving relief and compensation for damages to persons, property and the environment and for matters connected therewith or incidental thereto.
The Custom Act, 1962	To prevent entry of illegal hazardous goods or banned goods including hazardous or banned chemicals.
Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996	For Emergency Planning and Preparedness and Response to chemical accidents
The Explosives Act, 1884 The Explosives Rules, 1983	To regulate the manufacture, possession, use, sale, transport, export and import of explosives with a view to prevent accidents

- Compliance to State Rules and Notifications will also be ensured.

An application seeking prior environmental clearance has been made vide proposal no IA/MH/IND/78340/2018 dated 2nd November 2018 seeking Environmental Clearance for changes in the plant configuration under para 7 (II) of EIA Notification 2006 along with prescribed Form -1 & PFR to MOEF&CC. The presentation was made on 10th December 2018 to the Expert Appraisal Committee (EAC) of MOEF&CC for amendment of EC based on changes in configuration without any increase in pollution load. MOEF&CC vide their letter no F. No IA-J-11011/76/2013-IA .II (I) dated 21st December 2018 issued TOR for issuing amendment to the EC]

This EIA report contains information on the changes made in the configuration of Pellet & Sinter plants and other changes which were essential after detail engineering. The report also presents the status of existing environment around the steel plant besides quantifying the emissions generated and evaluating the predicted environmental of the proposed expansion. A detailed coverage of background environmental quality, pollution sources, anticipated environmental impacts and mitigation measures, Environmental Management Plan (EMP), additional studies, project benefits, environmental monitoring plan and all related aspects and changes if any from the original EIA has also been covered in this report. Since the EIA for the proposed expansion was earlier carried out by MECON, this report primarily focuses on the impacts of the proposed changes in the configuration of sinter and pellet plants. In case of other details not specifically covered in the report, the earlier EIA report of MECON 11.S2.2013.EEm 2114, April,2014 may be referred.

1.6 Terms of Reference (ToR) issued by MoEFCC

1.6A Generic Terms of Reference for Metallurgical Industries (ferrous & non-ferrous) Projects (Sector-8; as per NABET Guidelines, Ver.3)

1. Executive Summary
2. Introduction
   - i. Details of the EIA Consultant including NABET accreditation
   - ii. Information about the project proponent
   - iii. Importance and benefits of the project

3. Project Description
   - i. Cost of project and time of completion.
   - ii. Products with capacities for the proposed project.
   - iii. If expansion project, details of existing products with capacities and whether equate and is available for expansion, reference of earlier EC if any.
   - iv. List of raw materials required and their source along with mode of transportation.
   - v. Other chemicals and materials required with quantities and storage capacities
   - vi. Details of Emission, effluents, hazardous waste generation and their management.
   - vii. Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)
   - viii. The project proponent shall furnish the requisite documents from the competent authority in support of drawl of ground water and surface water and supply of electricity.
   - ix. Process description along with major equipment and machineries, process flow sheet (Quantative) from raw material to products to be provided
   - x. Hazard identification and details of proposed safety systems.
   - xi. Expansion/modernization proposals:
     - a) Copy of <u>all</u> the Environmental Clearance(s) including Amendments thereto obtained for the project from MoEF&CC/SEIAA shall be attached as an Annexure. A certified copy of the latest Monitoring Report of the Regional Office of the Ministry of Environment, Forest and Climate Change as per circular dated 30th May, 2012 on the status of compliance of conditions stipulated in <u>all</u> the existing environmental clearances including Amendments shall be provided. In addition, status of compliance of Consent to Operate for the ongoing /existing operation of the project from SPCB/PCC shall be attached with the EIA-EMP report.
     - b) In case the existing project has not obtained environmental clearance, reasons for not taking EC under the provisions of the EIA Notification 1994 and/or EIA Notification 2006 shall be provided. Copies of Consent to Establish/No Objection Certificate and Consent to Operate (in case of units operating

prior to EIA Notification 2006, CTE and CTO of FY 2005-2006) obtained from the SPCB shall be submitted. Further, compliance report to the conditions of consents from the SPCB shall be submitted.

4. Site Details

i. Location of the project site covering village, Taluka/Tehsil, District and State, Justification for selecting the site, whether other sites were considered.
ii. A toposheet of the study area of radius of 10km and site location on 1:50,000/1:25,000 scale on an A3/A2 sheet. (including all eco-sensitive areas and environmentally sensitive places)
iii. Co-ordinates (lat-long) of all four corners of the site.
iv. Google map-Earth downloaded of the project site.
v. Layout maps indicating existing unit as well as proposed unit indicating storage area, plant area, greenbelt area, utilities etc. If located within an Industrial area/Estate/Complex, layout of Industrial Area indicating location of unit within the Industrial area/Estate.
vi. Photographs of the proposed and existing (if applicable) plant site. If existing, show photographs of plantation/greenbelt, in particular.
vii. Landuse break-up of total land of the project site (identified and acquired), government/private - agricultural, forest, wasteland, water bodies, settlements, etc shall be included. (not required for industrial area)
viii. A list of major industries with name and type within study area (10km radius) shall be incorporated. Land use details of the study area
ix. Geological features and Geo-hydrological status of the study area shall be included.
x. Details of Drainage of the project upto 5km radius of study area. If the site is within 1 km radius of any major river, peak and lean season river discharge as well as flood occurrence frequency based on peak rainfall data of the past 30 years. Details of Flood Level of the project site and maximum Flood Level of the river shall also be provided. (mega green field projects)
xi. Status of acquisition of land. If acquisition is not complete, stage of the acquisition process and expected time of complete possession of the land.
xii. R&R details in respect of land in line with state Government policy

5. Forest and wildlife related issues (if applicable):

i. Permission and approval for the use of forest land (forestry clearance), if any, and recommendations of the State Forest Department. (if applicable).
ii. Land use map based on High resolution satellite imagery (GPS) of the proposed site delineating the forestland (*in case of projects involving forest land more than 40 ha).*
iii. Status of Application submitted for obtaining the stage I forestry clearance along with latest status shall be submitted.
iv. The projects to be located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden-

thereon.

v. Wildlife Conservation Plan duly authenticated by the Chief Wildlife Warden of the State Government for conservation of Schedule I fauna, if any exists in the study area.
vi. Copy of application submitted for clearance under the Wildlife (Protection) Act, 1972, to the Standing Committee of the National Board for Wildlife

6. Environmental Status

i. Determination of atmospheric inversion level at the project site and site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall.
ii. AAQ data (except monsoon) at 8 locations for PM_{10}, $PM_{2.5}$, SO_2, NO_X, CO and other parameters relevant to the project shall be collected. The monitoring stations shall be based CPCB guidelines and take into account the pre-dominant wind direction, population zone and sensitive receptors including reserved forests.
iii. Raw data of all AAQ measurement for 12 weeks of all stations as per frequency given in the NAQQM Notification of Nov. 2009 along with – min., max., average and 98% values for each of the AAQ parameters from data of all AAQ stations should be provided as an annexure to the EIA Report.
iv. Surface water quality of nearby River (60m upstream and downstream) and other surface drains at eight locations as per CPCB/MoEF&CC guidelines.
v. Whether the site falls near to polluted stretch of river identified by the CPCB/MoEF&CC.
vi. Ground water monitoring at minimum at 8 locations shall be included.
vii. Noise levels monitoring at 8 locations within the study area.
viii. Soil Characteristic as per CPCB guidelines.
ix. Traffic study of the area, type of vehicles, frequency of vehicles for transportation of materials, additional traffic due to proposed project, parking arrangement etc.
x. Detailed description of flora and fauna (terrestrial and aquatic) existing in the study area shall be given with special reference to rare, endemic and endangered species. If Schedule-I fauna are found within the study area, a Wildlife Conservation Plan shall be prepared and furnished.
xi. Socio-economic status of the study area.

7. Impact Assessment and Environment Management Plan

i. Assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features. In case the project is located on a hilly terrain, the AQIP Modelling shall be done using inputs of the specific terrain characteristics for determining the potential impacts of the project on the AAQ. Cumulative impact of all sources of emissions (including transportation) on the AAQ of the area shall be well assessed. Details of the model used and the input data used for modelling shall also be provided. The air quality contours shall be

plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any.

ii. Water Quality modelling – in case, if the effluent is proposed to be discharged in to the local drain, then Water Quality Modelling study should be conducted for the drain water taking into consideration the upstream and downstream quality of water of the drain.

iii. Impact of the transport of the raw materials and end products on the surrounding environment shall be assessed and provided. In this regard, options for transport of raw materials and finished products and wastes (large quantities) by rail or rail- cum road transport or conveyor-cum-rail transport shall be examined.

iv. A note on treatment of wastewater from different plant operations, extent recycled and reused for different purposes shall be included. Complete scheme of effluent treatment. Characteristics of untreated and treated effluent to meet the prescribed standards of discharge under E(P) Rules.

v. Details of stack emission and action plan for control of emissions to meet standards.

vi. Measures for fugitive emission control

vii. Details of hazardous waste generation and their storage, utilization and disposal. Copies of MOU regarding utilization of solid and hazardous waste shall also be included. EMP shall include the concept of waste-minimization, recycle/reuse/recover techniques, Energy conservation, and natural resource conservation.

viii. Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 2009. A detailed plan of action shall be provided.

ix. Action plan for the green belt development plan in 33 % area i.e. land with not less than 1,500 trees per ha. Giving details of species, width of plantation, planning schedule etc. shall be included. The green belt shall be around the project boundary and a scheme for greening of the roads used for the project shall also be incorporated.

x. Action plan for rainwater harvesting measures at plant site shall be submitted to harvest rainwater from the roof tops and storm water drains to recharge the ground water and also to use for the various activities at the project site to conserve fresh water and reduce the water requirement from other sources.

xi. Total capital cost and recurring cost/annum for environmental pollution control measures shall be included.

xii. Action plan for post-project environmental monitoring shall be submitted.

xiii. Onsite and Offsite Disaster (natural and Man-made) Preparedness and Emergency Management Plan including Risk Assessment and damage control. Disaster management plan should be linked with District Disaster Management Plan.

8. Occupational health

i. Details of existing Occupational & Safety Hazards. What are the exposure levels of above mentioned hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that

health of the workers can be preserved,

ii. Details of exposure specific health status evaluation of worker. If the workers' health is being evaluated by pre-designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre-placement and periodical examinations give the details of the same. Details regarding last month analysed data of abovementioned parameters as per age, sex, duration of exposure and department wise.

iii. Annual report of health status of workers with special reference to Occupational Health and Safety.

iv. Plan and fund allocation to ensure the occupational health & safety of all contract and casual workers.

9. Corporate Environment Policy

i. Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.

ii. Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.

iii. What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given.

iv. Does the company have system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism shall be detailed in the EIA report

10. 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.

11. Corporate Environment Responsibility (CER)

i. To address the Public Hearing issues, an amount as specified under Ministry's Office Memorandum vide F.No. 22-65/2017-IA.III dated 1st May 2018 amounting to Rs. .....crores, shall be earmarked by the project proponent, towards Corporate Environment Responsibility (CER). Distinct CER projects shall be carved out based on the local public hearing issues. Project estimate shall be prepared based on PWD schedule of rates for each distinct Item and schedule for time bound action plan shall be prepared. These CER projects as indicated by the project proponent shall be implemented along with the main project. Implementation of such program shall be ensured by constituting a Committee comprising of the project proponent, representatives of village Panchayat & District Administration. Action taken report in this regard shall be submitted to the Ministry's Regional Office. No free distribution/donations and or free camps shall be included in the above CER budget

12. Any litigation pending against the project and/or any direction/order passed by any Court of Law against the project, if so, details thereof shall also be included. Has the unit received any notice under the Section 5 of Environment (Protection) Act, 1986 or relevant Sections of Air and Water Acts? If so, details thereof and compliance/ATR to the notice(s) and present status of the case.

13. A tabular chart with index for point wise compliance of above ToRs.

14. The ToRs prescribed shall be valid for a period of three years for submission of the EIA- EMP reports along with Public Hearing Proceedings (wherever stipulated).

The following general points shall be noted:

i. All documents shall be properly indexed, page numbered.
ii. Period/date of data collection shall be clearly indicated.
iii. Authenticated English translation of all material in Regional languages shall be provided.
iv. The letter/application for environmental clearance shall quote the MOEF&CC file No. and also attach a copy of the letter.
v. The copy of the letter received from the Ministry shall be also attached as an annexure to the final EIA-EMP Report.
vi. The index of the final EIA-EMP report must indicate the specific chapter and page no. of the EIA-EMP Report
vii. While preparing the EIA report, the instructions for the proponents and instructions for the consultants issued by MOEF&CC vide O.M. No. J-11013/41/2006-IA.II (I) dated 4th August, 2009, which are available on the website of this Ministry shall also be followed.
viii. The consultants involved in the preparation of EIA-EMP report after accreditation with Quality Council of India (QCl)/National Accreditation Board of Education and Training (NABET) would need to include a certificate in this regard in the EIA-EMP reports prepared by them and data provided by other organization/Laboratories including their status of approvals etc. Name of the Consultant and the Accreditation details shall be posted on the EIA-EMP Report as well as on the cover of the Hard Copy of the Presentation material for EC presentation.
ix. ToRs' prescribed by the Expert Appraisal Committee (Industry) shall be considered for preparation of EIA-EMP report for the project in addition to all the relevant information as per the 'Generic Structure of EIA' given in Appendix III and IIIA in the EIA Notification, 2006. Where the documents provided are in a language other than English, an English translation shall be provided. The draft EIA-EMP report shall be submitted to the State Pollution Control Board of the concerned State for conduct of Public Hearing. The SPCBshall conduct the Public Hearing/public consultation, district-wise, as per the provisions of EIA notification, 2006. The Public Hearing shall be chaired by an Officer not below the rank of Additional District Magistrate. The issues raised in the Public Hearing and during the consultation process and the commitments made by the project proponent on

the same shall be included separately in EIA-EMP Report in a separate chapter and summarised in a tabular chart with financial budget (capital and revenue) along with time-schedule of implementation for complying with the commitments made. The final EIA report shall be submitted to the Ministry for obtaining environmental clearance.

Additional ToR for Integrated Steel Plants

1. Iron ore/coal linkage documents along with the status of environmental clearance of iron ore and coal mines
2. Quantum of production of coal and iron ore from coal & iron ore mines and the projects they cater to. Mode of transportation to the plant and its impact
3. For Large ISPs, a 3-D view i.e. DEM (Digital Elevation Model) for the area in 10 km radius from the proposal site. MRL details of project site and RL of nearby sources of water shall be indicated.
4. Recent land-use map 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 10 Km radius area from proposed site. The same shall be used for land used/land-cover mapping of the area.
5. PM (PM_{10} and $P_{2.5}$) present in the ambient air must be analysed for source analysis – natural dust/RSPM generated from plant operations (trace elements) of PM_{10} to be carried over.
6. All stock piles will have to be on top of a stable liner to avoid leaching of materials to ground water.
7. Plan for the implementation of the recommendations made for the steel plants in the CREP guidelines.
8. Plan for slag utilization
9. Plan for utilization of energy in off gases (coke oven, blast furnace)
10. System of coke quenching adopted with justification.
11. Trace metals Mercury, arsenic and fluoride emissions in the raw material.
12. Trace metals in waste material especially slag.
13. Trace metals in water
14. Details of proposed layout clearly demarcating various units within the plant.
15. Complete process flow diagram describing each unit, its processes and operations, along with material and energy inputs and outputs (material and energy balance).
16. Details on design and manufacturing process for all the units.
17. Details on environmentally sound technologies for recycling of hazardous materials, as per CPCB Guidelines, may be mentioned in case of handling scrap and other recycled materials.
18. Details on requirement of energy and water along with its source and authorization from the concerned department. Location of water intake and outfall points (with coordinates).
19. Details on toxic metal content in the waste material and its composition and end use (particularly of slag). Details on toxic content (TCLP), composition and end use of slag.

Figure 1.4 : Layout Map of JSW Steel Plant

Chapter 2
Project Description

Amongst the leading conglomerates in India, JSW Group is a $14 billion company. It is an integral part of the O. P. Jindal Group, and has been a part of major projects that have played a key role in India’s growth. Ranked among India's top business houses, JSW's innovative and sustainable ideas cater to the core sectors of Steel, Energy, Cement and Infrastructure. The Group continues to strive for excellence with its strength, differentiated product mix, state-of-the-art technology, excellence in execution and focus on sustainability.

From its humble beginnings in steel, the JSW Group has expanded its presence across India, South America, South Africa & Europe. Through its CSR projects, it also continues to participate in and initiate activities that assist in improving those areas of our country that lack resources. JSW is known to be the “strategic first mover” to venture away from status quo, have the conviction to make fundamental changes and drive operational excellence on its quest to become better every day. JSW Steel is a leading integrated steel manufacturer, and currently one of the fastest growing companies in India, its presence in over 100 countries.

The 5 MTPA integrated steel plant at Dolvi is advantageously located on the West coast of Maharashtra. It is connected to a jetty which can handle cargo of up to 15 MTPA. JSW Dolvi Works is India’s first to adopt a combination of Conarc Technology for both steel-making and compact strip production (CSP), aiding the production of hot rolled coils. From automotive and industrial to consumer durables, Dolvi manufactures products that meet the needs of companies across sectors.

2.1 Location of the Project

Existing JSW Dolvi plant is located at about 8 km from Pen Railway Station (on Mumbai-Goa Broad Gauge main railway line). The National Highway number NH17 touches eastern side of steel plant. The steel plant is 8 km form Pen and 40 km from proposed Navi Mumbai International airport. Nearest Railway station is Pen on Konkan railway and nearest port is JNPT, which is more than 20-22 km away. There is no National park/wildlife sanctuary/ecologically sensitive area within 10 km of the JSW steel plant. The project general layout for existing units and proposed expansion is appended in **Figure 1.4**.

2.1.1 Topography

Location of Raigad District is in Konkan Region of Maharashtra State, having Sahyadri Ranges in eastern side and Arabian Sea at Western side. Boundaries of the District includes Mumbai Harbour to the North West. Thane District to the North, Pune District to the East, Ratnagiri District to the South and Arabian Sea to the Western Direction of the District. Some part of the district is included in Navi Mumbai and Jawaharlal Nehru Port is located in its area at Nhava Sheva. The topography is mainly

hilly regions of the Sahyadri Ranges and sandy beaches near the Arabian Sea. The Sahyadri stretches like a huge wall from North to South of the District having valleys and peaks. River Amba flows along the western part the plant. The villages and towns are located in between Sahyadri Hills and Arabian Sea.

JSW integrated steel plant is located between latitude 18040'00" to 18045'00" N and longitude $73^0$00'00" to $73^0$05'00" E at Geetapuram, Dolvi of Raigad district of Maharashtra. Land measuring about 1800 acres, which is falling under village Dolvi, Khar, Karavi and Jui Bapuji in Taluka Pen district Raigad in Maharashtra, is under possession of JSW steel plant. The toposheet is appended in **Figure 2.1**.

Figure 2.1: The Toposheet of Raigad District showing JSW Steel Plant

2.2 Type of Project

JSW Steel, Dolvi Works is presently operating at a capacity of 5 MTPA crude steel through coke oven-pelletization-sintering-BF-CONARC-LF degasser-slab/billet

caster-HSM/ plate mill/bar mill route. Details of the unit, its capacity and status of operation are provided in **Table 2.1**. The plant is equipped with coke oven complex, pellet plant complex, sinter plant, BF, CONARC, ladle furnace, vacuum degasser, continuous casting facility, and 300 MW CPP.

Due to the increased demand for steel in the market, JSW Dolvi works proposed to expand the production from 5 MTPA to 10 MTPA with the capacity increment with additional units as provided in **Table 2.1**. JSW Steel has granted environmental clearance for the proposed expansion from MoEF&CC vide letter no. J-11011/76/2013-IA II(I) dated 25th August 2015. Details of all ECs granted for JSW Steel Dolvi Works is provided in **Table 2.2** and consent to operate the 5 MTPA plant details are given in **Table 2.3** (Details are provided **in Annexure 1**).

Table 2.1: Details of Existing 5 MTPA and Proposed Facilities at 10.0 MTPA

Sl No.	Manufacturing Facilities	Total Capacity at 5 MTPA (EC Received)	Present Status of Installation	Additional units from 5 MTPA to 10 MTPA	Total Capacity at 10 MTPA
1	DRI (Gas based Mega Module)	1 x 2.0 MTPA	In operation	1 x 2.0 MTPA	2 x 2.0 MTPA
	Cumulative	2.0 MTPA		2.0 MTPA	4.0 MTPA
2	Pellet Plant	1 x 4.0 MTPA	In operation	1 x 4.0 MTPA **(Proposed 1X9.0 MTPA)**	2 x 4.0 MTPA **(Proposed 13.0 MTPA)**
	Cumulative	4.0 MTPA		**9.0 MTPA**	**13.0 MTPA**
3	Sinter Plant	SP-1 : 2.8 MTPA SP-2 : 3.2 MTPA	In operation	SP 3: 8.0 MTPA **(Proposed 4.0 MTPA)**	14 MTPA **(Proposed 10.0 MTPA)**
	Cumulative	6.0 MTPA		**4.0 MTPA**	**10.0 MTPA**
4	Coke Oven – with COBPs Recovery type	2 x55, 5.5 m tall two coke oven batteries of 1.0 MTPA coke each	New 1.0 MTPA transferred to DCPL	4 x 65, 5.5 m tall coke oven batteries of 2.5 MTPA coke	2 x55 & 4 x 65, 5.5 m tall coke oven batteries
	Cumulative	2.0 MTPA		2.5 MTPA	4.5 MTPA
5	Blast Furnace Including Pig Casting	1 x 2581 m^3 being modified to 1 x 4350 m^3	In operation 3.5 MTPA	1 x 5500 m^3 BF	1 x 4350 m^3& 1 x 5500 m^3 BF
	Cumulative	3.6 MTPA		4.5 MTPA	8.1 MTPA
6	SMS - CONARC	4 x 200t twin shell CONARC	In operation 5.2 MTPA	-	4 x 200t twin shell CONARC
	Cumulative	5.2 MTPA		-	5.2 MTPA
7	SMS - BOF	-		2 x 300t BOF	2 x 300t BOF
	Cumulative	-		6.0 MTPA	6.0 MTPA
8	Ladle furnace	2 x 200t + 205t	In operation	2 x 300t	2 x 200t + 205t & 2 x 300t
9	VD/VOD & RHTP	2 x 200t + 205t	Work yet to start	2 x 300t	2 x 200t + 205t & 2 x 300t
10	CSP (HRC Coil) Thin Caster-cum-Hot Strip Finishing Train	3.5 MTPA	In operation	-	3.5 MTPA
	Cumulative	3.5 MTPA		-	3.5 MTPA
11	Conventional Slab Caster	2 x 1 strand slab casters	In operation	2 x 2 slab casters	Total 6 strand
	Cumulative	3.68 MTPA		5.73 MTPA	9.4 MTPA
12	Billet Caster	-		1 x 6 strands	6 strands (1.5 MTPA)

Sl No.	Manufacturing Facilities	Total Capacity at 5 MTPA (EC Received)	Present Status of Installation	Additional units from 5 MTPA to 10 MTPA	Total Capacity at 10 MTPA
13	Plate Mill	1 x 1.5 MTPA	Work yet to start	-	1 x 1.5 MTPA
	Cumulative	1.5 MTPA		-	1.5 MTPA
14	Hot Rolling Mill with Shearing & Slitting Line	-		5.0 MTPA	5.0 MTPA
15	Bar Mill	-		1.4 MTPA	1.4 MTPA
16	Cold Rolling Mill (hot rolled skin pass +Cold Rolled full Hard Coil + hot rolled pickled & Oiled Coiled) Complex	1.0 MTPA	Work yet to start	1.5 MTPA	2.5 MTPA
	Cumulative	1.0 MTPA		1.5 MTPA	2.5 MTPA
17	Galvanizing Lines (Cold rolled steel strips, hot dip zinc coated full hard)	1 x 0.6 MTPA	Work yet to start	-	1 x 0.6 MTPA
	Cumulative	0.6 MTPA		-	0.6 MTPA
18	Electrical Steel CRGO Line	1 x 0.4 MTPA	Work yet to start	-	1 x 0.4 MTPA
	Cumulative	0.4 MTPA		-	0.4 MTPA
19	Tin Plate Line	1 x 0.4 MTPA	Work yet to start	-	1 x 0.4 MTPA
	Cumulative	0.4 MTPA		-	0.4 MTPA
20	Color Coating Line	1 x 0.5 MTPA	Work yet to start	-	1 x 0.5 MTPA
	Cumulative	0.5 MTPA		-	0.5 MTPA
21	Lime &Dolo Kilns	3 x 600 tpd	In operation 1200 tpd	3 x 600 tpd	6 x 600 tpd
	Cumulative	1800 tpd		1800 tpd	3600 tpd
22	Oxygen Plant	1 x 4100 tpd	In operation 1660 tpd Additional 1000 tpd established	1 x 3500 tpd	1 x 4100 tpd& 1 x 3500 tpd
	Cumulative	4100 tpd		3500 tpd	7600 tpd
23	Captive Power Plant (BF + CO) Gas based	CPP -1 x 300 MW	In Operation 55 MW	1 x 300 MW	2 x 300 MW
	Cumulative	300 MW		300 MW	600 MW
24	Cement plant- Slag & Clinker Grinding unit (JSW Cement)	-		1 x 10.0 MTPA	1 unit of 10.0 MTPA Grinding Plant
	Cumulative	-		10.0 MTPA	10.0 MTPA
25	Township	-		150 acres township of 7500 dwellings	150 acres township of 7500 dwellings

Table 2.2: Status of Environmental Clearances from Ministry of Environment and Forests and Climate Change (MoEFCC), New Delhi

S. No	Name of the Plant	Environmental Clearance No	Date of Issue
1	Expansion of Integrated Steel plant capacity from **3 to 5 MTPA** of JSW Steel Ltd., Village Dolvi, Tehsil Pen, District Raigad, Maharashtra.	Letter No J-11011/166/ 2011-IA-II(I)	21/11/2012.
2	Pellet Plant of capacity 4 MTPA of Amba River Coke Ltd., Village Dolvi, Tehsil Pen, District Raigad, Maharashtra	Letter No J-11011/166/ 2011-IA-II (I)	21/10/2013
3	Expansion of Integrated Steel plant capacity from **5 to 10 MTPA** of JSW Steel Ltd., Village Dolvi, Tehsil Pen, District Raigad, Maharashtra	Letter No J-11011/176/ 2013-IA-II(I)	25/08/2015.
4	3.5 (1.0+2.5) MTPA Coke Oven and By-product plant – Transfer of 1.0 MTPA Coke oven and by-product plant – from EC of 3 to 5 MTPA and 2.5 MTPA Coke Oven with by-product plant from EC of Expansion of Integrated Steel plant from 5 to 10 MTPA and Power plant from 300 MW to 600 MW (Gas Based) of M/s. JSW Steel Limited in Village Dolvi, Teshil – Pen, District- Raigad, Maharashtra to M/s Dolvi Coke Projects Limited	F.No. IA-J-11011/497/ 2017-IA-II(I)	01/02/2018
5	10 MTPA Slag & Clinker Grinding Unit – Transfer of EC from Integrated Steel plant (5 MTPA to 10 MTPA) and Gas based Power plant (300 MW to 600 MW) of JSW Steel Ltd, Village Dolvi, Teshil – Pen, District- Raigad, Maharashtra to M/s JSW Cement Limited.	F.No. IA-J-11011/499/ 2017-IA-II(I)	01/02/2018

Table 2.3: Details of Consent to Operate of 5 MTPA units at JSW Steel, Dolvi Works

Sr. No	Name of the Plant	Consent No	Validity
Plants under JSW Steel Ltd			
1	Sponge Iron Plant	Format1.0/BO/CAC-Cell/Uan No. 0000034884-17/CAC -1804000348 dtd 07/04/2018	31.12.2022
2	BF 3.5 MTPA	Format1.0/BO/CAC-Cell/Uan No. 0000035084-17/CAC-1804000347	31.12.2022
3	Sinter Plant – I&II	Format1.0/BO/CAC-Cell/Uan No. 0000056996-18/8th CAC -1901000686	31.12.2023
4	HSM 3.5MTPA	Format1.0/BO/CAC-Cell/Uan No.0000045821-18/CAC-1811000099	30.04.2023
5	Coke Drying Plant	Format1.0/BO/CAC-Cell/Uan No.0000024582-17/CAC-1803000001	30.06.2022
4	LCP 600 TPD (LCP IV)	Format1.0/BO/CAC-Cell/Uan No.0000046342-18/CAC -1810001260	31.03.2023
5	RMC Batching Plant	SRO Raigad II/Consent /1708000670	31.01.2021
6	LCP III (600 TPD)	Format1.0/BO/CAC-Cell/Uan No. 0000044416-18/5th CAC -1812001827 dtd 31/12/2018	30.09.2022
7	55 MW Power Plant	1.0/BO/CAC-Cell /Uan No. NG 0000025212-17/CAC-1803000005	31.08.2022
Plants under JSW Steel Ltd (Expansion from5 to 10 MTPA)			
8	Billet Caster & Bar Mill	Format1.0/BO/CAC-Cell/Uan No.0000024109-17/CAC-1802000263	31.05.2022
Plants under Amba River Coke Ltd (ARCL)			
9	Coke Oven Plant	Format1.0/BO/CAC-Cell/Uan No.0000024004-17/CAC-1303000008	30.05.2022
10	Pellet Plant - I	Format1.0/BO/CAC-Cell/Uan No.0000045570-18/5th CAC -1811000098	30.09.2022
Plants under Dolvi Coke Projects Ltd (DCPL)			
11	Coke Oven II (1.5 MTPA)	Format 1.0 /BO/CAC-Cell/UAN No 0000059290-18/CAC-1904000662 dtd 15/04/2019	30.06.2019
Consent to Establish (CTE)			
12	Expansion from 5 to 10 MTPA	Format 1.0 /BO/CAC-Cell/UAN No 0000022288-18/CAC-1802000 254dtd 07/02/2018	5 Years

2.2.1 Present Expansion and its Justification

JSW Steel, Dolvi works has received Environment Clearance (EC) for expansion of its Integrated Steel Plant from 5 to 10 MTPA (MoEF&CC letter no. J-11011/76/2013-IA II(I) dated 25th August 2015). Construction activities for 10 MTPA steel plant are ongoing and the images are provided in **Plate 2.1.** In the earlier proposal, JSW has proposed for setting up of two identical Sinters of 4 MTPA sinter production capacity each and one pellet plant of 4 MTPA production capacity. Based on the

following technical factors, JSW is now proposing for increasing the proposed pellet plant capacity from 4 MTPA to 9 MTPA and by reducing the proposed sintering unit capacity from 8 MTPA to 4 MTPA. The capacity of Integrated Steel plant will remain same i.e.10 MTPA crude steel.

- æ The existing BF-1 is operating at 70% sinter and 30% pellet. The proposed large capacity BF-2 will be designed to operate with 70% pellet and 30% sinter. Since, sinter input to the Blast furnace is less, the yield of BF 2 will be higher with lesser slag production and other productivity improvements
- æ The portion of fines content in the iron ore is increasing day by day. While the iron ores fines are suitable for pellet making, coarser size iron ore fines are required for Sinter making.
- æ Accordingly, the capacity of the pellet plant is proposed to be enhanced from 4 MTPA to 9 MTPA. Consequently, the size of Sinter plant is being reduced from 8 MTPA to 4 MTPA

The details of the proposed expansion and its changes with respect to the existing EC (MoEF&CC letter no. J-11011/76/2013-IA II(I) dated 25th August 2015) are given in **Table 2.4**.As can be seen the proposal involves change in configuration of Sinter and Pellet Plant and no changes in all other facilities.

Table 2.4: Details of various units of JSW Steel Plant at 10 MTPA stage

Sl. No	Unit Name	Plant units & Capacities at 5 MTPA stage (A)	Units Proposed during 5 MTPA to 10 MTPA Expansion for which EC already accorded (B)	Present Proposal during 5 MTPA to 10 MTPA Expansion in (B)*	Total units and capacities after the proposal	Remarks
1	DRI (Gas based Mega Module)	2.0 MTPA	2.0 MTPA	No Change	4.0 MTPA	No Change
2	Pellet Plant	4.0 MTPA	4.0 MTPA	9.0 MTPA in place of 4 MTPA	13.0 MTPA	**Increase by 5 MTPA**
3	Coke Oven including By-product plant	1.0 MTPA	-	No Change	1.0 MTPA	No Change
4	Sinter Plant	6.0 MTPA	8.0 MTPA	4.0 MTPA in place of 8.0 MTPA	10.0 MTPA	**Decrease by 4 MTPA**
5	Blast furnace including pig casting	3.6 MTPA	4.5 MTPA	No Change	9.1 MTPA	No Change
6	SMS (CONARC)	5.2 MTPA	-	No Change	5.2 MTPA	No Change
7	SMS (BOF)	-	6.0 MTPA	No Change	6.0 MTPA	No Change
8	Ladle furnace (LF)	2X200t + 250t	2X300t	No Change	2X200t + 250t + 2X300t	No Change

Sl. No	Unit Name	Plant units & Capacities at 5 MTPA stage (A)	Units Proposed during 5 MTPA to 10 MTPA Expansion for which EC already accorded (B)	Present Proposal during 5 MTPA to 10 MTPA Expansion in (B)*	Total units and capacities after the proposal	Remarks
9	VD/VOD & RH-TP	1X200t + 1X205t	2X300t	No Change	1X200t + 1X205t + 2X300t	No Change
10	CSP (HRC Coil) Thin Caster-cum-Hot Strip Finishing Train	3.5 MTPA	-	No Change	3.5 MTPA	No Change
11	Conventional Slab Caster	2X1 strand 3.68 MTPA	2X2 Slab Casters 5.73 MTPA	No Change	9.41 MTPA	No Change
12	Billet Caster	-	1X6 Strands	No Change	1X6 Strands	No Change
13	Plate Mill	1.5 MTPA	-	No Change	1.5 MTPA	No Change
14	Hot Rolling Mill with Shearing & Slitting Line	-	5.0 MTPA	No Change	5.0 MTPA	No Change
15	Bar Mill	-	1.4 MTPA	No Change	1.4 MTPA	No Change
16	CRM	1 MTPA	1.5 MTPA	No Change	2.5 MTPA	No Change
17	Galvanizing Line	0.6 MTPA	-	No Change	0.6 MTPA	No Change
18	Electrical Steel CRGO Line	0.4 MTPA	-	No Change	0.4 MTPA	No Change
19	Tin Plate Mill	0.4 MTPA	-	No Change	0.4 MTPA	No Change
20	Colour Coating Line	0.5 MTPA	-	No Change	0.5 MTPA	No Change
21	Lime/dolo Plant	1800tpd	3X600tpd	No Change	3600tpd	No Change
22	Oxygen Plant	4100tpd	3500tpd	No Change	7600tpd	No Change
23	Captive Power Plant	300MW	300MW	No Change	600MW	No Change
24	Cement plant- Slag & Clinker Grinding unit (JSW Cement)	-	10.0 MTPA	No Change	10.0 MTPA	No Change
25	Township	-	150 acres township of 7500 dwellings	No Change	150 acres township of 7500 dwellings	No Change

2.3 Existing Project Description

2.3.1 The existing 5 MTPA Steel Plant have the following facilities for production of finished steel products

Table 2.5 : Major Technological Facilities

Sl. No.	Process	Technological facility
1.	Coke making	Coke Oven-1: 1 MTPA Recovery type Coke Ovens with by-product plant
2.	Agglomeration	Sinter Plant -1 & 2: 6 MTPA, Pellet Plant-1: 4 MTPA
3.	Iron making	Sponge Iron Plant : 2 MTPA DRI Blast Furnace: 3.6 MTPA
4.	Steel making & Secondary refining	CONARC 4x200 t furnace & Ladle Furnace, Vacuum Degassing
5.	Continuous casting	CSP : 3.5 MTP, Slab Caster:3.68 MTPA
6.	Finished Steel products	Slabs, HR Coils, CR Products etc
7.	Calcining Lime &Dolo	2x300 tpd+2x600 tpd
8.	Oxygen Plant	4100 tpd
9.	Power Plant (Captive Power Plant)	300 MW based on by-product fuel gases and waste heat recovery from Coke Dry Quenching.
10.	Cement Making (JSW Cement)	Slag & Clinker Grinding and mixing Unit

2.4 Size or Magnitude of Operation

The proposals involves setting up of 9.0 MTPA pellet plant and 4.0 MTPA Sinter Plant in place of 4.0 MTPA pellet plant and 8.0 MTPA sinter Plant.

2.5 Proposed Schedule for Approval & Implementation

The construction activities related to the approved 10 MTPA expansion project is in progress. The main production facilities shall be progressively commissioned and will be operational by December 2020. Other auxiliary facilities like Hot and Cold Rolling Mills will be commissioned by 2025. However, Pellet Plant II and Sinter Plant III will be commissioned by March, 2020.

2.6 Process Description

2.6.1 Process Description and Technology

The production of steel products in the proposed 10 MTPA expansion will be based on BF-BOF route. In the proposed expansion, state of the art production facilities like Raw Material Handling, Coke Ovens, Pellet plant, Sinter plant, Blast Furnace, BOF, Ladle Furnace, Vacuum Degasser, Continuous Casting facility, Hot Strip Mill, Bar and Rod Mill, Cold Rolling Mill etc. will be installed for the production of flat and long products. The supporting facilities like Captive Power Plant, Oxygen Plants, Water treatment plants, By-product fuel gases systems are also planned.

The process flow sheet for steel production at 10 MTPA stage is given in **Figure 2.2.**

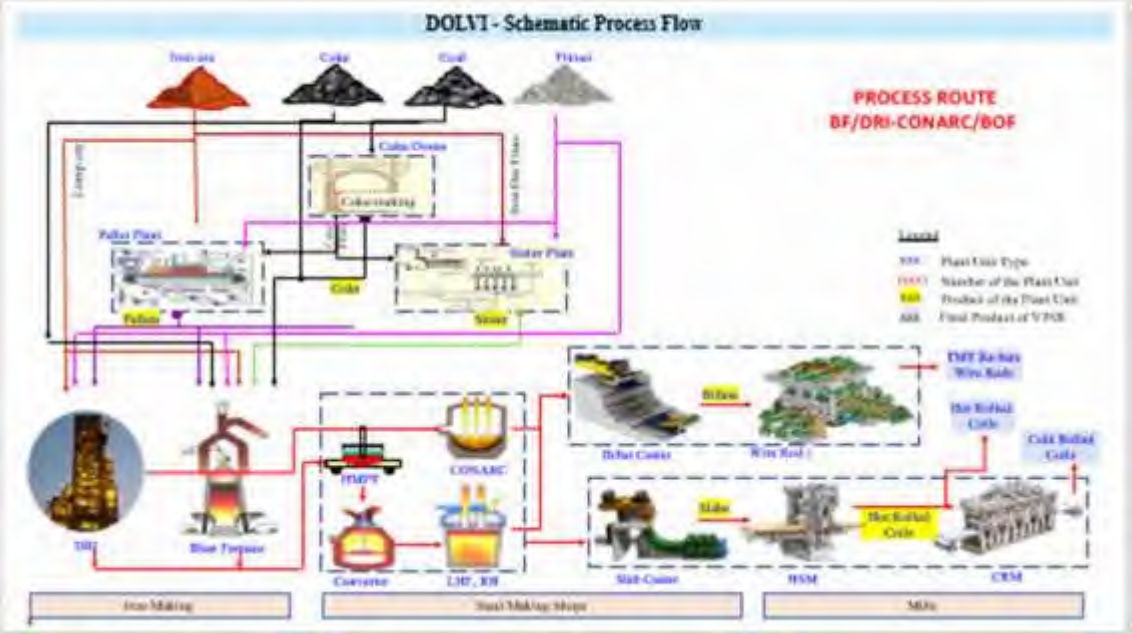


Figure 2.2 : Process Flow of Steel Making at Dolvi

2.7 Proposed Project Description

The proposed project involves setting up of 9.0 MTPA Pellet Plant (PP II) and 4.0 MTPA sinter Plant (SP III). The technical details on the basis of design of theses units are provided along with Form 2

2.7.1 Pellet Plant II – Main Plant Facilities

The process of palletization converts finely grained iron ore (even low grade iron ore) into balls of 10 to 15 mm diameter, which are suitable for blast furnace and direct reduction. Iron ore is crushed in wet condition and the impurities are removed. The moist ore is blended with flux, binding agents, coke breeze to produce a durable marble sized "green" pellets in rotary discs. These green pellets are dried and indurated at temperatures of more than 1000 °C, on a travelling grate. The indurated pellets have excellent physical and metallurgical properties and can be easily transported, due to their high strength and suitability for storage.

The technical details of Pellet Plant II is given below

Table 2.6 : Design & Operating Parameters of Pellet Plant

Sl. No.	Item Description	Unit	Value
1	No. of pellet machine x area	m2	1 x 816
2	Pellet Width	m	4.0
3	Annual Pellet demand	Mt/yr	9.0
4	Size of finished pellet	mm	12.5 to 16

Sl. No.	Item Description	Unit	Value
5	Annual working regime	d/y	330
6	No. of working hours/day	h/d	24
7	Gaseous energy consumption for ignition / ton of BF sinter	Kcal/t	1663000
8	Coke breeze consumption / ton of Pellet	kg/t	~10
9	Under-grate suction and Area	mm WC	1200 mm & 804 M2
10	Pellet m/c bed height	mm	650
11	Cooler type / bed height	Linear cooler	730 mm
12	Temperature of cooled Pellet	deg. C	Below 100
13	Dust content in exhaust gases at stack	mg/Nm3	Below 30
14	Fuel Used (Mixed gas)		BF + CO Gas

The palletization process involves three steps:

- Raw material preparation
- Forming green 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 flux such as limestone, lime olivine and dolomite (1–5 %). These give the pellets the proper physical and metallurgical properties needed for further processing. Mixing takes place in continuously operating drum or pan-type mixers of suitable capacity. Pellets are formed in pelletizing discs. The pellets thus formed have low mechanical strength; they are hardened in Travelling Grate coupled with drying and indurate furnace.

It is proposed to install a Pellet Plant capable of producing up to 9.0 MTPA of pellets. The proposed pellet plant shall comprise the following major technological units.

- Day bin
- Wet grinding of iron ore fines
- Thickener & slurry tanks
- Filtration
- Coarse additives (limestone, dolomite, coke, bentonite) ground storage
- Coarse additives storage bins & grinding
- Storage cum mixing
- Balling

- Induration
- Pellet screening
- Product pellet storage bins
- Process gas dedusting system
- Emergency filter cake stock pile
- Belt conveyors, junction houses & inter-connecting galleries

Apart from the above major units which are elaborated in details below, other auxiliary facilities like material handling, water supply system, compressed air system, fuel gas distribution, air-conditioning & ventilation system, plant dedusting system, electrics, instrumentation & automation facilities etc. have also been envisaged. Adequate hoisting & handling facilities have been provided in all the units for ease of maintenance and operation.

2.7.1.1 Day Bin Unit

The iron ore fines shall be received on one reversible conveyor at top of day bins in this unit. This reversible conveyor will feed to two parallel reversible cum shuttle conveyors envisaged over two bays of day bins. Eight numbers of bins with effective volume 500 m^3 shall be envisaged for storage of iron ore fines. The proportioned quantity of iron ore fines will be extracted from these bins through weigh feeders onto conveyors for further transportation to wet grinding unit. The flexibility of feeding any ball mills out of three from any iron ore fines bins shall also be envisaged in this unit. GCP dust shall also be received by dust tanker and pneumatically conveyed to dust bins. Total three numbers of GCP dust bins shall be envisaged in three junction houses before wet grinding unit. The required quantity of GCP dust shall be extracted through rotary airlock valve and fed to conveyors leading to wet grinding unit.

2.7.1.2 Wet grinding unit

The receiving conveyor from the day bin building shall feed the raw material to the screens provided before ball mills in wet grinding unit. The screen overflow shall be fed to three numbers ball mills and underflow shall be collected in a slurry tank. The slurry from slurry tank shall be pumped to classifying cyclones having #325 cut point. The overflow from classifying hydro-cyclones shall be collected in thickeners and the underflow shall be fed to the ball mills. Product from ball mills shall be collected into sump from where the slurry is pumped to hydro-cyclones. Ball mills shall have hydro-cyclones in closed circuit for grinding raw material to 45 micron. The overflow of the hydro-cyclones shall be collected into thickener having approx. 80%, (-) 45 micron size passing. The underflow of the hydro-cyclones shall be reground in the ball mills.

2.7.1.3 Thickener & Slurry tanks

One number concentrate thickener of 55 m diameter shall be envisaged for thickening of Iron ore concentrate slurry received from hydro-cyclones overflow from wet grinding unit. The thickened slurry shall be pumped to slurry storage agitator tanks which shall be pumped to the Filtration unit for getting filter cake for further

transportation to mixing unit. The thickener overflow shall be fed to Pump house. This thickener is provided with flocculent system.

2.7.1.4 Filtration

The slurry from the slurry agitator tanks (2 nos.) shall be pumped to the filters for filtration and the filter cake shall be discharged to the cake conveyors. The filter cake from the cake conveyors below each filter shall be collected on a common reversible conveyor which shall either convey the material to the mixing unit or to emergency storage area. The water required for cloth wash and manifold flush water shall be pumped from pump house. The filtrate water shall be collected in filtrate tanks and shall be pumped to thickener to reduce the mineral content in the filtrate water. Each filter will be equipped with cloth shaking and cloth flushing system for improved cake discharge and reliability. Cloth flushing will be applied after each cycle when the plate pack is open and cake discharge is complete. Flushing water will be collected with swivel plates underneath the plate pack. The filter cake having moisture content in the tune of 9.5 % collected from filters shall then be transported to storage cum mixing unit.

2.7.1.5 Coarse Additive Ground Storage Unit

Coarse additives like limestone, dolomite, coke & bentonite shall be received at one common ground storage unit inside pellet plant #2 by truck. The individual raw additive shall be fed by pay loaders onto one outgoing conveyor through over-ground hoppers & vibro-feeders as per requirement and transported to respective bins in coarse additive storage bins unit.

2.7.1.6 Coarse Additives Storage Bins & Grinding

Coarse additives shall be stored in separate bins, two numbers each for limestone, dolomite, coke & bentonite. The effective volume of each bin shall be approx 200 m^3. Limestone & coke and dolomite & coke shall be fed from the storage bins, to two ball mills on time sharing basis and bentonite to one vertical roller mill for grinding, by means of belt weigh feeder & feed hopper. Ball mills shall be complete with mill feed hopper, air slide, damper, cyclone, bag filter, hot gas generator, circulation fan, surge hopper and transport vessel. Roller mill shall be complete with rotary airlock valve, classifier, bag filter, hot gas generator, circulation fan, surge hopper and transport vessel. Ground additives from this unit shall be carried to respective ground material storage bins in storage cum mixing unit by pneumatic conveying.

2.7.1.7 Storage cum Mixing Unit

Ground ore concentrate (filter cake) shall be received from filtration unit by belt conveyor and fed to four numbers of bins, two of effective volume 780 m^3 and other two of 730 m^3 through one reversible and slewable belt conveyor on top of the bins. Ground bentonite and mix (flux-tone & coke) from additive grinding unit shall be fed pneumatically to respective bins in this unit. Four number of bins, each of effective volume 400 m^3 for mix, two numbers each of effective volume 450 m^3 for bentonite and one bin of effective volume 200 m^3 for ESP dust shall be envisaged. ESP dust shall

be pneumatically transported to ESP dust bin from process & plant dedusting ESPs. ESP dust bin shall have twin outlet with rotary weigh feeders.

Belt weigh feeders shall be mounted at outlet of filter cake bins and rotary weigh feeders at outlet of ground additive & ESP dust bins. All additive bins are equipped with bag filters for cleaning the transport air. Materials discharged from these bins shall be transported to two (02) High intensity mixers by belt conveyors for thorough mixing. Belt weigh scale shall be installed on conveyors before the mixer to control the feed rate of raw mix to the mixer.

The HI mixer shall be provided for thorough mixing of raw materials with controlled addition of process water to form green pellets with sufficient mechanical strength to withstand the subsequent transportation, screening and heat treatment process, and to adjust the chemistry of the pellets to favour the production of mechanically resistant product pellets with a high compression strength and low abrasion indices, and to adjust the chemistry of the product pellets. The moisture content of the raw mix is raised to approximately 9.5%. The mixed material from the mixer shall be transported by series of belt conveyors to balling unit.

2.7.1.8 Balling Unit

The production of green pellets is performed in thirteen (twelve operating and one stand-by) closed pelletizing discs circuits. The mixed material received from storage cum mixing unit shall be distributed to mixed material bins, each with storage capacity of 40 m^3, installed directly above each balling disc. All the bins shall be load cell mounted. A horizontal conveyor equipped with pneumatically operated ploughs will distribute the mixed materials into the mixed material bins. Any spillage passing under these ploughs will be discharged at the head end of the conveyor and recirculated through mixed material route or stored in emergency stockpile.

The material discharge from each mixed material bin will be controlled by dosing belt weigher equipped with variable speed drive, thus feeding the required amount of mixed material onto the corresponding pelletizing disc. The dosing belt weigher will discharge mixed material into the disc feeding chute, which are equipped with fluffing device for disintegration of any compacted material as well as for a distribution of the mixed material on the pelletizing disc. The green pellets will be formed in the discs with a diameter of 7.5 m each, with simultaneous and variable addition of water. The inclination of each disc will be variable and optimum setting is to be determined during start-up, according to mixed material properties, desired green pellet diameter and feed-rate. The rotary speed of the disc can also be varied during operation by means of frequency-controlled motor, depending on the pelletizing characteristic of the concentrate mixture. It can be possible to regulate the disc rpm from 5 to 7.5 during operation. The green pellets from the pelletizing discs will be conveyed to a single deck roller screens where undersize (<9 mm) and oversize (>18 mm) green pellets will be crushed in disintegrators installed on belt conveyors for reject pellets. The green pellet of (9-18) mm from the single deck roller screens will be finally discharged to the green pellet collecting belt conveyor, which is equipped with a reciprocating head. This belt conveyor ensures the smooth handling of the green pellets.

Undersize and oversize green pellets from the bi-layer double deck roller screen will be recycled by belt conveyors back to the green pelletizing area after crushing in disintegrator. The rollers on screen deck shall be chain driven by variable speed drive/ individually driven rollers. A belt weigher will measure the amount of undersize & oversize green pellets.

2.7.1.9 Induration

The traveling grate machine on which the green pellets will be heat treated, indurated and cooled will have a minimum reaction area of 816 m² (4 m wide and 204 m long). This travelling grate will consist of an endless chain of pallets, which continuously revolve. One of the process pre-requisites for obtaining a uniform product quality is a uniform bed height. This will be ensured by automatic control of the traveling grate speed as a function of the ultrasonic level measuring devices installed after green pellets are charged to travelling grate. Grate speed control by ultrasonic has significantly reduced the response times and thus improved pellet bed leveling on the indurating machine. Thermal attack on the pallets and grate bars, which would lead to excessive wear, will be avoided by using a hearth and side layer of indurated pellets. Side layer is used for protecting the sidewalls of the pallets. A storage bin for hearth and side layer will be arranged at the feed-end of the travelling grate. A motor-driven discharge gate can adjust the height of the hearth layer on the pallets. The standard height for this application is approx. 80 mm. The three components are fed onto the pallets in the following order: Hearth layer, Side layer, Green pellets.

The hearth and side layer bin is equipped with an emergency chute which permits additional filling of the pallets with hearth layer in case of failure in the green pellet feeding system and thus protecting the pallets and grate bars from over-heating. The required green balls, in the size range of 9 to 16 mm shall be fed to the indurating machine for heat hardening. Green pellets are then subjected to the different thermal zones during the process of induration on travelling grate machine. After drying of green pellets in the up-draught and down-draught drying zones, the dried pellets will be preheated to a progressively higher temperature to initiate oxidation and sulphur burning with fuel (coke) present in the green pellets.

The dried pellets will then be fired at approx. 1300^{o}C to provide the recrystallization and slag bonding which will impart adequate strength to the pellets. An unfired short section designated as ‘after firing’ allows the heat front to completely penetrate into the bottom of the bed thereby eliminating sudden quenching of pellets and consequent deterioration of pellet properties. Cooling of indurated pellets shall be accomplished by up-draughting ambient air, supplied by cooling air fans, through the pellet bed. The cooled pellets will leave the indurating machine at 100^{o}C or less.

2.7.1.10 Pellet Screening

In this unit, vibrating screen is installed to separate out certain quantity of fired pellets from the product pellets, which will be recycled as hearth layer to the indurating machine. Sized pellets are used as hearth layer to avoid clogging of side layer chutes and improve the permeability of the hearth layer and thus reduce pressure drop and energy consumption of the system. Screened hearth and side layer will be transported

by belt conveyors to the hearth layer bin at the feed end of the indurating machine. Vibrating feeders determine the portion of on-spec product pellets to be used as hearth layer and is controlled by the level of the hearth and side layer bin. A belt weigher will register the production rate of the pellet plant. A sampler shall be installed in the discharge chute of product conveyor, which will take samples for pellet quality control.

2.7.1.11 Pellet Storage Bins

Product pellet from pellet screening unit shall be transported to pellet storage bins by belt conveyor. The storage capacity of the unit shall be approx. 11 hours of finished pellet production. However, one emergency finished pellet ground stock pile near pellet screening unit shall also be envisaged. The expected mechanical and metallurgical properties of finished pellets are given in **Table 2.7.**

Table 2.7: Expected Mechanical and Metallurgical Properties of Finished Pellets

Sl. No.	Item	Value
i)	Size + 9 to 16 mm +16 mm - 9 mm	92 % 5 % max 3 % max
ii)	Porosity	25 % min
iii)	Cold crushing strength	>= 250 kg/pellet
iv)	Tumble index(+6.35 mm)	92 % min.
v)	Abrasion Index (-1 mm)	5 % max.
vi)	JIS swelling index	20 % max.
vii)	JIS reducibility	65 % min.
viii)	Compression strength after reduction	30 kg/p

2.7.2 Sinter Plant III

It is proposed that a sinter plant consisting of a sintering machine of 1x350 m^2 sintering area along with all necessary facilities be installed for production of sinter plant in place of 2 x350 M^2.

The capacity of the sinter plant has been estimated based on use of about 70 - 75% sinter in the burden of blast furnaces, which shall be obtained from the sintering machine of 4.0 MTPA capacity indicated in **Table 2.8**.

Table 2.8 : Design & Operating Parameters of Sinter Plant

Sl. No.	Item Description	Unit	Value
1	No. of sinter machine x area	m^2	1 x 350
2	Sinter Width	m^2	502
3	Annual sinter demand	Mt/yr	3.56
4	Size of finished sinter	mm	6-50
5	Annual working regime	d/y	330
6	No. of working hours/day	h/d	24
7	Gaseous energy consumption for ignition / ton of BF sinter	Kcal/t	20,000
8	Coke breeze consumption / ton of BF sinter	kg/t	~ 86

Sl. No.	Item Description	Unit	Value
9	Under-grate suction and Area	mm WC	1700 mm & 124 M2
10	Sinter m/c bed height (including 30-50 mm hearth layer)	mm	600 to 650
11	Cooler type / bed height	Circular cooler	730 mm
12	Temperature of cooled sinter	deg. C	Below 100
13	Dust content in exhaust gases at stack	mg/Nm3	Below 50
14	Fuel Used		BF + CO Gas

Sintering is an agglomeration process in which iron ore fines are mixed with return materials, limestone, and finely sized fuel such as coke breeze. The return materials consist of mill scale from hot rolling operations and dust from steel melting shop and blast furnaces. The raw materials are mixed before they are placed on the traveling grate of the sinter machine. Near the head end of the grate, the surface of the raw materials is ignited by a gas fired ignition furnace located over the bed. As the mixture moves along the grate, air is drawn through the mixture at the wind boxes to enhance combustion and sinter (fuse) the fine particles. As the bed burns, carbon dioxide, cyanides, sulfur compounds, chlorides, fluorides and oil and grease are driven off with the gases.

The sinter drops off the grate at the discharge end and is cooled (by air), crushed, and screened to maintain uniformity in the size of the sinter fed to blast furnaces. Improperly sized sinter and fines from screening are returned for reprocessing. The advantages of agglomerated burden in the blast furnace are well established and almost all the high capacity blast furnaces world-wide are using agglomerated burden for most efficient furnace operation. The major advantages for use of sinter in blast furnace are as follows:

- æ Control of physical, chemical and high temperature properties of burden materials
- æ Avoid use of raw flux charging directly in the blast furnace
- æ Increase in productivity of the furnace
- æ Decrease in coke/fuel rate
- æ Longer life of furnace
- æ Production of desired grade of hot metal, etc.

Apart from the above advantages, the iron ore fines generated in the mines during production of iron ore lumps are used in the sinter plant which avoids the problems related to disposal of fines in the iron ore mines. Moreover, metallurgical waste materials generated in different process steps shall be recycled in the sinter plant, which minimizes the dust pollution inside the plant boundary. The sinter plant is equipped with the following major facilities:

- æ Base blending for input materials

- Flux and fuel crushing facilities
- Lime dozing facility
- Mixing and nodulising unit
- Sintering machine equipped with sinter strand, ignition furnace, wind boxes, suction fan, dust cleaning unit, etc.
- Sinter Coolers
- Sinter screening and transportation facilities

2.8 Land Requirement

JSW Steel, Dolvi works has a total of 1200 acres of land in which it operates the existing 5 MTPA integrated steel plant. The proposed units under 10 MTPA expansion will comes within the existing plant boundary. JSW Steel, Dolvi works is also in the process of purchasing 600 acres of land near to the existing plant premises and with the permission of Government of Maharashtra. For the proposed changes, no additional land shall be required. The revised plant layout is given in **Figure 2.1.**

2.9 Raw Material Requirement

The additional annual (net and dry) requirements of various raw materials for capacity addition from 5.0 to 10.0 MTPA are given in **Table 2.9**. This includes the changes in the iron ore quantity for producing 9 MTPA pellet and 8 MTPA sinter.

Table 2.9: Additional Annual Major Raw Material Requirement (net & dry basis)

Sl. No.	Raw material	Quantity (tpa)
1.	Iron Ore Fines/Conc. (For Pellet Plant)	8,528,614
2.	Iron ore fines (for sinter plant)	3,440,000
3.	Iron Ore Lumps	380,000
4.	Coking Coal (for coke oven)	3,500,000
5.	Non-coking coal for PCI	675,000
6.	Limestone (for sinter plant)	245,500
7.	Limestone (for pellet plant)	504,941
8.	Dolomite (for sinter plant)	251,500
9.	Quartzite	60,000
10.	Limestone (for SMS)	860,000
11.	Dolomite (for SMS)	388,000
12.	Ferro-Alloy (for SMS)	103,600
13.	Bentonite (For pellet plant)	45,000
14.	Clinkers (For Grinding unit)	5,000,000
15	Dolomite (for Pellet plant)	270,000

The material balance for the Integrated Steel Plant at 10.0 MTPA stage after consideration of present proposal of change in the configuration is given in **Figure 2.3**.

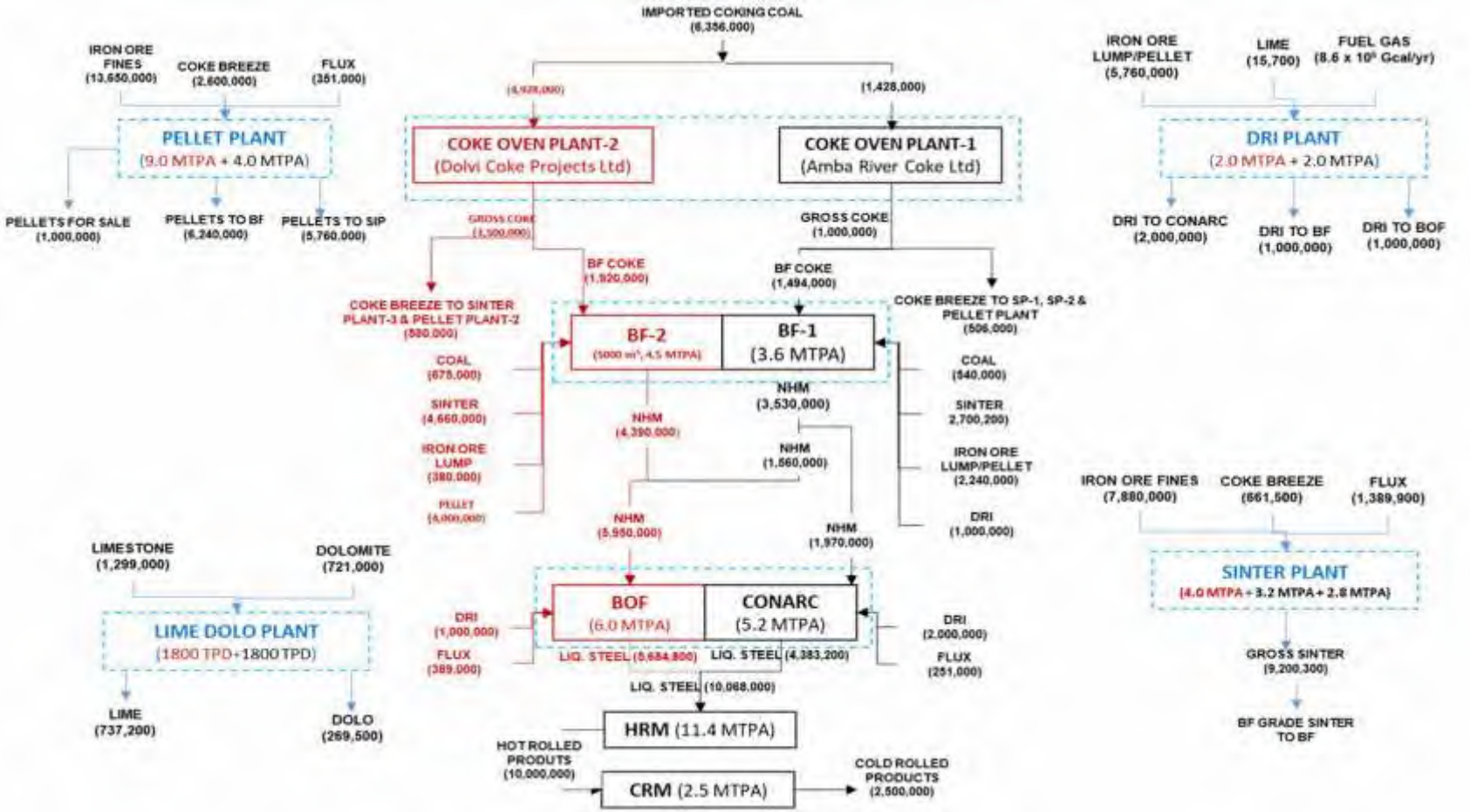


Figure 2.3 : Material Balance Diagram of Integrated Steel Plant at 10 MTPA Stage

2.10 Water Source and Requirement

2.10.1 Make up Water System

Cooling water is required in various processes for steelmaking which are heat intensive processes. Closed-circuit soft water/ Demineralized water re-circulation systems with water-to-water in 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 recirculation 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.

The total additional requirement of fresh water for the plant for expansion will be about 2413 m^3/h, which is in addition to existing plant usage of 31438 m^3/h. The make up water requirement at 10 MTPA stage will be 3851 m^3/h, which works out to 3.37 m^3/tcs (**Table 2.10**).

The requirement of Pellet Pant II and Sinter Plant III works out 3946 m^3 /day (165 m^3/hr) and will be met from the 10 MTPA water system.

Table 2.10 : Water Requirement at 10 MTPA Stage of Steel Plant (m^3/d)

Facilities	Capacity in MTPA	SpConsp m^3/tp	At 5MTPA	At 10 MTPA
Coke Oven #1	1.1	1.5	4521	
Coke Oven #2A	1.5	0.85		3493
Coke Oven #2B	1.5	0.85		3493
Sinter #1	2.55	0.15	1048	
Sinter #2	2.75	0.15	1130	
Sinter#3	4	0.18		1973
Pellet #1	4.2	0.1	1151	
Pellet # 2	9	0.08		1973
BF # 1	3.5	0.8	7671	
BF # 2	4.8	0.55		7233
SMS#1	5	0.75	10274	
SIP # 1&2	4	1	2700	2700
Bar Mill	1.43	0.4		1371
SMS#2	6.17	0.5		8452
CRM	2.5	0.35		2397
HSM#2	5	0.35		4795
Oxygen Plant-1	4100	0.6	2460	
Oxygen Plant-2	3500	0.5		1750
LCP (1-7)	1.26		180	180
55 MW PP	55	2.5	3300	
300 MW PP	300	2.5		18000
Others			70	100
Total in m^3/d			34505	57910

Facilities	Capacity in MTPA	SpConsp m^3/tp	At 5MTPA	At 10 MTPA
Total in m^3/hr			1438	2413
Total in m^3/hr at 10 MTPA				3851

JSWSL has necessary permission from Irrigation Dept of Govt of Maharashtra for drawl of 113.66 MLD(4735 m3/hr). The details of the approvals are given below in **Table 2.11**:

Table 2.11 : Letters of Approvals

Sl. No.	Name of the Company	Approval Quantity in MLD	Reference Letter of Irrigation dept No
1	JSW Steel Ltd	46.66	594/2016 dated 08/02/2016
2	Amba River Coke Ltd (ARCL)	7	4/566/2016 dated 06/02/2016
3	Dolvi Coke Projects Ltd (DCPL)	5	2507/2018 dated 03/08/2018
4	Phase 2 Projects	55	2019/(44/15) dated 28/05/2019
5	Total	113.66	

In the 10 MTPA water system, the raw water is lifted from Amba river by means of vertical turbine pump sets located in Nagothane Pump house (Latitude 18.523288 Longitude 73.148070) and pumped to the existing SIP reservoir having 2 compartments and a total water storage capacity of about 35,880 m3 and HSM Reservoir having a storage capacity of 225,000 m3.The water from the reservoir will be clarified in the raw water treatment plant for use as make-up water in different units of the steel plant. A part of the clarified water will be filtered and chlorinated for use as drinking water in the steel plant.

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

a. De mineralized (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.

f. Fire water, for emergency purposes.

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 2413 m3/hr for additional units under 10 MTPA including drinking water and water for the captive power plant.

Make-up water for different process units including PPII and SP III 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.

The main water recirculation systems envisaged are given below in **Table 2.12.**

Table 2.12 : Main Water Recirculation System Envisaged

Sl. No.	Re-circulation circuit	Process covered
1.	Closed soft water (primary circuit)	• Coke Oven • BF stave coolers, tuyeres and stoves • Lintel cooling in Pellet Plant • Lance cooling • LF cooling • Top lance cooling • Vessel pre-heater cooling • Vessel cooling • Mould cooling for slab casters • Machine cooling for casters • For removing scales in mills
2.	Open industrial water (clean water cycle)	• Secondary side cooling of plate heat exchangers. • Compressed air station • degasser cooling • LF transformer • BF cooling • Pellet Plants • Indirect cooling of plate mill • Sinter Plants cooling • Power plant cooling • Uncontaminated circuit of by-product plant • Indirect cooling of re-heating furnace
3.	Open industrial water (contaminated water cycle)	• Spray and machine cooling (direct cooling) in conventional slab caster. • Effluent treatment plant of BF GCP.

Sl. No.	Re-circulation circuit	Process covered
		• Contaminated circuit of by-product plant. • Direct cooling of plate mill.
4.	Emergency water circuit (Through overhead tanks)	• Blast Furnace • LF, VD/VOD, mould, machine and spray cooling of conventional slab caster. • Reheating furnace cooling • Coke Oven.

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

In addition to the above measures, the following state of the art technologies are being adopted to reduce water consumption in the 10 MTPA expansion project;

- æ Coke Dry Quenching
- æ Dry Gas Cleaning Plant in Blast Furnace II
- æ Dry Gas Cleaning in SMS II

2.10.2 Waste Water Treatment Systems

Waste water is generated from different units of the steel plant and can be physically and chemically contaminated. In addition there will be regular blowdown of water from the cooling tower to maintain the chemistry of the recirculated cooling water system.

Necessary waste water treatment facilities at the individual process plants are being planned to treat the waste water and reuse to the maximum extent within the plant itself. The balance water is proposed to be treated in a water recovery plant (WRP) for total recovery. The WRP will have multiple stages of Reverse Osmosis (RO) units followed by an evaporator. The plant will be designed for complete utilization of water except during monsoon. Water balance for the plant for the production capacity of 10 MTPA is given in **Figure 2.4.**

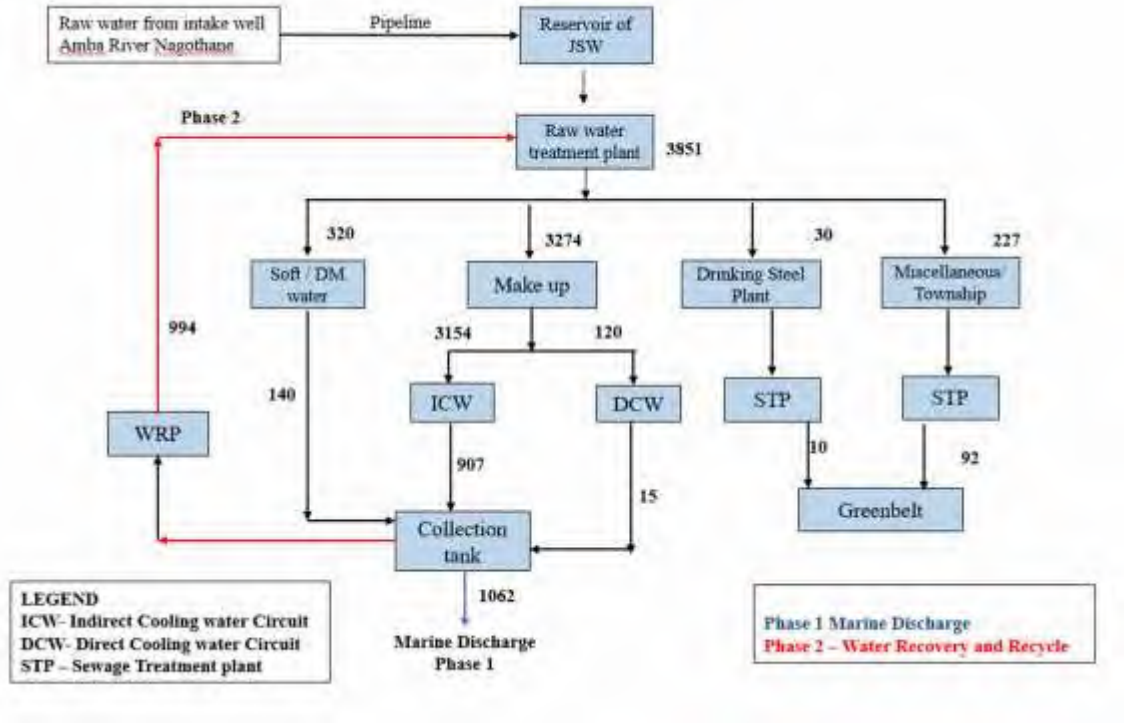


Figure 2.4: Water Balance Diagram for the Integrated Steel Plant

2.11 Fuel Gas Requirement

During the process of steel manufacture, the following by product fuel gases are generated.

- æ Blast furnace (BF) gas from Blast furnaces with a CV of 750-800 Kcal/Nm3
- æ Coke oven gas (COG) from Coke ovens with a CV of 4400 Kcal/Nm3
- æ BOF gas (LDG) from, SMS with a CV of 1800 Kcal/Nm3

The crude gases are treated in respective gas cleaning plants and the clean gases are used in the reheating furnaces of the steel plant. The Coke Oven gas will be desulphurized in a special desulphurization plant to remove hydrogen sulphide in Coke oven gas.

The use of clean fuel gases will ensure effective utilization with negligible emission to the atmosphere.

A network of gas pipeline with gas holders (COG: 1,00,000m3. BFG: 120,000 m3 and LDG: 80,000 m3) and mixing arrangements will be installed so that the fuel gas of specific CV is provided to individual process plants for energy efficiency. The surplus gases will be utilized in the gas based power plant for generation of power. The complete gas generation and distribution system shall be controlled from a central control center for optimizing the usage of fuel gases.

The hourly energy/fuel balance of Plant has been given in **Table 2.13**.

Table 2.13: Fuel Gas Balance at 10 MTPA stage

Production of fuel gases					
Units	capacity	Per hr prod.	Gas gen/ ton	Total gen (Nm3/hr)	Total Gas
	MTPA				
COG#1	1.0	126	350	58893	219509
COG#2 (5 on MG & 1 on COG)	3.0	342	350	160616	
BFG#1	3.5	417	1500	625000	1428571
BFG#2	4.5	536	1500	803571	
LDG	6.17	735	90	66107	66107

Consumption of Fuel gases					
Units	Plant capacity	Total Flow	Consumption of Gases NM3/hr		
	MTPA	Nm3/hr	COG	BFG	LDG
Coke Oven #1	1.10				
Battery-A (At 1050 CV)		53218	4032	49186	
Battery-B (At 4100 CV)		13629	13629	0	
Coke Oven Boiler & NH3		4500	4500	0	
Coke Oven #2	1.50				
Battery-A (At 1050 CV)		55447	4201	51246	
Battery-B (At 1050 CV)		55447	4201	51246	
Coke Oven Boiler & NH3		3000	3000	0	
Coke Oven #2	1.50				
Battery-C (At 1050 CV)		55447	4201	51246	
Battery-D (At 1050 CV)		55447	4201	51246	
Coke Oven Boiler & NH3		2000	2000	0	
Sinter #1	2.55	1178	1178	0	
Sinter #2	2.75	847	847	0	
Sinter-3	4.00	5000	0	5000	
Pellet #1	4.20	38116	9240	28875	
Pellet # 2	9.00	107494	24203	173291	
BF # 1 @10571 TPD	3.50	235294	3565	231729	
BF # 2 @13714 TPD	4.80	285714	8658	267056	
Billet caster	1.47	679	679	0	
SMS#1	5.00	600	600	0	
SIP # 1	1.60	15000	15000	0	
TF	3.50	7500	7500	0	
Bar Mill	1.43	28875	9188	19688	
SMS#2	6.17	15960	1620		14340
CRM	2.50	15000	5000	10000	
HSM#2	5.00	98390	11302	35320	51767

Consumption of Fuel gases					
Units	Plant capacity	Total Flow	Consumption of Gases NM3/hr		
	MTPA	Nm3/hr	COG	BFG	LDG
Cement Plant with new unit		30000	0	30000	
PCI # 1		6000	0	6000	
PCI # 2		13700	955	12745	
LCP (1,2,3 fuel conversion)	0.42	24324	7740	16585	
LCP 4	0.21	12162	3870	8292	
LCP (5-7)@1800 TPD	0.63	36486	11609	24877	
53.5 MW PP	57		0	172727	
300 MW PP	119		48221	127853	
Total consumption of gas			214937	1424211	66107
Flared gas Nm3/hr			4572	4360	
% Flare			2.08	0.3	0

The proposed Pellet plant II and SP II we utilize mixed gas (BFG+COF) in their furnaces. In addition to above, the waste heat energy recovery systems are planned to reduce the consumption of fuel gases as under:

1. COG sensible heat recovery from waste gases (for generation of 8 tph of LP steam)
2. BF stove waste gas sensible heat recovery for drying coal for injection for the Blast furnaces
3. Recuperator in reheating furnace to reduce the consumption of fuel gases
4. Waste heat recovery from CDQ in coke oven plant for power generation
5. Waste heat recovery from sinter cooler for steam recovery

2.12 Power Requirement

The power requirement for additional 5.0 MTPA is about 376 MW and will be made available by MSEB grid, at 220 kV from MSEB grid sub-station located near the plant site. The power will be received through double circuits of 220 kV transmission lines. Once the new 5 MTPA expansion plant operation stabilize, the total power requirement is proposed to be supplied as under. In the initial stages, the balance will be drawn from the grid and once the plant stabilizes, the power will be made available from the Captive Power Plant-III(CPP-III).

In addition to the captive power plants, some electrical power will also be available from the top pressure recovery turbine generators of the blast furnaces and Coke dry quenching unit of DCPL & ARCL.

From the main receiving station and step down sub-station of the plant, electrical power will be stepped down from 220 kV to 33 kV to feed to the various plant load centers. These load centers will have provision to step down further to 11

kV/6.6 kV and 415 V for distribution of power at required voltages to different consuming points.

Necessary power compensation equipment and harmonic filters will be provided to take care of the fluctuating loads of converter shop and continuous casters. For all 220 kV, 33 kV, 11 kV and 6.6 kV supplies, centralized supervision, monitoring and emergency control system will be adopted for efficient operation.

The power balance at 5 MTPA and 10 MTPA stages are given in **Table 2.14.**

Table 2.14 : Power Balance at 5 MTPA and 10 MTPA Stage of the Steel Plant

	At 5 MTPA	**At 10 MTPA**
Captive Generation	MW	MW
CPP-1(55 MW)	55	55
CPP-2(175 MW)	0	175
CPP-3 (300 MW)		120
TRT-1 (12 MW)	10	10
TRT-2 (27 MW)	0	25
CDQ (70 MW)	0	60
Total:	**65**	**445**
10 MTPA Units		
BF-2		60
HSM-2 (5 MTPA)		63
SMS-2 (BOF, Caster, RH & LF)		50
Sinter Plant-3(4 MTPA)		36
Pellet-2 (9 MTPA)		55
LCP-5, 6 & 7 (3x600 TPD)		5
2200 TPD Plant 2		38
RMHS (New)		17
Utilities		22
CRM		30
Total Load at 5 MTPA	**467**	**376**
Gross Total		**843**
From Grid		**398**

The proposed pellet Plant II and Sinter Plant III will receive 91 MW of electrical power from 10 MTPA electrical Power system.

2.13 Manpower

The requirement of manpower for the proposed new facilities has been estimated to be around 5000. This estimate covers the top management; middle and junior level executives and other supporting staff. It is proposed to outsource the manpower for non-core area of operations as practiced in the existing plant. The manpower for the proposed Pellet Plant II will be 380. The tentative categories wise break-up of manpower is indicated below in **Table 2.15.**

Table 2.15 : Categories wise Break-up of Manpower

Sl. No.	Category	Requirement
1	Managerial	180
2	Executive	400
3	Skilled	1300
4	Semi Skilled	1600
5	Unskilled	1400
6	Clerical	120
	Total	**5,000**

2.14 Capital Cost

The estimated block capital cost for capacity addition to take the integrated steel plant capacity from 5 MTPA to 10 MTPA is estimated at Rs 17,000 Cr. However, due to the change in configuration of Sinter and Pellet Plant, the capital expenditure is getting enhanced to Rs. 242 Cr.

Blast Furncae - II Project Site

Power Plant II

Filtration Unit of Blast Furnace II

Hot Strip Mill (HSM-II)

Blast Furnace II

Steel melting Shop II

Blast Furnace II Gas Holder

Plate 2.1 : Construction Activities for 10 MTPA Project

Chapter 3
Baseline Environmental Status

The baseline status of environmental quality in the vicinity of project site serves as a basis for identification and prediction of impacts. The baseline environmental quality is assessed through field studies within the impact zone for various components of environment, viz. air, noise, water, land, biological and socio-economic. The baseline environmental quality of Post-monsoon season has been assessed based on primary data generated during field survey and secondary data available for the proposed project site. The impacts due to the proposed project have been identified through network method involving cause-condition-effect relationship between an activity and environmental parameters. The cause-condition-effect networks are devised for individual environmental components as well as overall impacts.

3.1 Ambient Air Quality

The knowledge of quality of ambient air plays an important role in assessing the environmental scenario of the locality. The ambient air quality status in the vicinity of the project site forms an indispensable part of the Environment Impact Assessment studies. The quality of ambient air depends upon the concentrations of criteria pollutants, the emission sources and meteorological condition. Data collected during winter season has been analysed and presented herewith.

The baseline studies on air environment include identification of criteria air pollutants and assessing their existing levels in ambient air within the study zone. The existing status of air environment with respect to the identified air pollutants is assessed through air quality surveillance programme with scientifically designed ambient air quality monitoring network.

Micrometeorological data collection is an indispensable part of any air pollution study. The meteorological data collected from the meteorological station installed at JSW Steel Ltd. Dolvi, Raigarh District, Maharashtra and is used for proper interpretation of existing air pollution status. The ambient air quality monitoring was carried out through reconnaissance followed by air quality surveillance programme and micrometeorological study.

3.1.1 Reconnaissance

Reconnaissance was undertaken to establish the existing status of air environment in the study region. Ambient Air Quality Monitoring (AAQM) locations were selected based on guidelines of network siting criteria based on meteorological data of winter season. The ambient air quality monitoring was carried out in the study area of 10 km radial distance around the proposed site, details of these locations are presented in **Figure 3.1.1 & Table 3.1.1**

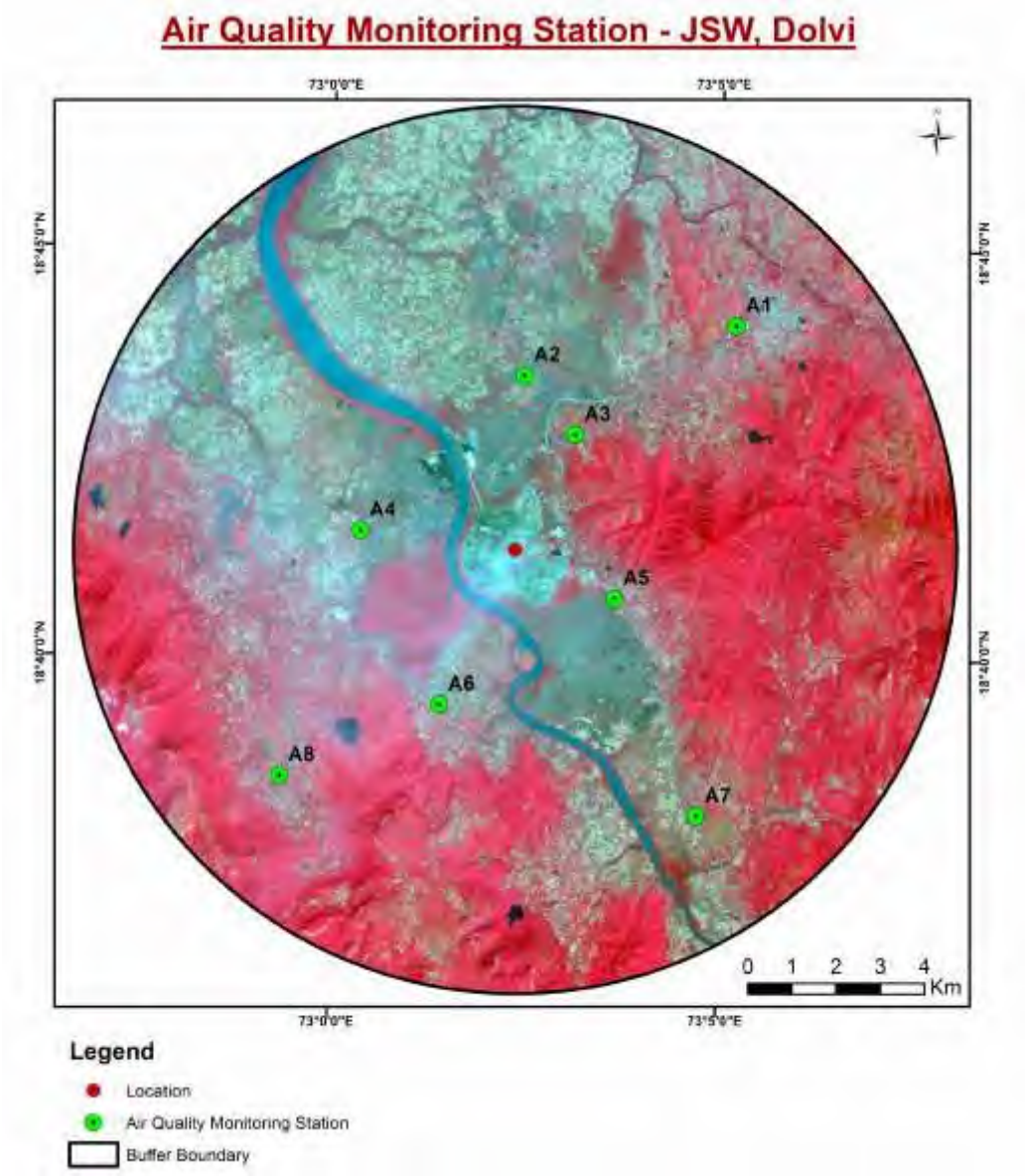


Figure 3.1.1: Ambient Air Quality Monitoring Stations around the JSW Plant

Table 3.1.1: Ambient Air Quality Monitoring Stations around the JSW Plant

Sr. No.	Sampling Location	Station Code	Latitude (N)	Longitude (E)
1.	Pen	A1	18° 44' 4.98"	73° 5' 11.66"
2.	Bori	A2	18° 43' 27.17"	73° 2' 28.50"
3.	Vadakhal	A3	18° 42' 44.17"	73° 3' 7.84"
4.	Shahbaj	A4	18° 41' 32.46"	73° 0' 22.59"
5.	Ghadab	A5	18° 40' 44.36"	73° 3' 39.19"
6.	Kusumble	A6	18° 39' 25.36"	73° 1' 24.75"
7.	Pandapur	A7	18° 38' 05.55"	73° 4' 43.93"
8.	Kolghar	A8	18° 38' 32.27"	72° 59' 22.01"

3.1.2 Ambient Air Quality Monitoring Network and Analytical Methods

The ambient air quality status in the study area is assessed through a network of ambient air quality monitoring locations. The studies on air environment include identification of air pollutants for assessing the impacts of existing JSW Steel plant operations. The existing status of air environment is assessed through a systematic air quality surveillance program, which is planned based on the following criteria:

- Topography/terrain of the study area
- Regional synoptic scale climatological normals
- Densely populated areas within the region
- Location of surrounding industries
- Representation of valid cross-sectional distribution in downwind direction of Port

As per NAAQS (2009) the pollutants viz., particulate matters (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), H_2S, PAHs and ammonia (NH_3) were stipulated parameters for air quality monitoring. All the parameters were monitored on 24 hourly basis. Standard analytical procedures were used for analysis and quantification of air quality parameters and the details are given in **Table 3.1.2**.

Eight AAQM locations were selected based on guidelines of network siting criteria. The eight identified sampling locations for AAQM are depicted in **Figure 3.1.1** and details of which is given in **Table 3.1.1**. In all sampling locations, High Volume Samplers (HVS) and Fine Particulate Samplers (FPS) designed by Envirotech Pvt. Ltd. were installed for continuous sampling of PM_{10}, $PM_{2.5}$ and gaseous pollutants. All the samples collected at the site were brought to the laboratory for further assessment for some concrete results.

3.1.3 Micrometeorology

The study of micro-meteorological conditions of a particular region is important to understand the variations in ambient air quality status in that region. The prevailing micrometeorology at project site plays a crucial role in transport and dispersion of air pollutants released from the plant. The persistence of the predominant wind direction and wind speed at the project site will decide the direction and extent of the air pollution impact zone. The principal variables which affect the micrometeorology are horizontal transport and dispersion (average wind speed and directions), convective transport and vertical mixing (atmospheric stability) and also topography of the area towards local influences.

Meteorology data for November, December, 2018 and January,19 was obtained from Lake International (Lakes Environmental Software) **(Table 3.1.3)**. The wind directions during the study period is taken are as shown in **Figure 3.1.2.** The predominant wind direction was blowing from NE to SW in the month of November, December & January. The calm conditions of winds are varies from 0.69% to 1.09% from November to January months; whereas the average winds speed is varies from 2.17 m/s to 3.17m/s in the study period

3.1.4 Baseline Air Quality Status

Particulate matter is ubiquitous component of the atmosphere and has become a persistent and pervasive environmental problem that imposes significant health risk. The sources, characteristics and potential health effects of the larger or coarse particle (>2.5 µm in diameter) and smaller or fine particles (<2.5 µm in diameter) are very different. The fine airborne particles have a high probability of deposition deeper into the respiratory tract and likely to trigger or exacerbate respiratory diseases. These particles also have higher burdens of toxins, which when absorbed in the body can result in health consequences other than respiratory health effects. Therefore, the US environmental Protection Agency promulgated a new $PM_{2.5}$ National Air Quality Standards to effective control the aerosol problem. Sources vary for gaseous pollutants viz. major source of SO_2 and NO_2 include burning of fossil fuels like coal and other petroleum products. For NH_3, sources include industrial processes, vehicular emissions.

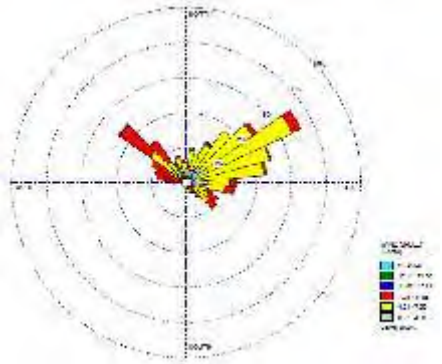
Table 3.1.2 : Analytical Methods used for Quantification of Air Quality Parameters in the Ambient Air

Sr. No.	Air Quality Parameter	Unit	Analytical Method used for Testing/Analysis	Analytical Measurement Range	Standard value as per NAAQs, 2009 and Monitoring duration
1.	Particulate Matter size < 10 microns or PM_{10}	µg/m³	Gravimetric IS-5182: Part-23, 2006	5-5000	100 (24 h)
2.	Particulate Matter size < 2.5 microns or $PM_{2.5}$	µg/m³	Gravimetric U.S.EPA EQM-0308-170	5-500	60 (24 h)
3.	Sulphur Dioxide (SO_2)	µg/m³	EPA Improved West and Gaeke Method IS-5182: Part-2, 2001	5-1000	80 (24 h)
4.	Nitrogen Dioxide (NO_2)	µg/m³	Modified Jacobs-Hachheiser Method IS-5182: Part-6, 2006	7-750	80 (24 h)
5.	Carbon Monoxide (CO)	mg/m³	Non Dispersive infra red (NDIR) Spectroscopy	50-1000	2.0 (8 h) 4.0 (1 h)
6.	Ozone (O_3)	µg/m³	In-situ Monitoring using O_3 Analyzer	5-1000	100 (8 h) 180 (1 h)
7.	Ammomia (NH_3)	µg/m³	Indophenol Blue method Method 401: Methods of Air Sampling and analysis, James P. Lodge	5-1000	400 (24 h)
8.	Lead (Pb)	µg/m³	AAS/ICP method for sampling on EPM 2000 IS-5182: Part-22, 2004	0.04-10	1.0 (24 h)
9.	Arsenic(As)	ng/ m³	AAS/ICP Method for sampling on EPM 2000 or equivalent filter paper Method 822: Methods of Air Sampling and analysis, James P. Lodge	0.01-10	6.0 (Annual)
10.	Nickel (Ni)	ng/ m³	AAS/ICP Method for sampling on EPM 2000 or equivalent filter paper	0.01-10	20.0 (Annual)
11.	Vanadium (V)	ng/m³	ICP Method for sampling on	0.01 – 10	0.1 (24 h)

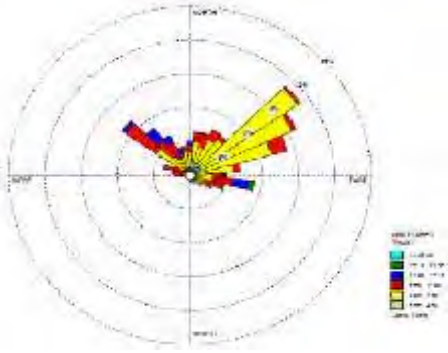
Sr. No.	Air Quality Parameter	Unit	Analytical Method used for Testing/Analysis	Analytical Measurement Range	Standard value as per NAAQs, 2009 and Monitoring duration
			EPM 2000		
12.	Benzene (C_6H_6)	µg/m³	GC based continuous analyzer IS-5182: Part-11, 2006	0.01-10	5.0 (Annual)
13.	Benzo-a-Pyrene (BaP)	ng/ m³	Solvent extraction followed by GC analysis IS-5182: Part-12, 2004	0.001-10	1.0 (Annual)
14.	VOCs	µg/m³	U.S. EPA Method TO17: 1999	0.01-10	0.01-500 (Annual)
15.	Hydrocarbons	µg/m³	HC Analyzer for Spot Concentration	0.01 – 10	-

Table 3.1.3: Meteorological Data of Dolvi Region

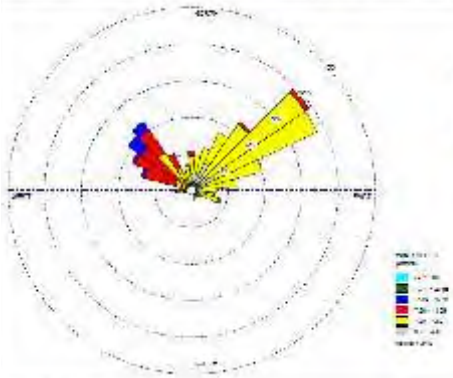
Period	Wind Speed (m/s			Temperature (K)			Relative Humidity (%)		
	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
January 2018	6.62	0.28	2.94	309.2	287.6	297.31	89	11	47.75
November 2018	6.88	0.28	2.71	309.2	292.2	300.24	92	18	53.81
December 2018	9.8	0.28	3.18	306.6	285.1	297.38	85	9	46.38



November'18 Month: Calm Winds 0.69 % Avg. Wind Speed 2.17 m/s and Wind



December'18 Month: Calm Winds 1.08%, Avg. Wind Speed 3.17 m/s and Wind Direction is Blowing From



January'19 Month: Calm Winds 1.34%, Avg. Wind Speed 2.93 m/s and Wind Direction is Blowing From

Figure 3.1.2 : Wind Directions during the Study Period

Particulate Matter:

- The concentration of PM_{10} varied from 149.4 to 307 µg/m^3. The lowest concentration of PM_{10} was found at Kolghar while the maximum concentration was found at Pen sampling site **(Table 3.1.4)**.
- $PM_{2.5}$ concentrations varied in the ranges from 72.6 to 132.8 µg/m^3. The lowest concentration of $PM_{2.5}$ was found at Kolghar while the maximum concentration was found at Pen sampling site **(Table 3.1.4).**

Gaseous Pollutants:

- The concentration of Sulphur dioxide (SO_2) varied from 1.6 to 9.3 µg/m^3, the concentration of Sulphur dioxide (SO_2) was observed minimum at Kusumble and maximum at Bori. The concentrations of SO_2 were observed to be within the stipulated standards of NAAQMS **(Table 3.1.4)**.
- The Concentration of Nitrogen dioxide (NO_2) was observed in the range of 6.3 to 14.1 µg/m^3, the minimum concentration was found at Kusumble while maximum concentration was accounted at Vadhkal **(Table 3.1.4)**.
- The concentration of NH_3 varied from 4.9 to 28.7 µg/m^3, Minimum concentration of Ammonia (NH_3) found at Pen, and maximum was found at Vadkhal sampling site **(Table 3.1.4)**.
- The concentration of H_2S varied from 0.2 to 1 µg/m^3, Minimum concentration of H_2S found at Vadkhal, and maximum was found at Bori sampling site **(Table 3.1.4)**.
- The concentration of CO varied from 1198 to 1619 µg/m^3, Minimum concentration of CO found at Vadhkal, and maximum was found at Shahbaj sampling site **(Table 3.1.4)**.
- C_2H_6 and Benzo (o) Pyrene were not detected in any of the sites.

Table 3.1.4: Air Quality Status within the Study Area Related to Particulate Matter

Results in (µg/m^3)										
Parameters		**PM 10**	**PM 2.5**	**SO_2**	**NO_2**	**NH3**	**BaP**	**H_2S**	**C_6H_6**	**CO**
NAAQ Standards * Annual ** 1 Hour	**(24 hours)**	**100**	**60**	**80**	**80**	**400**	**1***	**_**	**5***	**4000****
Pen	**Average**	307	132.8	6.9	7.8	4.9	BDL	0.6	BDL	1312
	Max	812.9	295.2	11.5	16.2	11.5	BDL	2.4	BDL	1498
	Min	163.9	75.6	5.2	2.6	2.4	BDL	0.5	BDL	1298
Bori	**Average**	232.6	95.7	9.3	10.9	15.2	BDL	1	BDL	1547
	Max	400.6	170.8	13.5	25.9	31.8	BDL	2.1	BDL	1658
	Min	107.2	43.6	5.7	4.2	3.2	BDL	0.6	BDL	1320
Vadhkal	**Average**	153.5	104.4	2.4	14.1	28.7	BDL	0.2	BDL	1198
	Max	349.2	212.5	4.5	50.5	240.4	BDL	1.3	BDL	1566
	Min	70.7	28.6	3	0.9	2.7	BDL	0.8	BDL	1012
Shahbaj	**Average**	166.8	83.1	2	11.5	12.1	BDL	0.3	BDL	1619
	Max	272	140	8.2	30.3	21.9	BDL	2.1	BDL	1844
	Min	96.3	39.6	4.2	5.2	1.3	BDL	0.4	BDL	1422
Gadab	**Average**	237.7	105.1	9	10	17.3	BDL	0.9	BDL	1441
	Max	381.9	160.8	14.5	18.1	74.8	BDL	2.4	BDL	1680
	Min	191.7	86.7	5	4.7	4	BDL	0.3	BDL	1125
Kusumble	**Average**	215.4	98.2	1.6	6.3	17.3	BDL	0.2	BDL	1237
	Max	380	156.8	4.5	18.1	41.7	BDL	0.8	BDL	1410
	Min	78.1	38.4	0.3	0.9	1.3	BDL	0.2	BDL	1088
Pandapur	**Average**	161.4	77.9	6.1	7	17.2	BDL	0.7	BDL	1298
	Max	238.5	118.9	11.5	12	74.5	BDL	1.9	BDL	1468
	Min	125.7	65.4	3.5	4.5	8.3	BDL	0.2	BDL	1102
Kolghar	**Average**	149.4	72.6	4.6	6.8	12.5	BDL	0.4	BDL	1214
	Max	207.1	110.3	12.5	13.6	24	BDL	1.6	BDL	1532
	Min	101	55.6	2.5	5.2	6.1	BDL	0.5	BDL	1189

Plates 3.1.1 : Air Monitoring at Sampling Locations

3.2 Noise Environment

The ambient noise levels were recorded at 11 different locations in Dolvi region to cover all types of areas i.e., residential, commercial and industrial area as given in **Table 3.2.1**, out of which 02 locations were inside the JSW industries and 09 locations were in nearby villages and outside industry**.** The locations are spatially distributed within the study area to ensure proper representation of noise levels. The Global Positioning System (GPS) was used to determine the exact position of the locations of the noise monitoring sites **(Figure 3.2.1).** The field results of the ambient noise levels as monitored during the study period are reported in **Table 3.2.2**.

3.2.1 Methodology and Baseline Environmental Status

In order to assess the ambient noise level in the environment, noise monitoring has been carried out in selected locations for 24 hours, during working and non-working days. As noise standards for ambient noise level during day and night are different; hence noise levels are measured during day time (06:00 hrs. to 22:00 hrs.) and night time (22:00 hrs. to 06:00 hrs.) as specified in Noise Pollution (Regulation and Control) Rules, 2000, Amendment 2010.

The noise measurements are carried out using calibrated Sound Level Meters with fast response mode keeping in view the quickly changing nature of noise levels. "A" weighting is applied for measuring the sound level as it replicates the response of human ear to noise and the measuring unit is denoted as dB(A). Data is logged at an interval of 1 second. The sound level meter was mounted on tripod stand and windball was used to minimize the effect of wind. The instrument was mounted at a height of 1.5 meters from the ground. The microphone on the sound level meter was positioned at least 3 meters away from the hard surface or walls to minimize the effect of reflections.

The monitored noise levels at the identified locations are analysed and the corresponding Leq in dB(A) during day and night time are calculated. The equivalent continuous sound level (Leq) is the sound pressure level of a steady sound that has, over a given period, the same energy as a fluctuating sound. It is calculated using following equation:

$$L_{eq,T} = 10\log\left(1/n \sum_{i=1}^{n} 10^{\frac{L_i}{10}}\right)$$

Where, Li= levels observed at n equally spaced times during interval T.

Table 3.2.1: Noise Monitoring Locations in Dolvi Region

Sr. No.	Sampling Locations	Station Code	Area Category	Latitude (N)	Longitude (E)
1	Pen	N1	Commercial	18°44'33.6"	73°05'24.1"
2	Bori	N2	Residential	18°43'23.5"	73°02'29.2"
3	Vadkhal	N3	Residential	18°43'02.6"	73°03'06.5"
4	Alibaug Gate	N4	Industrial	18°41'52.5"	73°01'59.7"
5	Shahabaj	N5	Residential	18°41'37.7"	73°00'01.8"
6	Gadab	N6	Residential	18°41'03.6"	73°03'36.7"
7	Kusumble	N7	Residential	18°39'29.33"	73°1'32.63"
8	Kolghar	N8	Residential	18°38'24.24"	72°59'23.15"
9	Pandapur	N9	Residential	18°38'04.2"	73°04'44.7"

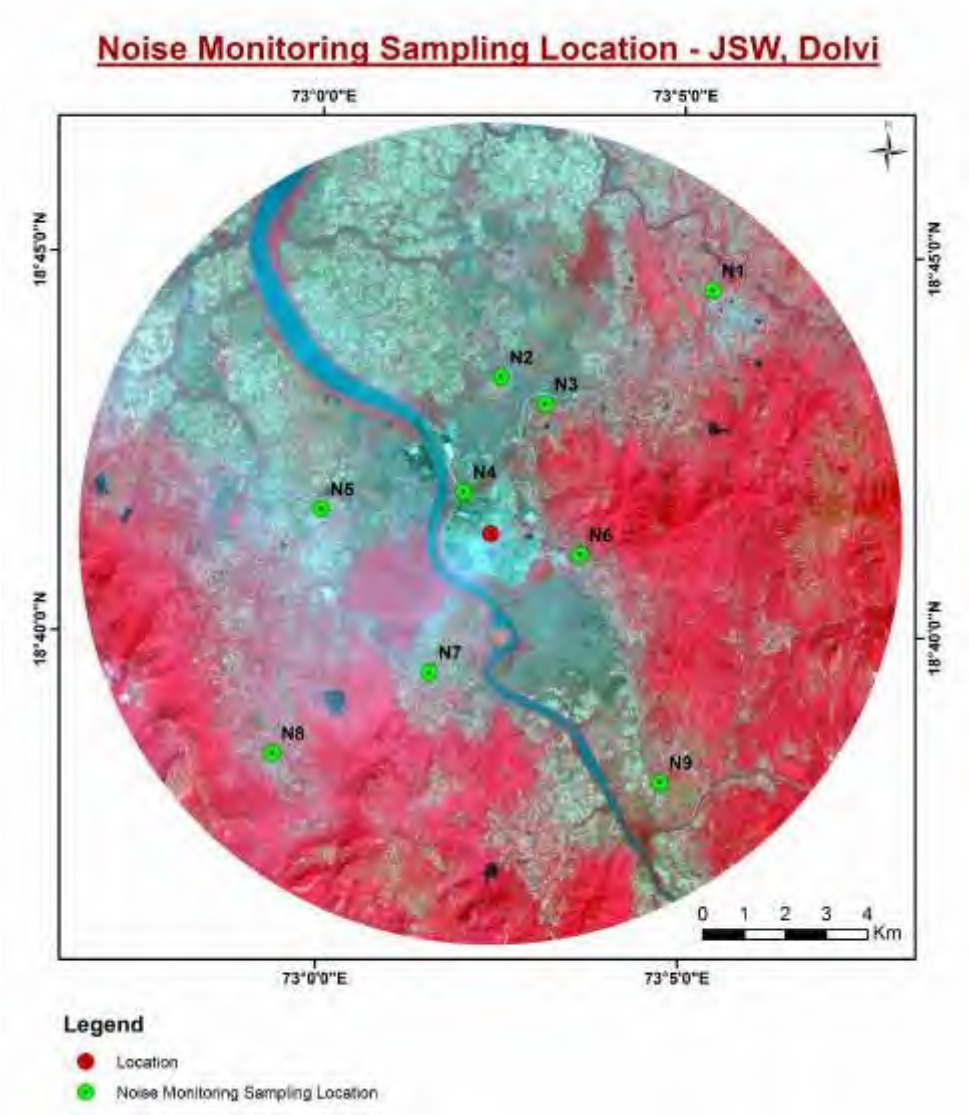


Figure 3.2.1: Sampling Locations for Noise Monitoring

(1) Identification and Characterization of Noise Sources

The noise sources in the study areas can be broadly grouped into two major categories: steel industrial activities and traffic related activities. JSW steel industry comprises several activities which are potential sources of noise, such as sintering plant, blast furnace operation, mechanized conveyor system, loading-unloading operation, cranes, cargo handling equipment, loader-unloader. Another major potential source of noise is traffic noise by vehicular movements, the rate of movement of heavy vehicles is very high and it is also responsible for increasing the traffic noise level significantly in the study area as well as on the highway.

(2) Measurement of Baseline Noise Levels in the Study Area

A total of 11 locations were monitored continuously for 24 hours on working day (WD) and Nonworking day (NWD). **Table 3.2.2** represents the ambient noise levels (Leq), minimum (Lmin) and maximum noise (Lmax), peak noise (L10) and background noise levels (L90) recorded at various locations in Dolvi region. At majority of the locations, noise levels were found to be exceeding the noise standards prescribed in Noise Pollution (Regulation and Control) Rules during day and night time. On a working day, the ambient noise levels were found to be in the range of 55.8 dB(A) to 96.4 dB(A) during day time whereas during night time, the noise levels were recorded in the range of 41.7 dB(A) to 97.2 dB(A). Noise levels at locations inside JSW industry premise was not within the standard of 75 dB(A) during day time whereas during night time, noise levels were found to be exceeding the standard of 70 dB(A). The industry operates continuously 24 x 7 which contributes to higher noise levels during night time. Alibaug gate of JSW industries (N5) was found to have maximum noise level during both day and night time on working days due to continuous vehicular movement. Noise levels in villages Kusumble and Bori were lowest at 55.8 dB(A) and 41.7 dB(A) during day and night time respectively on working days. On a non-working day, the ambient noise levels were found to be in the range of 55.8 dB(A) to 96.0 dB(A) during day time whereas during night time, the noise levels were recorded in the range of 41.1dB(A) to 96.8 dB(A). Very high noise levels were recorded at Alibaug gate and in Pen due to vehicular movement and increased commercial activities respectively during both day and night.

Table 3.2.2: Ambient Noise Levels at Various Locations in Dolvi Region

Stn. Code	Site Name	Category	Shift	Limit in dB(A) Leq*	Working Day, dB(A)					Non-Working Day, dB(A)				
					Leq	Lmax	Lmin	L10	L90	Leq	Lmax	Lmin	L10	L90
N1	Pen	Commercial	Day	65	85.5	124.7	46.5	80.7	58.1	96.0	126.8	50.3	89.2	70.2
			Night	55	77.1	108.5	38.8	73.7	44.6	90.6	126.1	49.6	84.7	66.6
N2	Bori	Residential	Day	55	75.2	89.5	34.2	77.5	38.3	67.1	108.5	33.6	57.9	40.5
			Night	45	41.7	60.1	35.7	44.3	36.8	41.1	60.7	35.3	42.3	37.7
N3	Vadkhal	Residential	Day	55	67.0	104.6	36.2	61.5	44.5	61.1	98.5	36.5	57.5	44.8
			Night	45	49.9	74.3	42.4	50.6	44.3	49.4	80.5	42.8	48.7	43.8
N4	Alibaug Gate	Industrial	Day	75	96.4	116.4	92.2	98	93.9	95.5	114	92	97.2	93.5
			Night	70	97.2	123.1	93.2	98.4	94.8	96.8	109.2	91	98.2	94.6
N5	Shahabaj	Residential	Day	55	62.5	101.4	30.3	57.1	41.9	70.4	111.5	30.7	59	41.4
			Night	45	73.1	108.1	37.7	45.9	39.5	51.0	82.5	37.8	49	39.7
N6	Gadab	Residential	Day	55	83.7	123.2	41.9	60.8	51.4	62.6	92.1	43.1	61.8	47
			Night	45	77.7	122	51.8	58.2	53.8	73.1	111.1	40	66.1	47.4
N7	Kusumble	Residential	Day	55	55.8	89.8	29.5	55.1	40.8	55.8	84.1	28.2	53.8	37.9
			Night	45	49.6	75.1	42.4	49.7	45.2	49.1	73.8	42	49.8	46.1
N8	Kolghar	Residential	Day	55	71.1	118.3	25.6	49.5	34.2	63.0	106.6	25.1	49.7	33.7
			Night	45	45.7	78.8	32.1	36.3	32.7	55.6	83.8	32.3	40.9	33.5
N9	Pandapur	Residential	Day	55	58.5	93.9	36.9	56.6	47.1	57.5	89.3	39	56	46.3
			Night	45	55.9	82.8	44.2	54.1	47.1	53.7	86.2	43.7	53.1	46.6

Gadab

Kusumble

JSW- Alibaug Gate

JSW-Coke Oven

Plate 3.2.1 : Noise Monitoring in Dolvi Region

3.3 Water Environment

3.3.1 Reconnaissance

A reconnaissance survey was done to identify the sampling locations to establish the baseline status of water quality in the study area. Dolvi is a large village located in Pen Taluka of Raigarh district, Maharashtra. The study area is located in the valley surrounded by the hills having the steepest slope of 57.4°. There are two major highways passing through the study area. One is Mumbai-Goa highway which is NH-66 and the other is Pen- Alibaug road. Also there are railway lines passing through the area. The nearest railway station is Pen. The JSW 5 MTPA integrated steel plant at Dolvi is advantageously located on the West coast of Maharashtra, located at 0.6 km from Dolvi village. JSWSL is located near Geethapuram-Dolvi village, Raigad District, Maharashtra. The site falls between 73°00′00″-73°05′00″ E longitude and 18°40′00″ to 18°45′00″ N latitude with an average altitude of 1.7 m above MSL.

The study area comprises 10 km radial distance considering JSW steel plant as the center (**Figure 3.3.1**). Steel Plant is located on the bank of River Amba. There are four Reserved Forests in the study area. There are no major industries located in the vicinity. However the two small industries are located within 10 km radius of JSWSL- Johnson & Johnson Industries Ltd. and Nitco Tiles Ltd. The main source of drinking water in study area is piped water supply however, for most of the domestic needs, villagers have to rely on groundwater i.e. hand pumps and dug wells.

3.3.2 Methodology of Water Quality Assessment

Based on the reconnaissance, the type of water bodies and their relative importance with the project site; water samples were collected in Post-monsoon season November to December, 2018. Water samples were collected to assess the surface, ground water quality within study area. Sampling, preservation and transport of water samples from the field was done as per guidance manual ISO (ISO 5667-1; 1980 water quality sampling part I: ISO 5667-11: 1993 part II) for surface and groundwater sources. Samples were analyzed for physico-chemical characteristics including physical, inorganic, organic, nutrient and heavy metals. Bacteriological characteristics for total and feacal coliforms were also analysed as per the methods prescribed in Standard methods for examination of water & Wastewater (APHA). Surface water quality can be estimated based on the 'Surface water quality criteria for different uses (specified by CPCB, 1979 and the Bureau of Indian Standards, 1982)' as well as 'IS 10500: 2012 Drinking Water Standards specified by Bureau of Indian Standards.' **(ANNEXURE)**

3.3.3 Physico-chemical Characteristics

Ground water samples were collected from the 08 dug wells, while 17 surface water samples were collected from lakes and intertidal zones within the study area. The samples were analyzed for parameters necessary to determine water quality and those that are relevant from the point of view of environmental impact of the proposed expansion of the steel plant. The surface and ground water samples collected within the study area were presented in **Plate 3.3.1.** The water sampling locations are shown in

Table 3.3.1. The surface and ground water samples were analyzed for different physico-chemical and bacteriological parameters, as per the list given in **Table 3.3.2.**

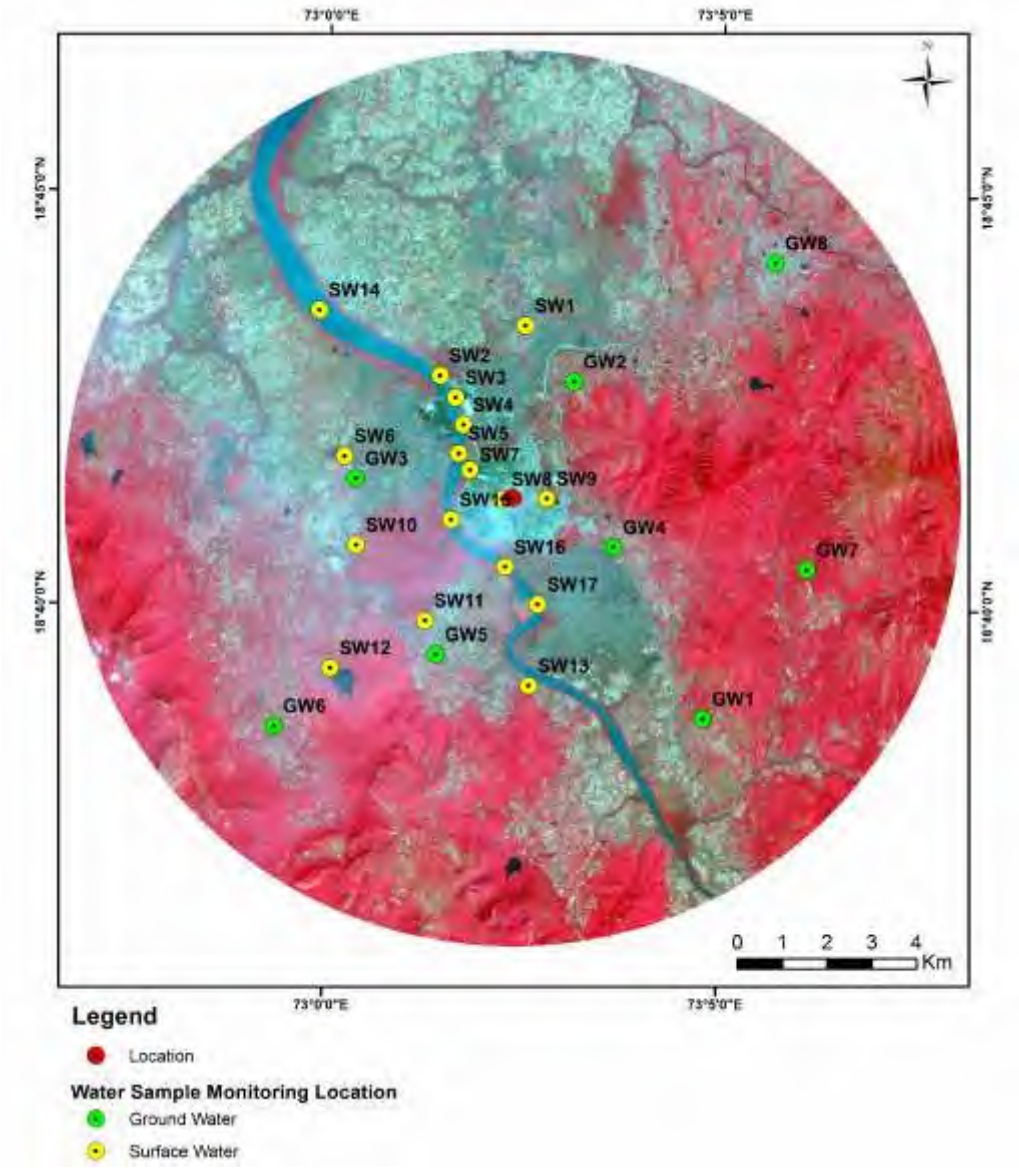


Figure 3.3.1: Surface & Ground Water Sampling Locations in the Study Area

A) **Surface Water Sampling (Amba River Estuary)**

B) **Ground Water Sampling**

Plate 3.3.1 : Surface and Ground Water Sampling in the Study Area

Table 3.3.1: Water Quality Monitoring Parameters and Analytical Methods

Sr. No.	Parameter	Method of analysis (APHA/ IS Standard)
1.	pH	APHA-4500-H+ B, 22ND Edition 2012
2.	Temperature (°C)	APHA - 2550 B, 22ND Edition 2012
3.	TSS (mg/L)	APHA-2540 D, 22ND Edition 2012
4.	TDS (mg/L)	APHA 2540 C, 22ND Edition 2012
5.	EC (µS/cm)	APHA 2510 B, 22ND Edition 2012
6.	Total Alkalinity as $CaCO_3$ (mg/L)	IS 3025-23 (1986)
7.	Total Hardness as $CaCO_3$ (mg/L)	APHA - 2340 C, 22ND Edition 2012
8.	Chlorides (mg/L)	APHA -4500 B, 22ND Edition 2012
9.	Sulphates (mg/L)	IS 3025-24 (1986)
10.	Nitrates as NO_3 (mg/L)	APHA - 4500 B, 22ND Edition 2012
11.	Total Phosphates (mg/L)	IS 3025-31 (1988)
12.	DO (mg/L)	APHA - 4500 C, 22ND Edition 2012
13.	COD (mg/L)	IS 3025-58 (2006)
14.	BOD (mg/L)	IS 30256-44 (1993)
15.	Heavy Metals (mg/L)	APHA - 3030 E, 22ND Edition 2012 using ICP-OES
16.	Total Coliform (MPN/100 ml)	APHA – 9222 B, 22ND Edition 2012 using Membrane Filtration Technique
17.	*E. Coli* (MPN/100 ml)	APHA – 9222 B, 22ND Edition 2012 using Membrane Filtration Technique

Table 3.3.2: Surface Water Quality- Sampling Location Details (Summer Season- April 2019)

Sr. No.	Sample Code	Location Name	Latitude	Longitude
Surface water				
Estuarine water				
1.	SW2	Near Port Start	18°42'47.6"	73° 1'25.92"
2.	SW3	Near Port Middle	18°42'31.94"	73° 1'37.96"
3.	SW4	Near Port End	18°42'12.19"	73° 1'43.96"
4.	SW5	Near Bridge	18°41'51.3"	73° 1'40.64"
5.	SW6	Near Village Ghaswad	18°41'48.56"	73° 0'13.92"
6.	SW7	Near Kasumata temple	18°41'39.54"	73° 1'49.43"
7.	SW11	Near Village Kachali	18°39'49.93"	73° 1'16.31"
8.	SW13	Near Village Jalashi	18°39'3.35"	73° 2'35.75"
9.	SW14	Near Village Dhakte Shahpur	18°43’34.5” N	72°59’53.4” E
10.	SW15	Near JSW Dolvi plant-middle	18°41’03.1” N	73°01’35.4” E
11.	SW16	Near JSW Dolvi plant-end	18°40’29.4” N	73°02’16.8” E
12.	SW17	Near Village Jui	18°40’02.4” N	73°02’42.0” E
Lake/Pond/Dam water				
13.	SW1	Near Village Bori- Lake	18°43'24.5"	73° 2'30.38"
14.	SW8	Near Company Middle- Pond	18°41'18.45"	73° 2'13.97"
15.	SW9	Near Company Start- Reservoir	18°41'19.25"	73° 2'48.08"
16.	SW10	Near Village Dehen- Pond	18°40'44.09"	73° 0'23.41"
17.	SW12	Near Village Shreegaon- Dam	18°39'14.77"	73° 0'4.45"

(I) Surface Water

No significant surface water source is available near the plant vicinity except the Amba River, which is filled up with tidal water. Samples were collected during low and high tide from the intertidal zones. Amba river is flowing from SE to NW adjacent to the JSWSL boundary. The main source of raw water is Amba River, which comes from Nagothane (approx. 30 km) through pipeline.

3.3.3.1 Physico-chemical Characteristics of Estuarine water of River Amba

Estuarine water samples were collected from Amba river estuary upstream and downstream of the industry. The estuarine water quality is summarized in **Tables 3.3.3** to **3.3.4.** The pH was found to be 7.1-8.3, whereas alkalinity was in the range of 132-1110 mg/l. The total suspended solids vary from 14-266 mg/l and Chlorides were in the range of 7807-19540 mg/l. Dissolved oxygen was found in the range of 2.2-5.7 mg/l and Nitrate as NO_3 was in the rage of 1.30-3.27 mg/l.

Table 3.3.3 : Surface Water Quality- Physicochemical and Biological Characteristics

Sr. No.	Sample code	Sampling Location	pH	Cond. (µS/cm)	TSS (mg/L)	TDS (mg/L)	DO (mg/L)	Alkalinity (mg/L as $CaCO_3$)	Hardness (mg/L as $CaCO_3$)	NH_3-N (mg/L)	Cl^- (mg/L)	PO_4^- (mg/L)	SO_4^{2-} (mg/L)	NO_3^- (mg/L)	Total Coliforms (MPN/100 ml)
Surface water															
Estuarine Water															
1.	SW2	Near Port Start	7.7	42335	192	31117	2.2	790	7708	3.7	13759	4.9	53.50	2	200
2.	SW3	Near Port Middle	7.8	42750	205	31421	2.2	1110	6334	2.4	13914	5.2	55	1.5	ND
3.	SW4	Near Port End	7.8	42403	219	31166	2.2	997	7106	3.0	10890	4.4	36.52	1.5	100
4.	SW5	Near Bridge	7.8	41260	190	30327	2.2	810	5000	3.6	13321	3.1	45.33	2.0	ND
5.	SW6	Near Village Ghaswad	7.1	41400	246	30429	2.5	900	5600	2.2	13913	4.6	37.44	1.7	ND
6.	SW7	Near Kasumata temple	8.3	24298	111	17859	2.7	900	4223	2.1	7807	4.9	51.06	1.5	90
7.	SW11	Near Village Kachali	7.7	33710	178	24777	2.8	500	3800	2.0	11337	3.9	30.78	1.3	700
8.	SW13	Near Village Jalashi	7.6	31210	266	22939	2.3	820	4600	3.0	10512	4.6	41.33	2.0	210
9.	SW14	Near Village Dhakte Shahpur	7.4	53000	14	31866	5.7	192	5560	2.93	18618	1.13	295	2.93	120
10.	SW15	Near JSW Dolvi plant-middle	7.4	52100	34	32736	3.7	132	5712	3.27	19356	0.24	304	3.27	250
11.	SW16	Near JSW Dolvi plant-end	7.2	51400	76	32844	4.3	152	5252	2.81	19079	0.16	372	2.81	190
12.	SW17	Near Village Jui	7.6	50000	42	32526	4.1	168	5640	2.80	19540	0.30	324	2.80	120
Lake/Pond/Dam water															
13.	SW1	Near Village Bori-Lake	7.1	758	84	379	0.7	500	1900	2.8	98	7.3	5.67	2.1	180
14.	SW8	Near Company Middle- Pond	8.9	2798	15	1399	2.0	500	773	2.3	670	4.8	17.44	0.9	750
15.	SW9	Near Company Start- Reservoir	8.7	4903	20	3604	3.0	656	900	1.2	1443	5.5	27.11	0.6	40
16.	SW10	Near Village Dehen-Pond	8.4	1859	63	930	2.3	320	800	0.6	448	4.8	13.00	0.2	50
17.	SW12	Near Village Shreegaon- Dam	8.0	211	27	105	3.0	800	1800	2.3	57	5.2	8.00	1.7	100

Table 3.3.4 : Surface Water Quality- Heavy Metals

Sr. No.	Sample code	Sampling Location	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
Surface water											
Estuarine Water											
1.	SW2	Near Port Start	ND	0.003	0.020	0.070	2.915	0.252	0.002	ND	ND
2.	SW3	Near Port Middle	ND	0.030	ND	0.001	2.205	0.445	0.001	0.021	ND
3.	SW4	Near Port End	ND	0.002	ND	0.003	1.715	0.205	ND	0.010	ND
4.	SW5	Near Bridge	ND	0.003	ND	ND	1.290	0.890	ND	ND	ND
5.	SW6	Near Village Ghaswad	ND	0.010	ND	0.003	1.800	1.640	ND	0.030	ND
6.	SW7	Near Kasumata temple	ND	0.021	ND	ND	1.115	0.750	ND	0.003	ND
7.	SW11	Near Village Kachali	ND	0.014	ND	0.200	1.900	1.000	ND	ND	ND
8.	SW13	Near Village Jalashi	ND	0.004	ND	ND	2.700	2.600	0.001	ND	ND
9.	SW14	Near Village Dhakte Shahpur	ND	ND	ND	ND	ND	0.004	0.006	ND	ND
10.	SW15	Near JSW Dolvi plant-middle	ND	ND	ND	ND	ND	0.013	0.011	ND	ND
11.	SW16	Near JSW Dolvi plant-end	ND	ND	ND	ND	ND	0.033	0.017	ND	ND
12.	SW17	Near Village Jui	ND	ND	0.106	0.002	ND	0.008	0.016	ND	ND
Lake/Pond/Dam water											
13.	SW1	Near Village Bori- Lake	ND	0.040	ND	0.002	0.050	0.460	ND	0.030	0.140
14.	SW8	Near Company Middle- Pond	ND	0.003	ND	ND	0.600	0.150	ND	0.003	ND
15.	SW9	Near Company Start- Reservoir	ND	0.002	ND	0.003	0.160	0.040	ND	ND	ND
16.	SW10	Near Village Dehen- Pond	ND	0.003	ND	ND	1.300	0.420	0.002	0.010	ND
17.	SW12	Near Village Shreegaon- Dam	ND	0.010	ND	ND	0.350	2.400	ND	ND	ND

Heavy metals were found to be as Cadmium: ND-0.030 mg/l, Chromium: ND-0.106 mg/l, Copper: ND-0.200 mg/l, Iron: ND-2.915 mg/l, Manganese: 0.004-2.600 mg/l, Nickel: ND-0.017 mg/l and Lead: ND-0.030 mg/l; whereas Arsenic and Zinc were found to be not detectable.

3.3.3.2 Physico-chemical Characteristics of Lake/Pond Water

Five surface water samples were collected from different lake and pond water bodies within the study area. The physico-chemical characteristics of Lake/pond water in summer season-April 2019 is summarized in the **Tables 3.3.3** to **3.3.4**. The surface water quality of Lake waters within the study area shows moderate water quality in terms of pH 7.1-8.9 and total suspended solids 15-84 mg/l. Buffering capacity in terms of alkalinity was found to be 320-800 mg/l. Nutrient load in terms of nitrate-NO_3 was in the range of 0.2-2.1 mg/l and levels of DO were observed to be 0.7-3.0 mg/l respectively.

Heavy metals were found to be, Cadmium: 0.002-0.040 mg/l, Copper: ND-0.003 mg/l, Iron: 0.050-1.300 mg/l, Manganese: 0.040-2.400 mg/l, Nickel: ND-0.002 mg/l, Lead: ND-0.030 mg/l and Zinc: ND-0.140 mg/l; whereas Arsenic and Chromium were found to be not detectable**.**

(II) Groundwater Quality

3.3.3.3 Physico-chemical Characteristics of Ground Water

Eight ground water samples were collected within study area which includes Seven dug wells and one bore well sample. The physico-chemical characteristics of the ground water are presented in the **Table 3.3.6 to 3.3.7.** The variation in different parameters was observed as; pH: 6.8-7.6, total dissolved solids: 146-528 mg/l, chlorides: 20-189 mg/l, sulphate: 0.6-10 mg/l, total alkalinity: 115-272 mg/l and total hardness: 100-280 mg/l. Nutrients as nitrate-NO_3 were observed in the range 0.04-1.40 mg/l and COD was in the range of 13-65 mg/l.

The concentration of heavy metals was in the range of, Arsenic: ND-0.040 mg/l, Cadmium: ND-0.030 mg/l, Chromium: ND-0.138 mg/l, Copper: ND-0.020 mg/l, Iron: ND-1.200 mg/l, Manganese: 0.014-0.400 mg/l, Nickel: ND-0.033 mg/l, Lead: ND-0.090 mg/l and Zinc: ND-2.800 mg/l.

3.3.4 Bacteriological Characteristics

The coliform group of bacteria are significant as a principal indicator of degree of pollution of water and thus of the sanitary quality of water. The coliform density is now a criterion to assess the suitability of water for domestic and recreational uses. The coliform group belongs to the family of *Enterobacteriaceae* and includes all aerobic and facultative anaerobic, gram-negative, nonspore-forming, rod-shaped bacteria that ferment lactose with gas and acid formation within 48 hrs at 35°C.

The standard test for the coliform group was carried out by the membrane filter (MF) technique. The MF technique involves direct plating for detection and estimation of total coliform and fecal coliform densities.

The bacteriological characteristic of estuarine and lake water are shown in **Table 3.3.3**. The total coliform count was found to be ND to 700 MPN/100 ml in estuarine water and 40 to 750 MPN/100 ml in Lake water samples

In order to assess the bacteriological quality of groundwater, 8 samples were collected from different villages within study area. The bacteriological quality of the groundwater is presented in **Table 3.3.6.** The ground water samples showed total coliform from ND to 90 MPN/100 ml and also *E. Coli* in the range of ND to 25 MPN/100 ml.

Table 3.3.5 : Ground Water Quality- Sampling Location Details

Sr. No.	Sample Code	Location Name	Latitude	Longitude
Ground Water				
Dug Well				
1.	GW1	Village Kasu	18°38'40.61"	73°4'48.439"
2.	GW3	Village Shahabaj	18°41'32.46"	73° 0'22.59"
3.	GW4	Village Gadab	18°40'44.36"	73° 3'39.19"
4.	GW5	Village Kusumbale	18°39'25.36"	73° 1'24.75"
5.	GW6	Village Kolghar	18°38'32.27"	72°59'22.01"
6.	GW7	Village Jirne	18°40’29.5”	73°06’06.6”
7.	GW8	Village Pen	18°44’11.6”	73° 05' 36.9"
Bore Well				
8.	GW2	Village Vadhkhal	18°42'44.17"	73° 3'7.84"

Table 3.3.6 : Ground Water Quality – Physicochemical and Biological Characteristics

Sr. No.	Parameters	IS 10500: 2012		Kasu	Vadkhal	Shahbaj	Gadab	Kusumble	Kolghar	Jirne	Pen
		Accp. Limit	Perm. Limit								
1.	pH	**6.5-8.5**	**NR**	6.9	7.1	7.6	7.0	7.6	6.8	7.6	7.6
2.	Conductivity (µS/cm)	---	---	484	610	583	439	292	304	444	947
3.	TSS (mg/L)	---	---	12	13	21	11	22	16	9	7
4.	TDS (mg/L)	**500**	**2000**	242	305	292	219	146	152	274	528
5.	COD (mg/L)	---	---	24	18	65	22	43	32	22	13
6.	BOD (mg/L)	---	---	12	11	33	12	22	17	2.7	1.9
7.	Alkalinity (mg/L as $CaCO_3$)	**200**	**600**	115	180	167	150	122	143	176	272
8.	Total Hardness (mg/L as $CaCO_3$)	**200**	**600**	180	280	192	180	100	120	156	260
9.	Ammonia (as total NH_3-N) (mg/L)	**0.5**	**NR**	ND	ND	0.2	0.1	0.1	ND	0.1	ND
10.	Chlorides (mg/L)	**250**	**1000**	179	189	143	51	66	20	58	124
11.	Phosphate (mg/L)	---	---	2.1	1.8	1.3	2.8	5.3	1.6	2.1	1.0
12.	Sulphate (mg/L)	**200**	**400**	0.9	0.6	2.3	1.4	1.2	1	5	10
13.	Nitrate (mg/L)	**45**	**NR**	0.1	0.2	0.5	0.3	0.2	0.04	1.4	1.1
14.	*E. Coli* (MPN/100mL)	Shall not be detectable in any 100 ml sample		ND	90	45	40	20	60	ND	ND
15.	Total Coliforms (MPN/100ml)			ND	18	8	12	6	25	ND	ND

Table 3.3.7: Ground Water Quality – Heavy Metals

Sr. No	Heavy Metals (mg/l)	IS 10500: 2012		Kasu	Vadkhal	Shahbaj	Gadab	Kusumble	Kolghar	Jirne	Pen
		Accp. Limit	Perm. Limit								
1.	As	0.01	0.05	ND	ND	0.02	0.04	ND	ND	ND	ND
2.	Cd	0.003	NR	0.002	0.002	0.007	0.003	0.007	0.03	ND	ND
3.	Cr	0.05	NR	ND	ND	ND	ND	ND	ND	0.138	0.015
4.	Cu	0.05	1.5	ND	ND	ND	0.02	ND	0.002	0.002	ND
5.	Fe	0.3	NR	ND	0.11	0.16	ND	ND	1.2	0.002	ND
6.	Mn	0.1	0.3	0.1	0.04	0.3	0.03	0.35	0.4	0.014	0.365
7.	Ni	0.02	NR	ND	ND	0.001	0.002	ND	ND	0.017	0.033
8.	Pb	0.01	NR	ND	ND	0.04	0.09	0.05	0.09	ND	ND
9.	Zn	5	15	ND	ND	2.8	ND	ND	ND	ND	ND

3.4 Land Environment

The impacts of any projects on land environment primarily depend on type/category of project. The impacts on the land environment would be in the form of permanent change in land use pattern as well as direct and indirect impacts on surrounding land due to the discharge of wastes on the land and unscientific means of disposal. The waste from the industry has potential to contaminate soils, reduce agricultural productivity and delink the delicate microbial food-web in topsoil. In major perspective, long-term implications would be change in land use pattern. In order to assess the impacts of industrial activity, initially, the quality of soils such as physical, chemical, microbiological parameters on land need to be determined and then it would be possible to assess the impact of industry-specific pollutants on the soil quality. By considering the importance of these soil related issues, the soil quality reference to fertility and productivity are evaluated as per the standard procedures. The land use and land cover pattern in the study area were studied using Remote Sensing and GIS and quantified land use and land cover in the study area i.e., 10 km radius from the JSW Steel plant. The solid and hazardous wastes generated from industry, if not properly stored/disposed of, cause contamination of soils and groundwater resources.

3.4.1 Soil Quality

3.4.1.1 Reconnaissance

The location identified for proposed capacity addition of Integrated Steel plant from 5.0 MTPA to 10.0 MTPA and captive power plant from 300 MW TO 600 MW is at M/s JSW Steel Ltd., Dolvi Works, Dolvi Village, Raigad Dist., Maharashtra. The project is located at Dolvi Village, Raigad Dist., Maharashtra. The rich fertile soil of the region, make the region good for cultivation of different crops. As per MoEF guidelines, an area of 10 km radius surrounding the proposed site was considered as the study area. The district is bounded by Mumbai Harbour to the northwest, Thana District to the north, Poona District to the east, Ratnagiri district to the south, and the Arabian Sea to the west. It includes the large natural harbour of Pen-Mandwa, which is immediately south of Mumbai harbour, and forming a single landform with.

3.4.1.2 Soil Sampling and Analysis

Keeping in view the existing and proposed activities at JSW plant, the baseline data related to nature & quality of soil, landuse and cropping patterns in impact zone as well as the solid/hazardous waste generation and management facilities at the plant are collected through field survey and available data sources including project proponents.

Thirteen (13) soil samples were identified and collected from 10 km study area during the summer season (March 2019). Location of soil sampling is depicted in **Figure 3.4.1** and summarized in **Table 3.4.1.** Representative soil samples from depth (15 - 30 cm) were collected from these villages around the project site for estimation of the physicochemical characteristics of the soil. Soil sampling done by CSIR-NEERI Team in the study area is depicted in **Plate 3.4.1.**

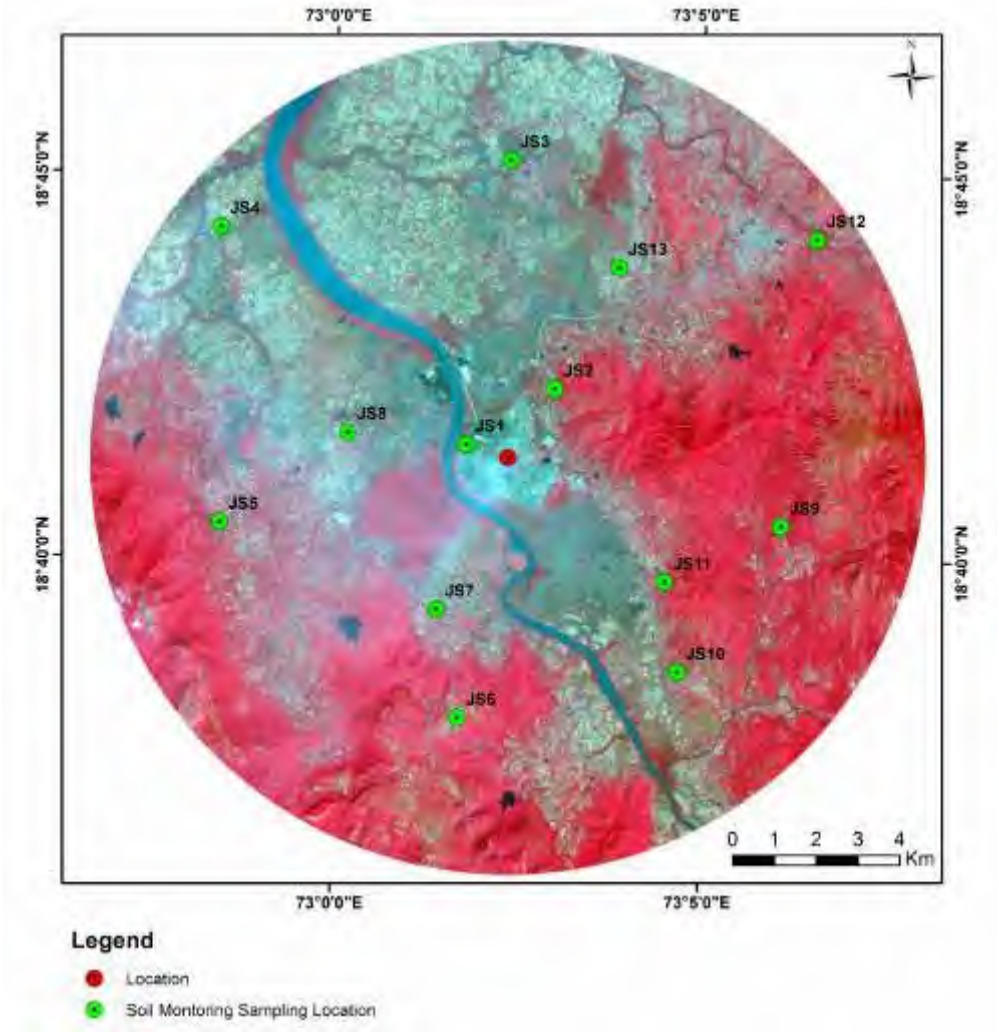


Figure 3.4.1 : Locations of Soil Samples Collected around JSW Steel Plant

Table 3.4.1: Locations of Soil Sample Collected Around the JSW Steel Plant

Sr. No.	Location/ Village	Coordinates		Colour	Soil / sample Type
		North	East		
1	JSW- proposed site	18°41'29.4"	73°01'48.2"	Brown	Barren land
2	Dolvi	18°42'13.3"	73°03'00.1"	Brown	Agri. soil
3	Washi	18°45'11.5"	73°02'22.5"	Blackish	Agri. soil
4	Dherand	18°44'17.6"	72°58'26.1"	Blackish	Agri. soil
5	Waghode	18°40'27.1"	72°58'27.4"	Blackish	Agri. soil
6	Bhomali	18°37'56.2"	73°01'43.0"	Black-brown	Agri. soil
7	Kusumbale	18°39'20.8"	73°01'24.8"	Brown	Agri. soil
8	Shahbaj	18°41'38.2"	73°00'11.6"	Black-brown	Agri. soil
9	Jirne	18°40'27.4"	73°06'05.9"	Brown	Agri. soil
10	Kasu	18°38'33.6"	73°04'42.1"	Black-brown	Agri. soil
11	Kharpale	18°39'43.7"	73°04'31.0"	Black-brown	Agri. soil
12	Pen	18°44'11.5"	73°06'33.4"	Black-brown	Agri. soil
13	Control Sample	18°43'48.3"	73°03'51.6"	Black-brown	Agri. soil

JS-1: JSW- proposed site

JS-2: Village Dolvi

JS-3: Village Washi

JS-4: Village Dherand

JS-5: Village Waghode

JS-6: Village Bhomali

Plate 3.4.1 : Soil Sampling in the Study Area

JS-7: Village Kusumbale

JS-8: Village Shahbaj

JS-9: Village Jirne

JS-10: Village Kasu

JS-11: Village Kharpale

JS-12: Village Pen

Plate 3.4.2 : Soil Sampling in the Study Area

In order to carry out physical and chemical characteristics of soil, the samples were air dried and then passed through a sieve of 2 mm and stored in zip lock bags for further analysis. Heavy metals in the soil were determined by extracting soil with acid mixture per chloric acid and nitric acid (1:2, v/v) and the obtained soil samples were analysed on ICP-OES (Acid Digestion, USEPA Manual 3050b). The chemical characteristics of soil were determined by preparing a saturated extract of soil with

distilled water in 1:2 ratio (as per Jackson procedure, 1967). Organic matter was determined in terms of organic carbon by Walkely & Black method (1972). Fertility status of soil in terms of available nitrogen was determined by the Kjeldahl method, available phosphorus was determined by chlorostannous reduced molybdo phosphorus blue color (Olsen's method, 1954)), and available potassium was determined by flame photometer method (Jackson M. L. 1967). The Hydrometer Method was adopted for determination of particle size analysis. The textural diagram was generated using "SEE soil Class 2.0 version software based on United States Department of Agriculture (USDA) classification of soils. Physical parameters such as bulk density, porosity,and water holding capacity were determined by KR Box Method (Keen and Raczkowski, 1921). Details of Standard methods followed for the analysis of soil samples are given in **Table 3.4.2.**

Table 3.4.2 : Soil Quality Analysis: Standard Methods and Procedures

Sr. No.	Specific Tests or Types of Tests Performed	Specification, Standard (Method), or Technique used	Range of Testing/ Limit of Detection	Measurement Uncertainty
1	pH	IS:2720 (Pt–26)	1-14	8.04 ± 0.04
2	Electrical Conductivity (EC), dS/cm	IS: 14767	0.1–1000	239±33
3	Ammoniacal Nitrogen, kg/ha	IS: 14684	25–1000	136±10
4	Available Phosphorous, kg/ha	Olsen Method	10-1000	17.3±2.2
5	Available Potassium, kg/ha	Ammonium Acetate Method	5-1000	50.1±3.3
6	Organic Carbon, %	IS:2720 (Pt-22) Walky and Black Method	0.1-1.5	0.888±0.4
7	Particle Size Distribution (PSD) A.Total Sand, % B.Silt, % C.Clay, %	IS: 2720 (Pt-4) Hydrometer Method	5-90	A. 57.3±0.35 B. 9.3±0.50 C. 3.4±0.38
8	Bulk Density (BD), gm/cm³	K.R. Box Method	0.7-2.5	1.473±0.15
9	Porosity, %	K.R. Box Method	5-80	52.5±7.2
10	Water Holding Capacity (WHC), %	K.R. Box Method	5-70	35.9±5.9
11	Soluble cations (meq/L)			
	A. Calcium (Ca)	USDA Titrimetric Method		A.26.18±1.26
	B. Magnesium (Mg)			B.6.4±1.06
	C. Sodium (Na)	Flame Photometric Method		C.0.0167±0.071
	D. Potassium (K)			D.0.0692±0.071
	Calcium (Ca)	USDA Titrimetric Method	1-30	
	Magnesium (Mg)			
	Sodium (Na)	Flame Photometric Method		
	Potassium (K)			
12	Cation Exchange Capacity (CEC), meq/100g	IS: 2720 (Pt-24) Ammonium Acetate Method	5-50	34.6±2.49

3.4.1.3 Soil Characteristics

(a) Physical Properties

Physical characteristics of the soil are delineated through specific parameters, viz., particle size distribution, texture, bulk density, porosity and water holding capacity. Air-dried and sieved samples have been used for determination of physical properties of soil. The particle size distribution in terms of percentage of sand, silt, and clay showed the dominance of silt loam, loam and clay in nature (**Table 3.4.3**). The texture of soil in the study area is depicted in **Figure 3.4.2**.

Table 3.4.3 : Textural Class of Soil

Sr. No.	Sampling Location	Particle Size Distribution (%)			Textural Class
		Sand	Clay	Silt	
1	JSW- proposed site	60.17	0.22	39.61	Sandy loam
2	Dolvi	40.72	0.29	58.99	Silt loam
3	Washi	9.36	26.24	64.4	Silt loam
4	Dherand	16.03	26.83	64.4	Silt loam
5	Waghode	32.76	4.63	62.61	Silt loam
6	Bhomali	37.09	3.73	59.18	Silt loam
7	Kusumbale	44.93	0.29	54.78	Silt loam
8	Shahbaj	49.37	0.29	50.34	Silt loam
9	Jirne	39.27	52.54	8.19	Clay
10	Kasu	42.13	24.67	33.2	Loam
11	Kharpale	38.6	17.69	43.71	Loam
12	Pen	42.89	14.72	42.39	Loam
13	Control Sample	11.71	62.49	25.8	Clay

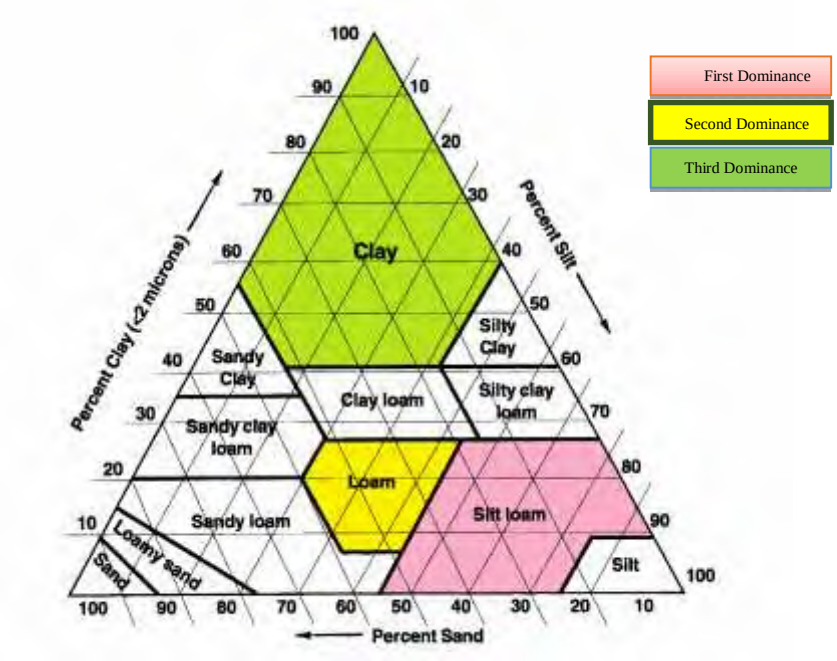


Figure 3.4.2: Soil Texture Class

Bulk Density: Bulk density is an indicator of soil compaction. Regular cultivation practices increase the bulk density of soils thus indicating compaction. This results in a reduction in water percolation rate and penetration of root through the soil. The bulk density was observed to be varying from 1.1–1.6 g/cm³ which is considered to be moderate to high.

Porosity: Soil porosity is a measure of air filled pore spaces and provides information about movement of gases, inherent moisture, and development of root system and strength of the soil. The porosity of soils is in the range of 55.5 -79.5 %.

Water Holding Capacity (WHC): One of the main functions of soil is to store moisture and supply it to plants between rainfalls and irrigations. Evaporation from the soil surface, transpiration by plants and deep percolation combine to reduce soil moisture status between water applications. If the water content becomes too low, plants become stressed. The water holding capacities of soil in the study area was observed in the range of 40.7–61.8 %. Variation in soil Bulk Density, Porosity and Water Holding Capacity (WHC) are presented in **Table 3.4.4.**

Table 3.4.4 : Physical Characteristic of Soil

Sr. No.	Sampling Location	Bulk Density (gm/cm^3)	Porosity %	Water Holding capacity %
1	JSW- proposed site	1.4	55.5	40.7
2	Dolvi	1.4	71.2	59.6
3	Washi	1.4	69.0	53.0
4	Dherand	1.2	66.6	59.2
5	Waghode	1.1	68.7	61.3
6	Bhomali	1.2	73.4	61.8
7	Kusumbale	1.3	61.6	48.9
8	Village Shahbaj	1.4	73.6	55.1
9	Village Jirne	1.4	79.5	61.3
10	Village Kasu	1.3	58.3	46.2
11	Village Kharpale	1.2	69.3	59.8
12	Village Pen	1.6	73.7	59.0
13	Control Sample	1.4	72.3	59.5

(b) Chemical Properties

Data collected for chemical characterization of soils through selected parameters, viz. pH, Electrical Conductivity, Soluble anions and cations, Cation Exchange Capacity (CEC), Exchangeable cations, Exchangeable Sodium Percentage, Nutrients, Organic Carbon and Heavy Metals are reported in **Table 3.4.5 to Table 3.4.10**.

pH is an important parameter which indicative of the alkaline or acidic nature of the soil. The soils are grouped under different soil reaction class viz extremely acidic (pH<4.5), very strongly acidic (pH 4.5-5.0), strongly acidic (pH 5.1-5.5), moderately acidic (pH 5.6-6.0), slightly acidic (pH 6.1-6.5), neutral (pH 6.6-7.3), slightly alkaline (pH 7.4-7.8), moderately alkaline (pH 7.9-8.4), strongly alkaline (pH 8.5-9.0) according to Soil Survey Manual (IARI, 1970). It greatly affects the microbial population as well

as the solubility of metal ions and regulates nutrient availability. Variations in the pH of the soil in the study area was found to be moderately acidic to slightly alkaline (5.8-7.6) in reaction. (**Table 3.4.5**).

Soil electrical conductivity (EC) is a useful indicator in managing agricultural systems. In actuality, the interpretation of EC of soil must be made considering the plant(s) to be grown. In general, an EC range of 0–1 dS/m is low indicates good soil health. A conductivity value 1–2.5 dS/m is medium and result in reduced growth of salt-sensitive plants and disruption of the microbial mediated processes of nitrification and denitrification. A conductivity value >2.51 is high and is poor, unsuitable for many agricultural crops. Electrical conductivity in study area was observed in the range of 0.2-23.3 dS/m.(**Table 3.4.5**)

The soluble salt was determined from soil extract (1:2). The most important cations present in soluble state in the soil are calcium and magnesium (**Table 3.4.5**). It was observed that calcium and magnesium are in the range of 0.2-16.2meq/l and 0.2–50.6meq/l respectively. The sodium and potassium are in the range of 4.6-243.7 meq/l and 0.1-6.1meq/l respectively. Chloride found in range of 2 – 287 meq/l. Ions of carbonates found to be nil whereas bicarbonates ranged in 2.0 – 4.4 meq/l. Sulphate in soil of study area was observed in range of 1.9 to 37.8 meq/l respectively. Salinity of soil ranged in 0.2–15 ppt. Sodium Adsorption Ratio is a widely accepted index for characterizing soil sodicity, which describes the proportion of sodium to calcium and magnesium in soil solution. Based on the concentration of Calcium, Magnesium and Sodium in soil, SAR has been calculated and found in range of 0.6 – 1. (**Table 3.4.6)**.

In general, the soil in the region has very high adsorption capacity as evident from the cations exchange capacity to be in the range of 34.4-67.3 cmol(p+) kg^{-1}. Amongst the exchangeable cations, Ca^{+2} and Mg^{+2} were observed in the range of 4.2-12.6 and 0.4-12.9 cmol (p+) kg^{-1} whereas sodium and potassium are in the range of 0.7-154.7 and 0.1-12.7 cmol(p+) kg^{-1} respectively.

The classification of soil and their relationship between productivity and absorptivity based on cations exchange capacity which indicates moderate to high productivity and very high adsorptivity in the study area (**Tables 3.4.7 and 3.4.8**). Exchangeable Sodium Percentage (ESP) is also an index that characterizes soil sodicity. Exchangeable sodium percentage ranged from 01.1-304.5% indicating that the soil in the study area is non-sodic to sodic in nature.

Table 3.4.5 : Chemical Characteristics of Soil Extract

Sr. No.	Sampling Location	pH (1:2)	EC ds/m	SALppt	Ca	Mg	Na	K	Cl	CO_3^{-2}	HCO_3^-	$SO4^{-2}$	SAR
					meq/l								
1	JSW- proposed site	7.5	2.8	1.6	3.6	1.6	17.4	0.7	22	0	2.8	14.6	1.1
2	Dolvi	6.5	0.4	0.2	2.2	0.8	10.4	0.1	4	0	2.4	7.0	1.5
3	Washi	6.1	23.3	15.0	13	50.6	243.7	6.1	287	0	3.2	37.8	0.9
4	Dherand	7.4	8.3	3.7	5.6	9.8	82.2	2.6	27	0	4.4	17.1	0.6
5	Waghode	7.6	0.2	0.2	0.2	0.8	5.8	1.1	3	0	2.8	2.7	0.8
6	Bhomali	6.6	0.6	0.3	0.4	1	5.5	0.1	4	0	2	3.2	0.7
7	Kusumbale	7.1	0.3	0.2	0.6	1	9.1	0.1	2	0	4	3.0	1.0
8	Shahbaj	6.8	0.8	0.4	1.2	0.8	11.2	0.7	6	0	6	7.3	1.1
9	Jirne	6.0	0.5	0.3	0.8	0.4	7	1.1	4	0	3.6	2.3	0.9
10	Kasu	5.8	0.6	0.3	2	1.2	8.9	1.1	2	0	2	8.2	0.7
11	Kharpale	6.0	0.3	0.2	0.8	0.2	4.6	0.8	3	0	2.4	2.4	0.7
12	Pen	6.2	0.2	0.2	0.4	0.6	9.2	0.1	3	0	3.2	1.9	1.3
13	Control Sample	6.1	15.5	8.9	16.2	25.2	139.5	1.4	129	0	2.8	37.2	0.6

Table 3.4.6 : Cation Exchange Capacity of Soil

Sr. No.	Sampling Location	Ca++	Mg++	Na+	K+	CEC	ESP(%)
		cmole(p^+) kg^{-1}					
1	JSW- proposed site	10.2	1.9	20.7	3.0	34.4	60.2
2	Dolvi	8	4.9	1.0	0.1	50.5	2.0
3	Washi	4.2	12.9	154.7	12.7	50.8	304.5
4	Dherand	7.5	9.2	2.8	0.6	61.6	4.5
5	Waghode	11.6	4.4	0.7	0.1	67.3	1.1
6	Bhomali	9.2	5.3	0.9	0.3	63.8	1.4
7	Kusumbale	11.4	1.8	1.1	0.1	57.8	1.9
8	Shahbaj	12.4	1.3	1.2	0.5	58.9	2.0
9	Jirne	7.6	5.4	0.9	0.1	54.9	1.7
10	Kasu	9.1	0.4	1.3	0.1	45.8	2.8
11	Kharpale	12	1.6	0.9	0.1	56.3	1.6
12	Pen	12.6	1.6	1.0	0.2	49.3	2.0
13	Control Sample	12	5.2	4.9	0.3	48.9	10.1

Table 3.4.7 : Relationship of CEC with Productivity

CEC	Range (cmol (p+) Kg^{-1})	Productivity	Location Sr. Nos.
Very low	<10	Very low	-
Low	10-20	Low	-
Moderate	20-50	Moderate	JSW- proposed site, Kasu, Pen, Control Sample
High	>50	High	Dolvi, Washi, Dherand, Waghode, bhamoli, Kusumbale, Shahabaj, Jirne, Kharpale

Table 3.4.8 : Relationship of CEC with Adsorptivity

CEC	Range (cmol (p+) Kg^{-1})	Adsorptivity	Location Sr. Nos.
Limited or Low	<10	Limited or Low	-
Moderate	10-20	Moderate	-
High	20-30	High	-
Very High	>30	Very High	JSW- proposed site, Kasu, Dolvi, Washi, Dherand, Waghode, bhamoli, Kusumbale, Shahabaj, Jirne, Kasu, Pen, Control Sample

Chemical analysis shows that soil in Washi and Dherand village as well as at control site are of high EC and contain high concentration of soluble cations and anions. It shows high exchangeable sodium percentage and salinity also. Organic carbon, available nitrogen, available phosphorus and available potassium are found to be in the range of 0.1-0.9 %, 63.3-329.1 kg/ha, 17.0-184.0 kg/ha, and 55.1-396.5 kg/ha respectively which shows that the soils are poor to fertile in organic carbon content. The concentration of Available Nitrogen, Available Phosphorous and Available Potassium shows nature of the land is poor to fertile in study area.(**Table 3.4.9**).

Table 3.4.9 : Fertility Status of Soil in Study Area

Sr. No.	Sampling Locations	Organic Carbon (%)	Available N	Available P_2O_5	Available K_2O
			Kg/ha		
1	JSW- proposed site	0.5	88.6	55.3	266.1
2	Dolvi	0.9	63.3	28.4	153.9
3	Washi	0.4	88.0	52.9	118.7
4	Dherand	0.1	75.9	60.4	216.7
5	Waghode	0.7	88.6	41.9	101.0
6	Bhomali	0.3	126.6	38.3	262.0
7	Kusumbale	0.4	98.7	17.0	199.3
8	Shahbaj	0.3	113.9	184.0	396.5
9	Jirne	0.7	329.1	18.6	234.3
10	Kasu	0.3	202.5	49.0	133.2
11	Kharpale	0.1	189.8	148.9	128.7
12	Pen	0.4	50.6	44.2	256.7
13	Control Sample	0.5	288.5	31.2	55.1
Level in poor soil		<0.5	<280	<23	<133
Level of medium Soil		0.5-0.75	280-560	23-57	133-337
Level in fertile soil		>0.75	>560.0	>57.0	>337.0

Heavy Metals: Plants requires some of the metals at microgram levels for their metabolic activities. These heavy metals are also termed as macronutrients. Their efficiency becomes a limiting factor in the plant growth, but at the same time their higher concentration in soil may lead to toxicity. Heavy metals such as Arsenic (As), Cadmium (Cd) Chromium (Cr), Cobalt (Co), Copper (Cu), Iron (Fe), Lead (Pb), Manganese (Mn), Nickel (Ni), Zinc (Zn)and Mercury (Hg) were estimated and their concentrations are presented in **Table 3.4.10.**

Table 3.4.10 : Heavy Metals in Soil

Sr. No.	Location Name	As	Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn	Hg
			mg/kg									µg/kg
1	JSW-proposed site	ND	9.9	39.7	146.9	123.4	29569.4	626.7	80.7	ND	115.6	0.001
2	Dolvi	ND	9.7	39.6	164.0	117.4	29480.3	567.4	83.3	ND	97.9	0.003
3	Washi	ND	10.2	42.2	69.9	97.6	30845.3	741.3	86.6	3.9	105.9	0.005
4	Dherand	ND	9.9	42.0	89.4	92.8	31725.3	1060.4	88.6	3.6	110.7	0.006
5	Waghode	ND	8.8	58.5	221.2	87.4	31135.3	1471.9	194.1	ND	89.2	0.003
6	Bhomali	ND	13.2	69.4	516.3	157.6	29051.0	1335.9	210.3	ND	146.1	0.002
7	Kusumbale	ND	9.9	48.4	177.3	120.7	29235.3	955.6	126.0	1.3	122.2	0.001
8	Shahbaj	ND	9.6	45.0	72.5	165.3	29375.3	919.7	93.7	6.1	141.2	0.004
9	Jirne	ND	2.8	7.9	44.6	6.7	15685.3	140.3	9.6	1.4	19.8	0.002
10	Kasu	ND	7.4	55.7	90.2	141.8	29033.4	1431.5	64.3	6.9	115.8	0.003
11	Kharpale	ND	11.2	52.9	60.1	127.8	30210.3	782.7	70.6	5.1	120.1	0.006
12	Pen	ND	14.9	69.3	218.1	177.3	28,751.8	1667.4	118.5	11.4	143.4	0.004
13	Control Sample	ND	12.1	63.5	72.9	127.1	29335.3	2099.4	98.9	4.4	131.5	0.003

(c) Soil Microbiology

Azotobactor is non-symbiotic nitrogen-fixing microorganisms and improves soil fertility by fixing nitrogen in the soil. Fungi also constitute an important part of the micro-flora of normal soil. They are active in initial stages of decomposition of plant residues and actively participate in the process of soil aggregation. Microorganisms present in soil samples are presented in the **Table 3.4.11**.

Total viable microbial population per gram of soil varied from 2x 10^6 to 26 x 10^6 CFU. Different microflora observed per gram of soil were Fungi (1x $10^5$to 17x 10^6 CFU), Actinomycetes 25 x10^5 to 7 x10^6CFU), Rhizobium (25 x $10^5$to 38 x 10^6 CFU) and Azotobacter (29 x10^5 to 51 x 10^6 CFU).

Table 3.4.11: Microbiological Characteristic of Soil

Sr. No.	Location Name	TVC	Actinomycetes	Fungi	Rhizobium	Azotobacter
		CFU/gm				
1	JSW-proposed site	24x 10^6	61x10^5	16x10^5	25x10^5	6x10^6
2	Dolvi	25x10^6	7x10^6	25x10^5	3x10^6	51x10^5
3	Washi	6x10^6	25x10^5	14x10^5	26x10^5	7x10^6
4	Dherand	26x10^6	4x10^6	1x10^5	42x10^5	29x10^5
5	Waghode	25x10^6	5x10^6	11x10^6	35x10^6	55x10^6
6	Bhomali	15x10^6	61x10^5	7x10^5	37x10^6	52x10^6
7	Kusumbale	5x10^6	6x10^6	15x10^6	38x10^6	59x10^5
8	Shahbaj	17x10^6	62x10^5	12x10^6	41x10^5	68x10^5

Sr. No.	Location Name	TVC	Actinomycetes	Fungi	Rhizobium	Azotobacter
		CFU/gm				
9	Jirne	$19x10^6$	$5x10^6$	$11x10^6$	$28x10^6$	$48x10^5$
10	Kasu	$2x10^6$	$4x10^6$	$15x10^6$	$22x10^6$	$39x10^6$
11	Kharpale	$5x10^6$	$65x10^5$	$13x10^6$	$32x10^6$	$51x10^6$
12	Pen	$6x10^6$	$42x10^5$	$17x10^6$	$24x10^6$	$48x10^6$
13	Control Sample	$4x10^6$	$4x10^6$	$3x10^5$	$21x10^6$	$4x10^6$

TVC: Total Viable Count; CFU: Colony Forming Unit
Source: Primary data collected by CSIR-NEERI team, summer 2019

3.4.2 Land Use / Land Cover using Remote Sensing

Remote sensing technology offers an efficient and timely data to map not only the current land use and land cover (LULC) distribution and pattern, but also to monitor such changes and trends in the LULC over a period of time. Land use refers to "man' activities and various uses which are carried on land. Land cover refers to "natural vegetation, water bodies, rock/soil, artificial cover and other resulting due to transformation" the term land use and land cover is closely related and interchangeable.

The methodology for remote sensing analysis of satellite images comprised of the following:

- æ acquisition of satellite data
- æ collection of Ground truth (GT) and Ground Control Points (GCPs)
- æ pre-processing of data
- æ Image classification
- æ accuracy assessment

For this, the satellite image was procured from National Remote Sensing Center (NRSC), Hyderabad. The metadata of the images are presented in **Table 3.4.12**.

Table 3.4.12 : Details of Satellite Data

Satellite	Sensor	Resolution, m	Date of pass
Resourcesat 2	LISS IV	5.8	21 October 2018

The national LULC classification system was designed as a reconnaissance scheme applicable in Indian environment with varying needs and perspectives. The LULC Classification Scheme is presented in **Annexure-I** as per NRSC/ISRO (2006).

The satellite data from the compact disc is loaded on the hard disk and by visual interpretation (the sampled image of the appropriate area); the sub-scene of the study area is extracted. Indian Remote Sensing images procured from NRSC are already georeferenced and ortho-rectified. The remote sensing analysis is performed

using Erdas Imagine. Study area is considering 10 km buffer from the JSW , Dolvi, (18° 41' 21.79" N and 73° 2' 5.41" E).

a) False Colour Composite (FCC)

Based on the above methodology, pre-processing of the image was carried out in terms of geo-referencing, rectification and preparation of FCC map. The image was subset for required study area of 10 km buffer zones from JSW , Dolvi (18° 41' 21.79" N and 73° 2' 5.41" E).. **Figure 3.4.3** show False Colour Composite (FCC) of the study area JSW , Dolvi for year 2018. The ground truth points collected for accuracy assessment are superimposed over FCC image (2018) of the study area. FCC is combination of near infra-red, red and green spectral bands. This FCC images was further used for remote sensing analysis along with the extensive ground truth survey for precise estimation and assessment of LULC classification. In the FCC image, vegetation appears red, agriculture in pink, built-up in cyan, barren land in light brown, beach in bright white, mangrove in bright red and water body appears black in colour. Attributes such as colour, tone, texture, shape and size are used for visual image interpretation. Based on the visual interpretation of the FCC images, the study area is majorly occupied by Fallow land followed by forest, vegetation, scrub land, mangrove, built up, waterbody, agriculture, mudflats and barren land.

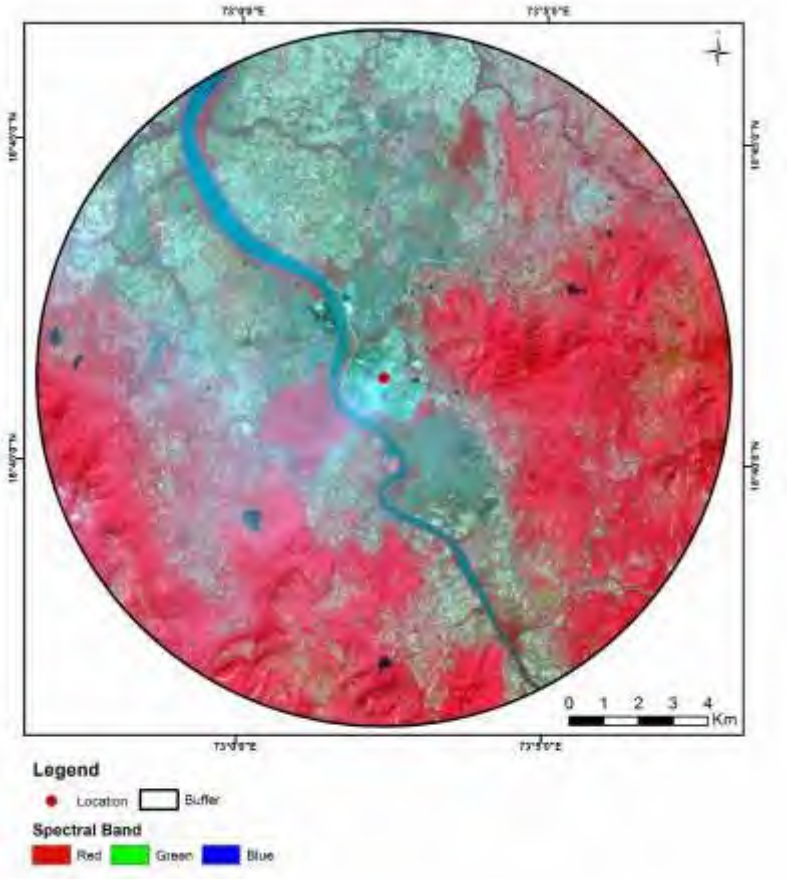


Figure 3.4.3 : False Color Composite (FCC) of the Study Area (JSW, 2018)

b) Supervised classification

Based on the procured satellite data, the supervised classification is performed for satellite imagery of October 2018.The image is classified under the LULC classes of Agriculture, Barren Land, Built-up, Fallow Land, Mangrove, Mud Flats, Vegetation, Scrub land, Forest and Waterbody. The LULC classification map is shown in **Figure 3.4.4.**

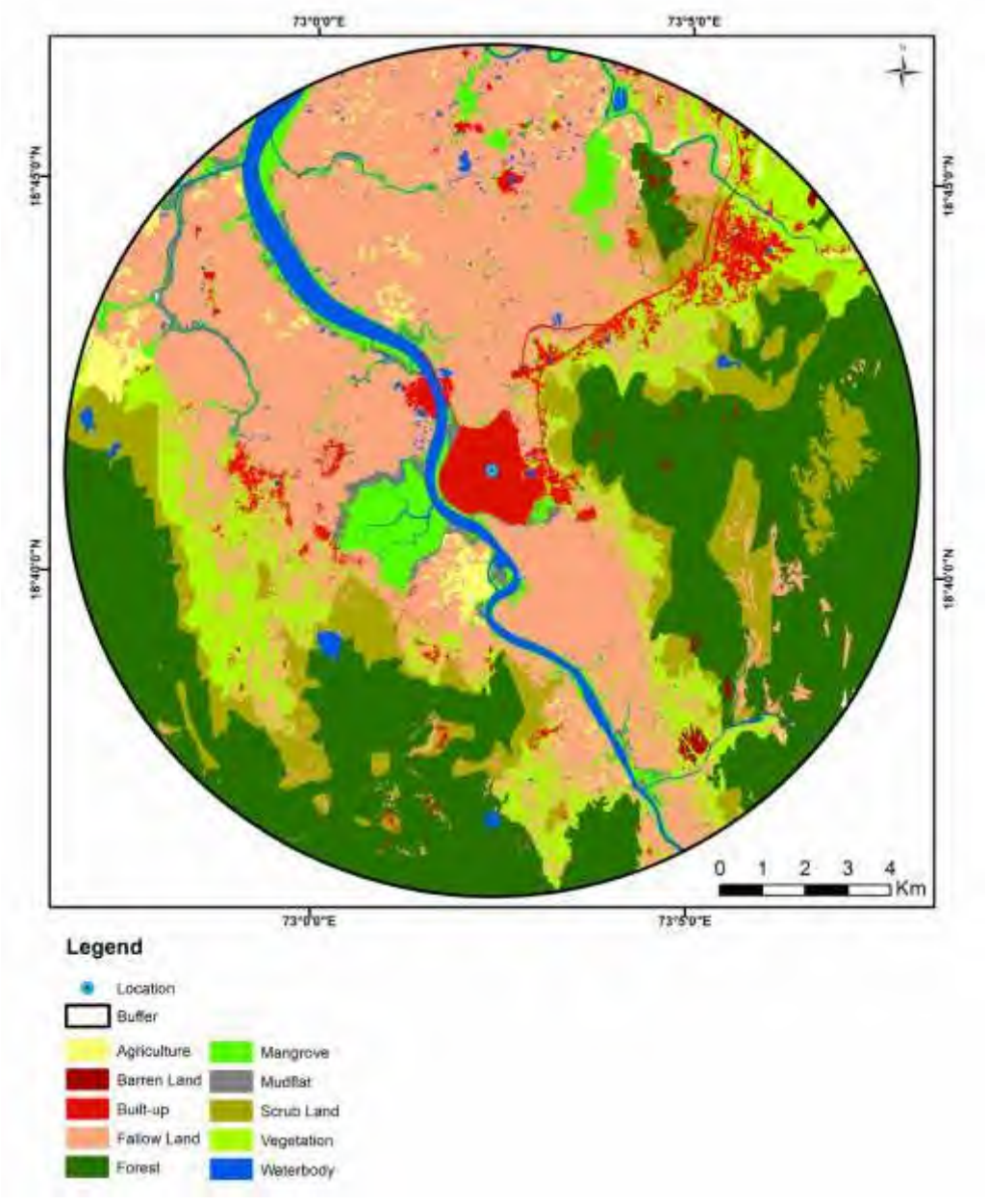


Figure 3.4.4 : LULC Classification of JSW, October 2018

The inventory of LULC in and around JSW, Dolvi is presented in **Table 3.4.13** and graphically represented in **Figure 3.4.5.**

Table 3.4.13 : Inventory of LULC Classes of JSW, Dolvi

Name	Area (sq.km)	Area (%)
Agriculture	5.94	1.89
Barren Land	0.96	0.30
Built-up	12.38	3.94
Fallow Land	113.88	36.27
Forest	91.16	29.03
Mangrove	14.08	4.49
Mudflat	2.29	0.73
Scrub Land	28.60	9.11
Vegetation	33.43	10.65
Waterbody	11.28	3.59

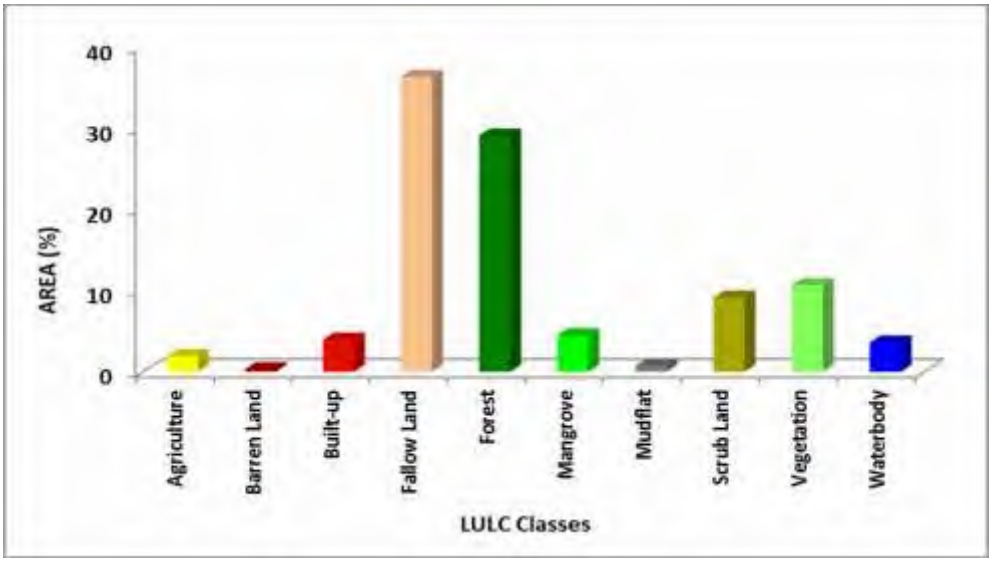


Figure 3.4.5 : Graphical Representation of LULC Inventory of JSW, Dolvi

The total geographical area coming under JSW, Dolvi with 10 km cluster is 314 sq.km. The highest spatial extent of LULC class is observed of fallow land followed by forest, vegetation, scrub land, mangrove, built up, waterbody, agriculture, mudflats and barren land with percentage share of 36.27%, 29.03%, 10.65%, 9.11%, 4.49%, 3.94%, 3.59%, 1.89%, 0.73% and 0.30% respectively.

This above classified images of October 2018 was used for post classification accuracy assessment as current practices of area usage and coverage as recorded during ground truth survey. Based on the spatial extent of classes and variability of distribution across the study area, a suitable sample size of 30 was used for the accuracy assessment. Accordingly, an error matrix was generated to assess the overall accuracy. The overall accuracy of supervised classification is found to be 86.3%.

Annexure-I

Classification scheme as per NRSC/ISRO

Sr. No.	Description-1	Description-2	Classes
1	Built-up	Urban	Residential, Mixed built-up, Public / Semi-Public, Communication, Public utilities/facility, Commercial, Transportation, Reclaimed land, Vegetated Area, Recreational, Industrial, Industrial / Mine dump, Ash / Cooling pond
		Rural	Rural
		Mining	Mine / Quarry, Abandoned Mine Pit, Landfill area
2	Agriculture	Cropland	Kharif, Rabi, Zaid, Two cropped, More than two cropped
		Plantation	Plantation - Agricultural Horticultural, Agro Horticultural
		Fallow	Current and Long Fallow
		Current Shifting cultivation	Current Shifting cultivation
3	Forest	Evergreen / Semi evergreen	Dense / Closed and Open category of Evergreen / Semi evergreen
		Deciduous	Dense / Closed and Open category of Deciduous and Tree Clad Area
		Forest Plantation	Forest Plantation
		Scrub Forest	Scrub Forest, Forest Blank, Current & Abandoned Shifting Cultivation
		Swamp / Mangroves	Dense / Closed & Open Mangrove
4	Grass/ Grazing	Grass/ Grazing	Grassland: Alpine / Sub-Alpine, Temperate / Sub Tropical, Tropical / Desertic
5	Barren/ unculturable /Wastelands	Salt-Affected Land	Slight, Moderate & Strong Salt Affected Land
		Gullied / Ravenous Land	Gullied, Shallow ravine & Deep ravine area
		Scrubland	Dense / Closed and Open category of scrub land
		Sandy area	Desertic, Coastal, Riverine sandy area
		Barren rocky	Barren rocky
		Rann	Rann
6	Wetlands /Water Bodies	Inland Wetland	Inland Natural and Inland Manmade wetland
		Coastal Wetland	Coastal Natural and Coastal Manmade wetland
		River / Stream / canals	Perennial & Dry River/stream and line & unlined canal drain
		Water bodies	Perennial, Dry, Kharif, Rabi & Zaid extent of lake/pond and reservoir and tanks
7	Snow and Glacier	-	Seasonal and Permanent snow

3.4.3 Geological Features of the Study Area

The study area falls under village Dolvi, taluka Pen, Raigad district, Maharashtra. Raigad district is one of the four coastal districts situated along the western coast of the State and is located between north latitude 17°51'00" and 19°08'00" and east longitudes 72°50'00" and 73°40'00". It is bounded by Thane district in the north, Ratnagiri district in the south, Pune district in the east and Arabian Sea forms the western boundary having a length of about 250 km. The district covers an area of 7152 sq. km and has been divided into four revenue division's viz., Alibag, Panvel, Mahad and Mangaon which are further divided into fourteen talukas viz., Alibag, Panvel, Uran, Karjat, Khalapur, Pen, Sudhagad, Mahad, Roha, Mangaon, Poladpur, Mahasala, Shriwardhan and Murud. It has total population of 22, 07,929 with density of 309 persons/sq.km as per 2001 census. The district has 19 towns and 1919 villages out of which 60 villages are un-habitated. Ulhas, Panvel and Patalganga are the three main rivers in northern part. Kundalika River is the main river in central part whereas in the southern part Savitri River is the main river.

As per land use details (2000 – 01) the district has an area of 1486 sq.km occupied by forest. The cultivable area of district is 3286 sq.km whereas net sown area is 1356 sq.km.

The climate of the district is typical of west coast and characterized with plentiful and regular seasonal rainfall, oppressive weather in summer and high humidity throughout the year. The mean minimum temperatures are 17.7°C and mean maximum temperature is 31.8°C. The analysis of long term rainfall data indicates that normal annual rainfall over the district ranges from 2200 mm to more than 3000 mm in the plains and it is above 5000 mm in the hills. The minimum rainfall is in the northwest around Uran (2197 mm) and maximum around Mahad (3360 mm).

3.4.3.1 Geology and Geotectonics

Geologically, the study area including project site and 10 km radial area comprising of Deccan Trap (igneous rock) like basalt Shown in **Figure 3.4.6**. The entire district is covered by basaltic lava flows known as "Deccan Traps" of upper Cretaceous to lower Eocene age. The lava flows were poured out of the long and narrow fissures in the earth's crust and are spread in the form of horizontal sheets. The thickness of the Lava flow is nearly 762 m to 865 m. around Matheran plateau and Raigad fort respectively. The individual flows vary in thickness from few meters to as much as 25 m. or even more.

Megascopically the basalt of the district can be grouped into aphinitic hard and compact basalts and vesicular Amygdaloidal basalts filled with silicates minerals. The Lava flows in the district have been intruded by innumerable dykes especially in the northern part of the district, one ring dyke is also observed at Mahad. The laterite and bauxite are seen on plateau tops in the middle and coastal tracts of Roha, Murud, and Shriwardhan taluka and also in Pen and Matheran. The thickness of laterite varies between few m to 24 m. Patches of alluvium are seen along the banks of the Patalganga, Amba and Kundalika river.The thickness of the coastal alluvium ranges from 3 to 9 m.

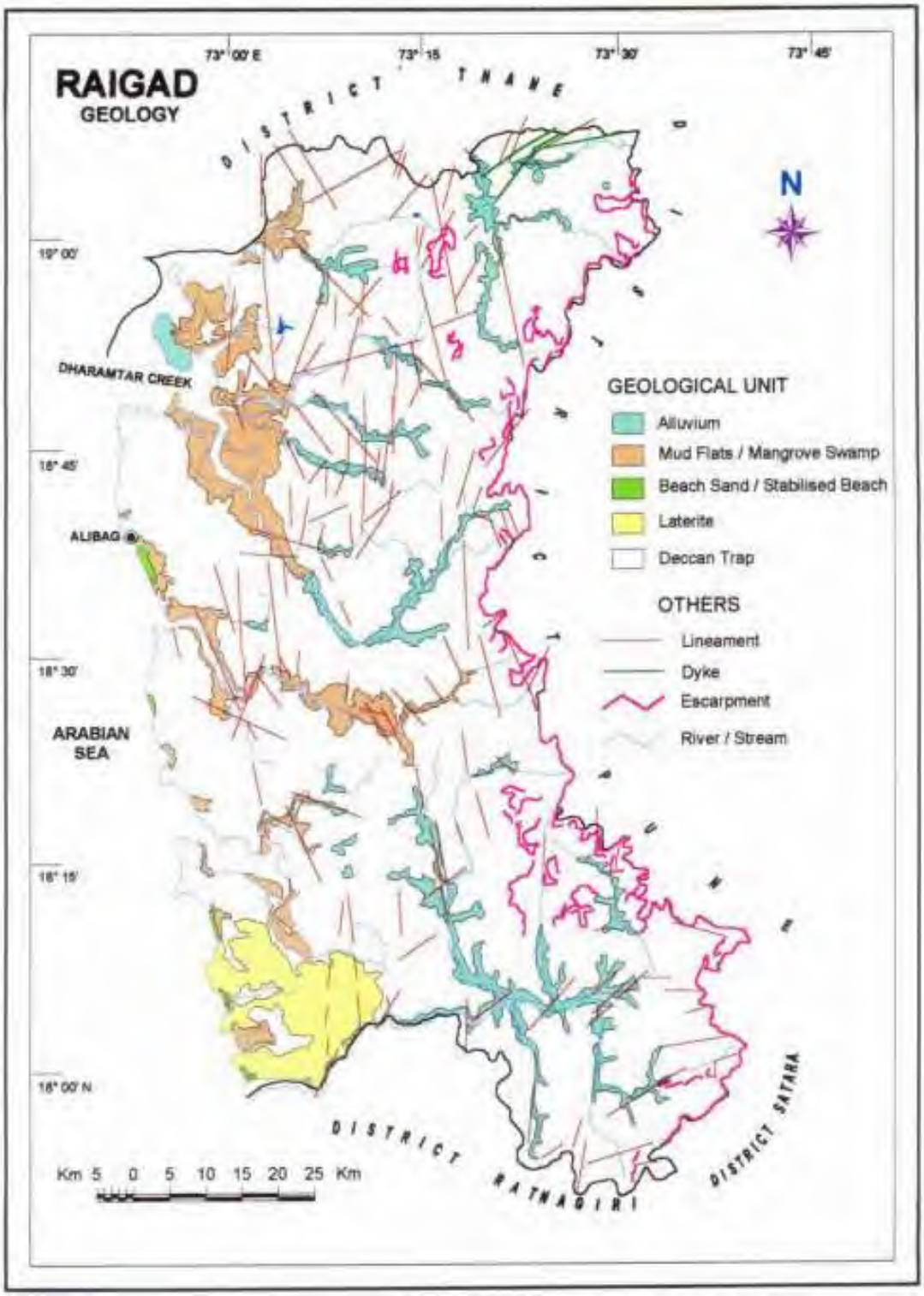


Figure 3.4.6 : Geological Map of Raigad District

Stratigraphic succession of the district is as follows:

Age	Formation	Aerial Extention
Recent	- Reddish coloured porous lateritic formation	- Coastal area of Shriwardhan Murud, Mhasla and part of Pen
	- Yellowish dark brown vesicular and tabular vesicles of Bauxite formation	- Shriwardhan, Part of Panvel near Kalundri river basin
	- Alluvium deposit of fresh water consist of fine sand, silt and clay Coastal alluvium consist of sand, shale, Matrix in calcareous material.	- Coastal parts of Alibag, Murud, Mhasla and Shriwardhan
Lower Eocene to upper creataceous	- The Deccan trap formation consist of hard massive, fine grain, black coloured, jointed and fractured or coarse grain, greyish coloured highly weathered. Vesicular trap rock filled with secondary mineral like silicates, zeolites.	- Almost all over the district

3.4.3.1.1 Lineaments

The entire region in interspersed with a large numbers of lineaments criss-crossing each other. These lineaments show the fractured faulted nature of basaltic rocks along the coast. The lineaments in the coast are not randomly distributed but appear to be grouped in sets. The majority of lineaments along the coastal part area follow a NNE-SSW and a few N-S trends. This substantiates the presence of an N-S trending fault paralleling the coast along the Western Ghats. The lineament patterns are characteristics of vertical uplift. There are also found many SE-NW trending linear, which control the course of some major west flowing rivers like Amba and Kundalika **Figure 3.4.7**. These rivers take a sudden SE-NW turn near the coast

3.4.3.1.2 Physiography

Raigad district forms a part of Maharashtra littoral, the micro level divisions of coastal plain. It is slightly elongated in the north – south direction. Raigad has a long indented coastline. The length of the coastline is about 240 km, with a number of creeks and inlets, suggesting submergence confirmed by the submerged khair forest in Thane creek and Mumbai harbour. Though the districts form an important part of the traditional Konkan Plain‟, ruggedness and uneven topography form the governing theme in its physical features. The Sahyadri (Western Ghats) in the east send several transverse numbers of subsidiary hills westwards denying the plains of a uniform level and continuous character. On the basis of variation in local relief, the district can be classified into six groups i.e. Shown in **Figure 3.4.8**.

Sahyadri Hills, Konkan Forested Hills, Sudhagad Plateau, Ulhas Basin, Kal-Savitri Valley, and Raigad Coast.

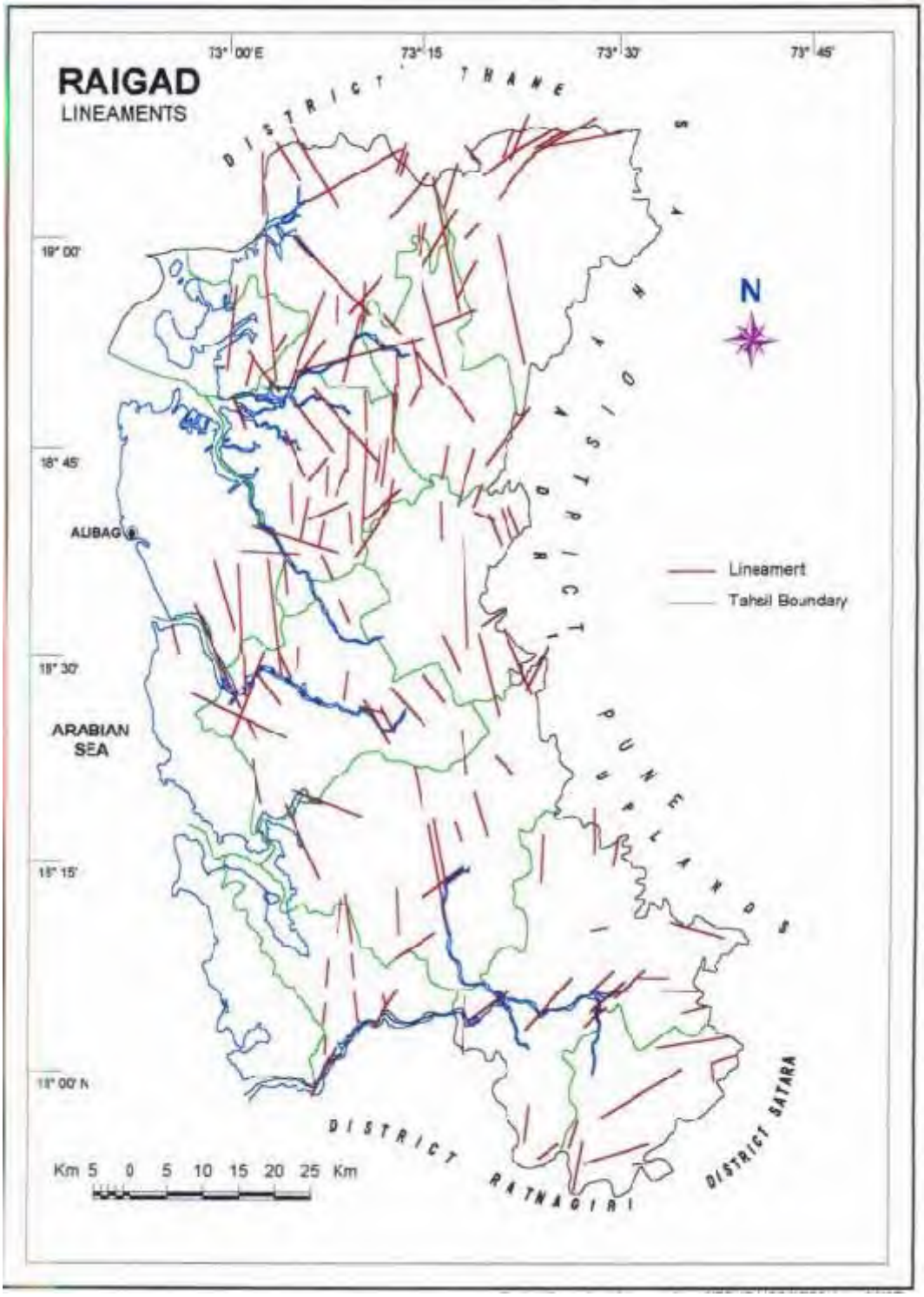


Figure 3.4.7 : Lineament Map of Raigad District

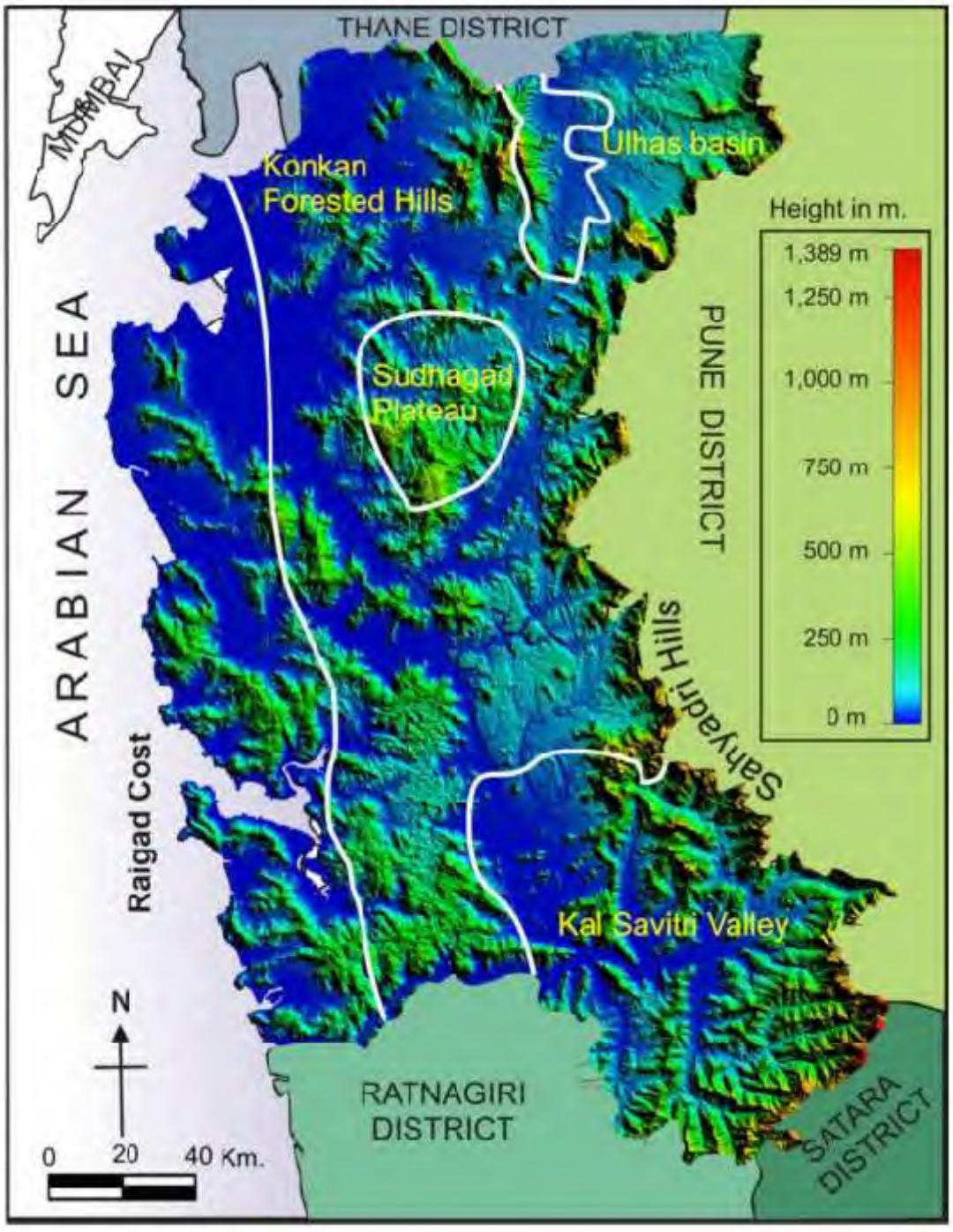


Figure 3.4.8 : Physiography Map of Raigad District

3.4.3.1.3 Sahyadri Hills

The Sahyadri hills are located in the extreme eastern part of the district. This region is a narrow belt comprising of part of Mahad, Poladpur, Karjat, Khalapur, Sudhagad and Mangaon tehsils. Although the Sahyadri forms a long unbroken range, within the district, this region is broken almost in the centre for a distance of about 5 km by the Sudhagad plateau and the Kal- Savitri valley. The hills at bottom have height above 200 meters; up to more than 600 meters at the upper reaches. The region is characterized by having very steep slopes. Pratapgad at 1084 meters is the highest point. Most of the rivers have their source in these hills. The hills are fairly covered with forests which are mainly reserved forest.

3.4.3.1.4 Konkan Forested Hills

The Konkan forested hills are situated at the centre of the district comprising parts of Panvel, Khalapur, Alibag, Pen, Roha, Mangaon, Tala, Murud, Mhasla and Shriwardhan tehsils and a small part of Karjat tehsil. These hills are basically an extension of the Sahyadri hills formed by the offshoots of the Sahyadri, which runs parallel to the drainage pattern of the district. The hill in general attains height above 200 meters. The spot heights of 791 meters at the northern boundary of the district at

During the rainy season, the west flowing rivers erode mountains and deposit rich and fertile soils at the coastal area.

3.4.3.1.5 Sudhagad Plateau

Sudhagad plateau region comprises of a major part of Sudhagad and Khalapur tehsils, and small part of Mangaon and Karjat tehsil. The plateau is sandwiched between the Sahyadri hills in the east and Konkan forested hills in the west and north - west. This plateau is located at a height of about 100 meters, the height 529 meters near Khemwadi and 444 meters near Pali. The slope of the plateau is towards the west. The important rivers are Patalganga, Amba and Kundalika. The soils are shallow and poor but provide better yields of millets and paddy.

3.4.3.1.6 Ulhas Basin

Ulhas basin is located in the north - eastern corner of the district. This region comprises of a part of Karjat tehsil. The slope of this region is towards the north. Ulhas River is the only important river in the region and it flows northwards. The economically important feature is Bhivapuri hydel power station located on Ulhas River at Bhivpuri.

3.4.3.1.7 Kal- Savitri Valley

Kal-Savitri valley is located in the south of the district. It comprises of parts of Mangaon and Mahad tehsils, and small parts of Mhasla and Poladpur tehsils. The Kal and Savitri are the main river systems in this region. The Kal River flows south into the Savitri River, which flows westwards. Coconut and Areca nuts gardening is also practiced in the valley.

3.4.3.1.8 Raigad Coast

Raigad coast is located in the west of the district in a narrow strip, the Raigad coast region comprises of the entire tehsil of Uran, Pen, Alibag, Roha, Murud, Tala, Mhasla and Shriwardhan. Limited forest covers with small pockets of reserved forest occur in the south of Murud and Shriwardhan tehsils. There are a number of creeks along the coast. Mangroves, marshes and tidal flats are common especially in Pen, Uran and Tala tehsils. Coconut and Areca nut are also grown; salt pans have developed in this region along the coast.

3.4.3.2 Topography

The topographic set up of the district is very uneven and rugged. The coast line is characterized by alternative bluffs and curved bays having narrow hinterlands. The central region of the district has many plateau and hills rising from the valleys. The Eastern part of the district is much rugged merging with the Sahyadris which are running North South direction. The eastern horizon is marked by Sahyadri hills. In the western direction with a steep slope dropping from 869 m at Raigad to 3 m. above M.S.L.at Shriwardhan.

3.4.3.3 Drainage

The entire coast is characterized by level coastal plains, which is unlike other level coastal plains of India, uneven and is interspersed with river valleys, creeks and ridges. Rivers or creeks cut across this lowland at an interval of about 8 to 16 km. The district is drained mostly by short westward flowing parallel streams, which originate in the Sahyadri hills in the east and flow into the Arabian Sea. Rivers in the region have reached their base level of erosion within a distance of 20 km. They have their knick points 'along the base of the scarps and have east to west course in general. Streams have NNW-SSE course corresponding to major fracture and joints. The river systems are young and owing to heavy rainfall, they exhibit head ward erosion capability, resulting in river piracy at places. In the lower reaches many of them are tidal in nature. These streams are swift and bring vast quantities of eroded material and deposit in the lowest zone that about the shoreline. Besides the general parallel pattern of the rivers, the tributary pattern tends, at places, to the rectangular suggesting the adaptation of the stream to the local rock structure. All the rivers are tidal for a considerable extent and can be divided into two well-marked sections above and below the limit of the tide. The upper courses are steep and rugged, with torrential waters flowing during the monsoon season. Fording is difficult and often dangerous during the monsoons, but during the dry season they cease to flow and form chains of pools separated by banks of gravel and ridges of rock. Below the tidal limit the bed is muddy, broken by occasional dykes of rock and the creeks wind between banks, which are high in places, but in others banks are so low that they have to be raised to prevent the overflow of the tide. Raigad district has six main drainage systems. In the extreme north lies the Ulhas drainage. An interesting and economically important feature of the Ulhas drainage is that it receives the tail waters of Bhivapuri Hydel System and this regulated flow of water is capable of agricultural and industrial utilization. In the northwest the Panvel creek collects water from a radial pattern of short streams of which the Kalundri is a major stream but others are

very short and seasonal. The Patalganga, Bhogawati and Amba rivers drain mainly Khalapur, Sudhagad and Pen tehsils into the Dharmtar creek. The Patalganga receives the tail waters of Khopoli Hydel Works. The Kundalika or Roha River drains a narrow central belt into the Chaul creek. The Mandad drainage is like an amphitheater closing round the wide estuary at the mouth of which stands the Jangira fort. The southern part of the district is drained by the well-developed system of Savitri. The main tributaries of the Savitri are the Ghod, the Gandhari, the Kal and the Nageshri. The drainage Map of the district is shown in **Figure 3.4.9**.

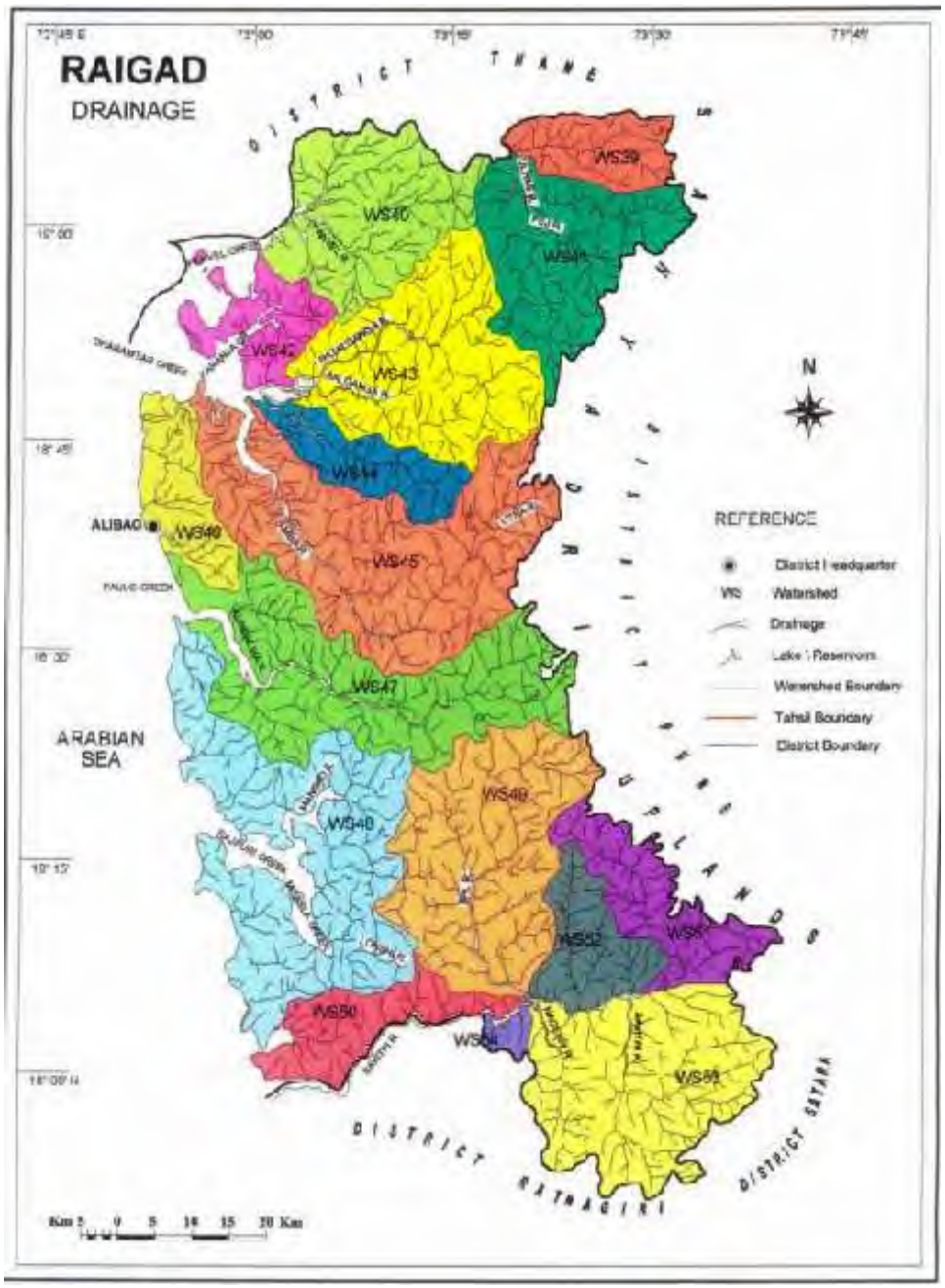


Figure 3.4.9 : Drainage Map of Raigad District

3.4.3.4 Geomorphology

The district has three physiographic divisions i.e. (i) Coastal zone in west covers about 20% percent of the district (ii) Central zone covers about 1/3 rd of the district, consisting of fertile land in low lying area (iii) Hilly zone in the eastern part highly uneven in altitude and covered with forest. This hill range is characterized by ruggedness and uneven topography, with crest line of peaks and saddles forming the eastern horizon. Ulhas, Panvel and Patalganga are the three main rivers in northern part. Kundalika River is the main river in central part whereas in the southern part Savitri River is the main river. The soils in the district are formed from the Deccan Trap which is predominating rock formation with small out crops of Laterite at a few places in the Poladpur taluka and Matheran hill. The soils are grouped as Forest, Varkas, Rice, Khar or Saline, Coastal Alluvium and Laterite as per the location and topographical situation.

3.4.3.5 Hydrogeology

Deccan Trap Basalt of upper Cretaceous to lower Eocene is the major rock formation and intruded by a number of dykes. The western part of the district consisting Basalt flows are altered to Laterite. Recent deposits comprising Beach Sand and Alluvium occur along the coast and in the river mouth; however they do not form potential aquifer.

3.4.3.6 Hard Rock Areas

(a) Deccan Trap - Basalt Ground water in Deccan Trap Basalt occurs mostly in the upper weathered and fractured parts down to 10 – 15 m bgl under unconfined condition. The water bearing strata at deeper depth exists under semi confined to confined conditions. The dug wells in these areas show rapid decline in water level during post monsoon period and practically go dry in peak summer. In foot hill zones the water table is relatively shallower near water course. The yield of dug wells tapping upper phreatic aquifer ranges between 45 to 60 m^3/day, whereas that of Borewells varies from 0.50 to > 20 m^3/hr. depending upon the local hydrogeological conditions, however in most of the Borewells it is up to 5 m/hr.

3.4.3.7 Soft Rock Areas

(a) Beach Sand/Alluvium - The Alluvial deposits are found along the coastal areas in few isolated patches having limited areal extent as Beach Sand and along the course of major rivers. In the alluvial deposits, primary porosity is due to the inter-granular pore spaces making sands and gravels good water bearing formations. The ground water occurs under phreatic/unconfined aquifer at relatively shallow depths of 3-5 m and their yield ranges from about 18 to 43 m/hr.

3.4.3.8 Water Level Scenario

3.4.3.8.1 Depth to Water Level – Pre-monsoon (March - 2019)

Reconnaissance Survey is carried out during March 2019 around Project site and surrounding 10 km radial area. During survey well monitoring data collected from 10 locations **(Plate 3.4.3 & 3.4.4)**.The Pre-monsoon depth to water levels in the study area observed during month of March - 2019 varies from 1.5 m bgl (Pen and

Kasu) to 4.8 m bgl (Kharpale) is shown in **Table 3.4.14**. Pre-monsoon depth to water level map is presented in **Figure 3.4.10**. Pre-monsoon depth to water level map of Study area reveals that in major portion of eastern and central part of the study area water level is occurring between 2.50 to 4.80 m bgl. In South-western and Northern part of the area depth to water level is observed between 1.50 to 2.50 m bgl.

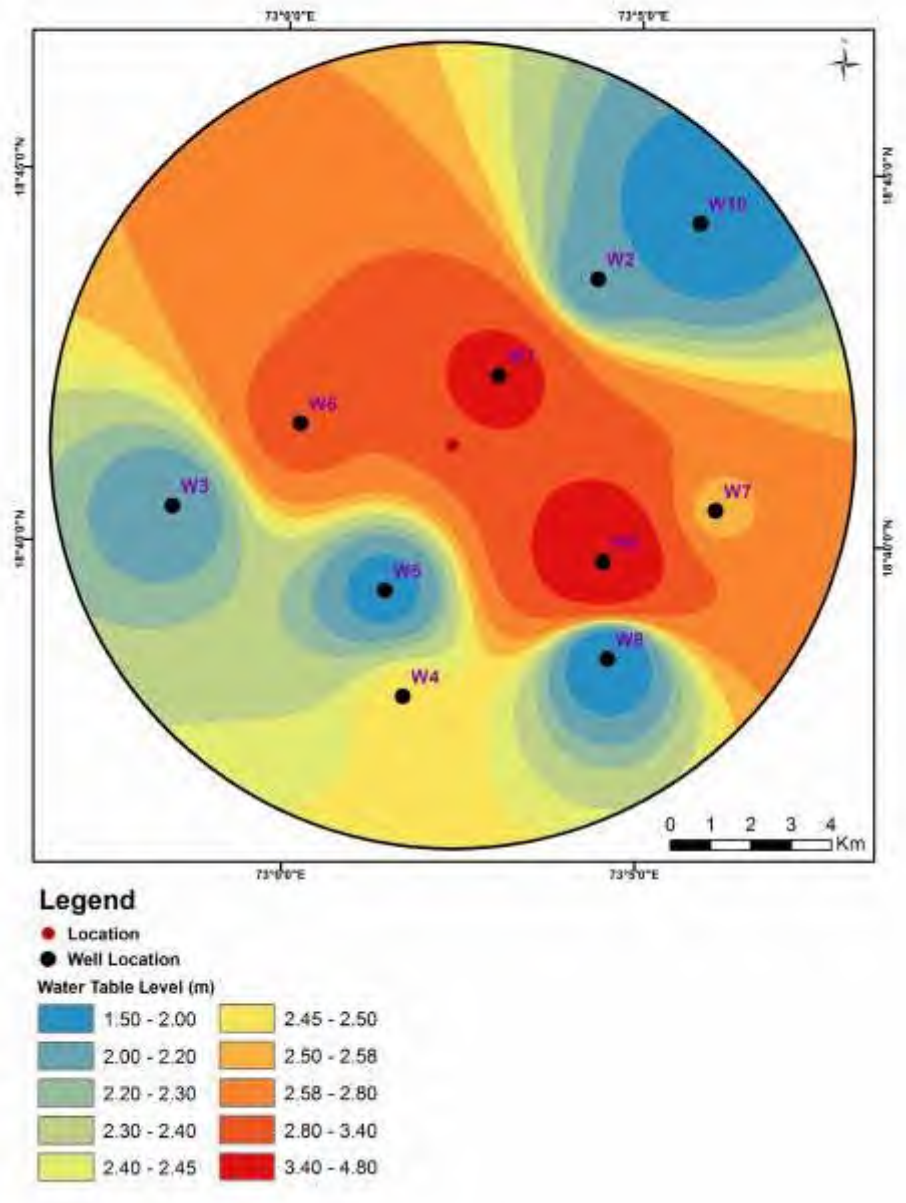


Figure 3.4.10 : Elevation and Location Map of Well Monitoring Water Well (Depth to Water Level Pre monsoon March-2019) of 10 km radial area

Plate 3.4.3 : Reconnaissance Survey Carried out at Project Site including 10 km Radial Area

Plate 3.4.4 : Reconnaissance Survey Carried out at Project Site including 10 km Radial Area

References:

- Ground Water Information booklet of Raigad district Maharashtra (2013), Government of India, Ministry of Water Resources, Central Ground Water Board.
- Raigad District Report Prepared by Groundwater Survey and Development agency, Maharashtra.
- 07_Chapter 2. From Shodhgandha
- 08_ Chapter 2. From Shodhgandha

Table 3.4.14 : Well Monitoring data (March-2019) of the Study Area

Sr. No.	Location	Latitude Sr.	Longitude	Elevation (m)	Water Table (m)	Type of Well	Name of owner	Observation
W 1	Dolvi	10° 42'16.20"N	073 °03'00.90"E	18	3.8	Dug Well	Ganesh Patil	Drinking, Domestic and Agriculture Use
W 2	Vashi naka	18°43'35.00" N	073°04'24.27"E	3	2	Dug Well	Dattatray Kamal Mhatre	Domestic and Agriculture Use
W 3	Waghoda	18 °40'28.60"N	072°58'25.30"E	13	2	Dug Well	Grampanchayat Waghoda	No Use
W 4	Bhomoli	18 °37'56.70"N	073°01'42.30"E	193	2.5	Dug Well	Grampanchayat Bhomoli	Domestic and agriculture Use
W 5	Kusumbade	18 °39'21.90"N	073°01'26.20"E	3	1.8	Dug Well	Grampanchayat Kusumbade	Domestic Use
W6	Shahabaj	18°41'36.00" N	073°00'13.10"E	2	3	Dug Well	Grampanchayat Shahabaj	Domestic Use
W7	Jirne	18°40'29.00"N	073°06'05.90"E	29	2.5	Dug Well	Grampanchayat Jirne	Domestic and Agriculture Use
W8	Kasu	18°38'28.60"N	073°04'35.40"E	1	1.5	Dug Well	Grampanchayat Kasu	Domestic Use
W9	Kharpale	18°39'47.20"N	073°04'31.00"E	16	4.8	Dug Well	Grampanchayat Kharpale	Drinking and Domestic Use
W10	Pen	18°44'20.60"N	073°05'50.40"E	60	1.5	Dug Well	Prakash Murlidhar Chondkar	Domestic use

3.4.4 Solid and Hazardous Wastes

3.4.4.1 Sources of Solid and Hazardous Wastes

Ministry of Steel, Government of India set target of 100% utilisation of solid waste (National Steel Policy 2011). Under Charter on Corporate Responsibility for Environment Protection (CREP), steel plants are required to set mutually agreed targets with the purpose to go beyond the compliance of regulatory norms for waste utilisation. These changes are increasingly applying pressure to minimise waste, encourage waste recycling and demanding waste disposal as landfill to be the last option.

Integrated waste management doesn't consider waste as 'waste', rather view as potential raw materials to be conserved or reused rather than wasted, both for environmental sustainability, social license to operate and bottom line cost saving. Utilizing solid wastes generated in the integrated steel plants, can fetch considerable revenue, mainly with the sale of blast furnace slag to domestic cement industry. The material has been used as replacement to clinker, which provides significant reduction in CO_2 emissions in the manufacture of cement.

The solid and hazardous wastes generated in JSW integrated steel plant, quantities and their utilization in the plant itself are summarized in **Table 3.4.15 and 3.4.16**. JSW integrated steel plant is reducing the generation of wastes significantly and increase the utilisation of solid wastes by adopting waste as input material in the process and enforcing better maintenance of the equipment and controls. Together with existing technologies, new developments provide environmentally and economically sustainable solutions to bring the steel industry ever closer to its goal of zero waste.

Table 3.4.15 : Solid Waste Generated in JSW Steel Plant at Dolvi

Sr. No.	Name of the Plant	Type of the Solid waste	Quantity MT/ Annum	Mode of Disposal
1	Hot Strip Mill Plant	EAF & LF Slag	1108459	Used for Land filling after processing
		GCP, Shop and De- Dusting System dust	187253	Used for Sinter plant
		Filtration Plant Sludge	6948	Used for Sinter making
2	Sponge Iron Plant	Oxides Fines	102321	Used for Sinter plant and Pellet plant
		Process Water Sludge	112033	Used for Sinter plant and Pellet plant
3	Blast Furnace	BF Slag	1190882	100 % used for cement making
		Dust Catcher	26638	Used in Sinter plant
		W. W. T. P. Sludge	5159	Used in Sinter plant
		Coke Fines	259706	Used in Sinter plant
		Oxides Fines	102460	Used in Sinter plant

Sr. No.	Name of the Plant	Type of the Solid waste	Quantity MT/ Annum	Mode of Disposal
		Sinter fines	658142	Used in Sinter & Pellet plant
4	Sinter Plant - I	Sinter Fines	519470	100 % used in Sinter plant
		ESP Dust	1865	100% used in Sinter Plant
5	Sinter Plant - II	Sinter Fines	483975	100 % used in Sinter plant
		ESP Dust	1998	100% used in Sinter Plant
6	Billet Caster & Bar Mill	Scale from Ladle Heating Furnace & Billet Caster	1584	Used in Sinter plant
		Bar Mill Scale	4866	Used in Sinter plant
7	Coke Oven Plant	Coke Breeze	10551	100% reused in Sinter & Pellet
		Coke & Coal Dust	459	100% reused in Coke Oven Plant
8	Pellet Plant	ESP & Bag filter dust from dedusting system	19232	100% Reused in Pellet Process

Table 3.4.16 : Hazardous Waste Details (2018-19)

Sr. No.	Name Of The Plant	Type of the Hazardous waste	Unit	Total	Disposal
1	Hot Strip Mill Plant	Used Oil (Category No. 5.1)	Liters	73800	Sold to M/s Meher Petrochem Pvt. Ltd., vill Hamrapur, Taluka - Wada, Thane
2	Sponge Iron Plant		Liters	18000	
3	Blast Furnace		Liters	22400	
4	1260 TPD Oxygen Plant		Liters	0	
5	Captive Power Plant (55 MW)		Liters	6000	
6	Sinter Plant I		Liters	6000	
7	Sinter Plant - II		Liters	0	
8	Billet Caster & Bar Mill		Liters	0	
9	LCP III		Litres	0	
10	Coke Oven plant	Used Oil (Category No. 5.1)	Liters	8800	
		Impure Sulphur paste (Category No. 34.3)	(MT/Month)	23.72	Disposed to MPCB/CPCB authorised party HWSDF
		Decanter Sludge (Category No. 13.3)	(MT/Month)	72.64	Reused in Coal blending process
11	Pellet Plant	Used Oil (Category No. 5.1)	Liters	0	

3.5 Aquatic Biological Environment

3.5.1 Aquatic Biological

3.5.1.1 Phytoplankton

(a) Sampling Methodology

Phytoplankton were collected by grab sampling method, preserved by adding Lugol's iodine and labelled properly with sampling station, study area, cruise number and date. Simultaneously, coordinates and description of sample location, secchi disk depth, date, time, dissolved oxygen (mg/l), electrical conductivity (mS/cm), pH, salinity (PSU), temperature (°C) and other observations were made(APHA AWWA, 22ndEdtn, 2012).

The preserved samples were further concentrated via batch centrifugation at 3500 rpm for 20 mins and multiple transects of the final one ml of the concentrated sample was analysed microscopically for identification, density and diversity studies. Lackey drop method was used for phytoplankton counting and the density is expressed as No. of phytoplankton/L. To determine community structure, population dynamics and diversity, various indices such as Shannon Weiner Diversity Index, Pielou's Evenness Index, and Species Composition (%) are evaluated **(Annexure)**. The results of number of phytoplankton and species identified are presented in **Tables 3.5.1 and 3.5.2** respectively.

Table 3.5.1 : Density, Diversity, Evenness and Composition of Phytoplankton

Sampling Location	Phytoplankton (No/L)	Composition of Phytoplankton Class (%)				Shannon Weiner Diversity Index	Pielou's Evenness Index
		Cyanophyceae	Chlorophyceae	Bacillariophyceae	Euglenophyceae		
JSW/14	67200	50	25	14	10	0.93	0.55
JSW/15	121800	76	19	2	2	1.15	121800
JSW/16	64400	51	25	16	7	0.97	0.58
JSW/17	64400	70	9	6	15	0.84	0.51

Table 3.5.2 : Distribution Pattern of Phytoplankton

Class	Genus
Cyanophyceae	*Plantothrix sp.*
	Gleocapsa magma
	Arthospyra fusiformis.
	Chondrocystis sp.
	Merismopedia tenuissma
	Aphanothece sp.

Class	Genus
	Chrococcus turgidus
	Cynothece aeruginosa
	Microcystis sp.
Chlorophyceae	*Gloeoactinium sp.*
	Chlorella sp.
	Scendesmus dimorphus
	Scendesmus opaliensis
	Scendesmus bijugatus
	Clymodomonas sp.
	Pediastrum simplex
	Closterium sp.
	Tetrastrum glabrum
	Coelastrum microporum
Bacillariophyceae	*Ankinsterodesmus sp.*
	Nitschia acicularis
	Navicula sp.
	Synedra acus
Euglenophyceae	*Phacus oscillans*
	Euglena sp.

Discussion:

In the present study of Phytoplanktons composition and diversity with respect to Shannon Weiner Diversity Index (SWI) is studied to access the biotic and abiotic relationships of these organisms with its Impact to the water quality. During the study period water samples from 4 sites of surface water were taken in order to check the Planktons composition and diversity. A total of 24 species from 4 families are found during the entire study period. The overall communities of the Phytoplankton's is represented mainly by four groups i.e. Cynophyceae, Chlorophyceae, Bacilleriophyceae and Euglenophyceae. The different genera that are present in different families are Cynophyceae(09) Chlorophyceae (10), Bacilleriophyceae (04) and Euglenophyceae (02).

Nine different genera of Cynophyceae belonging to different species are found during the study period. Species of *plantothrix, Gleocapsa, Arthospyra* are the most abundant species representing the family cynophyceae. The presence of cynophyceae family is seen in almost every sample and thus indicating the condition of water bodies to be moderately polluted. The presence of the second most abundant family which is found to be Chlorophyceae. Ten different species of the family chlorophyceae that belong to ten different genera are found in the water bodies in which Species like *Scendesmus,chlorella,Chlymodomonas* are found abundant during the study period. Four species representing the family Bacilleriophyceae was found in some of the samples including *Nitzchia, Navicula,* etc.The family Euglenophyceae accounted with two species i.e. *Phagus* and *Euglena*. and was the least abundant species family of the total planktons observed.

The Shannon wiener diversity index lies in the range of 0.84 and 1.15 indicating the water moderately polluted. The presence of cynophyceae family is observed the most which also indicates that the water may be slightly polluted. It was obsereved during the field visit and sampling that near these locations there was human interference. Some locations are found to be less polluted and there bacillariophyceae family is observed with other families which are also present in all the sampling locations. (**Table 3.5.2**). The distribution pattern of the phytoplankton families in surface water is shown **(Table 3.5.3) (Plate 3.5.1)** The distribution pattern of the phytoplankton families is shown in the **Figure 3.5.1.**

Table 3.5.3 : Distribution Pattern of Phytoplankton in Surface Water

Class	Genus	JSW/14	JSW/15	JSW/16	JSW/17
Cyanophyceae	*Plantothrix sp.*	+	-	-	+
	Gleocapsa magma	-	+	+	+
	Arthospyra fusiformis.	-	-	+	+
	Chondrocystis sp.	-	-	+	-
	Merismopedia tenuissma	+	-	-	+
	Aphanothece sp.	-	+	+	+
	Chrococcus turgidus	+	+	-	+
	Cynothece aeruginosa	-	+	-	+
	Microcystis sp.	-	-	-	+
Chlorophyceae	*Gloeoactinium sp.*	+	+	+	+
	Chlorella sp.	+	-	-	-
	Scendesmus dimorphus	+	-	+	+
	Scendesmus opaliensis	-	-	+	+
	Scendesmus bijugatus	+	+	-	+
	Clymodomonas sp.	-	+	+	+
	Pediastrum simplex	+	+	-	+
	Closterium sp.	-	-	-	-
	Tetrastrum glabrum	+	-	-	+
	Coelastrum microporum	-	+	+	-
Bacillariophyceae	*Ankinsterodesmus sp.*	-	+	+	-
	Nitschia acicularis	+	-	-	-
	Navicula sp.	-	+	+	+
	Synedra acus	-	-	+	-
Euglenophyceae	*Phacus oscillans*	+	+	-	+
	Euglena sp.	+	-	-	-

		
Phacus oscillans	***Microcystis aeruginosa***	***Plantothrix sp.***
		
Tetraedron lobulatum	***Navicula sp***	***Nitzschia sp.***
		
Scenedesmus dimorphus	***Arthrospira fusiformis***	***Euglena sp.***

Plate 3.5.1 : Phytoplanktons Observed in the Water Samples in the Study Area

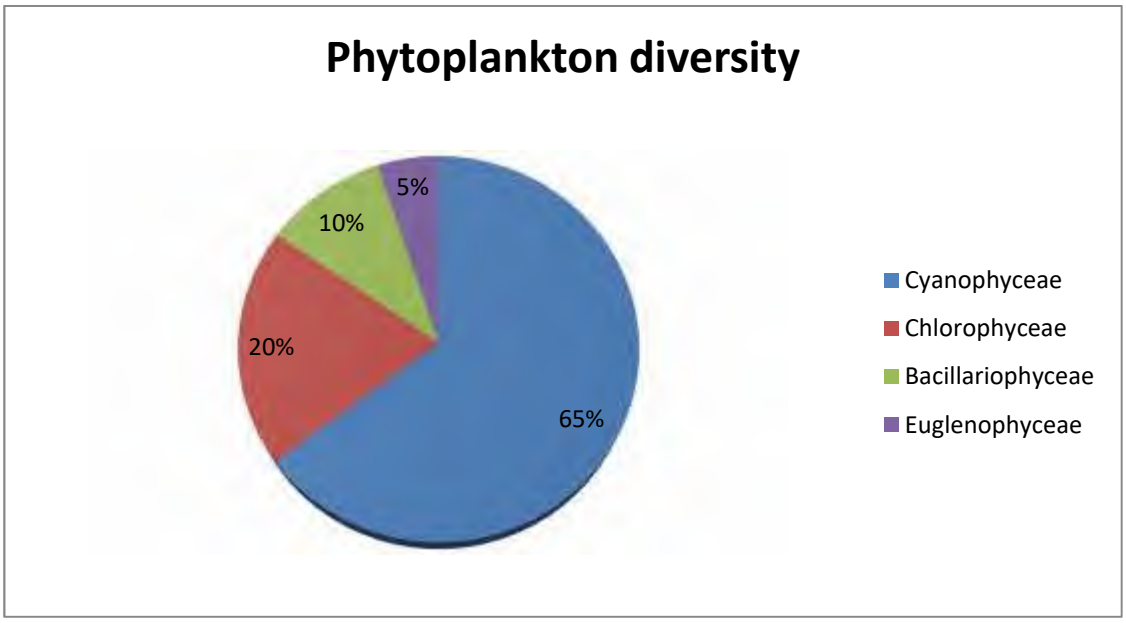


Figure 3.5.1 : Distribution Pattern of Phytoplankton Diversity

3.5.1.2 Zooplankton

(a) Sampling Methodology

The physical nature of the water (standing, flowing, tidal, depth) greatly influences the distribution pattern of plankton. Therefore, zooplankton sampling from surface and depth were carried out. For zooplankton,40 litres of water was filtered through the plankton net with mesh size of 20 µm, the sample retained in the nebula was collected into the sampling bottles labelled with sampling station, study area, and date and was preserved by adding 5% buffered formalin (APHA AWWA, 22ndEdtn, 2012).

Coordinates and description of sample location, depth, date, time, dissolved oxygen (mg/L), electrical conductivity (mS/cm), pH, salinity (PPT), temperature (°C) etc. and other observations were made.

The preserved samples were further concentrated via batch centrifugation at 3500 rpm for 20 mins and the final two ml of the concentrated sample was analysed microscopically using Sedgewick-Rafter (S-R) Cell. Density is expressed as No. of zooplankton/m^3. To determine community structure, population dynamics and diversity; species composition and indices viz. Shannon Weiner Diversity Index, and Pielou's Evenness Index, were used **(Annexure)**.

The potential for biological production in the area was evaluated using quantitative and qualitative data on organism's representative of different genera and species. The phytoplankton counts and zooplankton standing stock population covers the productivity at primary and secondary levels. Zooplankton standing stock and population indicate a wide variation as observed from **Table 3.5.4.** The species diversity is shown in **Table 3.5.5**.

Table. 3.5.4 : Density, Diversity, Evenness and Composition of Zooplankton

Sampling Location	Zooplan-kton (No/L)	Composition of Zhytoplankton Class (%)				Shannon Weiner Diversity Index	Pielou's Evenness Index
		Proto-zoa	Clado-cera	Roti-fera	Copepoda		
JSW/14	28500	10	15	42	31	0.54	0.42
JSW/15	27000	16	-	39	44	0.44	0.35
JSW/16	36000	8	4	46	41	0.52	0.31
JSW/17	40500	15	11	48	26	0.53	0.37

Table 3.5.5 : Distribution Pattern of Zooplankton

Group	Genus
Protozoa	*Filiana sp.*
Cladocera	*Bosmina sp.*
Rotifera	*Keratella tropica*
	Brachionus quadridentatus
	Brachionus calyciflorus
	Brachionus diversicornis
	Brachionus plicatilis
	Brachionus angularis
	Brachionus falcatus
	Brachionus urceolaris
Copepoda	*Mesocyclops leuckarti*
	Nauplius larva
	Cyclops sp.
	Pseudodiaptomus incises

***Ranges of Shannon-Wiener Diversity Index:**
<1: indicate maximum impact of pollution or adverse factor
1-2: indicate medium impact of pollution or adverse factor
>2: indicate minimum impact of pollution or adverse factor

Discussion

Total of 14 species belonging to four different groups Rotifera (8 species), Protozoa (1 species), Cladocera (1 species) ,Copepoda (4 species) are found during the study period.

The group Rotifera represented by 8 species belonging to different genera. Species of, *Keratella* and *Brachionus* is found belonging to this group and is also observed to be the dominant group. The Rotifera group is present in every water sample indicating the slight pollution of water. Cladocera group is represented with one

member viz. *Bosmina* species and is found in water samples were the water was not adversely polluted. Copepoda group is represented with four species *Cyclops, Mesocyclops, Pseudodiaptomus etc.* Copepoda is found in all the water samples. Protozoa group is represented by one member *Filiana* and is present in the water samples and is the least abundant species group of the total planktons observed**. (Table 3.5.5).** The distribution pattern of the zooplankton groups in surface water is shown **(Table 3.5.6).**

Table 3.5.6: Distribution Pattern of Zooplankton in Surface Water

Group	Genus	JSW/14	JSW/15	JSW/16	JSW/17
Protozoa	*Filiana sp.*	-	+	-	+
Cladocera	*Bosmina sp.*	-	+	+	+
Rotifera	*Keratella tropica*	-	-	-	+
	Brachionus quadridentatus	-	+	-	+
	Brachionus calyciflorus	+	+	+	-
	Brachionus diversicornis	-	+	-	-
	Brachionus plicatilis	-	-	+	+
	Brachionus angularis	+	-	-	+
	Brachionus falcatus	+	-	-	+
	Brachionus urceolaris	+	+	+	-
Copepoda	*Mesocyclops leuckarti*	+	+	-	-
	Nauplius larva	-	-	-	+
	Cyclops sp.	-	-	+	+
	Pseudodiaptomus incisus	-	+	+	-

The Shannon wiener diversity index lies in the range of 0.44 and 0.54 indicating the water moderately polluted. The presence of Rotifera and Copepoda groups are observed the most which also indicates that the water may be moderately polluted. Locations are found to be moderately polluted but having the presence of Cladocera group. Protozoa group was mainly abundant in the samples taken from the subsurface. The observed zooplanktons in the study area are shown in **(Plate 3.5.2).** The distribution pattern of the zooplankton families is shown in the **(Figure 3.5.2).**

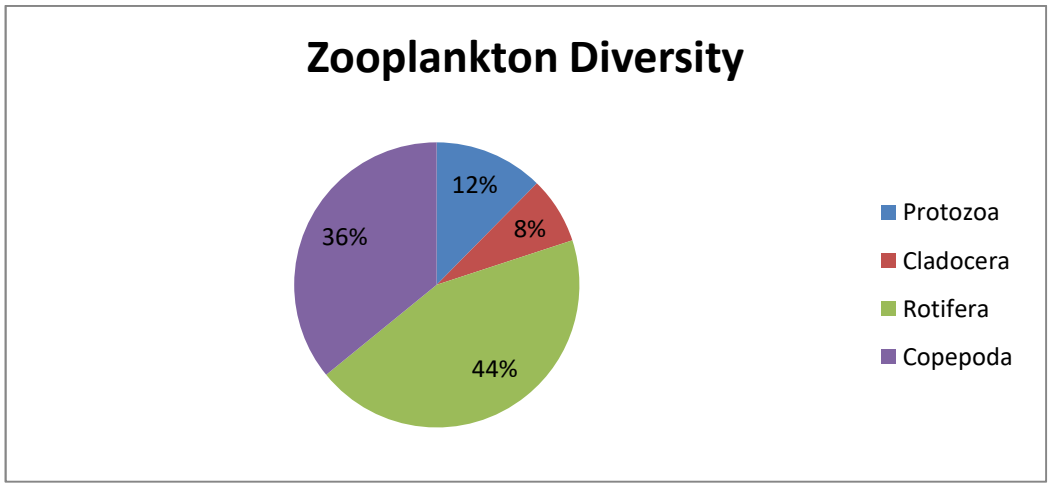


Figure 3.5.2 : Distribution pattern of zooplankton diversity

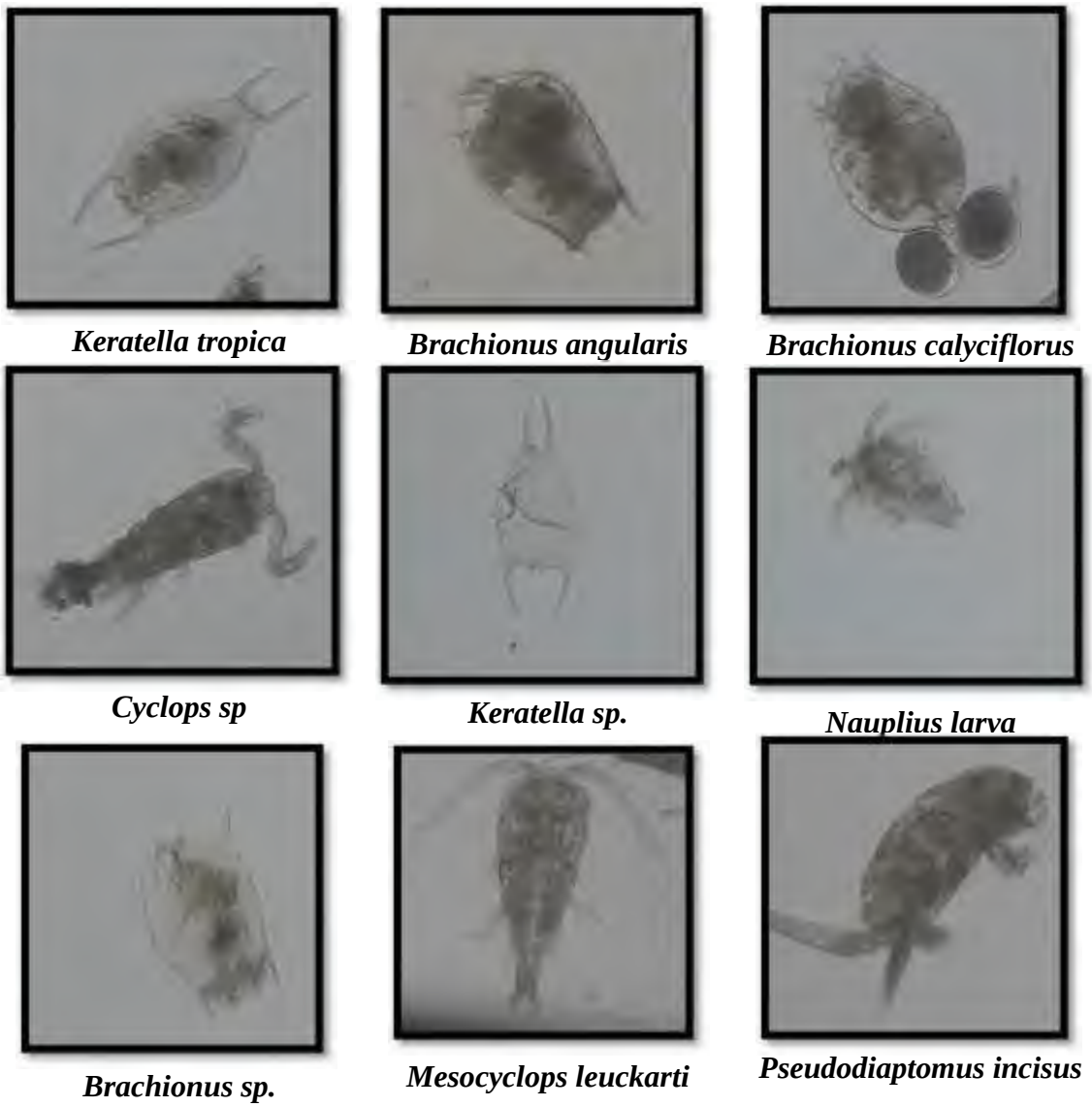


Plate 3.5.2 : Zooplanktons Observed in the Water Samples of the Study Area

3.5.2 Terrestrial Biological Environment

Study of biological environment is one of the most important components for Environmental Impact Assessment, for conservation of environment and biodiversity. The district is bounded by Mumbai Harbour to the northwest, Thana District to the north, Poona District to the east, Ratnagiri district to the south, and the Arabian Sea to the west. It includes the large natural harbour of Pen-Mandwa, which is immediately south of Mumbai harbour, and forming a single landform with it. The study area is blessed with rich biodiversity comprising the amazing Western Ghats which have been classified as one of the ecological hotspot of the planet.

A capacity addition of integrated steel plant and captive power plant is proposed at M/s JSW Steel Ltd., Dolvi works, Dolvi village, Raigad district, Mahrashtra. The proposed project is for the extention of the existing plant. Potential damage to the terrestrial and aquatic flora and fauna due to air emissions, discharge of effluents, noise pollution and change in land use pattern, habitat degradation and fragmentation as well as by anthropogenic activities from the proposed project can be presumed.

Present study was carried out to understand the baseline Ecology and Biodiversity of the study area with special reference to floral & faunal characteristics. The baseline status for biological environment is established by assessing the distribution pattern, community structure, population dynamics and species composition of flora and fauna within 10 km radius of proposed modification at M/s JSW Steel Ltd., Dolvi works ,Dolvi village, Raigad district, Mahrashtra.

3.5.2.1 Objectives

The present study was to establish the baseline biotic environment and also to understand the impact of upcoming activity on Ecology and Biodiversity of 10 km area with following objectives:

- Assessment and inventorization of of baseline of flora and fauna within the study area
- Identification of rare plants of economic importance including medicinal plants and wildlife species in study area
- Identification of measures for protection and conservation of flora (rare and endangered species, medicinal plants) and fauna (wildlife, migratory avi-fauna, reptiles, mammals and insects) etc.
- Secondary data survey followed by primary observations related to mangroves, wildlife, fisheries, forest, agriculture and horticulture activity in the study area
- Delineation of possible impacts and biological stress due to proposed activities on terrestrial biota
- To delineate mitigation measures with effective EMP to reduce the pressures and probable negative impacts on Terrestrial biota

3.5.2.2 Study Area

The study area comprises of the radial distance of 10 km from JSW Steel Ltd., and the study was carried out in and around the proposed project site **(Plate 3.5.3).**

Plate 3.5.3 : Study Area Around JSW Plant

Reconnaissance

The project site is located at Latitude of 18° 41' 29.4 North and Longitude of 73° 01' 48.2" .JSW Steel is a flagship company of the JSW Group.They are one of the leading integrated steel manufacturer. Currently one of the fastest growing companies in India, having presence in over 100 countries. JSW is also the first company to manufacture high-strength and advanced high-end steel products for its automotive segments.

The study area is rich in biodiversity and densely covered with native flora and agricultural crop plants. The forests lie mostly in the hilly region and have diverse floristic composition. The study area is dominated by *Cassia siamea, Peltophorum pterocarpum, Albizzialebbeck, Ficus sp., Acacia auriculiformis, Mangifera indica, pongamia pinnata, Cocus nucifera* etc. Extensive plantation of Coconut, Areca nut, Cashew, Jackfruit and Mango were seen in the study area. Some of the study areas

which are near to the creek are having dense and ample growth of mangroves **(Plate 3.5.4).**

Plate 3.5.4 : Mangroves Observed in the Study Area by CSIR-NEERI Team during April 2019

Sampling Locations

Quantitative assessment was carried out for vegetation around vicinity and nearby village areas within 10 km radius from JSW Steel and same was followed for faunal components too. The study site and the sampling locations were identified during the visit, April 2019 within proposed project site (**Figure 3.5.3**).

Total fifteen locations were indentified for the collection of baseline data comprising ecology and biodiversity of the area and nearby villages within the study site [**Figure 3.5.3** & **Table 3.5.7**]. Selection of sampling locations was made by random sampling technique and with reference to vegetation pattern present in area.

Quadrate samplings were carried out in forest patches and in several villages namely Navenagar, Pen, Jirne, etc., and the same sampling locations were followed for listing of flora and fauna of the study area (**Table 3.5.7**). A total of 10 square plots of 10 × 10 m size were sampled in selected locations. In each plot, the diameter at breast height, canopy cover and height of each individual species were recorded.

Table 3.5.7 : Sampling Locations Around 10 km from JSW Steel, Dolvi, Maharashtra during April, 2019

Sr. No.	Sampling Locations	Latitude	Longitude
1.	Near Dolvi pond	N 18° 41' 46.22"	E 73°3' 14.51"
2.	Karav	N 18° 41' 22.2"	E 73°3' 28.7"
3.	Jirne	N 18^{o} 40’17.3”	E 73^{o} 6’2.6”
4.	Pen	N 18^{o} 43’ 59.57”	E 73° 5' 48.99"
5.	Kalad	N 18^{o} 39’ 4.0”	E 73° 6' 1.4"
6.	Dehenkoni	N 18° 40' 38.4"	E 73° 0' 17.9"

Sr. No.	Sampling Locations	Latitude	Longitude
7.	Khatiwira	N 18° 49' 50.4"	E 73° 1' 19.3"
8.	Navenagar	N 18° 40' 2.8"	E 72° 59' 25.5"
9.	Near Chikli	N 18° 39' 1.4"	E 73° 2' 27.9"
10.	Dalavi Kharoshi	N 18° 38' 27.2"	E 72° 58' 54.2"
11.	Sagargad	N 18° 39' 22.2"	E 72° 58' 22.3"
12.	Near Ambeghar	N 18° 41' 11.6"	E 72° 57' 54.2"
13.	Kopar	N 18° 42' 25.3"	E 72° 57' 42.9"
14.	Near Mankule	N 18°45'19.5"	E 72° 58' 1.9"
15.	Kamarle	N 18°42'52.9"	E 72° 56' 37.8"

Figure 3.5.3 : Sampling Locations in the Study Area within 10 km Radius during April 2019

3.5.2.3 Methodology of Sampling and Data Collection

3.5.2.3.1 Floral Assessment Methodology

The baseline status of environmental quality in the vicinity of project site serves as a basis for identification and prediction of impacts and was assessed by visiting different sampling stations and the dominant plants species were recorded. Several field studies were undertaken in order to gather authentic information on enumeration, quantification and distribution of plant biodiversity in the study region. Quadrate sampling method was carried out around 10 km area of JSW Steel. Primary observations for flora and fauna from study area included different villages covering the patches of forest, agricultural fields, marshy lands, waste lands, grazing lands, and also coastal vegetation.

Quantitative study was carried out to understand the diversity of vegetation present near project site. Based on the individuals recorded in the discrete plot samples, vegetation data were quantitatively analyzed for basal area, relative density, relative frequency, and relative dominance. A measure often used to describe and compare the species dominance of the plots is the Importance Value Index (IVI),(Phillips, 1959). The importance value index of tree species was determined as the sum of relative frequency, relative density, and relative dominance (Curtis and McIntosh 1950). Structural composition was analyzed by comparing the distribution of tree diameter classes. The density measurements reflect as to how many individuals were present, the frequency measurements denote which species is largest in terms of its presence and the dominance measurements indicate how widely species is distributed among the same plots. Importance value index is a reasonable measure to assess the overall significance of a species since it takes into account several properties of the species in the vegetation. Thus, this index is used to determine the overall importance of each species in the community structure.

Quadrate size of 10m x 10m was laid down to determine Frequency, Density, Abundance, Important Value Index (IVI) and species diversity of trees (Misra, 1968; Muller Dombois and Ellenberg H., 1974) that reflects the dominance and distribution of species. While sampling, circumference at breast height (CBH) of tree species was measured at 1m from ground level, along with the name of the species, phenology (flowering, fruiting and flushes), and uses. The identification of the flora within study area was done primarily based on personal observations, authentic secondary literature, and in-depth exploration of the entire area **(Table 3.5.8** and **3.5.12 and 3.5.13).** Total 10 quadrates each of 10m X 10m were laid in the forest aeas and number of trees of different species and their girth, canopy, cover and height were recorded in each quadrate (**Plate 3.5.5**). Using this data, IVI was calculated by using below mentioned formulae.

Quantitative Analysis:

The important quantitative analysis such as Relative density, Relative frequency and Relative dominance of tree species, shrubs and herbs species were determined (Phillips, 1959).

Table 3.5.8 : List of Flora Observed in the Study Area duringApril, 2019

Sr. No.	Botanical Name	Common Name	Local Name	Family
HERBS				
1.	*Alternanthera sessilis*	Sessile Joyweed	Kanchari	Amaranthaceae
2.	*Achyranthes aspera*	Anghedi	Chirchita, Kutri	Amaranthaceae
3.	*Sida acuta*	Common wireweed	Chikana	Malvaceae
4.	*Sida cordifolia*	Kharinta, Barial	Bala	Malvaceae
5.	*Euphorbia hirta*	Asthma-weed	Dudhi	Euphorbiaceae
6.	*Indigofera species*	Heart-Leaf Indigo	Bechka	Fabaceae
7.	*Evolvulus alsinoides*	Dwarf Morning Glory	Vishnukranta	Convolvulaceae
8.	*Evolvulus nummularis*	Roundleaf Bindweed	Nimulwel	Convolvulaceae
9.	*Portulaca oleracea*	Lunia	Ghol	Portulacaceae
10.	*Ageratum conyzoides*	Goat weed	Ghanera osaadi	*Asteraceae*
11.	*Tridax procumbens*	Coat Buttons	Kambarmodi	Asteraceae
12.	*Argemone mexicana*	Mexican Prickly Poppy	Pivla dhotra	Papaveraceae
13.	*Solanum xanthocarpum*	Wild eggplant	Kantakari	Solaneaceae
14.	*Celosia argentea*	Flamingo Feathers	Kurdu	Amaranthaceae
15.	*Spermacoce pusilla*	Safed phooli	Tarakadal	Rubiaceae
16.	*Tephrosia purpurea*	Wild Indigo	Sharpankha	Fabaceae
17.	*Lagascea mollis*	Silk leaf	Jharwad	Asteraceae
18.	*Launaea nudicaulis*	Bold-leaf launaeae	Sagar pathari	Asteraceae
19.	*Phyllanthus virgatus*	Narrow piss weed	Bhuiavali	Euphorbiaceae
20.	*Sopubia delphinifolia*	Common sopubia	Dudhali	Scrophulariaceae
21.	*Cleome viscosa*	Tick weed	Pivala tilavan	Capparidaceae
SHRUBS				
22.	*Calotropis procera*	Rubber Bush	Rui	Asclepiadaceae
23.	*Datura inoxia*	Datura	Dhotra	Solanaceae
24.	*Lantana camara*	Raimuniya	Tantani, Ghaneri	Verbenaceae
25.	*Ricinus communis*	Castor	Erandi	Euphorbiaceae
26.	*Abutulon indicum*	*Indian Mallow*	Petari	Malvaceae
27.	*Abelmoschus ficulneus*	Jangli Bhindi	Kasthoori bhendi	Malvaceae
28.	*Hibiscus panduriformis*	Yellow hibiscus	Van Bhend	Malvaceae
CLIMBERS				
29.	*Ipomea sagittifolia*	Purple heart glory	Amti-vel	Convolvulaceae
30.	*Ipomea triloba*	Little Bell	-	Convolvulaceae
31.	*Ipomea alba*	Moonflower	Gulchandi	Convolvulaceae
32.	*Cucurbita* pepo	Field Pumpkin	Kohala, Bhopli	Cucurbitaceae

Sr. No.	Botanical Name	Common Name	Local Name	Family
33.	*Cucurbita moschata*	Butternut Pumpkin	kala bhopala	Cucurbitaceae
34.	*Ipomea carnea*	Bush Morning Glory	Besharam	Convolvulaceae
35.	*Momordica charantia*	Karela	Karla	Cucurbitaceae
36.	*Cayratia trifolia*	Bush Grape	Ambatvel, Amboshi	Vitaceae
37.	*Cucumis melo*	Wild Melon	Shinde	Cucurbitaceae
38.	*Cucumis maderaspatanus*	Madras pea pumpkin	Bilavi	Cucurbitaceae
39.	*Antigonon leptopus*	Coral vine	Kirmira	Polygonaceae
TREES				
40.	*Acacia nilotica*	Kikar	Babhali	Mimosaceae
41.	*Acacia leucophloea*	White Bark Acacia	Himvar	Mimosaceae
42.	*Albizia lebbeck*	Siris		Fabaceae
43.	*Peltophorum pterocarpum*	Peela Gulmohar	Tambrashimbi	Caesalpiniaceae
44.	*Ficus relegiosa*	Peepal	Pimpal	Moraceae
45.	*Bombax ceiba*	Simar	Kante savar	Bombacaceae
46.	*Bombax malabaricum*	Simar	Shalmali	Bombacaceae
47.	*Butea monosperma*	Palash	Padas	Fabaceae
48.	*Tamarindus indica*	Imli	Chinch	Caesalpiniaceae
49.	*Zizyphus mauritiana*	Ber	Bor	Rhamnaceae
50.	*Delonix regia*	Gulmohar	Gulmohar	Caesalpiniaceae
51.	*Azadirachta indic*a	Neem	Nimb	Meliaceae
52.	*Pongamia pinnata*	Pongam tree	Karanj	Fabaceae
53.	*Alstonia scholaris*	Saptaparni	Satvan	Apocynaceae
54.	*Vachellia nilotica*	Kikar	Babhali	Mimosaceae
55.	*Bamboosa species*	Bans	Bans, Bamboo	Poaceae
56.	*Dalbergia sissoo*	Indian rosewood	Shisham	Fabaceae
57.	*Eucalyptus species*	Nilgiri	Nilgiri	Myrtaceae
58.	*Emblica officinalis*	Amla	Avala	Phyllanthaceae
59.	*Annona squamosa*	Sitaphal	Sitaphal	Annonaceae
60.	*Sesbania species*	Jayanti	Shewarie	Fabaceae
61.	*Artocarpus heterophyllus*	Jackfruit		Moraceae
62.	*Psidium guajava*	Guava		Myrtaceae
63.	*Terminalia catappa*	DesiBadam		Combretaceae
64.	*Sizygium cumini*	Jamun		Myrtaceae
65.	*Tectonagrandis*	Teak		Lamiaceae

Sr. No.	Botanical Name	Common Name	Local Name	Family
66.	*Albizzialebbeck*	Siris		Mimosaceae
67.	*Moringaoleifera*	Drumstick		Moringaceae
68.	*Luceanaleucocephala*	Subabul		Mimosaceae
69.	*Acacia auriculiformis*	Austrian Acacia		Fabaceae
GRASSES				
70.	*Parthenium hysterophorus*	Congress grass	Gajar Gavat	Asteraceae
71.	*Heteropogon contortus*	Spear grass	-	Poaceae
72.	*Pennisetum purpureum*	Elephant grass	Kikuyu	Poaceae
73.	*Setaria viridis*	Green foxtail	-	Poaceae
74.	*Cymbopogon*	Citronella	-	Poaceae

Plate 3.5.5 : Quadrate Sampling in the study area by CSIR-NEERI Team during April 2019

Relative Density (RD):

Density is an expression of the numerical strength of a species in relation to the total number of individuals of each species in all the quadrats and can be calculated as:

$$\text{Density} = \frac{\text{Total number of individual of a species}}{\text{Total number of quadrats studied}}$$

$$\text{Relative Density} = \frac{\text{Density of a species}}{\text{Total density of all species}} \text{ x } 100$$

Relative Frequency (RF):

The degree of dispersion of individual species in an area in relation to the number of all the species occurred and expressed in terms of percentage occurrence.

$$\text{Frequency (\%)} = \frac{\text{Number of quadrats in which species occured}}{\text{Total number of quadrats studied}} \text{ x } 100$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} \text{ x } 100$$

Relative Abundance / Dominance (RA):

With dominance being an expression of the species richness and diversity describing the number of species in an area, these measures are appropriate in assessing the domination of a species in a set of species:

$$\text{Dominance} = \frac{\text{Total basal area of a species}}{\text{Total area sampled}}$$

$$\text{Relative Dominance} = \frac{\text{Dominance of a species}}{\text{Total dominance of all species}} \text{ x } 100$$

Where basal area = πr^2,where r is radius (diameter/2) (Girth of the tree)

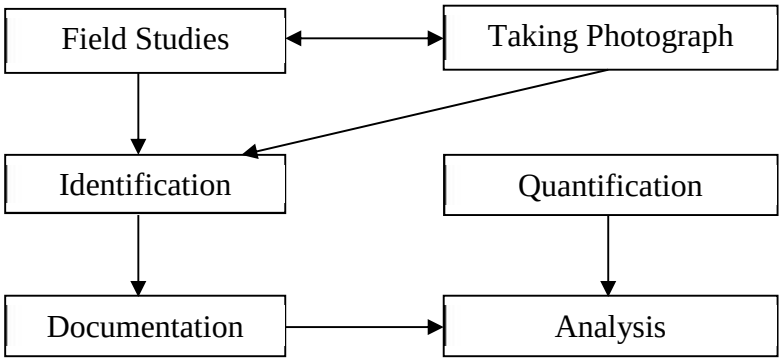
For total basal area of a species = Basal area x total number of that species

IVI= Relative density +Relative Frequency +Relative Dominance

3.5.2.3.2 Faunal Assessment Methodology

The assessment of fauna was carried out with the help of field observations by NEERI team and available secondary data from Alibag Forest Division. Field survey was carried out in the month of April, 2019. The visual observations were followed for vertebrates, insects, amphibians, mammals and birds in a study area. Surveys for avifaunal observation were carried out early in the morning from 06:00 to 10:00 h and in the late afternoon from 04:30 to 06:30 h. By using bird vocal sounds and photographs, the species were identified. Observations were made during a walk

through in the chosen transect for sighting birds and animals. The procedure for data collection in faunal studies in chart form is summerising below:



Results

Flora

(a) Structure and Species Composition of Flora

Phytosociological studies were conducted to assess the composition, diversity, distribution and their status in the nature by taking observations on diverse plant species and their numerical composition at each sampling site, also the phenological aspects of trees, shrubs and herbs were taken into consideration during the study. The forests of the division exhibit rich diversity. Because of their distribution in widely varying conditions of locality and a number of external factors of the ecosystem to which they are subjected, the forest types of the division are diverse and complex. Their immense biodiversity generates a variety of natural resources which helps to sustain livelihoods of both local and urban communities. Trees, apart from forming the major structural and functional basis of forest, are vital as carbon sinks, water sheds, provide shades and homes to many life forms and above all, act as a primary harvester of energy into the ecosystem (Singh, 2002). Tree species diversity and spatial distribution in forest are greatly influence by biogeography, niche requirement and disturbance (Huang et al., 2003).

Natural vegetation prominently consists of trees namely, , *Syzygium cumini, Terminalia paniculata, Machilus macarantha, Cinnamomum spp, Mangifera indica, Terminalia cattapa, Artocarpus heterophyllus, Cassia siamea, Maytenus rothiana, Tectona grandis, Bombax ceiba, Albizia lebbeck, Acacia auriculiformis, Borassus flabeliffer, Ageratum sp., Azadirachta indica, Ficus bengalensis, Ficus hispida, Ficus relegiosa, Alstonia scholaris, Pongamia pinnata* etc. Checklist of dominantly observed floral components in and around different villages within 10 km radius of the proposed project site as observed during primary data survey are reported in **(Table 3.5.8, Plate 3.5.6 and 3.5.7).**

The shrubs were observed in the study area comprises of *Calotropis procera, C. Gigentia, Ixora coccinea, Ziziphus mauritiana, Hyptis sp., Tecoma stans, Hibiscus rosa-sinensis, Ricinus communis, Datura inoxia, Lantana camara, Acalypha hispida, Crinum asiaticum, Jasmine multiflorum, Nerium indicum, Sesamum indicum, Abutulon*

indicum, Abelmoschus ficulneus, etc.**(Table 3.5.8** and **Plate 3.5.4**). Among the herbaceous species, *Mimusa pudica, Alternanthera sessilis, Sida acuta, Achyranthes aspera, Crotalaria pallida, Euphorbia hirta, Cassia tora, Psoralea corylifolia* and variety of grasses were recorded in the study site (**Table 3.5.8)**. The climbers such as *Ipomea ficifolia, Ipomea indica, Ipomea obscura Piper nigrum, , Asparagus racemosus, Jasminum arbrescens,* were observed during site visit.

Argemone mexicana

Calotropis gigantea

***Tridax procumbens* (Coat Buttons)**

Evolvulus alsinoides

Plate 3.5.6 : Herbs Observed in the Study Area by CSIR-NEERI Team during April 2019

***Peltophorum pterocarpum* (Peela Gulmohar)**

***Manilkara zapota* (chickoo)**

***Bamboosa sp*. (Bamboo)**

***Butea monosperma* (Palash)**

Plate 3.5.7 : Trees Observed in the Study Area by CSIR-NEERI Team during April 2019

The favorable climate and edapic factor of Raigad have privileged in experimenting with different type of plantation of plant species. During the primary survey, plantation of *Cocos nucifera*(Coconut), *Alstonia scholaris* (Sapatparni), *Mangifera indica* (Mango), *Artocarpus heterophyllus* (Jackfruit), *Tectona grandis* (Sag), etc. The Avenue plantation comprises of the tree species namely *Albizia lebbeck* (Siris), *Eucalyptus sp.* (Nilgiri), *Delonix regia* (Gulmohar), *Peltophorum pterocarpum* (Yellow Flame), respectively.

Edible plants such as *Manilkara zapota*(Chickoo), *Solanum lycopersicum* (Tomato), *Allium cepa* (Onion), *Emblica officinalis* (Amla), *Mangifera indica*(Mango), *Citrus limon*(Lemon), *Annona squamosal* (Sitaphal), *Murraya koenigii*(Kadipatta), *Solanum melongena* (Brinjal), *Brassica campestris* (Mustard), *Moringa oleifera*(Drumstick), *Piper nigrum*(Black pepper),*Carica papaya* (Papaya), *Cucurbita maxima* (Pumkin) *and Psidium guajava* (Guava) were observed to be manually grown by the villagers in their backyard and also in their agriculture field **(Table 3.5.8** and **Plate 3.5.8)**.

Tomato (*Solanum lycopersicum*)

***Cucurbita* Sp.**

***Solanum sp.* (*Brinjal*)**

***Capsicum sp.* (*Red chilli*)**

Lagenaria sp.

Plate 3.5.8 : Agricultural Crops Observed in the Study Area by CSIR-NEERI Team during April 2019

(b) Diversity of Forest Area

Field visit were undertaken to different localities in and around the proposed study area. To assess plant biodiversity, Quadtrate sampling method was followed, and accordingly, total 20 qaudrates were laid each of 10 × 10 m to determine Frequency, Density, Abundance and Importance Value Index and species diversity of flora reflects the dominance and distribution of species. The importance value index (IVI) for trees and shrubs were calculated by summing the relative frequency, relative density and relative dominance for trees.

A total of 23 tree species belonging to 23 Genera under 12 families were recorded at the study site as per quadrate study. Most of the species belonged to the family Fabaceae (6 species) followed by Anacardiaceae, Moraceae, Myrtaceae (2 species each) wheras, the families namely Lamiaceae, Arecacaeae, Meliaceae, Caesalpiniaceae, Mimosaceae, Combretaceae, Moringaceae and Bombacaceae, have one species each **(Table 3.5.9).**

Table 3.5.9 : Plant Density, Diversity and Important Value Index (IVI) in the Study Area during April 2019

Sr. No.	Botanical Name	Common Name	Family	Relative Density (RD)	Relative Frequency (RF) (%)	Relative Domin-ance (RDo)	Important Value Index (IVI)
1.	*Mangiferaindica*	Mango	Anacardiaceae	13.42	8.47	14.13	36.03
2.	*Ficusbengalensisi*	Bargad	Moraceae	3.36	4.24	19.64	27.23
3.	*Pongamiapinnata*	Karanj	Fabaceae	9.40	6.78	7.18	23.35
4.	*Artocarpusheterophyllus*	Jackfruit	Moraceae	6.04	5.93	8.30	20.28
5.	*Cocosnucifera*	Coconut	Arecaeae	7.38	6.78	5.20	19.36
6.	*Anacardiumoccidentale*	Cashew	Anacardiaceae	6.04	5.08	5.63	16.76
7.	*Azadirachtaindica*	Neem	Meliaceae	5.37	5.08	3.16	13.61
8.	*Bombaxceiba*	Simar	Bombacaceae	4.70	5.08	3.74	13.52
9.	*Thespesiapopulina*	Bhindi	Fabaceae	4.70	5.08	2.62	12.40
10.	*Albizzialebbeck*	Siris	Mimosaceae	4.03	5.08	3.01	12.12
11.	*Tamarindusindica*	Imli	Fabaceae	3.36	4.24	3.77	11.36
12.	*Peltophorumptero carpum*	Yellow flame	Caesalpiniaceae	2.68	3.39	5.23	11.30
13.	*Syzigiumcumini*	Jamun	Myrtaceae	3.36	4.24	3.46	11.05
14.	*Tectonagrandis*	Teak	Lamiaceae	4.70	4.24	0.91	9.85
15.	*Erythrina species*	Pajra	Fabaceae	3.36	4.24	1.96	9.56
16.	*Delonixregia*	Gulmohar	Fabaceae	2.68	3.39	3.15	9.22

Sr. No.	Botanical Name	Common Name	Family	Relative Density (RD)	Relative Frequency (RF) (%)	Relative Domin-ance (RDo)	Important Value Index (IVI)
17.	*Buteamonosperma*	Palash	Fabaceae	2.68	3.39	1.85	7.93
18.	*Luceanaleucocephala*	Subabul	Mimosaceae	3.36	3.39	0.63	7.37
19.	*Acacia auriculiformis*	Austrian Acacia	Fabaceae	2.01	2.54	1.37	5.93
20.	*Shembdi*	Shembdi	-	2.01	2.54	1.31	5.86
21.	*Terminaliacatappa*	DesiBadam	Combretaceae	1.34	1.69	2.40	5.43
22.	*Moringaoleifera*	Drumstick	Moringaceae	2.01	2.54	0.78	5.34
23.	*Eucalyptus grandis*	Nilgiri	Myrtaceae	2.01	2.54	0.58	5.13
Total				**100.00**	**100.00**	**100.00**	**300.00**

The highest relative frequencies were recorded by *Mangifera indica* **(8.47 %)** followed by **6.78%** for *Cocos nucifera and Pongamia pinnata* and **5.93 %** for, *Artocarpus heterophyllus*,; whereas, the lowest relative frequencies of **1.69%** *Terminalia catappa* and 2.54 **%** was observed for *Moringa oleifera*, *Acacia auriculiformis*, *Eucalyptus grandis* etc **(Table 3.5.9** and **Figure 3.5.4)**.

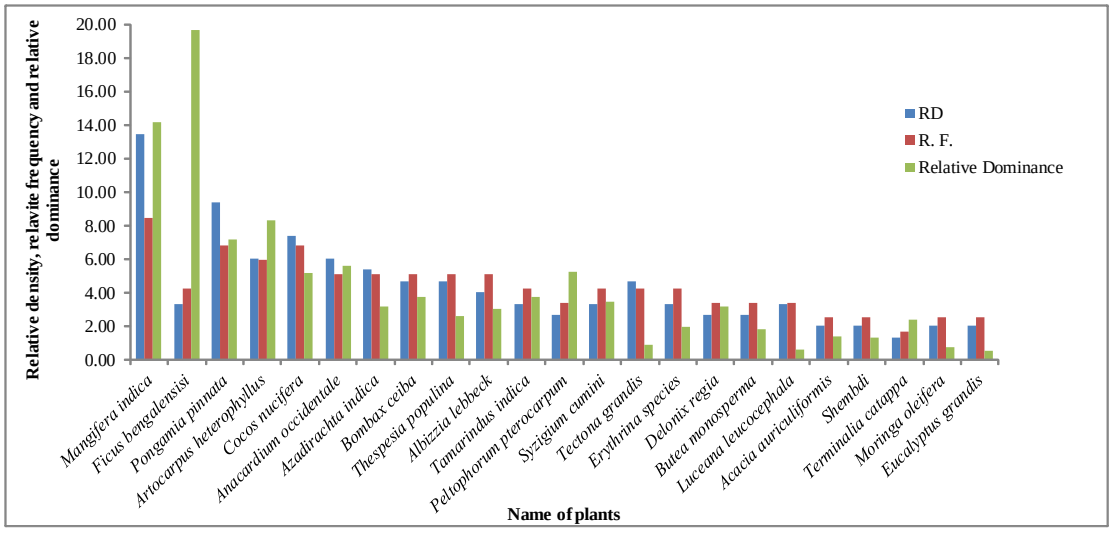


Figure 3.5.4 : Density, Frequency and Dominance of Flora in the Study Area (April, 2019)

The highest relative densities were recorded by *Mangifera indica* (13.42) and *Pongamia* pinnata (9.40), while the lowest was observed for *Terminalia catappa* (1.34). The relative abundance was recorded high in *Ficusbengalensis* (19.64) *Mangifera indica* and (14.13), whereas lowest was observed by *Eucalyptus grandis* (0.58) respectively **(Table 3.5.9 and Figure 3.5.5).**

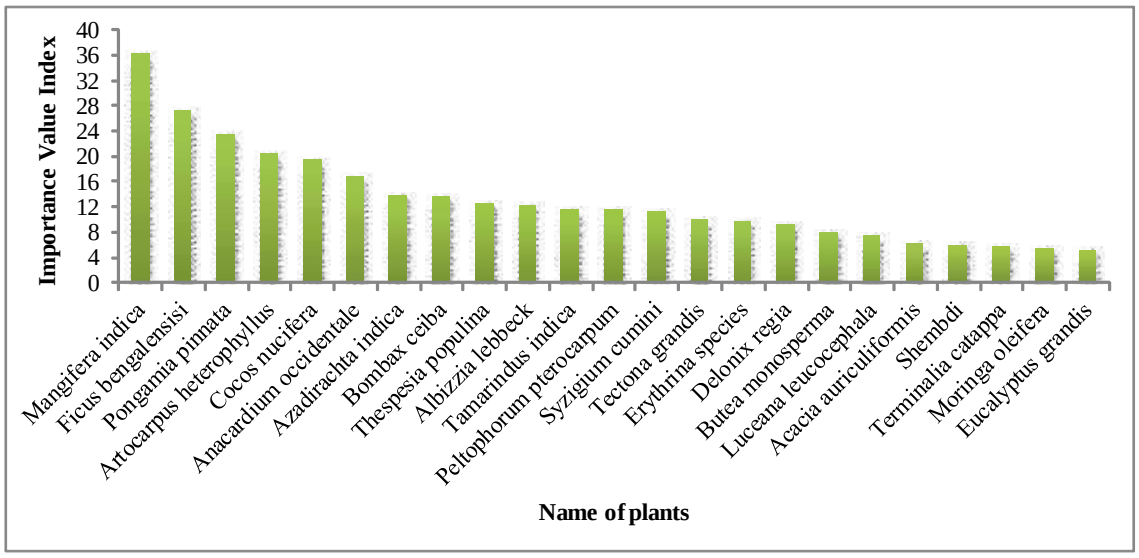


Figure 3.5.5 : Importance Value Index (IVI) of Flora in the Study Area (April, 2019)

The ecological status of a species with respect to the community structure can be obtained only by synthesizing the percentage values of relative frequency, relative density and relative basal area or relative dominance (Phillips, 1959). The Importance Value Index (IVI) of tree species ranged from **5.13 to 36.03** as per quadtrate sampling. *Mangifera indica Ficus bengalensis* and had the highest IVI of 36.03 and 27.23 which was followed by *Pongamia pinnata, Artocarpus heterophyllus, Cocos nucifera, Anacardium occidentale* with IVI of 23.35, 20.28, 19.36 and 16.76, respectively. The highest IVI indicates that these species are dominant and important for this region. However, certain plant species like *Eucalyptus grandis, Moringa oleifera, Terminalia catappa* whose IVI was found to belowest with the values **5.13, 5.34** and **4.43** respectively that signifies these species are moderately dominant and very frequently observed in the study area **(Table 3.5.9** and **Figure 3.5.3)**.

(c) Medicinal Plants in the Study Area

Medicinal plants have been prescribed and used widely for thousands of years to treat various disorders and ailments in traditional herbal medicine systems all over the world and have considerable importance in international trade today. There is an increasing demand for the utilization of medicinal plants for providing primary health care to populations, as they are extensively available and inexpensive. According to the World Health Organization (WHO) about 80 % of the population around the world depends on traditional medicine, mostly herbal remedies, for their primary health care needs.

An ethnobotanical survey was conducted to collect data and document traditional knowledge on the medicinal plants in the study area during April 2019.Being rich in vegetation the area harbors a variety of medicinal and aromatic plants. The information recorded during primary survey included the identification of medicinal plant species, local names. All reported medicinal species in the study site were identified with the help of available literature and by personal observation. The secondary information on medicinal plant collected from Working Plan of AlibagForest

Division, documented the detailed overview on medical use of medicinal plant **(Table 3.5.10).**

The Medicinal & Aromatic vegetation and the grasses in the study area comprised of herbaceous species namely *Ocimum sanctum, Allium cepa, Argemone Mexicana*. Among the shrubs, *Lantana camara, Hibiscus furcatus* while, among the trees, *Eucalyptus sp., Murraya koenigii, Annona squamosa, Aegle marmelos, Alstonia scolaris, Azadirachta indica,* etc. were present in the study area**(Table 3.5.8** and **3.5.10(a & b)).**

Table 3.5.10(a): Details of Plants and Medicinal Plants Occurring in Alibag Forest Division

Sr. No.	Local Name	Botanical Name	Family
1	Gunja	*Abrus precatories*	Fabaceae
2	Khair	*Acacia catechu*	Mimosaceae
3	Chirali,chilar	*Acacia torta*	Mimosaceae
4	Haldu	*Adina cordifolia*	Rubiaceae
5	Bel*	*Aegle marmeloes*	Rutaceae
6	Kinhai	*Albiziz procera*	Mimosaceae
7	Kalmegh,chirait	*Andragraphics paniculata*	Acanthaceae
8	Shatawari	*Asparagus recimosa*	Liliaceae
9	Neem*	*Azadirachta indica*	Meliaceae
10	Danti,dati	*Baliospermum montanum*	Euphorbiacae
11	Moha(flower)	*Bassica latifolia*	Sapotaceae
12	Aapta	*Bauhinia racemosa*	Casealpiniaceae
13	Sawar	*Bombox insigne*	Bombacaceae
14	Salai	*Boswllia serrata*	Burseraceae
15	Asan	*Bridelia retusa*	Euphorbiacae
16	Tabor charoli	*Buchanania lanzen*	Anacardiaceae
17	Palas*	*Butea monosperma*	Fabaceae
18	Palaswel*	*Butea superba*	Fabaceae
19	Ukshi	*Calycopteris floribunda*	Combrataceae
20	Wagoti	*Capparis zeylanica*	Capparidaceae
21	Kumbhi	*Careya arborea*	Lecythidaceae
22	Karwanda*	*Carissa carandas*	Apocynaceae
23	Bhokada	*Casearia graveolens*	Flacourtiaceae
24	Chaksoo	*Cassia absus*	Caesalpiniaceae
25	Senna,sonamukhi	*Cassia angustifolia*	Caesalpiniaceae
26	Bahawa	*Cassia fistula*	Caesalpinaceae
27	Takla/tarota	*Cassia tora*	Caesalpiniaceae
28	Takala	*Cassine glauca*	Celasttraceae
29	Kombadtura	*Celosia argentea*	Amaranthaceae
30	Safed musli	*Chlorophytum tuberosum*	Liliaceae
31	Raktarohinda	*Chukrassia tabularis*	Meliaceae
32	Kachni	*Cichorium intybus*	Asteraceae

Sr. No.	Local Name	Botanical Name	Family
33	Wasanwel	*Cocculus hirsutus*	Menispermaceae
34	Joomgoli	*Cocculus hirsutus*	Menispermaceae
35	Bakulwel*	*Combretum ovalifolium*	Combrataceae
36	Gugal	*Coomiphora mukul*	Burseraceae
37	Bhokrun,bhokar	*Cordial dichotoma*	Cordiaceae
38	Peva	*Costus speciosus*	zinziberaceae
39	Jamal gota	*Croton tiglium*	Eyphorbiaceae
40	Gauriche hat	*Curcuma montanna*	zinzinberaceae
41	Bandgul	*Dendrophthoe fulcata*	loranthaceae
42	karwel,karmal	*Dillenia pentagyna*	Dilleniaceae
43	Kadukand	*Dioscorea bulbifera*	dioscoriaceae
44	Tembhurni	*Diospyros melanoxylon*	Ebenaceae
45	Medshing	*Dolichondrone falcate*	bignoniaceae
46	Aaeala	*Emblica officiaelis*	Euphorbiaceae
47	Paringa	*Erythrina stricta*	Fabaceae
48	Mendhkut	*Euphorbia nerifolia*	euphorbiaceae
49	Kajli	*Excoecaria agallocha*	myrcinaceae
50	Wad*	*Ficus bengalensis*	Moraceae
51	Umber	*Ficus glomarata*	Moraceae
52	Gandya umber	*Ficus hispida*	Moraceae
53	Pimpal	*Ficus religiosa*	Moraceae
54	Khawas	*Firmiana coeolata*	Steraculiaceae
55	Kokam	*Garcinia indica*	cluciaceae
56	Dikamali	*Gardenia resinifera*	rubiaceae
57	Kakad	*Garuga pinnata*	Bursaraceae
58	Shivan	*Gmelina aeborea*	verbinaceae
59	Gudmar,bedaki	*Gymnema sylvestre*	asclepiadacea
60	Kewan	*Helicteres isora*	Sterculiaceae
61	Murud sheng	*Helictrus isora*	Sterculceae
62	Anantmul	*Hemidimus inducus*	Asclepiadaceae
63	Waras	*Heterophragma ruardriloculare*e	Malvaceae
64	Ran bhendi*	*Hibiscus furcatus*	Acanthaceae
65	Gokshur,thlimkhana	*Hoigrophila spinosa*	Apocynaceae
66	Kuda	*Holarrhea antidysenterica*	Urticaceae
67	Papdi,wala	*Holoptelea integrifolia*	Apiaceae
68	Bramhi	*Hydrocotyle asaitica*	Balasaminaceae
69	Terda	*Impatiens balasamin*	Rubiaceae
70	Hardwickia binnata	*Ixora brachiate*	Oleaceae
71	Kusarwel	*Jsminum malabaricum*	Lythraceae
72	Nana	*Lagestroemia microcapra*	Lythraceae
73	Heena	*Lawsonia inerrnis*	Luraaceae
74	Gadbhej	*Listea sebifeza*	Sapotaceae

Sr. No.	Local Name	Botanical Name	Family
75	Moha	*Madhuca longifolia*	Euphorbiaceae
76	Shendri	*Mallotus philipinensis*	Anacardiaceae
77	Amba*	*Mangifera indica*	Rubiaceae
78	Aalva,aalu	*Meyna spinosa*	Tiliaceae
79	Shatal	*Microcos paniculata*	Annonaceae
80	Humb	*Miliusa tomentosa*	Rubiaceae
81	Kalamb	*Mitragyna parviflora*	Cucurbitaceae
82	Kartoli	*Momordica dioica*	Rubiaceae
83	Ukshi	*Morinda tinctoria*	Moringaceae
84	Shevga	*Moringa pterygosperma*	Bignoniaceae
85	Tulas*	*Ocimum sanctum*	Bignoniaceae
86	Dagadphool	*Permelia peblata*	paemeriaceae
87	Tetu	*Oroxytum indicum*	bignoniaceae
88	Bhui awala	*Phyllanthus frateznus*	Euphorbiaceae
89	Lendi pimpali	*Piper longum*	Piperaceae
90	Barachi	*Psorelia caryfolia*	Fabaceae
91	Bija ,bible	*Ptetocaprus marsupium*	Fabaceae
92	Tajawi	*Putranjiva roxburgii*	Euphorbiaceae
93	Sarpgandha	*Rauvolfia sezpentina*	Apocynaceae
94	Ringani	*Sapindus laurifolius*	Sapindaceae
95	Kusum	*Schleichera oleosa*	Sapindaceae
96	Bible	*Semicarpus anacardium*	Anacardiaceae
97	Shevri	*Sesbania aegyptiaca*	Fabaceae
98	Bala	*Sida cardifolia*	Malvaceae
99	Ghotwel	*Smilax zeylanica*	Smilacaeae
100	Gorakhmundi	*Sphaeranthus indicus*	Asteraceae
101	Narakya	*Sterculia foetida*	Sterculceae
102	Kokeri	*Sterculia guttata*	Sterculiaceae
103	Jambhool*	*Syzygium cumini*	Myrtaceae
104	Sag	*Tectona grandis*	Verbennaceae
105	Hirda	*Ternalia chebula*	Combretaceae
106	Ghol	*Terma orientals*	Ulmaceae
107	Arjun	*Terminalia arjuna*	Combrataceae
108	Behada	*Terminalia belerica*	Combrataceae
109	Gulwel	*Tinospora cardifolia*	Menispermaceae
110	Petari	*Trewia nudiflora*	Euphorbiaceae
111	Nirgudi	*Vitex negando*	Verbinaaceae
112	Ashwagandha	*Withania somnifera*	Solanaceae
113	Dhawriphol	*Woodfordia flribunda*	Lythraceae
114	Indrajaw	*Wrightia tinctoria*	Apocynaceae
115	Toran	*Ziziphus ugosa*	Rhamnaceae

Source: Working plan of Alibag Forest Division
*: Observed by CSIR-NEERI Team during site visit

Table 3.5.10(b) : Details of Grasses Occurring in Alibag Forest Division

Sr. No.	Name of species	Botanical name of the species
1	Ber*	*Ischaemum rugossus*
2	Bhale kausal	*Andropogon triticus*
3	Bhaongrut(phulera,phul)	*Anthistriria ciliate(syn.therneda quadrivalvis)*
4	Bhuri	*Aristida paniculata*
5	Boru	*Andropogon halepensis*
6	Chirka	*Eragrostis tremula*
7	Dongari gavat	*Andropogon monticola*
8	Ghanya ,marvel	*Andropogon pertusus*
9	Gondval	*Andropogon pumilis*
10	Harali(durva)*	*Cynodon dectylon*
11	Kunda	*Ischaemum pilosum*
12	Kother	*Woodrowia diandra*
13	Kusali	*contortus(syn.H etropogon contotus)*
14	Lavhala	*Rottboollia perforate*
15	Marvel	*Andropogon annulatus(syn dichanthium annulatum)*
16	Pavnya	*Ischaemum sulcatum*
17	Phool	*Themeda triandra*
18	Rosha	*Andropogon schoenanthus*
19	Sheda	*Ischaemum laxum*

Source: Working plan of Alibag Forest Division
*: Observed by CSIR-NEERI Team during site visit

(d) Agroforestry or Social Forestry

Agriculture in Dolvi is recessive as there is land fragmentation and traditional way of farming. The agroforestry is prominent in the study area in the form of cash crops viz. *Cocos nucifera* (Coconut), *Carica papaya* (Papaya), *Manilkara zapota* (Chickoo), *Mangifera indica* (Mango), etc. **[Table 3.5.8, 3.5.11 (a) (b) & (c)].**

During primary data collection, *Allium cepa* (Onion), *Capsicum annuum* (Chili), *Spinaciaoleracea* (Spinach), *Piper nigrum* (Black pepper), *Cucurbita maxima* (Pumkin) *Cucurbita sp*.(Bottle gourd), *etc.* were seen in agriculture field and also in their backyard. Some plants like *Ziziphus jujube* (Ber), *Cinnamomum tamala* (Tejpatta), *Tamarindus indica* (Imli), *Emblica officinalis* (Amla) and *Averrhoa bilimbi* (Bilimbi/ Bimal) were recorded in village area and in wild habitat (**Table 3.5.8, Plate 3.5.7** and **3.5.8**). The ornamental plants include *Tagetespatula* (Marigold), *Tageteserecta, Rosa sinensis* (Rose), *Jasminum sambac* (Jasmine), *Cestrum nocturnum* (Ratrani), etc were recorded from study area.

Social plantations around industrial areas include various ornamental plants like *Nerium indicum, Polyalthia longifolia* and *Bougainvillea glabra*. The trees like *Acacia nilotica, Azadirachta indica, Saraca indica, Alstonia scholaris, Albizzia*

lebbeck, *Acacia auriculiformis* and *Delonix regia* were observed along the roadside for avenue plantation. In the village garden, plantation of *Artocarpus heterophyllus*, *Cocos nucifera* and *Zizypus jujube* were seen.

(e) Agricultural Practices in Area

The secondary information on agricultural practices in the study area was gathered from Agriculture Department , Alibag. According to this, two cropping season were found i.e. Kharif and Rabbi and the main crops of the region consist of Pulses, and Vegetables. Besides this, the major crops cultivated in the area are Coconut and Areca nut.[**Table 3.5.11 (a) (b)& (c)]**.

Table 3.5.11(a) : List of Rabbi Crops Occurring in the Alibag Agricultural Division

Sr. No.	Crop	Alibag		Pen		Murud		Total		Percentage
		Common area	Actual cultivated area	Common area	Actual cultivated area	Common area	Actual cultivated area	Common area	Actual cultivated area	
1.	Field beans	947.7	758.16		320.0		193.6		1271.74	
2.	Harbhara	212.9	170.32		44.00		0		214.32	
3.	Black eyebeans		104.00	530.60	90.00	370.00	35.0	2411.50	229.00	
4.	Other pulse	350.3	197.00		60.00		2		259.00	
	Total pulse	**1510.90**	**1229.48**	**530.60**	**514.0**	**370.0**	**230.6**	**2411.50**	**1974.06**	**81.86**
5.	Lady finger		0.00		46.00		0		46.00	
6.	Brinjal		45.00		45.00		3.6		93.60	
7.	Karela		68.00		56.00		14.3		138.25	
8.	pointed gourd		0.00		51.00		0.0		51.00	
9.	Chilli		0.00		25.00		0.0		25.00	
10.	Gherkins		89.00		16.0		0.0		105.00	
11.	Bottle Gourd	492.00	82.00	450.00	40.00	80.00	0.0	1042.00	122.00	
12.	Cucumber		0.00		33.00		0.0		33.00	
13.	Tomato		0.00		75.00		0.0		75.00	
14.	Other Vegetable		82.00		45.00		45.3		172.26	
15.	White Onion	110.00	145.00	0.00	0.00	0.00	0.0	110.00	145.00	
16.	Unhalibhhat	90.00	0.00	74.00	8.00	0.00	0.0	164.00	8.00	
17.	Watermelon	0	0.00	36.85	2.00	20.0	8.1	0.00	10.10	
	Total Vegetables	**692.00**	**511.00**	**560.85**	**442.00**	**100.00**	**71.21**	**1316.00**	**1024.21**	**77.828**
	Corn	50.00	50.00	50.00	50.00	16.00	16	196.00	116.00	100
	Total	**2202.90**	**1790.48**	**1091.45**	**1006.00**	**470.00**	**317.71**	**3843.50**	**3114.27**	**81.03**

Table 3.5.11 (b) : List of Kharif Crops Occurring in the Alibag Agricultural Division

District	Rice			Nagli			Vari			Tur			Total
	Common area	Actual cultivated area	percent	Common area	Actual cultivated area	percent	Common area	Actual cultivated area	percent	Common area	Actual cultivated area	percent	
Alibag	16498	13693.30	83.	68.64	0.00	0.00	32.00	0.00	0.00	100.0	112.0	112.0	13805.3
Pen	1280	12960	95	225	168.75	75	32	22.40	70.00	195.0	100	51.28	13032.2
Murud	3300	3102	14	0	0	0	0	0	0	300	158.4	54.80	3275.4
Total	**62598**	**28955.60**	**88.83**	**293.64**	**168.75**	**57.47**	**64.00**	**22.40**	**35**	**370.4**	**62.25**	**515.0**	**30111.9**

Table 3.5.11 (c) : List of Fruits Occurring in the Alibag Agricultural Division

Sr. No.	Fruit	Alibag			Pen			Murud		
		Cultivable area(Ha)	Cultivable area (Q)	Productivity Kg/ha	Cultivable area(Ha)	Cultivable area (Q)	Productivity Kg/ha	Cultivable area(Ha)	Cultivable area (Q)	Productivity Kg/ha
1.	Mango	1450	3	3000	717.65	61.50	8570	1511	20 to 25	2500
2.	Cashewnut	0.80	19	2.5	2723	54.46	2000	25	20	3000
3.	Coconut	495	90 coconut per tree	100 coconut per tree	520.50	80 coconut per tree	90 coconut per tree	275	80 coconut per tree	100 coconut per tree
4.	Arecanut	156	20.7	2700	0	0	0	390	34.25	4110
5.	White onion(vegetable)	250	150	15000	0	0	0	0	0	0

Fauna

A habitat is formed by a particular combination of vegetation and land types in an area, and often corresponds broadly to major structural vegetation communities. The combined attributes of a habitat may provide a unique set of resources that can support a characteristic fauna assemblage. The diversity in fauna basically depends upon density and diversity of flora. The richer the diversity among the flora better will be the diversity in fauna**.** The forests of Alibag are typical of Western Ghats (Southern Maharashtra & Karnataka). There is diversity in the forests due to the variations in the altitude, aspect, soil characters, slope, etc. which harbor great diversity for fauna. The wild animals of the study area falls into two Categories- Forest dwelling, grass land dwelling **(Table 3.5.12, 3.5.13** and **3.5.14)**.

(a) Mammals

As per management and working plan of Alibag, mammals reported from the study site are Wild Pig, Indian Porcupine, barking deer, Mongoose, common Indian Hare and are also reported to be present in the area as per information gathered from villagers in 10 km vicinity of the proposed project. However, during primary data collection, Monkey, Squirrel, Mongoose, Indian field mouse, etc. were observed in the study area **(Table 3.5.12** and **3.5.14).**

(b) Reptiles

According to working plan of Alibag Forest Division, the important reptiles in the region are Snakes, Crocodiles, Turtles, Lizard and Skinks. During primary survey, Garden lizards, Indian chameleon, Common skink and snakes were observed in the study area (**Table 3.5.12** and **3.5.14).**

(c) Insects

The forests of the region have great diversity of insects which comprises of a number of Anisoptera (Dragonflies), Lepidoptera (Butterflies), Zygoptera (Damselflies), Araneae (Spider), etc. The coastal habitats are characteristically recognized to harbour rich biodiversity of insects as they play an important role in soil turnover and nutrient recycling.

During primary survey, Honey bee ,Red Dragonfly, Common grass yellow butterfly, Plain tiger, common gull, common jezebel, tiger striped dragonfly etc were recorded from study area (**Table 3.5.12** and **Plate 3.5.9)**.

(d) Avifauna

Birds are very specific to their respective habitats and are also key indicators of environment being susceptible to any change. The bird population of study area is also rich and diverse. The birds observed during primary data collection were, *Vanellus indicus* (Red-wattled lapwings), *Corvus splendens* (House Crow), *Phalacrocorax auritus* (Cormorant), *Pycnonotus cafer* (Red-vented bulbul), *Turdoides striata* (jungle babbler), *Bubulcus ibis* (Cattle Egret),*Acridotheres tristis*(Common Myna) etc. The study area was dominated by the presence of Crow, Pigeon and Egret sp. of bird.

The checklist of avifauna as per available secondary literature and personal observations is reported in **Table 3.5.12 and 3.5.13**. Mangrove vegetations were

observed near coastal area villages namely Mankula, Khatvire etc. constitutes unique habitat for birds by offering rich feeding grounds to many aquatic as well as tree dwelling birds. Birds observed by NEERI Team and reported from the study area are presented in **Table 3.5.12** and **Plate 3.5.10)**.

Tiger striped dragonfly

Cepora nerissa **(common gull)**

Danaus chrysippus **(plain tiger)**

Delias eucharis **(common Jezebel)**

Junonia coenia **(common buckeye)**

Plate 3.5.9 : Insects Observed in the Study Area by CSIR-NEERI Team during April 2019

		
white-throated kingfisher (***Halcyon smyrnensis***)	**Black-winged stilt** (*Himantopus himantopus*)	**Asian whitenecked stork** (**Ciconia episcopus**)
		
painted stork (***Mycteria leucocephala***)	**barn swallow** (*Hirundo rustica*)	**house crow** (*Corvus splendens*)
		
Little cormorant (*Microcarbo niger*)	**Indian roller** (***Coracias benghalensis***)	**Red-wattled lapwing** (***Vanellus indicus***)
		
pond heron or paddybird (*Ardeola grayii*)	**Cattle egret** (*Bubulcus ibis*)	**great** egret (***Ardea alba***)

Plate 3.5.10 : Birds observed in the study area by CSIR-NEERI Team during April 2019

(e) Ecologically Sensitive Areas and Threatened Species

There are not any notified ecological sensitive areas like Wildlife Sanctuaries, Reserve Forest and National park within the study area. The Government of India enacted Wildlife (Protection) Act 1972 with the objective of effectively protecting the wildlife of this country and to control poaching, smuggling and illegal trade in wildlife and its derivatives. The Act consists of 60 Sections and VI Schedules- divided into Eight Chapters. During primary data survey, some of the faunal species comes under the schedule category of Wildlife Protection Act (WPA), 1972. The Common Mongoose and Rhesus macaque belongs to Schedule II and of Lower risk/ Least concern species according to IUCN (International Union for Conservation of Nature).Whereas; Egret, Five-striped palm squirrel comes under Schedule IV of WPA and are Least concern species.The Common Crow butterfly listed under Schedule V and according to IUCN it is of Lower Risk species. **(Table 3.5.15)**.

Table 3.5.12 : List of Fauna Observed in the Study Area April, 2019

Sr. No.	Common Name	Scientific Name	Family
Mammals			
1.	Monkey	*Chlorocebus pygerythrus*	Cercopithecidae
2.	Five-striped palm squirrel	*Funambulus pennantii*	Sciuridae
3.	Three-striped Palm Squirrel	*Funambulus palmarum*	Sciuridae
4.	Indian grey mongoose	*Herpestes edwardsii*	Herpestidae
Reptiles			
5.	Oriental Garden Lizard	*Calotes versicolor*	Agamidae
6.	Fan throated lizard		
7.	Indian Chameleon	*Chamaeleo zeylanicus*	Chamaeleonidae
8.	Common garden skink	*Lampropholis guichenoti*	Scincidae
Insects			
9.	Golden winged skimmer	*Libellula auripennis*	Libellulidae
10.	Tiger stripped dragonfly	-	Libellulidae
11.	Red stink bug	*Melanphaus species*	Pentatomidae
12.	Indian Honeybee	*Apis cerana indica*	Apidae
13.	Roseate skimmer	*Orthemis ferruginea*	Libellulidae
14.	Common green Grasshopper	*Omocestus viridulus*	Acrididae
15.	Robber Fly	*Varies species*	Asilidae
16.	Blister beetle	*Mylabris pustulata*	Meloidae
17.	Orb weaver	*Agalenatea species*	Araneidae
18.	Plain tiger	*Danaus chrysippus*	Nymphalidae
19.	Swallow tail butterfly	*Papilio demoleus*	Papilionidae

Sr. No.	Common Name	Scientific Name	Family
20.	Common grass yellow butterfly	*Eurema hecabe*	Pieridae
21.	Common Crow	*Euploca core*	Nymphalidae
22.	Common Gull	Cepora nerissa	Pieridae
23.	Common Buckeye	Junonia coenia	Nymphalidae
24.	Common jezebel	*Delias eucharis*	
Avifauna			
25.	Laughing Dove	*Spilopelia senegalensis*	Columbidae
26.	House crow	*Corvus splendens*	Corvidae
27.	Indian roller	*Coracias benghalensis*	Coraciidae
28.	White throated Kingfisher	*Halcyon smyrnensis*	Alcedinidae
29.	Painted stork	*Mycteria leucocephala*	Ciconiidae
30.	Asian whitenecked stork	*Ciconia episcopus*	Ciconiidae
31.	Red-vented Bulbul	*Pyconotus cafer*	Pycnonotidae
32.	Little Cormorant	*Microcarbo niger*	Phalacrocoracidae
33.	Yellow-billed Egret	*Ardea intermedia*	Ardeidae
34.	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae
35.	Asian pied Starling	*Gracupica contra*	Sturnidae
36.	Scaly breasted Munia	*Lonchura punctulata*	Estrildidae
37.	Indian Robin	*Copsychus fulicatus*	Muscicapidae
38.	Green bee eater	*Merops orientalis*	Meropidae
39.	Rose ringed Parakeet	*Psittacula krameri*	Psittaculidae
40.	Brahminy Starling	*Sturnia pagodarum*	Sturnidae
41.	White throated Munia	*Euodice malabarica*	Estrildidae
42.	Purple Heron	*Ardea purpurea*	Ardeidae
43.	Little Egret	*Egretta garzetta*	Ardeidae
44.	Pond heron	*Ardeola grayii*	Ardeidae
45.	Cattle egret	*Bubulcus ibis*	Ardeidae
46.	Great egret	*Ardea alba*	Ardeidae
47.	Barn Swallow	*Hirundo rustica*	Hirundinidae
48.	Grey Wagtail	*Motacilla cinerea*	Motacillidae
49.	White wagtail	*Motacilla alba*	Motacillidae

Table 3.5.13: Details of Birds Commonly Found in the Alibag Forest Division

Sr. No.	*Scientific Name*	Common Name	Local Name
1.	*Gyas indicus*	Longbilled brown vulture	
2.	*Pseudogyps bengalensis*	White backed vulture	
3.	*Neophron ginginianus*	White scavengervulture	
4.	*Falco jugger*	Laggar	
5.	*Falco chiquera*	Redheaded merlin	Gihjad
6.	*Cerchoneies tinnunculus*	Kestrel	
7.	*Astur babius*	Shikra	sasana
8.	*Accipiter nirus*	Sparrow hawk	
9.	*Aquila vindhiana*	Tawny eagle	Garud
10.	*Neopus malayensis*	Black eagle	
11.	*Nisaetus boneli*	Creastless hawp eagle	
12.	*Spilornis cheela*	Created tent eagle	
13.	*Buteo ferox*	Long legged buzzared	
14.	*Butasturteesa*	White eyed buzzared	
15.	*Circus macrurus*	Pale harrier	
16.	*Haliasture Indus*	Brahmani kite	
17.	*Milvas govinda*	Common pariah kite	
18.	*Strix javanica*	Indian screech owl	ghubad
19.	*Syrnium indrani*	Brown wood owl	
20.	*Strix candida*	Green owl	
21.	*Bubo bengalensis*	Rock horned owl	
22.	*Carine brama*	Spotted owlet	pingla
23.	*Caprimulgas indicus*	Jungle nightjar	
24.	*Caprimulgas asiaticus*	Common Indian nightjas	
25.	*Pelargopsis gurial*	Brown headed kingfisher	
26.	*Halcyon smynensia**	White breasted kingfisher	
27.	*Ceyx tridactyla*	tree road kingfisher	
28.	*Alcedobengalensis*	Common lndia kaikil kingfisher	
29.	*Ceryle rudid**	Pied kingfisher	
30.	*Palacornid torauatus*	Rose ringed parakeet(parrot)	Popat
31.	*Pslacornis purpurens*	Ross headed paroquet	
32.	*Palacornis columboides*	Blue ringed paroquet	
33.	*Picus marathensis*	Yellow fronted wood peckera	
34.	*Crysocolaptes festivus*	Black backed wood peckera	
35.	*Xantholaema heamacephala**	Coppesamith tuktuk barbet	
36.	*Megalaema inornata*	Malber green barbet	
37.	*Megalaema viridis*	Small green barbet	

Sr. No.	*Scientific Name*	Common Name	Local Name
38.	*Eudynamys honorata**	Indian koel	kokil
39.	*Centropus sinensis*	Crow pheasant	Bharadwaj
40.	*Oethopyga vigorsi*	Violerteared	Honey sucker
41.	*Cinnyris asiatica*	Purple hoey sucker	
42.	*Fxos luteolus*	White browed bush bulbul	Balbul
43.	*Otocompsa fusicaudata*	Red whiskered bulbil	
44.	*Mepastes heammorrhous*	Common green bulbul	
45.	*Phyllornis malabaricus*	Malabar green bulbul	
46.	*Copsychus saularis**	Magpie robin	
47.	*Cercotrichas macrura*	Shama	
48.	*Thamnobia fulcata*	Indian black robin	
49.	*Pratincola coprata*	White ringed black robin	
50.	*Pratincola indica**	Bush chat	
51.	*Pyrrhulanda grisea**	Black bellied finch lark	
52.	*Ploceus indica**	Common weaver bird	Shimpi
53.	*Calandrella brachydactyla*	Social lark	
54.	*Spizalanda deva*	Small creasted lark	
55.	*Spizalanda malabarico*	Southern crownersted lakr	
56.	*Croccopus chlorigaster**	Pigeon	Kabutar
57.	*Streptopelia decaocto**	Dove ,the Indian ringed	Fakhta(H)
58.	*Pavo cristatus*	Peacock	Mor
59.	*Gallus scunerati*	Gray jungle fowl	Rankombadi
60.	*Galloperdix spadiceus*	Red spur fowl	Kokatri
61.	*Fracolinus picyus*	Painted partridge	Titar
62.	*Ortigarnis pondicerianus*	Grey partridge	Titar
63.	*Perdicula asiatica*	Jungle bush quail	Pater(H)
64.	*Perdicula argoond*	Rock bush quail	
65.	*Micooperdix erythorychus*	Painted bush quil	
66.	*Gallinago stenura*	Paintailed snipe	
67.	*Gllinago gallinaris*	Common snipe	
68.	*Gallinago minima*	Jack snipe	
69.	*Rynchaea bengalensis*	Painted snipe	
70.	*Hydrophasianus chirurgus*	Pheasant tailed jacana	
71.	*Parra indicus*	Bronze winged jacana	
72.	*Gallinula chloropus*		Pankombadi
73.	*Dissura episorpa*	White necked stork	
74.	*Ardea puraea*	Blue heron	
75.	*Ardea torra*	Purple honey	
76.	*Herodica torra*	Smaller white heron or egret	
77.	*Ardeda grayii**	Indian pond heron	

Table 3.5.14 : Details of Animals Commonly Found in the Alibag Forest Division

Sr. no.	Scientific name	Common English name	Local name	Status/occurrence
1	*Panther tigris*	Tiger	Wagh	Confined to remote areas
2	*Panther pardus*	Panther	Biblya	Hills
3	*Felis chaus*	Wild cat	Ranmajar	Common
4	*Canis lupus*	Wolf	Landga	Occasional
5	*Hyaena hyaena*	Hyena	Taras	Common all over
6	*Canis aureus*	Jackal	Kolha	Common all over
7	*Vulpes bengalensis*	Indian fox	Khokad	Rare
8	*Cuon alpines*	Wild dog	Jungle kutra	
9	*Bos gaurus*	Bison	Gava	Rare
10	*Melursus ursinus*	Bear	Aswal	Very rare
11	*Sus serofa*	Wild boar	Ran dukkar	Common
12	*Hystrix indica*	Porcupine	Salu	Common
13	*Seiuma species**	Squirrel	Khar	Common
14	*Crocodiles palustris*	Alligator	Susar	Found in creek and rivers
15	*Rusa unicolor nigez*	Sambar	Sambar	On high hills
16	*Cervus axix(syn axis)*	Spotted deer	Chital	Occasional
17	*Muntiacus muntjak*	Barking deer	Bhekad	
18	*Memimus indica*	Mouse deer	Ahira/pisori	
19	*Boselaphus tragocamelus*	Blue bull	Nilgai	Not common
20	*Antilope cervicapra*	Black buck	Kalwit	
21	*Tetracerus quadricornis*	Four horned antilope	Chousinga	
22	*Gazelle gzella bennetti*		Chinkara	Occasional near the lake
23	*Lepus nigricollisruficaudatus*	Common hare	Sasa	Very common
24	Not available	Wild pig	Randukar	-
25	muntiacus muntjak	Barking deer or muntjac	Bhekar	-
26	hystrix indica	Indian porcupine	Salinder	-
27	-	common Indian Hares	Sasa	-
28	-	Monkey	Makad	-
29	-	Common fox	Kolha	-
30	felis chaus	Jungle cat	Ran manjar	-
31	hyaena hyaena	Hyaena	Taras	
32	-	Giant squirrell	Shekaru	-
33	Mongoose*	Mangoose	Mangoos	-
34	-	Kite	Ghar	-
35	-	Horb bills	Dhanesh	-

Table 3.5.15 : List of Rare, Endangered and Vulnerable Fauna in the Study Area

Sr. No.	Scientific Name	Common Name	Conservation Status	
			WPA 1972	IUCN
1.	*Herpestes species*	Common Mongoose	Schedule II	Least Concern
2.	*Egretta garzetta*	Egret	Schedule IV	Least Concern
3.	*Euploea core*	Common Crow	Schedule V	Least Concern
4.	*Funambulus pennantii*	Five-striped palm squirrel	Schedule IV	Least Concern
5.	*Cepora nerissa*	Common Gull	Schedule II	

3.5.2.3.3 Fishing Activity in Dolvi

Fish and fisheries are an integral part of most societies and make important contributions to economic and social health and well-being in many countries and areas. The coast line of Alibag harbor a rich diversity of marine fishes. Fishing forms an important part of the economy for the local people in Alibag. The production of fishes is in quarterly basis the production of Mackerals (Bangdo) was highest for thethird quarter in 2016-17; and the annual production was reported normal in the subsequent years. The annual production of Sardlines (Tarlo) has shown the rise in production annually. Prawns (Sungtam) has shown approximately steady rate of production per year. The quarter wise marine fish production (in tones) for Alibag is given in **Table 3.5.16**.

Table 3.5.16 : List of Marine Fishes Occurring in the Alibag Fisheries division

Sr. No.	Variety	Q1	Q2	Q3	Q4	Total
1.	Elasmobranchs	3	68	93	27	**191**
2.	Eels	0	24	3	90	**117**
3.	Catfishes	5	46	204	12	**267**
4.	Chirocentrus spp.	0	1	22	2	**25**
5.	Sardine	0	23	225	323	**571**
6.	Hilsha ilisha	0	9	20	2	**31**
7.	Anchovies	69	605	548	48	**1270**
8.	Thrissocles	14	1	30	0	**45**
9.	Other clupieds	0	0	0	2	**2**
10.	Harpadon nehereus	21	620	83	9	**733**
11.	Perches	0	0	0	0	**0**
12.	Redsnapper	0	20	5	0	**25**
13.	Polynemidae	2	5	4	1	**12**
14.	Sciaenids	0	19	10	69	**98**
15.	Otolithoides sp.	49	28	132	8	**217**
16.	Trichiuridae(Ribbon fishes)	79	79	165	48	**371**
17.	Caranx	0	38	52	9	**99**
18.	Pomfrets	3	6	24	19	**52**

Sr. No.	Variety	Q1	Q2	Q3	Q4	Total
19.	Black pomfret	0	3	41	5	**49**
20.	Mackerals	0	15	1012	334	**1361**
21.	Seerfishes	0	237	96	64	**397**
22.	Tunnies	0	38	77	62	**177**
23.	Bregmaceros macelendi	50	0	0	4	**54**
24.	Soles	30	0	5	9	**44**
25.	Sphyraena spp.(Bara cudas)	0	0	0	0	**0**
26.	Leiognathus	0	0	2	0	**2**
27.	Upeneus spp.	0	0	5	0	**5**
28.	Penaeid prawns	75	99	249	62	**485**
29.	Non-penaeid prawns	2476	23	6791	3381	**12671**
30.	Natantion decapods(Lobsters)	5	0	2	0	**7**
31.	Lactarius	0	2	2	3	**7**
32.	Loligo duvaucelli(cephalopoda)	0	1	19	1	**21**
33.	Miscellaneous	10	123	333	236	**702**
	Total	**2891**	**2133**	**10254**	**4830**	**20108**

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3.6 Socio-economic Environment

3.6.1 Introduction

A prosperous nation needs well-developed industries to provide the amenities of life to its citizens. Industrial development has had an important role in the socio - economic growth of countries. Rapid economic growth is often essential for achieving a reduction in absolute poverty. Industrialization is often essential for economical and social growth. Poverty reduction the pattern of industrialization, however, impacts remarkably on how the poor benefit from growth. Pro-poor economic and industrial policies focus on increasing the economic returns to the productive factors that the poor possess, e.g. raising returns to unskilled labour, whereas policies promoting higher returns to capital and land tend to increase inequality, unless they also include changes in existing patterns of concentration of physical and human capital and of land ownership. Use of capital-intensive methods instead of labour-intensive ones tends to increase employment, labour regulation, social protection, health, education, etc.

Where the level of education is low and human capital concentrated. Income disparities, as does the employment of skill-based technologies, especially Also, the location of industrial facilities has an impact on overall poverty reduction and inequality. As enterprises are often concentrated in urban areas. The industrial revolution led to the development of factories for large-scale production, with consequent changes in society like Growth and structure of employment, impact of Socio-economic reforms and globalization trade and employment, labour regulation, social protection, health, education, etc. In this manner all developmental projects have direct as well as indirect relationship with socio-economic aspect, which also include public acceptability for new developmental projects. Thus the study of socio-economic component incorporating various facets related to prevailing social & cultural conditions and economic status of the project region is an important part of EIA study.

3.6.2 Project Description

Any developmental activity exerts a direct impact on the socio-economic environment of the region. Usually, the beneficial impacts such as better job opportunities, improved education, communication, energy, housing, health, transportation facilities etc. outweighs the adverse impacts, if any. JSW Steel Ltd, Dolvi Works has current annual production capacity is 5 MTPA of steel and is proposed to expand it to 10 MTPA by increasing pellet pant capacity from 4 MTPA to 9 MTPA and 6 MTPA sinter plant to 10 MTPA. In addition to this, the industry is proposed to expand the capacity of CPP from 300 MW to 600 MW. The industry had submitted the Form 1 to MOEF&CC and the government had issued combined ToR in 2nd meeting of the Re-constituted EAC (Industry-I) held during 10th to 12th December, 2018.

Description of the Project

- Cost of project and time of completion.
- Details of existing products with capacities and whether adequate land is available for expansion, reference of earlier EC if any.

- List of raw materials required and their source along with mode of transportation.
- Other chemicals and materials required with quantities and storage capacities
- Details of Emission, effluents, hazardous waste generation and their management.
- Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract)
- The project proponent shall furnish the requisite documents from the competent authority in support of drawl of ground water and surface water and supply of electricity
- Process description along with major equipment and machineries, process flow sheet (Quantities) from raw material to products to be provided
- Hazard identification and details of proposed safety systems.

The study of socio-economic component of environment incorporates various facets, viz. demographic structure, availability of basic amenities such as housing, education, health and medical services, occupation, water supply, sanitation, communication and power supply, prevailing diseases in the region as well as features such as places of tourist attraction and monuments of archaeological importance. The study of these parameters helps in identifying predicting and evaluating the likely impacts due to project activity in the surrounding region.

3.6.3 Project Influence Area

The study area for the project has been considered 10 km peripheral from Raigarh district of Maharashtra state from the project boundary. Fifty villages and one town are falling from Pen tehsil, forty-eight villages and one town are falling from Alibag tehsil, one village from Mhasla tehsil and one village is falling from Panvel tehsil under district of Raigarh respectively. Total 100 villages and 02 Towns are falling from 04 tehsil in the study area. The parameters selected for the baseline information on socio-economic components were demographic structure, infrastructure base in the area, economic structure, health status, and cultural attributes, socio-economic status in relation to quality of life and public awareness & public concern about the project. Relevant information was collected from randomly selected villages. The salient features of the demographic and socio-economic aspects in study area have been described in the following sections. Similarly, village wise demographic data as per 2011 census is presented in subsequent sections. Study area map of 10km radial distance with demarcated survey location is given in **Figure 3.6.1.**

1) Dolvi	2) Shahabaj	3) Kusumbale	4) Washi	5) Dherand	6) Shahapur
7) Vaghode	8) Ruishet Bhomoli	9) Hemnagar	10) Kasu	11) Kharpale	12) Jirne

Figure 3.6.1 : Socio-economic Survey Locations in the Study Area

3.6.4 Demographic Structure

Details regarding the demographic structure of the region were collected from Primary Census Abstract of Raigarh district for the year 2011. Demographic details such as number of persons per household, total area, population density, sex ratio, SC and ST population, and literacy rate and employment pattern are summarized. The salient observations are as follows:

3.6.4.1 Population Structure

As per 2011 Census, total population of the study area was 132084, out of which male population was 66826(50.59%) and female population was 65258(49.41%)

- Total number of households were 31802 with average occupancy of 4.15 persons per household
- Total geographical area of the study area was 259.2512 sq.km and its density was 344 person/per sq.km.
- Total child (below 6 years of age) population was 13888 (10.51%)
- Total SC population was 3543(2.68%), ST population was 14706(11.13%) in the study area
- Sex ratio (number of females per 1000 males) of total population was 977.

Tehsil and village wise demographic details are given in **Table 3.6.1** and **Figure 3.6.2.**

Table 3.6.1 : Tehsil / Village wise Details of Population

Sr. No.	Town/ Village	Name	Households	Total Population			Child Population	SC	ST
				Total	Male	Female			
Tehsil- Pen, District- Raigarh, Maharashtra									
1	553850	Wadkhal	802	3419	1808	1611	423	61	248
2	553851	Beneghat	139	589	302	287	54	0	0
3	553852	Dolvi	602	2553	1321	1232	229	2	167
4	553853	Wave	656	2747	1442	1305	378	116	318
5	553833	Washi	661	2671	1333	1338	249	17	31
6	553834	Odhangi	189	796	391	405	55	0	1
7	553835	Koproli	293	1245	619	626	132	0	0
8	553836	Patnoli	320	1388	683	705	195	7	489
9	553837	Antore	269	1153	585	568	124	98	31
10	553838	Dhondpada	292	1237	622	615	95	0	0
11	553839	Umbarde	550	2239	1138	1101	267	174	186
12	553840	Shirki	265	1164	590	574	118	0	0
13	553941	Kharkarawi	214	826	440	386	66	15	24
14	553842	Masad Bk	71	290	160	130	25	0	0
15	553844	Masad Kh	36	140	69	71	6	0	0
16	553845	Borwe	167	711	368	343	73	1	3
17	553846	Bori	284	1213	600	613	137	1	1
18	553847	Sarebhag	178	766	404	362	81	0	0
19	553848	Shinganvat	58	273	149	124	25	0	0
20	553849	Kolave	259	1083	551	532	110	4	243
21	553902	Uchede	202	808	400	408	94	5	77
22	553903	Kandlepada	299	1371	688	683	144	34	35
23	553904	Kashmire	196	836	419	417	99	2	43
24	553905	Kandale	173	723	368	355	80	41	143
25	553906	Meleghar	138	602	309	293	64	0	9
26	553907	Vadgaon	379	1582	830	752	154	63	172
27	553824	Lakhola	100	453	225	228	29	3	0
28	553826	Bahiramwatak	88	368	184	184	56	0	4
29	553828	Wadhav	382	1660	846	814	162	4	6
30	553955	Khar Dhombi	75	311	156	155	27	0	0
31	553943	Karav	503	2177	1085	1092	229	2	358
32	553944	Chirbi 1	122	503	252	251	42	0	0
33	553945	Kharmachela	145	619	312	307	50	0	0
34	553946	Kharghat	108	458	218	240	49	0	0
35	553947	Khar Jambola	89	357	179	178	22	0	0
36	553949	Jirne	271	1110	546	564	164	0	348
37	553919	Borgaon	248	1093	542	551	164	0	618
38	553932	Wirani	143	567	275	292	78	1	566
39	553933	Pen Rural	142	562	266	296	95	0	562
40	553934	Rode	248	1142	581	561	163	126	530
41	553953	Kalad	80	267	137	130	36	0	196
42	553954	Moujepale	142	572	290	282	49	0	147
43	553956	Kharpale	345	1382	712	670	139	5	8
44	553957	Jui Habbas Khani	93	419	205	214	44	0	0
45	553958	Mhaisbad	165	646	339	307	50	0	0
46	553959	Burdi	89	331	164	167	35	5	2
47	553960	Kasu	264	1086	532	554	118	2	0
48	553961	Salinde	285	1188	581	607	145	23	182
49	553962	Usar	44	164	71	93	22	0	47
50	553963	Patani Pandapur	397	1683	861	822	158	0	0

Sr. No.	Town/ Village	Name	Households	Total Population			Child Population	SC	ST
				Total	Male	Female			
51	802800	Pen (M Cl)	9070	37852	19257	18595	3910	2050	945
Sub-total			**21330**	**89395**	**45405**	**43990**	**9513**	**2862**	**6740**
Tehsil- Alibag, District- Raigarh, Maharashtra									
52	554095	Pezari	432	1652	852	800	187	4	98
53	554096	Divlang	85	342	177	165	23	4	0
54	554097	Bhangar dadaji	14	60	29	31	6	0	0
55	554098	Talband	127	492	270	222	65	9	7
56	554100	Shahabaj	705	2796	1381	1415	277	0	26
57	554101	Ghasawad	131	526	266	260	38	0	511
58	554103	Walawade	73	255	129	126	23	4	0
59	554109	Poynad	778	3240	1709	1531	291	46	394
60	554111	Vaghode	156	636	322	314	71	0	266
61	554112	Sagargad	97	364	194	170	59	0	325
62	554113	Nagazari	161	704	350	354	80	0	318
63	554114	Kalwad	228	888	453	435	119	8	506
64	554107	Dehenkoni	99	438	220	218	42	0	0
65	554108	Bhakarwad	63	269	134	135	20	0	0
66	554115	Medhekhar	249	990	498	492	88	8	14
67	554116	Kachali	87	317	154	163	14	0	0
68	554117	Pitakiri	95	357	167	190	32	0	0
69	554119	Chikhali	68	255	116	139	20	0	131
70	554120	Waghwira	66	239	120	119	21	0	0
71	554121	Kusumbale	265	1069	513	556	118	0	376
72	554122	Khatwira	200	727	350	377	48	0	0
73	554123	Shrigaon	291	1335	639	696	147	79	34
74	554141	Aweti	176	635	318	317	60	0	303
75	554142	Sambari	105	399	189	210	38	0	0
76	554143	Durgadarya	35	129	62	67	16	0	62
77	554128	Jalashi	7	27	14	13	2	0	0
78	554129	Ravet	149	503	236	267	44	0	22
79	554135	Hemnagar	162	645	325	320	53	0	0
80	554136	Kolghar	178	733	376	357	110	4	478
81	554137	Dalavi Kharoshi	63	256	139	117	32	0	117
82	554138	Bopoli	135	698	332	366	133	1	538
83	554139	Ruishet Bhomoli	304	1682	869	813	264	0	1639
84	554140	Bidwagale	164	635	309	326	62	0	276
85	554110	Navenagar	79	366	182	184	38	0	75
86	554125	Wadawali	85	382	198	184	41	0	30
87	554126	Tadwagale	139	552	267	285	68	0	206
88	554127	Talashet	108	421	219	202	45	0	185
89	554078	Gan Tarf Shrigaon	54	223	110	113	35	0	182
90	554080	Kurkundi Koltembhi	251	1030	511	519	103	74	183
91	554057	Khopane Khar	7	20	11	9	0	0	0
92	554061	Chari	225	928	434	494	88	9	0
93	554036	Mankule	345	1282	611	671	97	0	6
94	554130	Kopari	17	57	30	27	0	0	0
95	554132	Simadevi	7	25	12	13	0	0	0
96	554133	Navkhar Tarf Shrigaon	106	392	181	211	25	0	0
97	554092	Dherand	180	711	366	345	68	0	0
98	554093	Shahapur	967	4140	2114	2026	361	24	4
99	554134	Kurdus	434	1676	827	849	138	50	216

Sr. No.	Town/ Village	Name	Households	Total Population			Child Population	SC	ST
				Total	Male	Female			
100	554203	Ambepur (CT)	1218	5035	2593	2442	471	308	75
Sub-total			**10170**	**41533**	**20878**	**20655**	**4181**	**632**	**7603**
Tehsil- Mhasla, District- Raigarh, Maharashtra									
101	554920	Dehen	**86**	**273**	**82**	**191**	**26**	**0**	**4**
Tehsil- Panvel, District- Raigarh, Maharashtra									
102	553358	Nagzari	**216**	**883**	**461**	**422**	**168**	**49**	**359**
Grand-total			**31802**	**132084**	**66826**	**65258**	**13888**	**3543**	**14706**

Source: Primary Census Abstract 2011, District Raigarh, Maharashtra

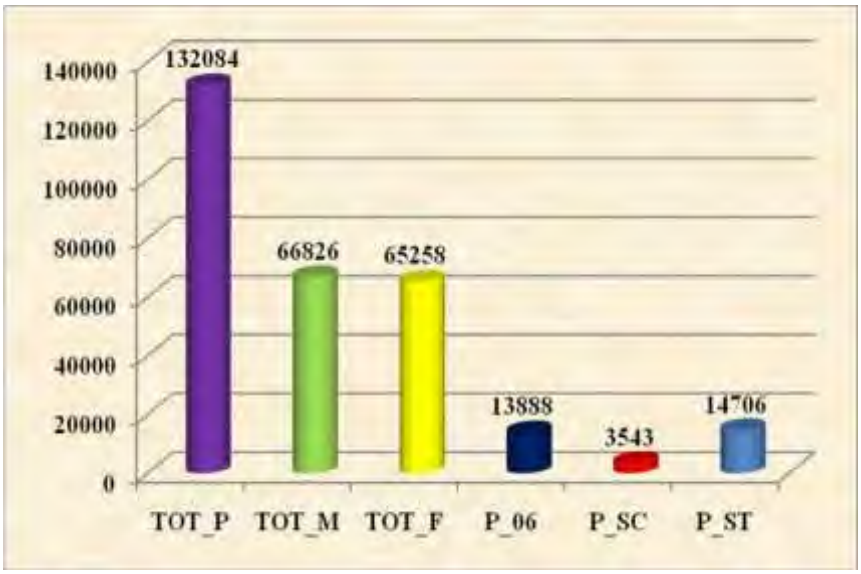


Figure 3.6.2 : Population Details

3.6.4.2 Literacy Details

According to census 2011, in the study area,

- Overall literate population 99336(75.21%) and illiterate population was 32748(24.79%)
- Out of total literates, male literates were 53750(54.11%) and female literates were 45586(45.89%)
- Out of total illiterates, male illiterates were 13076(39.93%) and female illiterates were 19672(60.07%)

Tehsil and village wise literacy details are given in **Table 3.6.2** and **Figure 3.6.3.**

Table 3.6.2 : Tehsil / Village Wise details of Literacy

Sr. No.	Town/Village	Name	TRU	Literate			Illiterate		
				Total	Male	Female	Total	Male	Female
Tehsil- Pen, District- Raigarh, Maharashtra									
1	553850	Wadkhal	Rural	2444	1399	1045	975	409	566
2	553851	Beneghat	Rural	454	261	193	135	41	94
3	553852	Dolvi	Rural	1921	1074	847	632	247	385
4	553853	Wave	Rural	1885	1067	818	862	375	487

Sr. No.	Town/Village	Name	TRU	Literate			Illiterate		
				Total	**Male**	**Female**	**Total**	**Male**	**Female**
5	553833	Washi	Rural	2035	1119	916	636	214	422
6	553834	Odhangi	Rural	735	359	376	61	32	29
7	553835	Koproli	Rural	940	515	425	305	104	201
8	553836	Patnoli	Rural	948	521	427	440	162	278
9	553837	Antore	Rural	948	505	443	205	80	125
10	553838	Dhondpada	Rural	919	502	417	318	120	198
11	553839	Umbarde	Rural	1634	908	726	605	230	375
12	553840	Shirki	Rural	882	474	408	282	116	166
13	553941	Kharkarawi	Rural	629	377	252	197	63	134
14	553842	Masad Bk	Rural	227	127	100	63	33	30
15	553844	Masad Kh	Rural	125	66	59	15	3	12
16	553845	Borwe	Rural	558	319	239	153	49	104
17	553846	Bori	Rural	922	505	417	291	95	196
18	553847	Sarebhag	Rural	572	331	241	194	73	121
19	553848	Shinganvat	Rural	220	135	85	53	14	39
20	553849	Kolave	Rural	809	461	348	274	90	184
21	553902	Uchede	Rural	553	294	259	255	106	149
22	553903	Kandlepada	Rural	1023	568	455	348	120	228
23	553904	Kashmire	Rural	620	336	284	216	83	133
24	553905	Kandale	Rural	588	312	276	135	56	79
25	553906	Meleghar	Rural	439	246	193	163	63	100
26	553907	Vadgaon	Rural	1242	663	579	340	167	173
27	553824	Lakhola	Rural	362	199	163	91	26	65
28	553826	Bahiramwatak	Rural	257	143	114	111	41	70
29	553828	Wadhav	Rural	1229	688	541	431	158	273
30	553955	Khar Dhombi	Rural	230	132	98	81	24	57
31	553943	Karav	Rural	1515	847	668	662	238	424
32	553944	Chirbi 1	Rural	380	213	167	123	39	84
33	553945	Kharmachela	Rural	435	249	186	184	63	121
34	553946	Kharghat	Rural	335	176	159	123	42	81
35	553947	Khar Jambola	Rural	283	155	128	74	24	50
36	553949	Jirne	Rural	497	306	191	613	240	373
37	553919	Borgaon	Rural	610	323	287	483	219	264
38	553932	Wirani	Rural	165	91	74	402	184	218
39	553933	Pen Rural	Rural	149	94	55	413	172	241
40	553934	Rode	Rural	706	386	320	436	195	241
41	553953	Kalad	Rural	113	70	43	154	67	87
42	553954	Moujepale	Rural	406	230	176	166	60	106
43	553956	Kharpale	Rural	1007	577	430	375	135	240
44	553957	Jui Habbas Khani	Rural	324	175	149	95	30	65
45	553958	Mhaisbad	Rural	490	290	200	156	49	107
46	553959	Burdi	Rural	253	136	117	78	28	50
47	553960	Kasu	Rural	750	426	324	336	106	230
48	553961	Salinde	Rural	792	427	365	396	154	242
49	553962	Usar	Rural	99	48	51	65	23	42
50	553963	Patani Pandapur	Rural	1267	733	534	416	128	288
51	802800	Pen (M Cl)	Urban	31022	16162	14860	6830	3095	3735
Sub-total				**67948**	**36720**	**31228**	**21447**	**8685**	**12762**
Tehsil- Alibag, District- Raigarh, Maharashtra									
52	554095	Pezari	Rural	1223	678	545	429	174	255
53	554096	Divlang	Rural	284	154	130	58	23	35
54	554097	Bhangar dadaji	Rural	49	26	23	11	3	8
55	554098	Talband	Rural	405	223	182	87	47	40
56	554100	Shahabaj	Rural	2214	1152	1062	582	229	353
57	554101	Ghasawad	Rural	395	226	169	131	40	91

Sr. No.	Town/Village	Name	TRU	Literate			Illiterate		
				Total	**Male**	**Female**	**Total**	**Male**	**Female**
58	554103	Walawade	Rural	205	112	93	50	17	33
59	554109	Poynad	Rural	2650	1457	1193	590	252	338
60	554111	Vaghode	Rural	463	251	212	173	71	102
61	554112	Sagargad	Rural	136	84	52	228	110	118
62	554113	Nagazari	Rural	558	274	284	146	76	70
63	554114	Kalwad	Rural	504	295	209	384	158	226
64	554107	Dehenkoni	Rural	342	183	159	96	37	59
65	554108	Bhakarwad	Rural	214	116	98	55	18	37
66	554115	Medhekhar	Rural	772	424	348	218	74	144
67	554116	Kachali	Rural	251	143	108	66	11	55
68	554117	Pitakiri	Rural	259	132	127	98	35	63
69	554119	Chikhali	Rural	127	62	65	128	54	74
70	554120	Waghwira	Rural	179	103	76	60	17	43
71	554121	Kusumbale	Rural	743	398	345	326	115	211
72	554122	Khatwira	Rural	563	300	263	164	50	114
73	554123	Shrigaon	Rural	1040	530	510	295	109	186
74	554141	Aweti	Rural	417	237	180	218	81	137
75	554142	Sambari	Rural	318	164	154	81	25	56
76	554143	Durgadarya	Rural	61	31	30	68	31	37
77	554128	Jalashi	Rural	25	13	12	2	1	1
78	554129	Ravet	Rural	370	199	171	133	37	96
79	554135	Hemnagar	Rural	542	289	253	103	36	67
80	554136	Kolghar	Rural	407	247	160	326	129	197
81	554137	Dalavi Kharoshi	Rural	157	91	66	99	48	51
82	554138	Bopoli	Rural	285	164	121	413	168	245
83	554139	Ruishet Bhomoli	Rural	666	433	233	1016	436	580
84	554140	Bidwagale	Rural	390	221	169	245	88	157
85	554110	Navenagar	Rural	267	151	116	99	31	68
86	554125	Wadawali	Rural	315	170	145	67	28	39
87	554126	Tadwagale	Rural	390	211	179	162	56	106
88	554127	Talashet	Rural	256	146	110	165	73	92
89	554078	Gan Tarf Shrigaon	Rural	117	63	54	106	47	59
90	554080	Kurkundi Koltembhi	Rural	795	407	388	235	104	131
91	554057	Khopane Khar	Rural	18	10	8	2	1	1
92	554061	Chari	Rural	759	383	376	169	51	118
93	554036	Mankule	Rural	1019	550	469	263	61	202
94	554130	Kopari	Rural	50	29	21	7	1	6
95	554132	Simadevi	Rural	20	12	8	5	0	5
96	554133	Navkhar Tarf Shrigaon	Rural	305	157	148	87	24	63
97	554092	Dherand	Rural	583	331	252	128	35	93
98	554093	Shahapur	Rural	3395	1843	1552	745	271	474
99	554134	Kurdus	Rural	1226	664	562	450	163	287
100	554203	Ambepur (CT)	Urban	4117	2212	1905	918	381	537
Sub-total				**30846**	**16751**	**14095**	**10687**	**4127**	**6560**
Tehsil- Mhasla, District- Raigarh, Maharashtra									
101	554920	Dehen	Rural	**164**	**57**	**107**	**109**	**25**	**84**
Tehsil- Panvel, District- Raigarh, Maharashtra									
102	553358	Nagzari	Rural	**378**	**222**	**156**	**505**	**239**	**266**
Grand-total				**99336**	**53750**	**45586**	**32748**	**13076**	**19672**

Source: Primary Census Abstract 2011, District Raigarh, Maharashtra

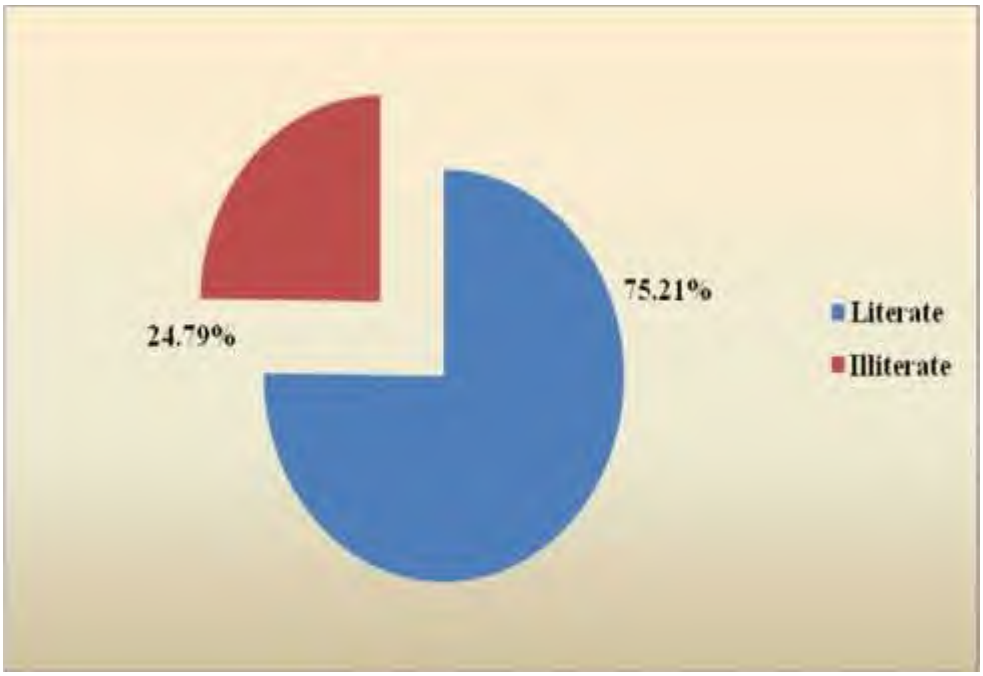


Figure 3.6.3 : Literacy Details

3.6.4.3 Employment Pattern

Economic resource base of any region mainly depends upon its economically active group i.e. the working population involved in productive work. Work may be defined as participation in any economically productive activity. Such participation may be physical or mental in nature. Work not only involves actual work but also effective supervision and direction of work. It also includes unpaid work on farm or in family enterprise. There are different types of workers that may be classified as - those persons who had worked for at least six months or 183 days are treated to be Main Workers, on the other hand if person categorized as worker has participated in any economic or productive activity for less than six months or 183 days during the last one year is treated as Marginal Worker. Non–workers are those who have not worked any time at all in the year preceding the enumeration. The workers coming under the main and marginal workers category are those involved in activities such as cultivation, agriculture, livestock, forestry, fishing, hunting, plantations, orchards and allied activities, mining and quarrying, manufacturing, processing, servicing and repairs in household industry, construction, trade and commerce, transport, storage and communication and other services.

- According to 2011 Census, total worker population in the study area was 58142(44.02%).
- Main workers were 43054(32.60%) and marginal workers were 15088(11.42%).Total non-working population was 73942(55.98%**)**

Tehsil and village wise details of employment pattern are given in **Table 3.6.3** and **Figure 3.6.4.**

Table 3.6.3 : Tehsil / Village wise details of Employment Pattern

Sr. No.	Town/ Village	Name	TRU	Total Workers	Workers Pattern		
					Main	Marginal	Non-workers
Tehsil- Pen, District- Raigarh, Maharashtra							
1	553850	Wadkhal	Rural	1423	870	553	1996
2	553851	Beneghat	Rural	204	106	98	385
3	553852	Dolvi	Rural	1091	669	422	1462
4	553853	Wave	Rural	1073	756	317	1674
5	553833	Washi	Rural	1402	1044	358	1269
6	553834	Odhangi	Rural	274	49	225	522
7	553835	Koproli	Rural	579	373	206	666
8	553836	Patnoli	Rural	590	500	90	798
9	553837	Antore	Rural	449	220	229	704
10	553838	Dhondpada	Rural	509	477	32	728
11	553839	Umbarde	Rural	804	607	197	1435
12	553840	Shirki	Rural	524	301	223	640
13	553941	Kharkarawi	Rural	368	200	168	458
14	553842	Masad Bk	Rural	96	74	22	194
15	553844	Masad Kh	Rural	110	94	16	30
16	553845	Borwe	Rural	284	173	111	427
17	553846	Bori	Rural	597	119	478	616
18	553847	Sarebhag	Rural	514	436	78	252
19	553848	Shinganvat	Rural	146	46	100	127
20	553849	Kolave	Rural	488	307	181	595
21	553902	Uchede	Rural	349	120	229	459
22	553903	Kandlepada	Rural	617	258	359	754
23	553904	Kashmire	Rural	274	237	37	562
24	553905	Kandale	Rural	297	100	197	426
25	553906	Meleghar	Rural	189	177	12	413
26	553907	Vadgaon	Rural	519	422	97	1063
27	553824	Lakhola	Rural	248	211	37	205
28	553826	Bahiramwatak	Rural	213	172	41	155
29	553828	Wadhav	Rural	794	507	287	866
30	553955	Khar Dhombi	Rural	101	50	51	210
31	553943	Karav	Rural	759	412	347	1418
32	553944	Chirbi 1	Rural	160	148	12	343
33	553945	Kharmachela	Rural	300	245	55	319
34	553946	Kharghat	Rural	136	118	18	322
35	553947	Khar Jambola	Rural	161	109	52	196
36	553949	Jirne	Rural	672	580	92	438
37	553919	Borgaon	Rural	549	341	208	544
38	553932	Wirani	Rural	258	207	51	309
39	553933	Pen Rural	Rural	310	1	309	252
40	553934	Rode	Rural	517	431	86	625
41	553953	Kalad	Rural	163	148	15	104
42	553954	Moujepale	Rural	252	165	87	320
43	553956	Kharpale	Rural	755	463	292	627
44	553957	Jui Habbas Khani	Rural	153	149	4	266
45	553958	Mhaisbad	Rural	331	315	16	315
46	553959	Burdi	Rural	151	137	14	180
47	553960	Kasu	Rural	475	462	13	611
48	553961	Salinde	Rural	533	370	163	655
49	553962	Usar	Rural	101	75	26	63
50	553963	Patani Pandapur	Rural	879	535	344	804
51	802800	Pen (M Cl)	Urban	13725	12586	1139	24127
Sub-total				**36466**	**27672**	**8794**	**52929**
Tehsil- Alibag, District- Raigarh, Maharashtra							
52	554095	Pezari	Rural	728	479	249	924
53	554096	Divlang	Rural	144	57	87	198

Sr. No.	Town/ Village	Name	TRU	Total Workers	Workers Pattern		
					Main	Marginal	Non-workers
54	554097	Bhangar dadaji	Rural	23	14	9	37
55	554098	Talband	Rural	168	168	0	324
56	554100	Shahabaj	Rural	1234	608	626	1562
57	554101	Ghasawad	Rural	321	301	20	205
58	554103	Walawade	Rural	118	108	10	137
59	554109	Poynad	Rural	1244	1115	129	1996
60	554111	Vaghode	Rural	364	84	280	272
61	554112	Sagargad	Rural	235	234	1	129
62	554113	Nagazari	Rural	465	462	3	239
63	554114	Kalwad	Rural	455	425	30	433
64	554107	Dehenkoni	Rural	187	169	18	251
65	554108	Bhakarwad	Rural	115	88	27	154
66	554115	Medhekhar	Rural	453	266	187	537
67	554116	Kachali	Rural	172	144	28	145
68	554117	Pitakiri	Rural	214	207	7	143
69	554119	Chikhali	Rural	179	175	4	76
70	554120	Waghwira	Rural	153	54	99	86
71	554121	Kusumbale	Rural	549	386	163	520
72	554122	Khatwira	Rural	303	63	240	424
73	554123	Shrigaon	Rural	554	396	158	781
74	554141	Aweti	Rural	397	291	106	238
75	554142	Sambari	Rural	179	21	158	220
76	554143	Durgadarya	Rural	65	1	64	64
77	554128	Jalashi	Rural	20	16	4	7
78	554129	Ravet	Rural	291	89	202	212
79	554135	Hemnagar	Rural	348	58	290	297
80	554136	Kolghar	Rural	390	382	8	343
81	554137	Dalavi Kharoshi	Rural	158	157	1	98
82	554138	Bopoli	Rural	398	395	3	300
83	554139	Ruishet Bhomoli	Rural	1005	838	167	677
84	554140	Bidwagale	Rural	254	169	85	381
85	554110	Navenagar	Rural	123	34	89	243
86	554125	Wadawali	Rural	194	152	42	188
87	554126	Tadwagale	Rural	291	69	222	261
88	554127	Talashet	Rural	274	256	18	147
89	554078	Gan Tarf Shrigaon	Rural	139	93	46	84
90	554080	Kurkundi Koltembhi	Rural	587	554	33	443
91	554057	Khopane Khar	Rural	19	18	1	1
92	554061	Chari	Rural	546	260	286	382
93	554036	Mankule	Rural	689	300	389	593
94	554130	Kopari	Rural	33	1	32	24
95	554132	Simadevi	Rural	17	5	12	8
96	554133	Navkhar Tarf Shrigaon	Rural	166	125	41	226
97	554092	Dherand	Rural	384	108	276	327
98	554093	Shahapur	Rural	2186	1788	398	1954
99	554134	Kurdus	Rural	816	484	332	860
100	554203	Ambepur (CT)	Urban	2819	2469	350	2216
Sub-total				**21166**	**15136**	**6030**	**20367**
Tehsil- Mhasla, District- Raigarh, Maharashtra							
101	554920	Dehen	Rural	**161**	**97**	**64**	**112**
Tehsil- Panvel, District- Raigarh, Maharashtra							
102	553358	Nagzari	Rural	**349**	**149**	**200**	**534**
Grand-total				**58142**	**43054**	**15088**	**73942**

Source: Primary Census Abstract 2011, District Raigarh, Maharashtra

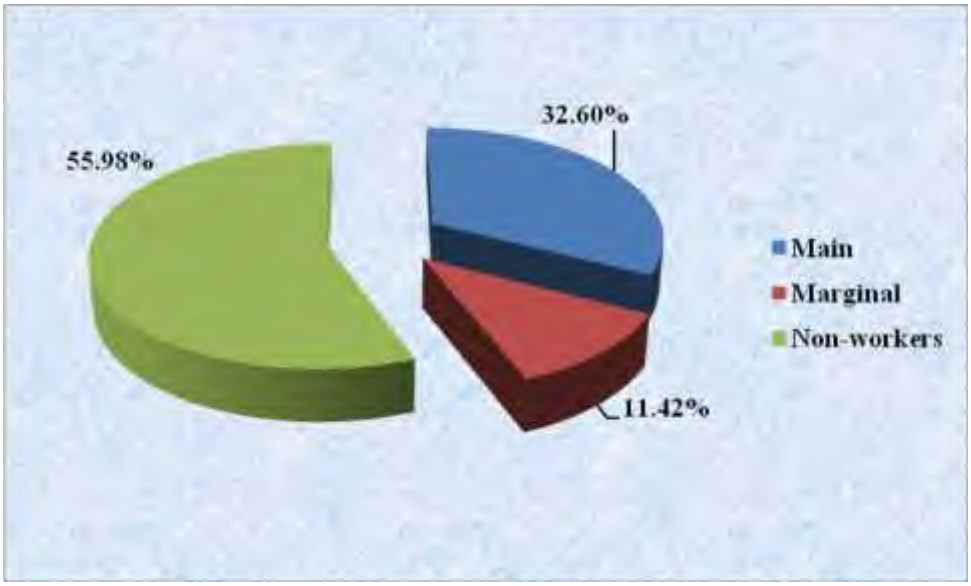


Figure 3.6.4 : Employment Details

3.6.4.4 Main Workers Employment Pattern

Main workers are classified in four categories as cultivators, agricultural workers, household industry workers and other workers. As per 2011 Census, Out of total 43054 main workers in the study area, there were total 8039 cultivators (18.67%), 8729 agricultural workers (20.27%), 1582 household industry workers (3.67%) and other workers 24704 (57.39%). Mostly in main workers population other workers were highly found in study area. Tehsil and village wise details of main workers employment pattern, is given in **Table 3.6.4** and **Figure 3.6.5.**

Table 3.6.4 : Tehsil / Village wise Details of Main Workers Employment Pattern

Sr. No.	Town/ Village	Name	TRU	Main Worker Employment Pattern			
				Cultivator	Agriculture	Household	Other
Tehsil- Pen, District- Raigarh, Maharashtra							
1	553850	Wadkhal	Rural	100	91	86	593
2	553851	Beneghat	Rural	6	0	1	99
3	553852	Dolvi	Rural	131	122	39	377
4	553853	Wave	Rural	103	22	8	623
5	553833	Washi	Rural	443	217	113	271
6	553834	Odhangi	Rural	1	0	1	47
7	553835	Koproli	Rural	65	98	14	196
8	553836	Patnoli	Rural	54	50	52	344
9	553837	Antore	Rural	33	1	8	178
10	553838	Dhondpada	Rural	141	149	6	181
11	553839	Umbarde	Rural	81	26	53	447
12	553840	Shirki	Rural	53	135	15	98
13	553941	Kharkarawi	Rural	5	42	7	146
14	553842	Masad Bk	Rural	16	26	2	30
15	553844	Masad Kh	Rural	60	4	8	22
16	553845	Borwe	Rural	139	2	1	31
17	553846	Bori	Rural	4	0	4	111
18	553847	Sarebhag	Rural	304	93	2	37
19	553848	Shinganvat	Rural	24	2	3	17
20	553849	Kolave	Rural	41	39	25	202
21	553902	Uchede	Rural	8	3	2	107

Sr. No.	Town/ Village	Name	TRU	Main Worker Employment Pattern			
				Cultivator	**Agriculture**	**Household**	**Other**
22	553903	Kandlepada	Rural	45	5	19	189
23	553904	Kashmire	Rural	39	96	2	100
24	553905	Kandale	Rural	9	14	8	69
25	553906	Meleghar	Rural	43	1	1	132
26	553907	Vadgaon	Rural	21	8	13	380
27	553824	Lakhola	Rural	141	35	17	18
28	553826	Bahiramwatak	Rural	146	21	1	4
29	553828	Wadhav	Rural	135	208	11	153
30	553955	Khar Dhombi	Rural	28	13	1	8
31	553943	Karav	Rural	40	105	14	253
32	553944	Chirbi 1	Rural	13	93	0	42
33	553945	Kharmachela	Rural	96	87	4	58
34	553946	Kharghat	Rural	8	83	0	27
35	553947	Khar Jambola	Rural	52	26	4	27
36	553949	Jirne	Rural	149	348	2	81
37	553919	Borgaon	Rural	9	246	3	83
38	553932	Wirani	Rural	2	186	0	19
39	553933	Pen Rural	Rural	0	0	1	0
40	553934	Rode	Rural	59	149	2	221
41	553953	Kalad	Rural	21	113	3	11
42	553954	Moujepale	Rural	61	74	1	29
43	553956	Kharpale	Rural	204	16	4	239
44	553957	Jui Habbas Khani	Rural	133	1	0	15
45	553958	Mhaisbad	Rural	162	19	2	132
46	553959	Burdi	Rural	47	5	2	83
47	553960	Kasu	Rural	178	168	7	109
48	553961	Salinde	Rural	211	69	0	90
49	553962	Usar	Rural	24	29	8	14
50	553963	Patani Pandapur	Rural	273	42	3	217
51	802800	Pen (M Cl)	Urban	153	90	656	11687
Sub-total				**4314**	**3472**	**1239**	**18647**
Tehsil- Alibag, District- Raigarh, Maharashtra							
52	554095	Pezari	Rural	86	86	22	285
53	554096	Divlang	Rural	7	0	1	49
54	554097	Bhangar dadaji	Rural	1	0	1	12
55	554098	Talband	Rural	1	0	4	163
56	554100	Shahabaj	Rural	101	171	21	315
57	554101	Ghasawad	Rural	125	150	1	25
58	554103	Walawade	Rural	15	45	3	45
59	554109	Poynad	Rural	116	140	106	753
60	554111	Vaghode	Rural	22	24	1	37
61	554112	Sagargad	Rural	11	219	3	1
62	554113	Nagazari	Rural	104	314	0	44
63	554114	Kalwad	Rural	64	293	5	63
64	554107	Dehenkoni	Rural	12	61	2	94
65	554108	Bhakarwad	Rural	11	17	0	60
66	554115	Medhekhar	Rural	86	93	10	77
67	554116	Kachali	Rural	87	20	0	37
68	554117	Pitakiri	Rural	47	143	0	17
69	554119	Chikhali	Rural	18	150	0	7
70	554120	Waghwira	Rural	37	10	0	7
71	554121	Kusumbale	Rural	44	253	0	89
72	554122	Khatwira	Rural	0	0	21	42
73	554123	Shrigaon	Rural	81	37	12	266
74	554141	Aweti	Rural	27	204	15	45
75	554142	Sambari	Rural	0	0	6	15
76	554143	Durgadarya	Rural	0	1	0	0

Sr. No.	Town/ Village	Name	TRU	Main Worker Employment Pattern			
				Cultivator	**Agriculture**	**Household**	**Other**
77	554128	Jalashi	Rural	11	0	1	4
78	554129	Ravet	Rural	34	16	4	35
79	554135	Hemnagar	Rural	1	0	0	57
80	554136	Kolghar	Rural	29	293	0	60
81	554137	Dalavi Kharoshi	Rural	27	117	0	13
82	554138	Bopoli	Rural	31	359	1	4
83	554139	Ruishet Bhomoli	Rural	74	727	5	32
84	554140	Bidwagale	Rural	76	78	0	15
85	554110	Navenagar	Rural	25	0	0	9
86	554125	Wadawali	Rural	86	55	0	11
87	554126	Tadwagale	Rural	5	40	5	19
88	554127	Talashet	Rural	109	132	1	14
89	554078	Gan Tarf Shrigaon	Rural	0	87	2	4
90	554080	Kurkundi Koltembhi	Rural	161	233	5	155
91	554057	Khopane Khar	Rural	9	8	0	1
92	554061	Chari	Rural	185	30	4	41
93	554036	Mankule	Rural	183	49	2	66
94	554130	Kopari	Rural	0	0	1	0
95	554132	Simadevi	Rural	4	0	0	1
96	554133	Navkhar Tarf Shrigaon	Rural	60	46	3	16
97	554092	Dherand	Rural	63	9	0	36
98	554093	Shahapur	Rural	1125	317	9	337
99	554134	Kurdus	Rural	160	157	32	135
100	554203	Ambepur (CT)	Urban	87	49	33	2300
Sub-total				**3648**	**5233**	**342**	**5913**
Tehsil- Mhasla, District- Raigarh, Maharashtra							
101	554920	Dehen	Rural	**46**	**22**	**1**	**28**
Tehsil- Panvel, District- Raigarh, Maharashtra							
102	553358	Nagzari	Rural	**31**	**2**	**0**	**116**
Grand-total				**8039**	**8729**	**1582**	**24704**

Source: Primary Census Abstract 2011, District Raigarh, Maharashtra

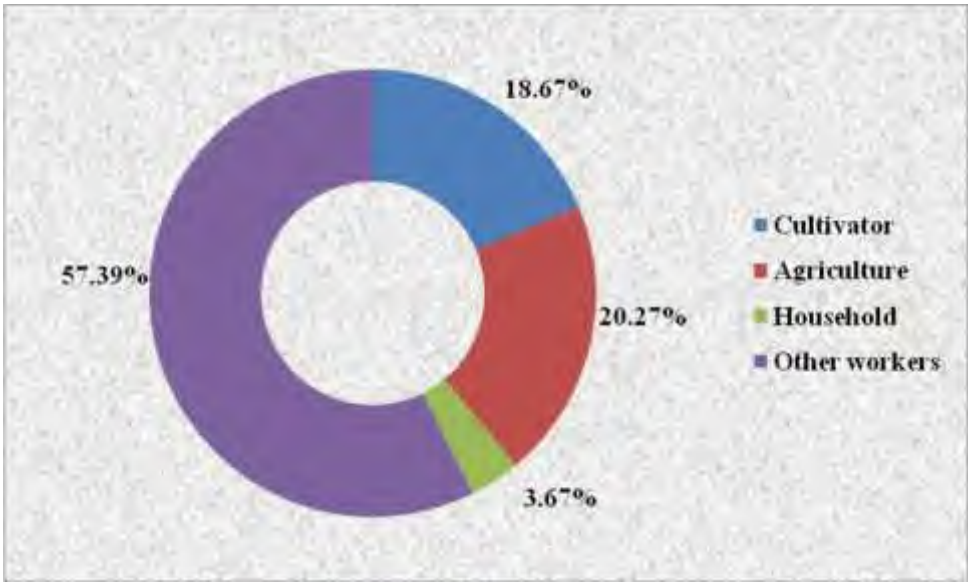


Figure 3.6.5 : Main Worker Employment Details

3.6.5 Infrastructure Resource Base

The infrastructure resources base of the eleven study areas with reference to education, medical facility, water supply, post and telegraph, transportation, communication facility, power supply and existence of nearest town etc. according to the Village Directory Census CD 2011. The significant features of these important parameters for each study area are discussed as follows and summarised at **Table 3.6.5**

Education: As per 20011 village directory record, almost all villages having education facility in the form of primary schools, and middle school, **Medical/Primary Health Care** :Medical facilities in terms of community health workers are available in some of the villages. Only primary health sub centers are available in few villages. **Drinking Water:** The water supply in the region is through dug wells, hand pumps, taps and other allied sources. **Drainage and Sanitation Facilities:** Drainage and sanitation facilities were not adequate in the study area. Mostly Open drainage, and open kuccha drainage observed in the village. **Communication:** Communication facility is fairly good in this region. Near about 50% villages having telephone connectivity and having post office. **Transportation:** A well planned and efficient network of transport is an essential component for a developing country. In the absence of efficient network of transport, a State's economy would suffer from major grid lock in terms of overall growth potential of that area. In village public bus facility was availed and other facilities were private bus. **Road Approach:** Roads are the basic means of communication for the development of any economy. All type of roads was present in the study area. **Bank Facilities:** Banking and credit society facility was not found in village. Self help group activities were performed by the women groups. **Power Supply:** Almost all villages are electrified in the region and electricity is available for both domestic and agriculture.

3.6.6 Main Commodities

Main commodities details have been taken from DCHB 2011 of Maharashtra. Paddy is major crop in the study area **Table 3.6.7**

Table 3.6.5: Infrastructure Resource Base in Study Area

Education Facilities									Health Care Facilities			
Govt. Pre - Primary School (Nursery/LKG/UKG) (Numbers)	Private Pre - Primary School (Nursery/LKG/UKG) (Numbers)	Govt. Primary School (Numbers)	Private Primary School (Numbers)	Govt. Middle School (Numbers)	Private Middle School (Numbers)	Govt. Secondary School (Numbers)	Private Secondary School (Numbers)	Govt. Senior Secondary School (Numbers)	Primary Health Centre (Numbers)	Primary Health Sub Centre (Numbers)	Dispensary (Numbers)	Veterinary Hospital (Numbers)
138	1	136	7	50	5	10	5	2	3	14	5	1
Drinking Water Facilities									Sanitation Facilities			
Tap Water-Treated	Tap Water Untreated	Covered Well	Uncovered Well	Hand Pump	Tube Wells/Borehole	Spring	River/Canal	Tank/Pond/ Lake	Open Drainage	No Drainage	Open Pucca Drainage Uncovered	Open Kuccha Drainage
68	37	4	87	34	22	11	15	48	51	49	30	18
Communication Facilities					Transportation Facilities				Banking Facilities			
Post Office	Sub Post Office	Post And Telegraph Office	Telephone (landlines)	Public Call Office /Mobile (PCO)	Public Bus Service	Auto/Modified Autos	Taxi	Vans	Sea/River/Ferry Service	Cooperative Bank	Agricultural Credit Societies	Self - Help Group (SHG)
3	24	3	48	33	68	9	9	9	3	0	37	65
Road Approach Facilities					Power Supply Facilities							
Black Topped (pucca) Road	Gravel (kuchha) Roads	Water Bounded Macadam	All Weather Road	Footpath	Power Supply For Domestic Use	Power Supply For Agriculture Use	Power Supply For Commercial Use	Power Supply For All Users				
85	54	29	89	100	99	98	48	48				

Source: District Census Handbook 2011, Raigarh, Maharashtra State

Table 3.6.6 : Land use Pattern in Hectares

Sr. No.	Village Name	Total Geographical Area	Forest Area	Area under Non-Agricultural Uses	Barren & Un-cultivable Land Area	Culturable Waste Land Area	Fallows Land other than Current Fallows Area	Current Fallows Area	Net Area Sown
1	Wadkhal	252.11	42.51	42.58	11.85	45.99	0	41.22	67.96
2	Beneghat	73	0	2	22	0	20	0	29
3	Dolvi	449.86	93.03	174.68	44.55	19.96	80.64	0	33.56
4	Wave	395.4	83.33	185.08	48.52	15.2	0	10.05	52.19
5	Washi	483	0	120	0	0	0	0	363
6	Odhangi	266	0	122	0	0	0	0	144
7	Koproli	482	33.02	128.44	0	25.54	0	0	295
8	Patnoli	195	0	2	29	0	0	129	35
9	Antore	126.64	0	2.75	0	0	0	0	88.75
10	Dhondpada	286	0	126.62	0	9.74	0	0	149.64
11	Umbarde	522	24	213	0	162	0	0	123
12	Shirki	134	0	2	19	0	0	3	110
27	Kharkarawi	157.17	0	126.61	9.9	0	0	0	20.66
14	Masad Bk	241	0	2	45	0	13	0	181
15	Masad Kh	205	0	2	44	0	10	0	149
16	Borwe	194	0	2	39	0	0	3	150
17	Bori	77.56	0	2	0	14.72	0	0	60.84
18	Sarebhag	346	0	105	0	0	0	0	241
19	Shinganvat	58	0	2	3	0	23	6	24
20	Kolave	144.01	0	2	10	14.66	0	20.25	97.1
21	Uchede	27	0	1	3	0	0	2	21
22	Kandlepada	164	19	2	32	0	5	0	106
23	Kashmire	44	6	2	6	1	0	7	22
24	Kandale	259	112	2	11	0	0	39	94
25	Meleghar	97	0	2	6	0	0	0	87

Sr. No.	Village Name	Total Geographical Area	Forest Area	Area under Non-Agricultural Uses	Barren & Un-cultivable Land Area	Culturable Waste Land Area	Fallows Land other than Current Fallows Area	Current Fallows Area	Net Area Sown
26	Vadgaon	143	55	2	12	0	0	3	68
27	Lakhola	198	0	2	10	3	0	0	183
28	Bahiramwatak	196	0	2	34	1	0	0	159
29	Wadhav	299	0	2	30	25	0	20	222
30	Khar Dhombi	123.24	0	15.58	0	0	0	2.1	103.7
31	Karav	746.56	443.21	6.85	17.59	0	0	0	278.91
32	Chirbi 1	125.76	0	2.75	16.43	0	0	0	106.58
33	Kharmachela	109.47	0	2	35.47	0	0	0	72
34	Kharghat	49	0	2	3.02	0	0	0	43.98
35	Khar Jambola	80	0	13	0	0	0	0	67
36	Jirne	1292.4	726.21	2	0	0	0	382.93	0
37	Borgaon	652	98	2	0	0	0	104	446
38	Wirani	171	37	2	23	0	0	0	109
39	Pen Rural	1001	229	48	0	0	0	0	724
40	Rode	544	0	2	158	0	0	3	377
41	Kalad	272.34	127.31	2	20.4	81.55	0	0	41.08
42	Moujepale	176.72	57.16	51.14	0	0	0	1	61.52
43	Kharpale	160.87	0	22.08	0	0	0	0	132.22
44	Jui Habbas Khani	116.35	0	66.55	0	0	0	0	49.8
45	Mhaisbad	162.52	0	22.19	0	0	0	1.35	138.98
46	Burdi	94.69	0	1.55	10.13	0	1.63	26.45	54.93
47	Kasu	104	0	2	24.66	0	2.31	0	75.03
48	Salinde	678.14	337.24	18.05	94.78	94.61	0	0	133.46
49	Usar	133.31	73.05	2	11.74	32.57	0	0	13.95
50	Patani Pandapur	265.79	0	4.54	32.02	0	24.18	0	205.05

Sr. No.	Village Name	Total Geographical Area	Forest Area	Area under Non-Agricultural Uses	Barren & Un-cultivable Land Area	Culturable Waste Land Area	Fallows Land other than Current Fallows Area	Current Fallows Area	Net Area Sown
51	Pezari	160.49	0	2	6.13	9.5	2.12	13.95	123.46
52	Divlang	7	0	2	1.33	0	0	1.25	2.42
53	Bhangar dadaji	2	0	2	0	0	0	0	0
54	Talband	54.53	0	2.1	5.79	0	0	0	46.64
55	Shahabaj	568.94	0	50.38	56.33	6.24	5.8	8.72	437.7
56	Ghasawad	14	0	2.75	2.9	0	2.11	0	5.38
57	Walawade	48	0	1.9	6.17	12	0	2.18	25.25
58	Dehenkoni	177.13	0	8.73	0	0	29.47	0	138.93
59	Bhakarwad	26	0	5.5	2.44	2	0	0	16.06
60	Poynad	135.21	35	85	0	0	0	0	15.21
61	Vaghode	64.89	3.98	2.03	0	7.98	0	1.42	49.48
62	Sagargad	1044	570.03	2	0.45	16.41	48.91	6.08	400.12
63	Nagazari	144	0	30.93	0	0	0	0	113.07
64	Kalwad	97.7	0	2.25	0	0	0	0	95.45
65	Medhekhar	227.56	0	34.26	0	0	0	158.6	34.7
66	Kachali	160	0	21	0	11.04	0	0	127.96
67	Pitakiri	133.6	0	2	13.68	0	11.31	0	106.61
68	Chikhali	57.41	0	2	15.98	0	0	0	39.43
69	Waghwira	71	0	2.1	5.88	17.8	0	45.22	0
70	Kusumbale	404.58	328.35	5	9.08	0	0	0	62.15
71	Khatwira	60.95	0	2.75	1.72	0	0	0	56.48
72	Shrigaon	604.57	169.08	8	0	0	141.97	0	281.87
73	Aweti	371.03	142.13	3.34	38.1	0	0	0	186.46
74	Sambari	100.67	0	20.51	0	0	0	0	80.16
75	Durgadarya	12	0	2	4.17	0	0	0	2.85
76	Jalashi	18	0	2.86	1.41	0	0	0	13.73

Sr. No.	Village Name	Total Geographical Area	Forest Area	Area under Non-Agricultural Uses	Barren & Un-cultivable Land Area	Culturable Waste Land Area	Fallows Land other than Current Fallows Area	Current Fallows Area	Net Area Sown
77	Ravet	209.7	56.91	3.78	0	0	0	85.83	63.18
78	Hemnagar	166	46.96	2.1	12.58	0	0	0	104.36
79	Kolghar	199.6	0	2	14.6	2.56	0	0	180.44
80	Dalavi Kharoshi	424.7	285.25	2	20.61	0	1.37	0	115.47
81	Bopoli	333.42	248.97	2	12.18	0	0	0	70.27
82	Ruishet Bhomoli	281.26	230.68	7.58	0	0	0	0	43
83	Bidwagale	1478.23	1180.58	2.66	42.67	0	0	0	252.32
84	Navenagar	194.67	0	2	0	0	0	0	192.67
85	Wadawali	89.52	0	2	6.19	0	0	0	71.83
86	Tadwagale	440.03	192.36	2	33.68	4.83	0	0	207.16
87	Talashet	299.64	48.58	2	56.12	0	6.23	0	186.71
88	Gan Tarf Shrigaon	164.31	96.82	1.28	2	3.03	0	0	61.18
89	Kurkundi Koltembhi	208.49	0	2.5	16.44	0	0	0	165.5
90	Khopane Khar	142.64	0	2	32.66	0	0	0	107.98
91	Chari	93.8	0	2	35.72	0	0	0	56.08
92	Mankule	339	0	2	98	0	6	0	233
93	Kopari	71.92	0	24.23	0	0	0	0	47.69
94	Simadevi	24	0	3.49	4.94	0	0	0	15.57
95	Navkhar Tarf Shrigaon	99.56	0	6.22	17.66	0	0	0	75.68
96	Dherand	233.41	0	39.71	39.81	0	0	0	153.89
97	Shahapur	1387.74	0	182.39	111.93	0	0	0	1093.42

Sr. No.	Village Name	Total Geographical Area	Forest Area	Area under Non-Agricultural Uses	Barren & Un-cultivable Land Area	Culturable Waste Land Area	Fallows Land other than Current Fallows Area	Current Fallows Area	Net Area Sown
98	Kurdus	271.49	80.18	7	27.81	0	0	0	156.5
99	Dehen	345.82	106.28	1.42	92.17	2.2	12.08	6.25	32.15
100	Nagzari	87	16.51	2	7.66	21	0	0	39.71
Total		**25925.1**	**6434.72**	**2283.79**	**1774.05**	**663.13**	**447.13**	**1133.85**	**12798.2**

Source: District Census Abstract 2011, Raigarh, Maharashtra

Table 3.6.7 : Main Commodities

Sr. No.	Name of Tehsil	Village Code	Village Name	Agricultural Commodities (First)	Manufacturers Commodities (First)	Handicrafts Commodities (First)
1	Pen	553850	Wadkhal	NA	Salt	Ganapati Clay Statues
2	Pen	553851	Beneghat	NA	NA	NA
3	Pen	553852	Dolvi	NA	Steel	NA
4	Pen	553853	Wave	NA	NA	NA
5	Pen	553833	Washi	NA	Salt	Ganapati Clay Statues
6	Pen	553834	Odhangi	NA	NA	Ganapati Clay Statues
7	Pen	553835	Koproli	NA	Salt	NA
8	Pen	553836	Patnoli	NA	NA	NA
9	Pen	553837	Antore	NA	NA	NA
10	Pen	553838	Dhondpada	NA	Salt	NA
11	Pen	553839	Umbarde	NA	NA	NA
12	Pen	553840	Shirki	NA	NA	Ganapati Clay Statues
27	Pen	553941	Kharkarawi	NA	Iron & Steel	NA
14	Pen	553842	Masad Bk	NA	NA	Ganapati Clay Statues
15	Pen	553844	Masad Kh	NA	NA	NA
16	Pen	553845	Borwe	NA	Salt	NA
17	Pen	553846	Bori	NA	Salt	Ganapati Clay Statues
18	Pen	553847	Sarebhag	NA	Salt	NA
19	Pen	553848	Shinganvat	NA	Salt	NA
20	Pen	553849	Kolave	NA	NA	NA
21	Pen	553902	Uchede	Rice	NA	NA
22	Pen	553903	Kandlepada	Rice	NA	NA
23	Pen	553904	Kashmire	Rice	NA	NA
24	Pen	553905	Kandale	Rice	NA	NA
25	Pen	553906	Meleghar	Rice	NA	NA
26	Pen	553907	Vadgaon	Rice	NA	NA
27	Pen	553824	Lakhola	NA	NA	NA
28	Pen	553826	Bahiramwatak	NA	NA	NA
29	Pen	553828	Wadhav	Paddy	NA	NA
30	Pen	553955	Khar Dhombi	NA	NA	NA
31	Pen	553943	Karav	NA	Tiles	NA
32	Pen	553944	Chirbi 1	NA	NA	NA
33	Pen	553945	Kharmachela	NA	NA	NA
34	Pen	553946	Kharghat	NA	NA	NA
35	Pen	553947	Khar Jambola	NA	NA	NA
36	Pen	553949	Jirne	NA	NA	NA
37	Pen	553919	Borgaon	NA	Medicine	NA
38	Pen	553932	Wirani	NA	NA	NA
39	Pen	553933	Pen Rural	NA	NA	NA

Sr. No.	Name of Tehsil	Village Code	Village Name	Agricultural Commodities (First)	Manufacturers Commodities (First)	Handicrafts Commodities (First)
40	Pen	553934	Rode	NA	NA	NA
41	Pen	553953	Kalad	NA	NA	NA
42	Pen	553954	Moujepale	NA	NA	NA
43	Pen	553956	Kharpale	NA	NA	NA
44	Pen	553957	Jui Habbas Khani	NA	NA	NA
45	Pen	553958	Mhaisbad	NA	NA	NA
46	Pen	553959	Burdi	NA	NA	NA
47	Pen	553960	Kasu	NA	NA	NA
48	Pen	553961	Salinde	NA	NA	NA
49	Pen	553962	Usar	NA	NA	NA
50	Pen	553963	Patani Pandapur	NA	NA	NA
51	Alibag	554095	Pezari	NA	NA	NA
52	Alibag	554096	Divlang	NA	NA	NA
53	Alibag	554097	Bhangar dadaji	NA	NA	NA
54	Alibag	554098	Talband	NA	NA	NA
55	Alibag	554100	Shahabaj	NA	NA	NA
56	Alibag	554101	Ghasawad	NA	NA	NA
57	Alibag	554103	Walawade	NA	NA	NA
58	Alibag	554107	Dehenkoni	NA	NA	NA
59	Alibag	554108	Bhakarwad	NA	NA	NA
60	Alibag	554109	Poynad	NA	NA	NA
61	Alibag	554111	Vaghode	NA	NA	NA
62	Alibag	554112	Sagargad	NA	NA	NA
63	Alibag	554113	Nagazari	NA	NA	NA
64	Alibag	554114	Kalwad	NA	Tiles	NA
65	Alibag	554115	Medhekhar	Paddy	Bricks	NA
66	Alibag	554116	Kachali	NA	NA	NA
67	Alibag	554117	Pitakiri	NA	NA	NA
68	Alibag	554119	Chikhali	NA	NA	NA
69	Alibag	554120	Waghwira	NA	NA	NA
70	Alibag	554121	Kusumbale	NA	NA	NA
71	Alibag	554122	Khatwira	NA	NA	NA
72	Alibag	554123	Shrigaon	Paddy	NA	NA
73	Alibag	554141	Aweti	NA	NA	NA
74	Alibag	554142	Sambari	NA	NA	NA
75	Alibag	554143	Durgadarya	NA	NA	NA
76	Alibag	554128	Jalashi	NA	NA	NA
77	Alibag	554129	Ravet	NA	NA	NA
78	Alibag	554135	Hemnagar	NA	NA	NA
79	Alibag	554136	Kolghar	NA	NA	NA
80	Alibag	554137	Dalavi Kharoshi	NA	NA	NA
81	Alibag	554138	Bopoli	NA	NA	NA

Sr. No.	Name of Tehsil	Village Code	Village Name	Agricultural Commodities (First)	Manufacturers Commodities (First)	Handicrafts Commodities (First)
82	Alibag	554139	Ruishet Bhomoli	NA	NA	NA
83	Alibag	554140	Bidwagale	NA	NA	NA
84	Alibag	554110	Navenagar	NA	NA	NA
85	Alibag	554125	Wadawali	NA	NA	NA
86	Alibag	554126	Tadwagale	NA	NA	NA
87	Alibag	554127	Talashet	NA	NA	NA
88	Alibag	554078	Gan Tarf Shrigaon	NA	NA	NA
89	Alibag	554080	Kurkundi Koltembhi	NA	NA	NA
90	Alibag	554057	Khopane Khar	NA	NA	NA
91	Alibag	554061	Chari	NA	NA	NA
92	Alibag	554036	Mankule	NA	NA	NA
93	Alibag	554130	Kopari	NA	NA	NA
94	Alibag	554132	Simadevi	NA	NA	NA
95	Alibag	554133	Navkhar Tarf Shrigaon	NA	NA	NA
96	Alibag	554092	Dherand	NA	NA	NA
97	Alibag	554093	Shahapur	NA	NA	NA
98	Alibag	554134	Kurdus	NA	NA	NA
99	Mhasla	554920	Dehen	NA	NA	NA
100	Panvel	553358	Nagzari	NA	NA	NA
NA= Not Applicable						

Source: District Census Handbook 2011, Raigarh, Maharashtra State

3.6.7 Trade and Industries

People in the Pen city are employed in various sectors such as trade/business, education, banking, industries, services, papad making (women's co-operatives) and most importantly, idol making. Most villagers are dependent for livelihood on Paddy farming in monsoon. Various vegetables are also grown as by-products, especially in eastern part of the county. The industrial belt in the western part of the county is causing a major problem of pollution in surrounding rural areas, creating health problems and reducing crop yields.

- **Ganesh Idols:** Pen is very famous for its Ganesh Idols which are used widely for the "Ganesh Festival". Many of Ganesh Idols in Mumbai are brought from Pen. There are multiple lanes which consist only of such Idol Making craftsmen. Going through these lanes one can see the whole process of developing Ganesh Idols. Number of Ganesh Idols is now even exported to the Marathi population in the US.
- **Papad business** Women in Pen are occupied in the domestic business of preparing "Pohe" (flattened rice) and papad. Significance of Papad business is that this business is women dominated business. Number of women workers is significantly high. There is hardly any male worker

working in the Papad business. Moreover, owner of these papad business are women. There has been betterment in this business in past few years and they have introduced varieties of Papads. Today, there are approximately 72 to 75 types of papad that they manufacture. Types of papad include Tikali papad, Miragunda papad, Poha Papad, Rice Papad, Nachani Papad Fenugreek Papad etc. This business is on such high peack that they distribute papad not only in India but they export papads out of India.

- **Salt Production** Due to unique geological features of Western part of Pen County (Vashi Subdivision), Pen has been for century's hub of salt making industry dominated by koli community while Brahmin people are also involved.

3.6.8 Health Status

Government health institution is connected with district level, rural hospital, Primary health center and sub center. A district hospital typically is the major health care facility in this region, with large numbers of beds for intensive care and long-term care; and specialized facilities for surgery, plastic surgery, childbirth, bioassay laboratories, and so forth make treatment facilities available to the public-at-large. PHCs remain the first contact between village community and medical officer. Medical officer supported by 14 Paramedical and other staffs. It acts as a referral unit for 6-sub center. It has 4-6 beds for patient.

Sub-centers: The sub-center is the most peripheral health unit and first contact point between the primary health center system and the community. Each sub-center has one female health worker. One female assistant and male health assistant supervise six-sub center. During the field survey, villagers revealed that the general prevailing diseases are malaria, Skin diseases, gastroenteritis, inching, diarrhea, dysentery, viral fever, respiratory infection and jaundice etc. The health problem as reported could be attributed to improper sanitation and salty water in the survey villages. The diseases prevailing in the region has increased due to air pollution caused by the industries in the region, vehicular pollution due to heavy traffic creating unsanitary conditions. In the surveyed area sufficient health services are available in the area like Asha worker, nurses, community health worker, primary health center, primary sub center, government hospital and private clinics.

3.6.9 Methodology used for the Field survey

In order to access and evaluate likely impacts arising out of any development projects on socio-economic environment, it is necessary to gauge the apprehensions of the people in the study areas.

3.6.9.1 Methodology applied for selection of sample & data collection

The methodology which is applied for primary source of data collection i.e. gathering data through field survey for socio-economic environment

Level of Consultation

Level	Type	Key participants
Individual	Household survey	People including those are impacted directly or indirectly
Settlement	FGD	Villagers and Village Leader etc.
Govt. office	Discussion	Gram Panchyat Sarpanch, Gram Panchyat Secretary,

3.6.9.2 Site Visit

Site visit was done by National CSIR- Environmental Engineering Research Institute (NEERI) consultant for socio-economic studies in the month of March 12th to 17th March 2019 for 5 days. Survey team performed the survey in villages with socio-economic study format. In study area villages by random sampling total 12 villages are choose for socio-economic survey. Survey villages list is given at **Table 3.6.8.**

Table 3.6.8 : Socio-economic Survey Areas

Sr. No.	Village Code No.	Name Of Village	Tehsil
1	553852	Dolvi	Pen
2	553833	Washi	
3	553956	Kharpale	
4	553960	Kasu	
5	553949	Jirne	
6	554100	Shahabaj	Alibag
7	554135	Hemnagar	
8	554121	Kusumbale	
9	554093	Shahapur	
10	554092	Dherand	
11	554139	Ruishet Bhomoli	
12	554111	Vaghode	

3.6.9.3 Sampling Method

A judgmental and purposive sampling method was used for choosing respondents of various sections of the society i.e. Sarpanch, adult males and females, teachers, medical practitioners, businessmen, agriculture laborers, unemployed group etc. Judgmental and purposive sampling method includes the right cases from the total population that helps to fulfill the purpose of research needs.

3.6.9.4 Data Collection Method

For the process of data collection through primary source farming methods are used:

3.6.10 Field Survey and Observations

Field survey and observations is made at each sampling village and the socio-economic status of that region is studied.

3.6.10.1 Interview Method

Structured interview method is used to collect data regarding the awareness and opinion from the samples selected of the various socio- economic sections of the community. Structured interviews involve the use of a set of predetermined questions that includes fixed and alternative questions. The questionnaire mainly highlights the parameters such as income, employment and working conditions, housing, food, water supply, sanitation, health, energy, transportation and communication, education, environment and pollution to assess the standard of living of that particular region and general awareness, opinion and expectation of the respondents about the proposed project. Interview method helps to collect more correct and accurate information as the interviewer is present during the field survey.

Socio-economic survey was conducted in the villages within the study areas located in all directions with reference to the project site. The respondents were asked for their awareness / opinion about the existing plant and also of their opinion about the positive and negative impacts of the plant activities viz. job opportunities, education, health care, housing, transportation facility and economic status etc. Public consultation meeting was organized at 12 villages. The number of participants in consultation was 200-250 including all categories.

3.6.10.2 Data Collection and Quality Assurance

The latest available data have been complied to generate the existing socio-economic scenario of the study area. Information on socio-economic profile was collected from the Primary Census Abstract CD 2011, including the population details of the region and Village Directory CD 2011, having the details of basic amenities available in the region. In the 10 km radial study area 100 village and 02 towns are falling from the study area.

3.6.10.3 Salient Observation of the Survey/ Study Area

- **House pattern:** Quality of houses is in well condition and mostly people have permanent cemented (pucca) constructed houses few villagers are having kaccha houses
- **Employment:** Most of the population is engaged in port related labour work, in JSW plant near Dolvi, there are few companies nearby which are providing labour work and permanent job also. Some population is engaged in business activities such as land dealer, fishing, shops etc. peoples having their own land engaged in farming in a rainy season. The district is mainly produced rice, but because of insufficient irrigation facility farmers get only one season crop in one year. Fishing activities carried out by the number of fishermen. The labours were getting daily wage in the range of Rs. 200-250, depending on type of work involved.
- **Fuel:** Most of the villagers use fire woods and LPG for cooking purpose
- **Language:** The main language as mother tongue in the district is Marathi but Hindi, and English speaking population is increased also because of industrialization

- **Migration:** During survey it was found that local population were migrating for employment purpose. As well as others state peoples were came in that area for the labour work also.
- **Sanitation:** Sanitation facilities are in good condition, 90% villagers are using toilets, it shows that villagers are aware about sanitation, but some villages which are near by the industry, there population is increasing day by day because of migration of other states labor in the study area and they are living in any unsettled condition they couldn't get sufficient facility because of shortage of place for their daily needs and therefore creating unhygienic condition
- **Drinking Water Facilities:** Tap water is a major source of drinking purpose.. The main problem regarding to the drinking water is saltiness, scarcity in summer season. Some villages JSW & MIDC provide water through purifier water.
- **Education Facilities:** Anganwadi Centers are available in most of the villages. The survey data indicated that most of the villages are having primary school facility while for further education people have to travel about 20 km. highest educational level in the study area is up to 10th class. The scope for higher and technical education is existing only at the district place and only few people are able to take benefits of these educational institutions
- **Road Connectivity & Transportation Facility:** Approach roads are mainly damber roads. Bus services and other private sources for transportation are available for villagers; Roads are well connected with main district. Villagers who are deprived from transportation facility in their village, they have to walk down 1 to 3 km.
- **Communication Facilities:** Communication facility is good in the study area. Every villager is having mobile phone, television, newspaper facility. It indicates that the study area is well developed in communication.
- **Medical Facilities:** Most of the village residents have to travel an approximate distance of 5-10km to get medical facilities in tehsil place, as there is no such availability of PHC/CHC. During the site visit it was understood through public consultation with stakeholders that Anganwadi and ASHA workers are available in most of the villages of the study area. There are no chronic or epidemic diseases reported/or observed during the course of site visit of the study area except general cases of fever and cough.
- **Pollution:** Due to of industries and construction of highways affected villages going to suffering from noise air pollution it was unsatisfactory. According to villagers industry theirs soil and water also polluted reason paddys and vigitables production were lost.
- **Electricity:** Electricity is available in almost all the villages, however most of the villages are having only for domestic and other purposes.

- **Market Facility:** Study area was predominantly semi urban type. In villages, small shops were available for daily needs. Weekly market facility was available in some villages. Wholesale markets were available at town place.

3.6.10.4 Consultation with Women

CSIR-NEERI officials have also consulted with women groups and asked them about their education, employment opportunity, health and position in the society. In addition to their household works, their secondary involvement is limited to agricultural works which is seasonal in nature. They are comparatively less educated with respect to male and have limited opportunity of employment but they are aware about their rights.

3.6.10.5 Consultation with Youth of the Study Area

A consultation was conducted with youths to record their perception and the opinion about the project. NEERI team has discussed the developmental issues and employment opportunity in the region. They are very hopeful with the proposed project and its positive impacts in future. It is observed that youth in the study area are much conscious with their education, career and also seeking employment opportunities in proposed project and metropolitan cities like Mumbai and abroad.

Details of interaction with different groups with village speciality and major problems of the villagers are discuss at **Table 3.6.9** Public consultation photographs at **Plate 3.6.1 to 3.6.6**

Table 3.6.9 : Details of Interaction with Different Groups in the Study Area

Sr. No.	Name Of Village	Gram Panchayat & Under Villages	Tehsil & District	Brief Information Of Village	Major Issues
1)	Dolvi	Dolvi	Pen, District-Raigarh, MS	Village dominant caste is Agry (OBC), major occupation of the village of labour work. Major Drinking water source of JSW/MIDC purifier water tank, Sub post office and ration shop available in the village, PHSC also available, Very few agriculture land available in village and Paddy is major crops. JSW doing CSR activities (Sanitation, Education, Road and SHG)	School Building, Load Shedding, Air, Noise, Water & Soil pollution is major, Health problems and Employment etc.
2)	Washi	Vashi (Odhangi, Sarveo)	Pen, District-Raigarh, MS	Village dominant caste is Agry (OBC), major occupation of the village of Farming. Paddy is major crops as well as Salt farming and Fish pond also but no any irrigation facilities are available depend on only rain. Major Drinking water source of Dam but not get regularly, Sub post office Bank, Co-operative Society and ration shop available in the village, no any CSR activities	Air Pollution, Employment, Power Cut and Drinking water etc.
3)	Kharpale	Kharpale	Pen, District-Raigarh, MS	Village dominant caste is Agry (OBC), major occupation of the village of Farming. Paddy is major crops as well as Salt farming and Fish pond also but no any irrigation facilities are available depend on only rain. Major Drinking water source JSW/MIDC purifier water tank, Sub post office Bank, Co-operative Society and ration shop available in the village, JSW	Air Pollution, Employment and Health etc

Sr. No.	Name Of Village	Gram Panchayat & Under Villages	Tehsil & District	Brief Information Of Village	Major Issues
				doing CSR activities (Sanitation, Education, Road, Sports and SHG)	
4)	Kasu	Kasu (Patni Pandapur, Burdi and Salendhi)	Pen, District-Raigarh, MS	Village dominant caste is Agry (OBC), major occupation of the village of Farming. Paddy is major crops but no any irrigation facilities are available depend on only rain. Major Drinking water source JSW/MIDC purifier water tank, Sub post office and ration shop available in the village, Electricity supply is available but some tribal communities home not available JSW doing CSR activities (Sanitation, Education, Road, Sports and SHG)	Drinking water, Employment, Air and noise pollution etc.
5)	Jirne	Jirne	Pen, District-Raigarh, MS	A small village situated in the mountains & valley, Village dominant caste is Maratha (Open), major occupation of the village of Farming. Paddy and vegetables is major crops but no any irrigation facilities are available depend on only rain. Major Drinking water source is Open well, ration shop available in the village, no any CSR activities	Transportation, School, Drinking water, Employment, Health Care Facilities, Communication Facilities etc.
6)	Shahabaj	Shahabaj (Walwade, Ghaswar & Talbandh)	Alibagh, District-Raigarh, MS	Village dominant caste is Agry (OBC), major occupation of the village of Farming. Paddy is major crops but no any irrigation facilities are available depend on only rain. Major Drinking water sources Tap water, Sub post office and ration shop available in the village, JSW doing CSR activities (Sanitation, Education, Road,	Electricity, Employment and Drinking Water etc.

Sr. No.	Name Of Village	Gram Panchayat & Under Villages	Tehsil & District	Brief Information Of Village	Major Issues
				Sports and SHG), ancient temple is Lord Shiva	
7)	Hemnagar	Kusumbale (Kachli, Pitkiri, Khatviran, Vagvisa, Chikhli, Raver and Jalsi)	Alibagh, District-Raigarh, MS	Village dominant caste is Agry (OBC), major occupation of the village of Farming. Paddy is major crops but no any irrigation facilities are available depend on only rain. Major Drinking water source is Dam but not get regular, ration shop available in the village, no any CSR activities	College problem, Educational facilities problem, Power Supply, Communication facilities, Employment and Drinking water etc.
8)	Kusumbale	Kusumbale (Kachli, Pitkiri, Khatviran, Vagvisa, Chikhli, Raver and Jalsi)	Alibagh, District-Raigarh, MS	Village dominant caste is Agry (OBC), major occupation of the village of Farming. Paddy is major crops but no any irrigation facilities are available depend on only rain. Major Drinking water source is Dam but not get regular, ration shop available in the village, no any CSR activities	Educational facilities problem, Power Supply, Communication facilities, Employment and Drinking water etc.
9)	Shahapur	Shahapur (Mota) (Dhakte Shahapur, Dherand, Dholpad, Pezari, Dhamanpada)	Alibagh, District-Raigarh, MS	Village dominant caste is Agry (OBC), major occupation of the village of Farming. Paddy is major crops but no any irrigation facilities are available depend on only rain. Major Drinking water source is MIDC(Tata Power) but not get regular, SPO and ration shop available in the village, no any CSR activities	Air Pollution, Drinking Water, Health, and Employment etc.
10)	Dherand	Shahapur (Mota) (Dhakte Shahapur, Dherand, Dholpad, Pezari, Dhamanpada)	Alibagh, District-Raigarh, MS	Village dominant caste is Agry (OBC), major occupation of the village of Farming. Paddy is major crops but no any irrigation facilities are available depend on only rain. Major Drinking water source is MIDC(Tata Power) but not get	Air Pollution, Drinking Water, Health, and Employment etc.

Sr. No.	Name Of Village	Gram Panchayat & Under Villages	Tehsil & District	Brief Information Of Village	Major Issues
				regular, SPO and ration shop available in the village, no any CSR activities	
11)	Ruishet Bhomoli	Kurdus	Alibagh, District-Raigarh, MS	A small village situated in the mountains, Village dominant caste is Maratha (Open), major occupation of the village of Farming. Paddy and vegetables is major crops but no any irrigation facilities are available depend on only rain. Major Drinking water source is River water, ration shop available in the village, no any CSR activities	Student problem, Drinking Water, Communication facilities, Transportation, Sanitation, Open Defection, Health Care facilities and Employment etc.
12)	Vaghode	Vaghode	Alibagh, District-Raigarh, MS	Village dominant caste is Agry (OBC), major occupation of the village of Farming. Paddy is major crops but no any irrigation facilities are available depend on only rain. Major Drinking water source JSW/MIDC purifier water tank, Sub post office and ration shop available in the village, , no any CSR activities	Transportation, Drinking Water, Health and Employment etc.

Public consultation photographs are showing as following.

Plate 3.6.1 : Focus Group Discussion with Villagers

Plate 3.6.2 : Interaction with Village Sarpanch/Leader

Plate 3.6.3 : Gram Panchayat in Study Area

Plate 3.6.4 : School Building in Study Area

Plate 3.6.5 : Temples in Study Area

Plate 3.6.6 : Roads & Housing Pattern of the Study Area

Plate 3.6.7: Mobile Clinic & Sanitation Facilities in the Study Area

Plate 3.6.8 : Drinking Water Facilities in the Study Area

Plate 3.6.9: Beautification of the Villages in the Study Area

3.6.10.6 Awareness and Opinion of People about the Project

An attempt was made to know the awareness and opinion of the people about the project. .

- Some respondents were happy to know about the expansion of project and they opined positively because any industrial development activity would definitely contribute to development towards improvement in the local as well as regional economy and creation of job opportunities. Some respondent asked for better health services and better transportation facilities.
- Respondents added that due to non-availability of technical education most of the local educated youth are not offered jobs in company so would promote professional educational and training facilities in the region
- Unauthorized / illegal dumping of solid & hazardous wastes by industries in the study area is another issue of great concerned. During the survey villagers requested us to recommend prohibitory rules for illegal activities and strict action should be taken for industries.
- Some of the study area part belongs to coastal belt. According to the fisherman respondents, due to industrial activities fish productivity was not satisfactory. It was revealed that air and water pollution were main reasons to affecting fishing activity.

Interaction with respective village Sarpanch/Society Heads/villagers was done to understand the socio-economic issues of the region and their needs.

3.6.11 Conclusion

On the basis of interpretation made above, primary survey (interaction with stakeholders, FGD, community consultation and discussion with influential person of the study area) and secondary sources, the major outcomes specify the following observations and gap in the study area Sanitation and Drainage system is very poor of the study area. Approx. 80.05% no drainage system in the study area. Drinking water

and employment is major problem seen in the study area. Livelihood of the most of the people of the study area depends on jobs, fishing, fishing allied, Agriculture, and cattle rearing. Tap water and wells are the source of drinking water in the study area. There are no any chronic or epidemic disease has been reported in the study area except general cases of cough and fever. Mix opinion about expansion of new plant of JSW. People want to employment for local people in industry. CSR activities carry out in village development through the industry. According to villagers industry will take a proper action to air, water, noise and land pollution.

3.6.12 Quality of Life Assessment

Quality of life (QoL) indicates overall status of socio-economic aspects in a given area. Quality of life (QoL) is defined as a function between "objective conditions" and "subjective attitudes" involving a defined "area" of concern. The "objective conditions" are numerically measurable artifacts of a physical, sociological event or economic event. Objective conditions may be defined as any number, which stands for a given quantity of a variable of interest so long as it is independent of subjective opinion. "Subjective attitude" is primarily concerned with effective and cognitive dimensions. It is specifically concerned with 'how aspects of cognition vary as objective conditions vary'.

Once objective measures are obtained for each factor they are transformed to a normal scale varying from 0 to 1 (value function curve) in which 0 corresponds to the lowest or least satisfactory measure, and 1 corresponds to the highest. The weights are assigned to each factor by ranked-pair wise technique (by the expert group) based on the secondary data and general observations. For each objective measure, a corresponding subjective measure is developed for each individual of the sample population by asking him to rate his satisfaction scale (value function curve). It is used such that 0 corresponds to the lowest level of attitudinal satisfaction and 1 corresponds to the highest level of satisfaction. Weights are assigned to each factor using ranked - pair wise comparison techniques.

The socio-economic indicators used for computation of QoL are:

• Employment	• Housing
• Income	• Health
• Transportation	• Recreation
• Education	• Agriculture
• Medical Facilities	• Cost of Living
• Communication	• Business
• Power	• Per Capita Income
• Sanitation	• Pollution

Subjective, objective and cumulative quality of life is estimated as :

(I) Subjective QoL Calculations:

$$QoLs = 1/p \sum_{i=1} \sum_{j=1} QIij \text{ X } Wi$$

Where,

QoLs = Subjective quality of life index

p = No. of respondents, j = 1, ..., p

m = No. of factors, i = 1, ..., m

QIij = Subjective quality index for ith factor assigned by jth respondent

∑ Qiij = Subjective quality index for ith factor assigned by all respondents in an area

Wi = Relative weightage of the ith factor

(II) Objective Quality of Life

$$QoLo = \sum_{i=1}^{i=n} QIi \times Wi$$

Where,

QoLo = Objective quality of life index

n = No. of QoL Factors

i = 1, ..., n

QIi = Satisfaction level (assigned by the expert group) for the ith objective indicator

Wi = Normalized weight for its factor

(II) Quality of Life (Cumulative Index)

$$QoLc = \frac{QoLo + QoLs}{2}$$

The subjective and objective QoL indices prior to commissioning of the project are presented in **Table 3.6.10**.

The average QoL index values are estimated as:

QoL (s) = 0.50

QoL (o) = 0.52

QoL (c) = 0.51

The average QoL index value for the study area is leading to satisfactory level due to satisfactory status like, educational facilities, roads also availability of basic needs viz., food, clothing & housing. Medical and communication facilities were not adequate in the study area; Improvement in these fields will help to increase quality of life of the study area. Following **Table 3.6.10** is showing quality of life in the study area.

Table 3.6.10 : Quality of Life Existing in Sampling Village

Sr. No.	Village	QoL(S)	QoL(O)	QoL(C)
1	Dolvi	0.52	0.54	0.53
2	Washi	0.57	0.59	0.58
3	Kharpale	0.47	0.49	0.48
4	Kasu	0.52	0.54	0.53
5	Jirne	0.47	0.49	0.48
6	Shahabaj	0.54	0.56	0.55
7	Hemnagar	0.42	0.44	0.43
8	Kusumbale	0.52	0.54	0.53
9	Shahapur	0.53	0.55	0.54
10	Dherand	0.5	0.52	0.51
11	Ruishet Bhomoli	0.51	0.53	0.52
12	Vaghode	0.52	0.54	0.53
Average		**0.50**	**0.52**	**0.51**

QoL(s) = Subjective Quality of Life
QoL (o) = Objective Quality of Life
QoL (c) = Cumulative Quality of Life

Chapter 4
Anticipated Environmental Impacts and Mitigation Measures

4.1 Introduction

JSW Steel Limited (JSWSL), Dolvi is currently operating an integrated steel plant at Dolvi, Raigad (Maharashtra) at a capacity of 5.0 MTPA of crude steel products, producing wide range of steel products. The proposed enhancement of the production of crude steel from 5 MTPA to 10.0 MTPA is currently under execution. In the meanwhile, it has been proposed to install 9.0 MTPA pellet plant and 4.0 sinter plant in place of 4.0 MTPA Pellet plant and 8.0 MTPA sinter plant.

Assessment of Environmental Impact

Impact prediction is a way of mapping the environmental consequences of the significant aspects of the proposed expansion plant and its activities. The impact assessment will focus on the expansion plant and will broadly cover the following information and components:

- æ Assessment of physical effects for all phases including design, construction, and operation.
- æ 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:

- æ Impacts and mitigation measures during construction.
- æ Impacts and mitigation measures during operation.

4.1.1 Initiative taken during design stage

The capacity addition in the expansion of the steel plant to 10 MPTA will have environmental impacts. It is essential that appropriate environment control facility are consider at the design stage to reduce the impacts. The expansion is being planned to installation of state-of-the art technologies for steel manufacturing and environment control. The salient features are as follows:

i) Installation of largest blast furnace of 5500 m3 of the country with state of the art energy efficient and environment control facilities;

ii) State of the art stamp charged coke ovens with coal charging emission controls and coke dry quenching technologies;

iii) Installation of high efficiency bag filters after ESP in exiting Sinter Plant I and II and new sinter plants III first in country, to achieve the dust emission <10 mg/NM3

iv) Installation of high productive 9.0 MPTA pellet plant, largest in the country, to achieve the dust emission <30 mg/Nm3,

v) Large capacity (300t) BOF Converters with hot metal desulphurization and secondary metallurgical furnaces

vi) Use of 100%Continuous Casting technology, with considerable energy savings.

vii) Steam box technology for in situ weathering of steel slag

viii) State of the art Hot and Cold rolling mills producing special value added products using byproduct fuel gases in their furnaces.

ix) State of Art air and water pollution technologies like Gas Cleaning Assistant(GCA) for Sy FE systems; Variable speed fans for large APC equipment; dry type GCP for BOF & Blast furnace gas cleaning,

With the latest facilities, the JSWSL plant at Dolvi will be the most advanced integrated steel plant in the country

4.1.2 Impact and Mitigation Measures During Construction Phase

The construction activities related to the proposed expansion units to 10 MTPA are currently in progress. These activities are predominantly confined within the steel plant complex. The proposed project will have large-scale construction activities, mostly mechanized, related to foundations, piling, RCC structures, roads, erection of structures, piping, cabling, electrical equipment etc. The construction equipment such as trucks, dozers, concrete-mixers, welding /cutting machines are likely to be continuously operational. The structural fabrication has been kept to the minimum as ready to erect structures are fabricated in different workshops and transported to site for final erection to save time, greatly reducing the impacts due to handling and welding of such large structures.

The project site is already a developed site and further development of additional green belt and greenery in the new area will provide further mitigation and improved vegetation habitat. The units in the expansion will be accommodated in the overall 1800 acres of industrial land.

As the surroundings of Dolvi is already a fairly well developed area with all sorts of infrastructure available for settlement, the influx of construction labor at site is not going to change present land use pattern significantly. Further, there will be no impact on the wildlife as they are restricted mainly to the dense forest area, which is beyond 10 km area and does not form part of the project area. Thus, there will be a minor temporary impact on the flora and no Impact on the fauna of the study area during the construction stage of the proposed project.

Mitigation Measures

No significant impact envisaged. The welfare facilities for workmen wrt travel, drinking water, sanitation, canteen services, health care facilities shall be provided from the existing infrastructure with suitable upgradation.

4.1.2.1 Air Quality

Impacts

The construction and other associated activities will lead to emission of different pollutants. During the construction phase, dust will be the major pollutant. As plant is proposed to be constructed in phases, construction activity covering a large area is not envisaged. Therefore, the particulate matter emission will be limited and localized. Minor releases of 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:

- æ 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 soils etc.
- æ Generation of pollutants due to operation of heavy vehicles and movement of machineries and equipment for material handling, earth moving, laying of concrete, metal, stones, asphalt, etc.

Mitigation Measures

The following mitigation measures will be deployed during construction phase to reduce the pollution level to acceptable limits.

- æ Proper and prior planning, appropriate sequencing and scheduling of all major construction activities to be done. Further, timely availability of infrastructure and supports needed for construction will be ensured to shorten the construction period to reduce pollution.
- æ Truck carrying soil, sand, stone dust, and stone is being be duly covered to avoid spilling and creation of fugitive emissions. The movement of concrete pouring trucks etc. are planned in advance so that traffic arrangements are made accordingly.
- æ 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.

- æ The speed of all vehicles has been restricted to 20 Km per hour to reduce spillage and dust emissions. Movement of two wheelers and walking inside the plant has been strictly banned.
- æ Low emission construction equipment, vehicles and generator sets will be used in construction. 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.
- æ Vehicles and machineries are being checked for PUC and are being checked by the safety department to assess their fitness and safe operations.
- æ Construction workers will be provided with masks as necessary to protect them from inhaling dust.

4.1.2.2 Water Quality

Surface Water

Impacts

During construction phase, provision for infrastructural services including water supply, sewage, drainage facilities and electrification will be made from the existing facilities. The construction labour would be provided drinking water, canteen and mobile toilet facilities in the plant area to allow proper standards of hygiene.

The impacts on surface and ground 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 proposed expansion plant, no large scale excavation and leveling is required.

Mitigation Measures

- æ Quality of construction wastewater emanating from the construction site is being controlled through suitable drainage system with sediment traps (shallow silting basin as water intercepting ditch) for arresting the silt / sediment load before its disposal to surface water.
- æ The sediment traps and storm water drainage of the existing network is being periodically cleaned and especially before monsoon season.
- æ A small quantity of effluent after treatment will be let out in surface drain, which will be utilized for dust suppression and plantation within the plant premises.

4.1.2.3 Noise level

Impacts

Major sources of noise during the construction phase are vehicular traffic, operation of the 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 boundary. Further in high noisy areas, the construction workers are provided with ear plugs to reduce the impact of noise. The measured noise levels are within permissible limits.

Mitigation Measures

- Protective gears such as earplugs etc. is being be provided to construction personnel exposed to high noise levels as preventive measures. This is being strictly supervised by safety supervisors.
- 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.

4.1.2.4 Socio-economic Environment

Impacts

During the peak construction phase, construction manpower including contract workers will be about 2500. The maximum construction workers are from the nearby villages. However skilled personnel are coming from other areas. Also, since the construction phase of this project will be in phases, the socioeconomic impact due to construction activities is not significant.

Mitigation Measures

Considering the above-mentioned factors, the construction phase of the project will have economically positive impact on population in the study area. No measures are envisaged

4.1.3 Impacts and Mitigation Measures during Operation Phase

General

During the operation phase, depending upon operating conditions releases to the environment may arise from raw material handling to product handling, processing, manufacture of steel, fuel burning etc. Environmental releases may be in the form of:

1. Emission to Air Environment
2. Waste water discharges
3. Solid waste disposal
4. Noise level etc.

These emissions, discharges and disposal may release different pollutants, which may affect air, water, land and ecological environment directly. In addition to these primary impacts, any industrial project has some secondary and 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 plan 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 operation phase of expansion units are elaborated. The socio-economic impacts due to the expansion plan are separately discussed.

The new facilities have been provided with the state of the art environment control facilities and the highlights of the new facilities are given in **Table 4.1**.

Table 4.1 : Salient Features of Details of Environment Control Facilities Proposed in 10 MTPA Units

S. No	Name of the Unit	Salient Features of the Unit
1	Raw Material Handling System (RMHS)	Covered sheds for Coal/Coke storage
		100 % Coverage of Conveyors
		De- dusting system at Junction Houses
		Pneumatic transport of Dust.
		More than 95% raw material input through Sea
2	Coke Oven	100 % De sulphurisation of Coke Oven Gas (COG)
		Claus process for Sulphur recovery
		Coke Dry Quenching to produce steam at 120 bar.
		Coke pushing emission control
		CGT car for charging emission control
		High Pressure Liquor Ammonia (HPLA) system for dust extraction
		Value addition products from Crude tar and Benzol
		Biological Oxidation and Phenolization (BOD) Plant for Waste water treatment with Nitrification and De-Nitrification
		Belt Feed mechanism with combined operation of stamping, charging & Pushing in one machine (SCP Machine)
		De-dusting system for coal & coke handling
		First 6.5 m tall battery with Stamp charging
3	**Sinter plant 3**	**Maximum Emission Reduction to Sinter (MEROS)** A very efficient and economical solution for the substantial reduction of the waste-gas volume is the application of "Waste Gas Recirculation System." The 30 – 45% waste gas taken from the waste gas collecting duct after the existing waste gas ESP & fan, is mixed with ambient air and is recirculated to the recirculation hood which is situated above the sinter strand. Balance 55 – 70% of the waste gas is directed to the secondary cleaning equipment (Bag filter) and subsequently clean waste emitted to the atmosphere from stack.
4	**Pellet Plant 2**	**Largest capacity single strand (816 m2), high productive Pellet plant in India**
5	Blast Furnace	Largest Blast furnace in India - 5500m3
		Dry Gas Cleaning Pant (GCP) - First in India
		Metal granulation
		Top Gas Recovery Turbine (TRT)- 27 MW
6	Basic Oxygen	Steam box technology for slag management

S. No	Name of the Unit	Salient Features of the Unit
	Furnace (BOF)	Dry Gas Cleaning Plant (GCP)
		LHF Briquetting
7	Captive Power Plant (CPP)	Gas Based 175 MW
		Coke Dry Quenching (CDQ)
8	Energy efficiency measures	Top Gas Recovery Turbine (TRT)
		Coke Dry Quenching (CDQ)
		Dry GCP in BF
		Dry GCP in BOF
9	STP Plant (300 m^3/d)	Centralized treatment of sewage generated from various units is planned and sewage after treatment shall be recycled back for horticultural use. Sludge generated can be used as organic manure in horticultural application.

4.1.3.1 Air Environment

In an Integrated Steel plant, air pollutants are generated at different stages of production. Air pollutants may be particulate matter, sulphur dioxide, oxides of nitrogen etc. In addition, fugitive emissions are also released as line sources due to vehicular movements and handling of raw materials.

The proposed expansion of the plant to 10 MTPA and the change in configuration of capacity of Sinter Plant and Pellet plants will have an impact on the air environment. Further, the fugitive dust emissions also

Once the air emissions are emitted into the atmosphere, the dilution and dispersion of the pollutants are controlled by various factors like wind speed and wind direction, ambient temperature, mixing height etc. The impact of air emissions from different sources at discreet receptors and identified grid are evaluated as Ground level concentration (GLC) by using AERMOD software. For the dispersion model calculations, the software AERMOD, latest version 9.10 has been used.

The prediction of Ground level concentrations (GLC) of pollutants emitted from the stacks have been carried out using 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 Blast Furnace-1 as the centre. GLC have been calculated at every 1000 m grid point in addition to the discrete receptors where the Ambient Air Quality was measured.

The impact of air emissions on ground level concentrations at different receptors are estimated as under:

a) Reduction in Pollution Load due to change of configuration of SP-III & PP-II :

Earlier the capacity of SP – II & PP-II was considered as 8 MTPA & 4 MTPA. This has is being proposed to change from 4 MTPA and 9 MTPA respectively. Further it is proposed to install high efficiency bag filters in the Sinter plant after ESP for dust control. The impact of air emissions due to the proposed changes is given in **Table 4.2**.

Table 4.2 : Impact of Air Emissions due to the Proposed Changes

Sl. No.	UNIT	Pollution Load (Kg/hr)		
		PM	SO_2	NOx
As per original configuration				
1	2 X 4.0 MTPA Sinter Plant	176.4	293	379
2	1 X 4.0 MTPA Pellet Plant	83.2	75	262
	Sub-total	259.6	368	641
As per revised configuration				
1	1 X 4.0 MTPA Sinter Plant	35	147	189
2	1 X 9.0 MTPA Pellet Plant	86.5	144	505
	Sub-total	121.5	291	694
	Difference	-138.1 (-53 %)	-77 (-20.9%)	+53 (+8.2%)

The reduction in emission is due to the introduction of a high efficiency bag filter after ESP which will limit the emissions to < 10 mg/Nm3 in case of Sinter Plant and 30 mg/Nm3 in pellet plant. The emission values for SO2 & NOx are 120 mg/Nm3 & 155 mg/Nm3 (for SP) and 50 mg/Nm3 and 175 mg/Nm3(for PP) (Ref EU- BREF 2012) has been consider.

In view of the change in the configuration of the sinter and pellet plant, there is a reduction of 138.1 Kg/h of dust; 77 kg/hr of SO2 and increase of 53 kg/h of NOx. The switch over of process of agglomeration from sinter to pellet is therefore beneficial from pollution load point of view.

The impact of these reduction on the ground level Concentrations(GLC) at each receptor is given in **Table 4.3**.

b) Upgradation of pollution control facilities in the existing 5 MTPA steel Plant

The following improvements are currently being made to improve the work area environment, which will result in reduction of Particulate Matter emission. The improvement projects are as follows

i. Upgrading of existing Gas cleaning plants in SMS -I (4 bag houses) at an expenditure of Rs 180 Crores.

ii. Installation of additional Bag filters in Stock house of BF-I to improve work area air quality

iii. Emission reduction in Coke Oven by installing a muff in the charging car to guide emissions to the main collection duct and to reduce fugitive emissions.

iv. Installation of 12 bag filters to reduce fugitive dust emissions in the RMHS area.

These measures are expected to reduce 29.8 kg/h of fugitive dust in the work area. The impact of these reduction on the ground level Concentrations(GLC) at each receptor is given in **Table 4.3.**

Impact of new units in 10 MTPA with revised emission norms: In line with Corporate strategy of JSWSL(internal) of JSWSL, the design emission limits for all air pollution control systems have been reduced to 30 mg/Nm3, against the norm of 50 mg/Nm3 and 10 mg/Nm3 in Sinter plants. Further, with additional information after detailed design and information furnished supplied by the equipment suppliers, the emission values have been updated. The details of stack emissions are given in **Table 4.4.** It can be seen that there is an increase in dust emission by 571.32 Kg/h, 462.7 kg/h of SO_2 and 1047 kg/h of NOx. emission.

Table 4.3: Impacts of Air Emission on GLC at Different Receptors due at Different Initiatives in µg/m^3

Initiavtes	Emission in Kg/h	Changes in GLC for pollutant at each receptors in µg/m3							
		Pen	Bori	Vadkhal	Shahbaj	Gadab	Kusumble	Pandapur	Kolghar
a) PM-10		307	232.6	153.5	167	237	215	161	149
Impact of additional dust emission from stacks in 10 MTPA	+ 553.7	+0.08	+0.14	+0.17	+0.68	+1.3	+0.92	+0.56	+0.79
Change of configuration in sinter & pellet plants	-138.1	-0.03	-0.041	-0.048	-0.12	-0.2	-0.16	-0.13	-0.13
Upgradation of facilities in 5 MTPA stage	-101.9	-0.12	-1.4	-0.37	-71	-19	-78	-28	-125
Cumulative Impacts	**330.7**	**-0.15**	**-1.44**	**-0.42**	**-71.12**	**-19.2**	**-78.16**	**-28.13**	**-125.13**
b) SO2		6.9	9.3	2.4	2.0	9.0	1.6	6.1	4.6
Impact of additional stacks in 10 MTPA on SO2	+ 462	+ 0.11	+0.20	+0.23	+0.93	+11.6	+1.23	+0.71	+4.07
Changes in Configurations in PS & SP	-77	-0.02	-0.03	-0.05	-0.18	-0.25	-0.28	-0.11	-0.11
Cumulative Impacts	385	0.09	0.17	018	0.75	10.35	0.95	0.60	3.96
c) NO2		7.8	10.9	14.1	11.5	10.0	6.3	7.0	6.8
Impact of additional stacks in 10 MTPA on NOx	+ 1047	+0.14	+0.27	+0.31	+1.40	+2.33	+1.78	+0.95	0.85
Changes in configuration in SP & PP	+53	+0.09	+0.16	+0.18	+1.03	+0.98	+1.09	+0.49	+0.49
Cumulative Impacts	**1100**	**0.23**	**0.43**	**0.49**	**2.43**	**3.31**	**2.87**	**1.45**	**1.34**
Impact due to external roads	-661.2	-274	-149.5	-851.1	-99.7	-42.9	-32.0	-13.2	-26.4
Impact due to internal roads	-60.6	-0.26	-0.3	-2.18	-0.49	-14.2	-13.1	-36.1	-5.65

Table 4.4: Details of Stack Emission from New Units under 5.0 MTPA to 10.0 MTPA

Sr. No.	Plant Name	Stack attached to	Pollution Control Equipment	Stack Height (m)	Stack Dia. (m)	Temp. (^oC)	Velocity (m/s)	Flow rate (Nm^3/hr)	PM (g/s)	SO_2 (g/s)	NOx (g/s)
1	SMS 2	"Primary De-dusting Flare Stack-1"	Bag Filter	77.6	2.62	60	9.28	180000	1.5	-	-
2	SMS 2	"Primary De-dusting Flare Stack-2"	Bag Filter	100	2.6	60	9.42	180000	1.5	-	-
3	SMS 2	Secondary GCP	Bag Filter	70	8.8	60	21.1	4618695	38.5	-	-
4	Blast furnace 2	Stock house 1	Bag Filter	71	6.2	40	9.02	980000	8.2	-	-
5	Blast furnace 2	Stock house 3	Bag Filter	45	4.4	40	1.64	90000	0.8	-	-
6	Blast furnace 2	Stock house 4	Bag Filter	45	3	40	14.43	367000	3.1	-	-
7	Blast furnace 2	Cast House	Bag Filter	71	6.4	80	21.6	2500000	20.8	-	-
8	Blast furnace 2	Stove	Bag Filter	75	5	200	2.41	170000	1.4	2.08	6.9
9	Coke oven plant 2	Battery A & B	Bag Filter	150	9.46	120	1.48	375000	3.1	13.3	20
10	Coke oven plant 2	Battery C & D	Bag Filter	150	9.46	120	1.48	375000	3.1	13.3	20
11	Coke oven plant 2	Coke dry quenching 1	Bag Filter	30	2.48	110	15.02	261000	2.2	-	
12	Coke oven plant 2	Coke dry quenching 2	Bag Filter	30	2.48	110	15.02	261000	2.2	-	
13	Coke oven plant 2	Coke dry quenching 3	Bag Filter	30	2.38	110	15.62	250000	2.1	-	
14	Coke oven plant 2	Charging GDDS (Battery A & B)	Bag Filter	30	1.48	110	12.92	80000	0.7	-	
15	Coke oven plant 2	Pushing GDDS (Battery A & B	Bag Filter	30	2.78	120	18.31	400000	3.3	-	
16	Coke oven plant 2	Boiler CDQ 1	Bag Filter	30	0.98	100	5.71	15500	0.1	2.1	2.1
17	Coke oven plant 2	Boiler CDQ 2	Bag Filter	30	0.98	100	5.71	15000	0.1	2.1	2.1
18	Coke oven plant 2	Coke cutting station	Bag Filter	30	1.78	60	14.52	130000	1.1	-	-
19	Coke oven plant 2	Coal Crushing station	Bag Filter	30	1.48	60	15.99	99000	0.8	-	-
20	Coke oven plant 2	Coke bunker De dusting	Bag Filter	30	2.48	60	14.96	260000	2.2	-	-

Sr. No.	Plant Name	Stack attached to	Pollution Control Equipment	Stack Height (m)	Stack Dia. (m)	Temp. (^oC)	Velocity (m/s)	Flow rate (Nm^3/hr)	PM (g/s)	SO_2 (g/s)	NOx (g/s)
21	Coke oven plant 2	Charging GDDS (Battery C & D)	Bag Filter	30	1.48	110	12.92	80000	0.7	-	-
22	Coke oven plant 2	Pushing GDDS (Battery C & D	Bag Filter	30	2.78	120	18.31	400000	3.3	-	-
23	**Pellet plant 2**	**ESP 1 – Exhaust 1**	**ESP**	**100**	**10.6**	**130**	**3.13**	**995000**	**8.3**	**13**	**45.6**
24	**Pellet plant 2**	**ESP 2 – Exhaust 2**	**ESP**				**3.18**	**1010000**	**8.4**	**13**	**47.5**
25	**Pellet plant 2**	**ESP 3-Hood exhaust**	**ESP**				**2.83**	**900000**	**7.5**	**14**	**46.9**
26	**Pellet plant 2**	**Plant ESP 4-Plant Dedusting**	**ESP**	**55**	**3.2**	**130**	**7.19**	**208000**	**1.7**	**0**	**-**
27	**Pellet plant 2**	**Product bin bag filter stack**	**Bag Filter**	**45**	**1.8**	**60**	**2.29**	**21000**	**0.2**	**-**	**-**
28	**Sinter Plant 3**	**Main ESP**	**ESP**	**129.45**	**12.6**	**300**	**6.24**	**1224000**	**6.8**	**40.8**	**52.7**
29	**Sinter Plant 3**	**Product Screening**	**Bag Filter**	**65**	**2.5**	**60**	**39.63**	**540000**	**3**	**-**	**-**
30	HSM 2	Fume Extraction	Bag Filter	30	5.3	40	4.54	360000	3	-	-
31	HSM 2	Reheating Furnace 1	Bag Filter	82	5.7	450	2.25	207000	1.7	1.67	2.7
32	HSM 2	Reheating Furnace 2	Bag Filter	82	5.7	450	2.25	207000	1.7	1.67	2.7
33	CPP 175 MW	Boiler	Bag Filter	60	7.7	118	4.99	835285	7	6.5	31.5
34	LCP 4	Kiln	Bag Filter	62	1.42	120	15.79	90000	0.8	1.25	2.5
35	LCP 4	DES JH 20B	Bag Filter	36	0.42	50	14.64	7300	0.1	-	-
36	LCP 4	DE Feed Building	Bag Filter	40	2.27	50	6.03	88000	0.7	-	-
37	LCP 4	DES JH 21	Bag Filter	14	0.65	120	14.74	17600	0.1	-	-
38	LCP 4	DES JH 22	Bag Filter	16.7	0.42	50	13.24	6600	0.1	-	-
39	LCP 4	DES Lime Storage	Bag Filter	42	2.75	50	5.14	110000	0.9	-	-
40	LCP 5,6,7	Kiln Discharge	Bag Filter	50	2.3	100	5.22	78000	0.7	-	-
41	LCP 5,6,7	Kiln Fed Building	Bag Filter	55	2.1	50	12.68	158000	1.3	-	-
42	LCP 5,6,7	JH LS JH 1	Bag Filter	15	0.55	100	25.74	22000	0.2	-	-

Sr. No.	Plant Name	Stack attached to	Pollution Control Equipment	Stack Height (m)	Stack Dia. (m)	Temp. (^oC)	Velocity (m/s)	Flow rate (Nm^3/hr)	PM (g/s)	SO_2 (g/s)	NOx (g/s)
43	LCP 5,6,7	Lime/Dolo Storage	Bag Filter	40	0.45	50	16.39	93500	0.8	-	-
44	LCP 5,6,7	Lime Stone Storage	Bag Filter	50	2	50	4.91	55500	0.5	-	-
45	LCP 5,6,7	Kiln 5	Bag Filter	62	1.42	120	15.79	90000	0.8	1.25	2.5
46	LCP 5,6,7	Kiln 6	Bag Filter	62	1.42	120	15.79	90000	0.8	1.25	2.5
47	LCP 5,6,7	Kiln 7	Bag Filter	62	1.42	120	15.79	90000	0.8	1.25	2.5
								Total Emission g/s	**158.7**	**128.5**	**290.7**
								Total emission (kg/hr)	**571.32**	**462.7**	**1047**

c) Dust emissions due to vehicular Movement:

It is seen that the air quality is also affected due to the movement of vehicles. The fugitive dust emission occurs whenever vehicles travel over paved or unpaved roads. The force of the wheels on the road surface causes pulverisation of surface material. These particles are lifted and dropped from the wheels of the vehicles. The movement of the vehicles create strong air currents in turbulent shear with the surface. In addition to the dust emissions from the surface of the roads, there will be direct emissions due to the emissions due to the combustion of the fuel used by the vehicles. The emissions of dust from the vehicles due to movement on the roads is computed as per the procedure AP-42 – 13.2.1 for paved roads and 13.2.2 for the unpaved roads. The dust emissions due to the combustion of fuel has not been considered since all these vehicle will be compliant with the latest BS-IV and BS-VI norms. The emissions have been computed based on the following. The impact of dust emissions due to vehicular traffic has been modelled as a line source using AERMOD software.

Internal Roads: due to the construction activities, there is an increase in vehicular traffic. Since the roads leading to the construction sites are still not completely paved, fugitive dust emission is seen. The traffic density study was conducted by physical counting, at each section of the road and the average values for 5 days for internal roads are given below. The data on similar study conducted earlier is also included in the **Table 4.5**.

Table 4.5 : Internal Roads with Major Traffic (within JSWSL)

Stretch	Average traffic density (NOs)			Previous EIA report
	Day time	Night time	Total	
Goa gate to glass house	HV: 1312 LV : 2208	HV: 875 LV : 1472	HV : 2187 LV : 3680	HV:350 LV: 190
Alibagh gate to RMHS	HV: 864 LV : 828	HV: 576 LV : 552	HV : 1440 LV : 1380	HV: 345 LV: 991

It is seen that there has been increase in the traffic density due to construction activities. It is expected that the dust emissions will reduce after pavement of roads with concrete is completed once the construction activities are completed.

d) Dust Emissions due to Movement of Vehicles on the External Roads:

The National Highway NH- is being converted from 2 lane to 4 lane and the construction activity is at its peak. Due to road construction using heavy equipment and machinery, congestion of traffic and unpaved road surfaces, the dust emissions is very high. The traffic intensity is high and is given in **Table 4.6**.

Table 4.6: The Traffic Intensity Details

Stretch	Average traffic density (NOs)		
	Day time	Night time	Total
Pen to Khopoli	HV: 3264 LV: 4776	HV: 1680 LV: 2928	HV: 4944 LV: 8808
Pen to Panvel	HV: 6240 LV: 6552	HV: 2520 LV: 2688	HV: 8760 LV: 9240
Dolvi to Alibag	HV: 4248 LV: 4776	HV: 2976 LV: 2928	HV: 7224 LV: 7704
Dolvi to Nagothane	HV: 3576 LV: 6240	HV: 1224 LV : 2376	HV: 4800 LV: 8616

It is expected that the dust emissions will reduce after pavement of roads with concrete is completed once the construction activities are completed. This aspect is further being investigated by NEERI in their study on the carrying capacity of the area.

Impact on Air Environment

The impact of air emissions on ambient air quality under different scenarios is given below in the table for PM-10, SO_2 and NOx. In view of above initiative taken, there is a reduction at the 10 MTPA stage as under

Dust emission : from 553.7 kg/hr to 253 kg/hr; SO_2 from 462 Kg/hr to 385 kg/hr; marginal increase of NOx by 53 kg/hr

The villages Pen, Vadhkal, are located on the upstream wind flow direction where as Kusumble and Kolghar are on down Wind side of the Plant and other villages like Shahbaj, Bori, Pandapur and Ghadab are on crosswind direction.

The impact of gaseous emission like SO_2 and NO_2 is as under:

i. The level of SO_2 in the surrounding villages is varying from 1.6 to 9.3 $\mu g/m^3$. Similarly, the levels of NO_2 in the surrounding villages from 6.3 $\mu g/m^3$ to 14.1 $\mu g/m^3$. The level are of gaseous pollutants are very low as compared to NAAQM norms of 80 $\mu g/m^3$.

ii. Impact of 10 MTPA expansion on GLC at the receptors

- The GLC of SO_2 level in upstream villages is varying from 0.11 $\mu g/m^3$ to 0.23 $\mu g/m^3$. Similarly, the SO_2 in downwind villages is varying from 1.23 $\mu g/m^3$ to 4.07 $\mu g/m^3$.
- The GLC of NO2 level in upstream villages is varying from 0.14 $\mu g/m^3$ to 0.31 $\mu g/m^3$. Similarly, the NO_2 in downwind villages is varying from 0.85 $\mu g/m^3$ to 1.78 $\mu g/m^3$.
- The GLC of SO2 level in other villages which ae not affected by wind flow is varying from 0.17 $\mu g/m^3$ to 10.35 $\mu g/m^3$ and 0.35 $\mu g/m^3$ to 3.31 $\mu g/m^3$ upstream villages is varying from 0.11 $\mu g/m^3$ to 0.23 $\mu g/m^3$. Similarly, the SO_2 in downwind villages is varying from 1.23 $\mu g/m^3$ to 4.07 $\mu g/m^3$.

This shows that the emission of SO_2 and NO_2 from the steel plant operation is insignificant. The levels of dust (PM10) in the ambient air is influenced by emission from Steel plant operations, vehicular movement and other local activities.

i. The level of PM 10 in the surrounding villages is varying from 149 to 307 µg/m^3. The level of Particulate matters is higher as compared to NAAQM norms of 100 µg/m^3.

ii. Impact of stack emission from 10 MTPA expansion units on GLC at the receptors

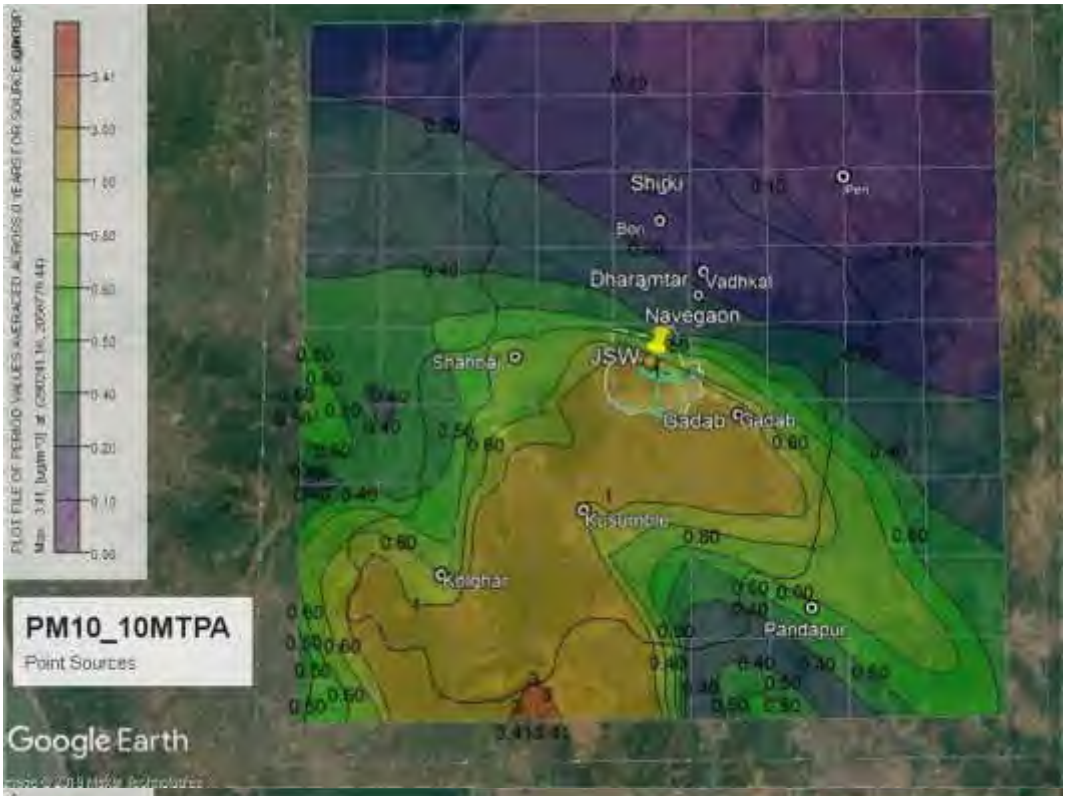
- The GLC of PM 10 level in upstream villages is varying from 0.08 µg/m^3 to 0.17 µg/m^3. Similarly, the PM 10 in downwind villages is varying from 0.79 µg/m^3 to 0.92 µg/m^3 and in other areas varying from 0.14 µg/m^3 to 1.3 µg/m^3. This shows that the impact of dust emission from the stacks are insignificant**.**

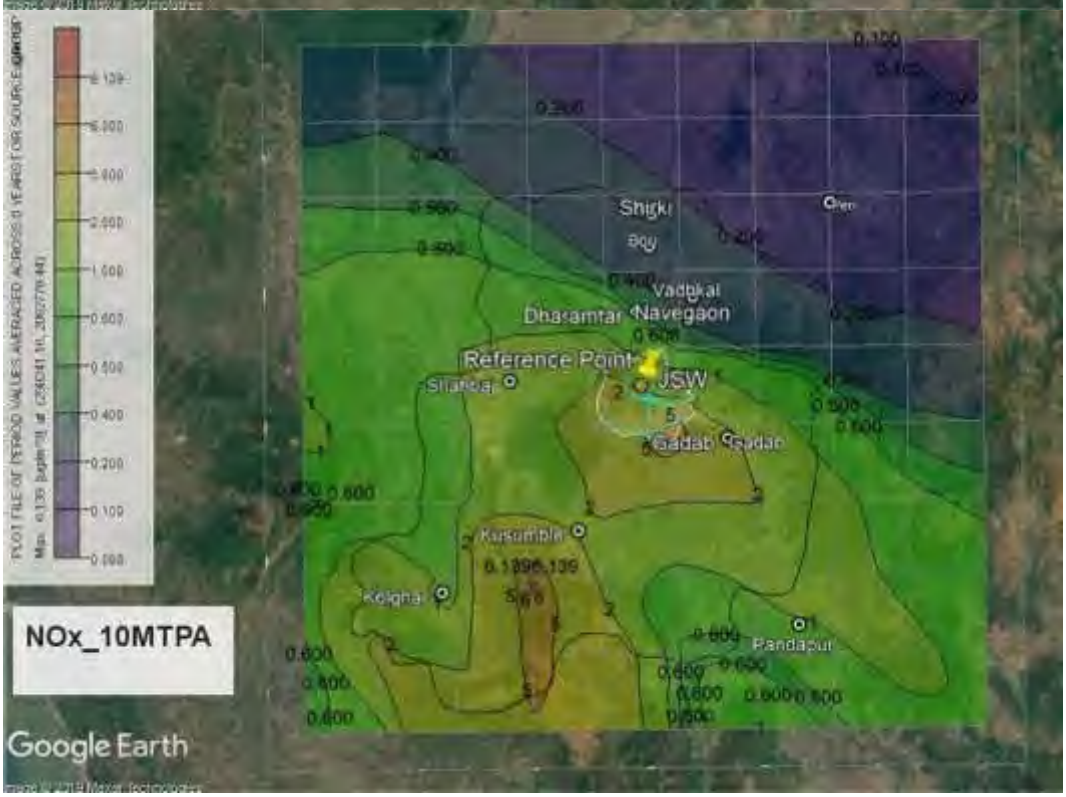
iii. Impact of change of Configuration in SPIII & PPII & initiatives of 5 MTPA

iv. The GLC of PM 10 level is varying from 0.15 µg/m^3 to 125.13 µg/m^3. While there is marginal decrease in GLC level due to the configuration change, there is substantial improvement in PM level due to the upgradation/modification in exiting 5 MTPA facilities. Similarly, the NO_2 in downwind villages is varying from 0.85 µg/m^3 to 1.78 µg/m^3.

- Impact of Vehicular movement on GLC at the receptors
- The fugitive dust emission from vehicular movement is estimated to be 721.8 kg/hr (70 %) of the total dust emission from the steel plant operation and roads. Due to low release height, the impact on the surrounding villages is substantial as compared to emission from the stacks where the releases height is higher. The level om PM 10 is high in the area is due to construction activity of steel plant and national Highway construction
- The contribution of fugitive emission of internal roads is approx. 10 % of the overall fugitive emission.
- Fugitive emission from road and construction activity is a temporary activity and is expected to reduce significantly after completion of 10 MTPA expansion and NHAI roads.

The impact of emissions on the GLC at the receptors due to expansion of steel plant of 10 MTPA. The isopleths are provided in **Figure 4.1.**


PM10_10MTPA
Point Sources
Google Earth
Shigki
Dharamtar
Vadhkal
Navegaon
JSW
Shahoa
Badab
Kolghar
Pandapur


NOx_10MTPA
Google Earth
Shigki
Vadhkal
Dharamtar
Navegaon
Reference Point
JSW
Shahoa
Badab
Karsumbla
Kolghar
Pandapur

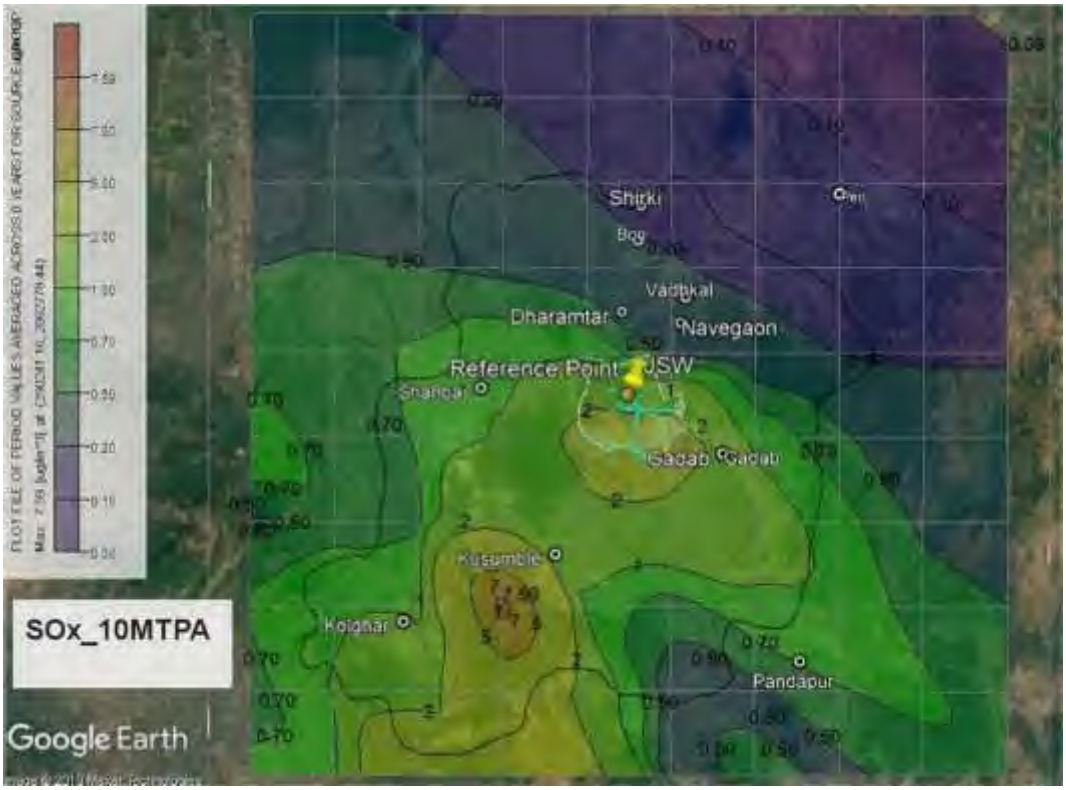


Figure 4.1 : Isopleths for PM10, NOX and SOX Dispersion

It is also noted that NEERI is separately carrying out a carrying capacity of the region which will look at the overall impact of all activities in the area, the recommendations of NEERI as applicable to JSW Steel will be implemented.

4.1.3.2 Impact of Transportation of Raw Materials and Finished Products by Road

Impact

The quantity of raw materials to be received and the finished products to be dispatched annually along with mode of transportation is shown in **Table 4.7 and 4.8**.

From the Table, it can be seen that bulk quantity (>99%) of raw material / finished product is being transported by sea/rail and only small quantity of material quartzite, HR coils is being transported by road within Maharashtra. Hence there will be minimal impact on surrounding environment due to transportation of raw material as well as products.

Table 4.7 : Additional Annual Major Raw Material Requirement (net & dry basis)

Sl. No.	Raw material	Quantity (tpa)	Source	Transportation
1.	Iron Ore Fines/Conc. (For Pellet Plant)	8,528,614	NMDC- Bacheli & Kirandul	Rail / Sea.
2.	Iron ore fines (for sinter	3,440,000	NMDC- Bacheli ,	Rail / Sea.

Sl. No.	Raw material	Quantity (tpa)	Source	Transportation
	plant)		Kirandul & Donimalai	
3.	Iron Ore Lumps	380,000	NMDC- Bacheli & Kirandul	Rail / Sea.
4.	Coking Coal (for coke oven)	3,500,000	Imported (Australia)	Sea
5.	Non-coking coal for PCI	675,000	Imported (Australia)	Sea
6.	Limestone (for sinter plant)	245,500	Rajasthan/Imported	Rail/Sea
7.	Limestone (for pellet plant)	504,941	Rajasthan/Imported	Rail/Sea
8.	Dolomite (for sinter plant)	251,500	Rajasthan, Karnataka & Egypt	Rail / Sea
9.	Quartzite	60,000	Maharashtra / Karnataka	Road
10.	Limestone (for SMS)	860,000	Rajasthan/Imported	Rail/Sea
11.	Dolomite (for SMS)	388,000	Rajasthan, Karnataka & Egypt	Rail / Sea
12.	Ferro-Alloy (for SMS)	103,600	Local purchase	Rail/Sea
13.	Bentonite (For pellet plant)	45,000	Gujarat	Rail/Sea
14	Dolomite (for Pellet plant)	270,000	Rajasthan, Karnataka & Egypt	Rail / Sea

Table 4.8: Additional Annual Major Finished Products (net & dry basis)

Sl. No.	Finished Products	Quantity (tpa)	Source	Transportation
1.	HRC Coil	9,000,000	Export/internal value addition	Sea/Rail
2.	Plate	1,500,000	Export	Sea/Rail
3.	CR Products	1,000,000	Export/internal market	Sea/Rail
4.	GP/GC products	600,000	-do-	Sea/Rail
5.	Electrical Steel CRGO products	400,000	-do-	Sea/Rail
6.	Tin coated Products	400,000	-do-	Sea/rail
7.	Colour Coated Products	500,000	-do-	Sea/Rail

Mitigation Measures

All the raw materials will be received through sea by barges and unloaded at Jetty area of Dharamtar Port. The port authorities have upgraded the Jetty to handle 33 MTPA of cargo. For this the capacity of the barges is being enhanced from 2500 to 8000 tons.

In order to handle larger capacity barges, the dredging of the cargo channel is being carried out. The upgraded Jetty to handle increase cargo capacity will be fully operational by March 2020.

The finished steel products will be partly moved through rail. A railway siding has been established by laying a dedicated rail line to connect the steel plant to Pen.

The unit wise emission sources and their mitigation measures are discussed below:

A) Raw Material Handling Complex (RMHC)

The raw materials viz coal, iron ore and fluxes are received by sea in barges and is unloaded at the Jetty. Dust emission takes place in the following areas:

- æ Un loading from jetty
- æ Transfer of unloaded materials through conveyors to the storage area
- æ Reclamation of raw materials from the storage area to feed to individual shops
- æ Unloading of raw material into the bunkers/silo

Mitigation Measures

The following mitigation measures are planned in the proposed expansion of the plant.

- æ Necessary pollution control facilities in the form of dust extraction / dust suppression system are being provided to control the dust during material handling.
- æ Complete conveyor system is totally enclosed to avoid spillages and dust emission.
- æ Dedusting system with bag filters are provided in all the Junction houses wherever the material falls from one conveyor to another conveyor.
- æ Two covered sheds in coal, coke storage area due to avoid dust emissions due to wind erosion. (details given in **Figure 4.2**). The photograph of the first of the two sheds constructed cover shed is shown below. Another shed is under construction.

Figure 4.2 : Covered Shed at Raw Material Handling Area

Figure 4.3 : Dust Suppression System at Raw Material Handling Area

- æ Rain guns in storage area to sprinkle dust to avoid wind erosion due to carry over of dust.
- æ Bag filter in tipper discharge points.
- æ Tyre-washing facilities before the vehicles enter the main roads from the storage area.
- æ Wind fence arrangements in storage areas to reduce the wind speed so that the dust carry over is controlled.
- æ In addition to the above, 12 nos. of existing junction houses (in the 5 MTPA stage) for the conveyor transfer points are being provided with bag filters. The dust collected in these bag filters will be collected periodically by closed dust tankers and conveyed to the micro pellet plant.

a) Sintering Plant and Pellet Plant

During the process of agglomeration by sintering and palletization, waste gases are generated which carry along with them particulate matter, oxides of sulphur and oxide of nitrogen as major pollutants. The waste gases generated during the process stage and cooling of sinter and pellet after passing through an electrostatic precipitator are released to the atmosphere. Further, transportation and handling of different materials in the sinter plant area will also generate dust, for which dust extraction systems have been planned.

Mitigation Measures

The following mitigation measures are planned in the proposed expansion for control of air emissions;

- æ Dust extraction systems in material transfer, junction houses, screening, crushing operations, to evacuate dust from all the generating points

followed by bag filters/ESP in Sinter and pellet plants. The process emissions from these plants are treated as below.

- æ ESPs in Pellet plants (hood exhaust and wind box). The ESPs are deigned to meet 30 mg/Nm3
- æ High efficiency bag filters after ESP for achieving the norm of 10 mg/Nm3 in the clean waste gases.
- æ Dust collected from these units will be recycled through the micro pellet plant.
- æ A 0.6 MTPA micro pellet plant is being proposed to be installed to recycle all dust and sludge back in sintering.
- æ Continuous emission monitoring systems have been installed to measure PM, SO2 & NOx in line with the guide lines of CPCB. The data is hooked up to CPCB and MPCB servers for online communication of data.

b) Coke Ovens

The operation of a Coke Oven battery comprises the following activities:

- æ Coal preparation & Feeding it into the ovens.
- æ Heating / Firing of the flue chambers (Carbonization)
- æ Coke pushing after carbonization, and
- æ Coke quenching
- æ Treating of crude COG in the By products plant for recovery of chemicals and impurities

During crushing, and screening of coal and coke, dust is generated creating air pollution. The carbonization of coal is carried out by using COG & BFG fuels. The waste gases after combustion are led to the waste gas stack and emitted to the atmosphere. In addition to the above air emissions, fugitive emissions takes place during coal charging; Carbonization from sealing surfaces, Coke pushing operations. Toxic gases like PAH and BAP are also generated during the carbonization process. The crude coke oven gas is treated in a byproducts plant where the impurities like naphthalene, ammonia, hydrogen sulphide are removed before the clean COG is used as fuel. Some VOC emissions are also generated due to leakage from process equipment.

Mitigation Measures

The first battery of 1.5 MTPA of the 3.0 MTPA has been commissioned recently. The second unit is under commissioning and the construction of tar plant and processing facility for tar and other value added products is under construction. Currently the crude tar produced is sent to Vijayanagar for processing. The mitigation measures implemented in the recently commissioned coke oven battery are given below. Some of these facilities are being installed for the first time in the country

- æ Direct coal charging to the SIP machine avoiding the coal silo and associated dust emissions

- æ HPLA with charge gas transfer car with U tube for evacuation of gases into the adjacent ovens during charging of coal cake into the ovens.
- æ Muff to direct the charging emissions to the duct leading to bag filter for controlling coal charging emissions.
- æ Bag filter to collect coke dust during pushing operations
- æ 100% desulphurization of Coke oven gas (Clauss Process) to recover Hydrogen sulphide as elemental sulphur. Sulphur is sold for manufacture of fertilizers.
- æ Gas holder to store clean coke oven gas, which also acts as a buffer vessels avoiding the flaring of gases.
- æ Following energy saving measures are planned in the Coke ovens:
  - J Waste heat boiler in the waste gas stack to recover 5 tph of LP steam, from each coke oven.
  - J Dry quenching of Coke (under erection)
  - J Variable speed drives for exhausters and boosters.
  - J Waste heat recovery as steam in Clauss process of desulphurization
- æ Continuous emission monitoring systems have been installed to measure PM, SO2 & NOx in line with the guide lines of CPCB. The data is hooked up to CPCB and MPCB servers for online communication of data

The photographs showing some of these facilities in the first unit of coke oven is shown in **Figure 4.4 and 4.5.**

Figure 4.4 : Coal Cake Charging and Pushing Emission Control at 10 MTPA Stage

Figure 4.5 : Coke Oven Gas Desulphurization Plant

c) Sponge Iron (DRI) Unit

The proposed DRI plant is identical to the existing SIP -I in terms of capacity and production facilities. The air emissions are released from Flue Gas Ejector stack in the form of dust, SOx, NOx, CO etc. and dust from the product handling area. The air contaminated with dust from the product handling area is cleaned in a bag filter. With natural gas as a reducing agent, the emission of SO2 & NOx are lower. Bag filters have been provided to control dust.

Mitigation measures; The measures are similar to the ones existing at SIP-1. Further, Continuous emission monitoring systems have been installed to measure PM, SO2 & NOx in line with the guide lines of CPCB. The data is hooked up to CPCB and MPCB servers for online communication of data.

d) Blast Furnace

The main sources of air pollution are dust in material handling; casting & pouring of hot metal. Other gaseous emissions in the form of dust, SO2, NO and dust are also emitted from the BF Stoves wherein the clean by product fuel gases (BFG & COG) are burnt to provide heat to the cold blast. Flue gas after combustion in the hot stoves is discharged to the atmosphere through stacks.

In addition to the above emissions, fugitive dust emissions also occur during material handling in the stock house and during tapping of hot metal in the cast house.

Metal Granulation Plant :A metal granulation plant (MGP) is proposed to convert surplus hot metal during poor off-take of hot metal from SMS into granules. During the operation of MGP generates fugitive emissions, which are controlled in a

bag filter. The operation this plant is only during emergencies and the impact of air emissions have not been considered as it is insignificant.

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 there will be formation of steam. The waste gases along with steam is cleaned in a spray system to reduce dust.

De-sulphurisation of Hot metal: 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-sulphurisation involves removal of sulphur by injecting a desulphurization compound like lime. During injection, large amount of fumes are generated which are treated in a bag filters. The collected dust is processed in micro pellet plant.

Mitigation Measures

The construction of BF-2 is in progress. The BF is the largest blast furnace of its kind in the world. The Blast furnace is provided with the state of the art facilities for high productivity and energy efficiency. Some of the salient features in BF-2 are given below:

- æ Bag filters designed to meet 30 mg/Nm3 in stock house and cast house.
- æ Water spray system in stack attached to slag granulation plant
- æ Dry gas cleaning system using high efficiency bag filters in place of conventional high pressure venturi system for dust control.
- æ Vent filter in PCI coal silo
- æ Dust control during intermediate feeding of burden
- æ Continuous emission monitoring systems have been proposed to be measure
  PM, SO_2 & NOx in line with the guide lines of CPCB. The data is hooked up to CPCB and MPCB servers for online communication of data.
- æ Energy efficiency measures like:
  - J Top gas pressure recovery system (TRT) to generate electrical power
  - J Waste heat recovery system from waste gases to heat PCI coal for moisture removal
  - J High productivity systems like steam injection; Coal injection; High top pressure etc
  - J Dry Gas cleaning system, with large savings in energy

The photograph of a typical Bag filter for cleaning of crude BF gases is given **Figure 4.6**.

Figure 4.6 : Photograph of a Typical Bag Filter for Cleaning Crude BF Gas

e) SMS–BOF Shop

In the BOF converters, impurities like Carbon, silicon, phosphorus are removed at high temperature by oxygen injection. During the process, large volume of fumes are generated which is required to be controlled in the primary system of dedusting. In addition to the above, fugitive dust emissions take place during material transfer, leakages to air emissions from BOF shop is primarily from the primary fume extraction system connected to the individual converters. The air emissions also take place during secondary operations like pouring of hot metal, material handling, tapping of steel and from the ladle furnaces. There are no major air emissions in the continuous casting area.

Mitigation Measures

- æ Dry gas cleaning based on electrostatic precipitation technology in place of traditional high pressure venturi system.
- æ Secondary fume extraction system with bag filter designed to meet 30 mg/Nm3, for all other dust emitting sources.
- æ Flare stack to burn the clean BOF gases in case the gas is not recovered.
- æ Evacuation system in the steam box technology system for venting the vapors.

The photograph of a typical dry type GCP is given in **Figure 4.7.**

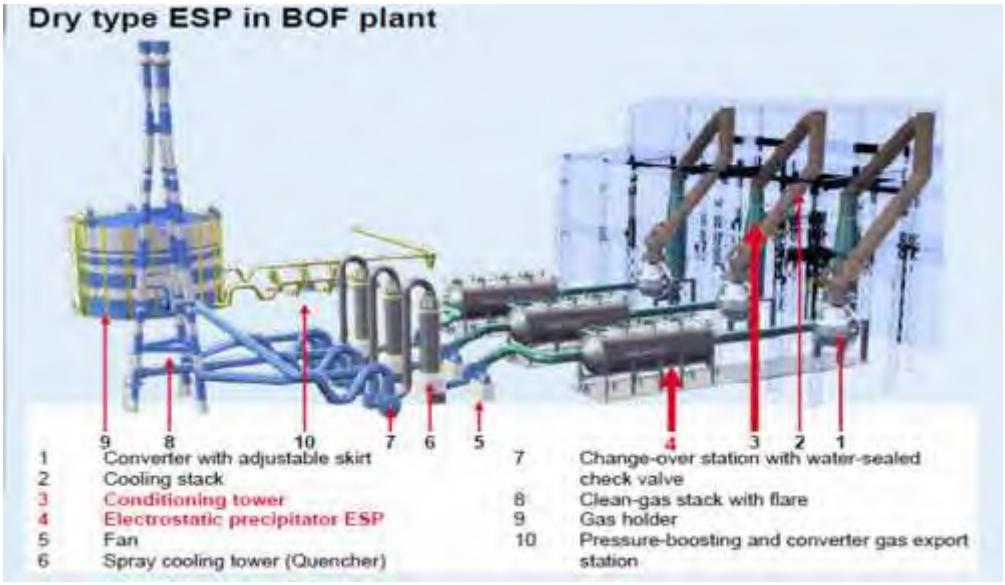


Figure 4.7 : Photograph of a Typical Dry Type GCP

f) Hot Rolling Mills

In the proposed expansion, an additional Hot Strip Mill, a Bar Mill and a Plate mill has been considered. The slab / billet from the Steel Melt Shop (SMS) is reheated in respective reheating furnaces of HSM, Bar Mill and Plate Mill. These furnaces utilize clean by-product fuel gases as fuel. The waste gases after combustion is let off to the atmosphere through respective stacks. A waste heat recovery system to generate steam is proposed to be installed in reheating furnaces of HSM.

Mitigation Measures

Since clean by product fuels are used in the reheating furnaces, the waste gases are emitted through respective stacks. Continuous emission monitoring systems will be installed for measurement of PM, SO2 & NOx.

g) Cold Rolling Mill

The hot rolled coils are further processed in the Cold Rolling Mill (CRM) to produce value added steel products to meet the requirement of the customer. The Cold Rolling Mill process involves operations like pickling, annealing, galvanizing, tinning and colour coating.

Fumes are evolved during pickling of steel products. The fumes are cleaned in a fume extraction system before emitting to the atmosphere. The spent pickle liquor is processed in an acid regeneration plant, where the acid is recovered by roasting the spent pickle liquor. A nag filter system will be provided in the system.

In the annealing process the cold rolled sheet is heat treated to achieve desired mechanical properties. The annealing furnaces utilizes clean by-product fuels and the waste gases are emitted from the chimney.

In the colour coating line the air emissions are from the painting unit where the volatile organic Compounds (VOC) are emitted. The evacuated waste gases are

passed through an incinerator to remove VOC. Since these operations are relatively smaller, the impacts are not considered.

Mitigation Measures

The following mitigation measures for air emission control are envisaged:

- æ Fume extraction system followed by scrubber to clean the entrained acid mist
- æ Bag filter in the acid regeneration plant
- æ Incinerator for burning VOC during colour painting

4.1.3.3 Water Environment

JSWSL, Dolvi works draws its make up water requirement from its reservoir located within the steel plant. The reservoir receives water from Amba River at the pumping station located at Nagothane, at a distance of about 26 Km. JSWSL has obtained approval for drawl of 113.6 MLD of water(4735 m3/h) from the Irrigation Department of Maharashtra. The reservoir is lined inside to prevent sea water ingress. The water from the reservoir is treated in clarifiers and the clarified water is pumped to individual processing units. The current water drawl rate at 5 MTPA is 1438 m3/h and the water requirement at 10 MTPA is (3851 m3/h, This will be met from the same source and this additional quantity is approved by the Irrigation department.

Water being a scare resource, this allocation is planned to be used judiciously in direct/indirect cooling facilities and process need as per current industry benchmark (JSWSL Vijayanagar).

JSWSL does not use any underground water in its 5 MTPA stage, due to high salinity and is not envisaged in the expansion phase as well. Thus there is no impact on ground water due to steel plant operations.

Wastewater Generation

In an integrated Steel plant wastewater will be generated from different units / shops. Most of the treated water is reused in the plant itself after treatment and only blow down quantity is being discharged from individual plant units meeting the respective wastewater discharge standards applicable to the unit.

Impacts

In an integrated steel plant water is primarily used for cooling the process equipment involved in the steel making operations. Water is also used in gas cleaning; fume flushing; pollution abatement in scrubbers and material handling operations. In view of this, different quality of water can be accepted by the different applications. Thus the total water management approach focuses on the cascaded use of water so that the water is used maximum number of times before it is discharge. Typically 70 % 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 spraying on EAF slag for cooling, spray chamber cooling at casters and evaporation in cooling towers.

Water is used in a series of heat exchangers in coke oven gas treatment, blast furnaces, CONARC furnaces, and rolling operations and boilers. This non-contact water like in cooling towers is not chemically contaminated, but there will be an increase in the dissolved solids. Due to repeated re-circulation and high temperature, concentration of these salts starts to build up necessitating bleeding off of some part of circulating water. Water is also used for contact cooling e.g. Coke oven gas treatment, slag handling etc. This contact water discharges may be contaminated physically and chemically with different pollutants and need to be specially treated prior to discharges.

a) Sinter Plant / Pellet Plant

Water use in sinter plant is restricted to use in non-contact type cooling towers and in the nodulizing section to adjust the moisture content in the burden. Similarly water use in pellet plant is restricted in wet grinding of the ore burden. In view of the 10-12% moisture in the burden, In view of this, the water requirement / consumption in sinter plant and pellet plant is very less and as the blow down water is used in process purposes, the wastewater generated from these processes is insignificant.

b) Sponge Iron Plant (SIP)

Sponge Iron plant needs water for industrial purpose, process / cooling, drinking and sanitary use. The small volume waste water is generated from cooling process and is reused for secondary usage within plant itself.

c) Blast Furnace

Blast furnace requires a considerable quantity of water for cooling applications. Since the proposed Blast furnaces will have dry gas cleaning plants, the requirement is lower. This makeup water is mainly required for direct contact cooling. The blow down water from the cooling towers is proposed to be used in quenching of slag. The blow down wastewater 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 adverse impact on water environment.

d) Steel Making and Primary Refining: CONARC furnace

The water requirement for CONARC furnace is required to be used in direct cooling in mill, caster, indirect cooling in CSP, caster etc. There is substantial quantity lost as evaporation loss from different shops. The 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.

e) Steel Making and Primary Refining: BOF furnace

The water required in steel melt shop is mainly for cooling purposes. The blow down from cooling towers will be used for slag quenching. The proposed BOF converters use dry process of gas cleaning in electrostatic precipitators. The blow down

water is used in the steam box process for weathering slag. Thus no adverse impact on water environment is anticipated

f) Secondary Refining Facilities: Ladle Furnace

The other water usages indicated are mainly for refining and casting operations. The refining operation, except vacuum degassing, does not generate any effluent. Thus no adverse impact on water environment is anticipated.

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 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 reused in the system within steel plant. However, the cold rolling unit will generate acidic, alkaline and oily wastewater during the processing of rolling. The wastewater will be treated in a specialized treatment unit to remove these chemicals and to meet the applicable discharge standards.

h) Coke Oven & By Product Plant

Coke oven and by-product plant require makeup fresh water for its various operational needs. Waste waters are generated from the coke oven & by-product plant will be contaminated with ammonia, phenol, cyanides, oils etc. The wastewater is treated in a BOD plant specially designed to take care of the pollutants. In the expansion of the plant, a Biological treatment unit of 350 m3/h is being implemented for treating the water. The process is identical too the one installed in the Coke oven unit in the 5 MTPA stage. The photograph of the BOD Plant is shown in **Figure 4.8**.

Figure 4.8 : Biological Oxidation Depheolization Plant

The treated wastewater will be used in coke quenching and balance in other non-critical applications. With the commissioning of the Coke drying unit, the requirement of the treated wastewater will reduce and will be treated to recover the water in the Water Recovery Plant.

The water and waste water network of the existing steel plant and the expansion have been designed to ensure full utilization of makeup water in a cascaded manner. A summary of various wastewater treatment schemes considered is given in the table below:

Wastewater from Other Sources

In addition to the above, some wastewater may be generated due to floor washings and also from the toilet blocks of the units envisaged during the expansion plan. The sewage generated from the toilet blocks will be treated in a STP.

Mitigation Measures

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 deployed during operation period to reduce the pollution level to acceptable limits.

- æ Re-circulating water in the process whereby discharged volume is minimized.
- æ Clarifier and sludge pond for removal of suspended solids
- æ Neutralization of acidic water by lime for DM water plant.
- æ Removal of oil and grease from the contaminated water by means if oil traps, skimming devices, etc.
- æ Effluent quality monitoring at inlet and outlets of different effluent treatment plants to ensure proper functioning of treatment facilities.
- æ Use of treated wastewater in different shops and for plantation development as far as practicable.

The treated wastewater complying to the marine discharge water quality will be discharged into the marine environment near the jetty, The location of the discharge point is being finalized considering the mixing behavior and is being designed by NIO, Mumbai. Necessary approvals for marine discharge will be taken from MCZMA/MPCB.

4.1.3.4 Solid Waste Generation and Disposal

Integrated Iron & steel plant generates solid wastes during the process of steel manufacture from iron ore. Some of these wastes are hazardous while most other wastes are non-hazardous. Some of these wastes are reused / re-utilised within the plant. Solid wastes are mainly generated from:

- æ Sinter Plant/Pellet Plant
- æ Blast Furnace
- æ SIP Plant
- æ EAF/CONARC unit

- æ BOF Shop
- æ Coke Oven & By-product Plant
- æ Different Rolling Mills(Hot Strip Mill)
- æ CRM operations
- æ Plate Mill
- æ Lime & Dolomite Plant

In addition to above, wastes are also generated during operation / maintenance / annual maintenance of other units / shops etc, which are:

- æ Flue dust from BF
- æ Blast Furnace Gas Cleaning Plant dust
- æ EAF/BOF fume extraction system dust
- æ Waste Refractory materials
- æ Waste lubricant / oil etc. and Waste Lead – Acid Batteries

The characteristics of the generated solid wastes are presented in **Table 4.9.** From the table it can be noticed that except some sludge generated from Coke Oven and By Product area, none are hazardous. The shop wise details of solid waste generated and its characteristic is presented in **Table 4.9**.

Table 4.9 : Source of Generation / Characterization of Solid Wastes

Shop	Type of waste	Source of Generation	Typical Chemistry (%)	Waste Characterization as per Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules, 2008 & its amendments
SIP Unit	Sludge	Sludge from ETP	Ash: 60-70% C: 18-22% H2O: 3.5% VM: 2% Calorific Value --800 kCal/kg	Not Applicable
	Iron Oxide fines	Iron oxide fines/sludge	Ash: 70% C: 20 – 25% VM:2% Mithyle–Blue value 50-100	Not Applicable
	De-dusting Dust	De-dusting dust from pollution control equipment installed with Raw Material Handling, and Product processing &handling area unit.	Ash: 70% C: 20 – 25% VM:2% Mithyle–Blue value: 50-100	Not Applicable

Shop	Type of waste	Source of Generation	Typical Chemistry (%)	Waste Characterization as per Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules, 2008 & its amendments
BF Plant	BF Flue Dust	Flue dust of coarser particle is collected in dust catcher located before wet scrubbing	$Fe_{(t)}$: 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
SMS Shop	CONARC/BOF Dust	CONARC Fume extraction dust collected in gas cleaning system in dry form	CONARC 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	Not Applicable

Shop	Type of waste	Source of Generation	Typical Chemistry (%)	Waste Characterization as per Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules, 2008 & its amendments
	CONARC/ BOF Slag	CONARC steel making slag	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
Refractory Materials Plant	Limestone / Dolomite Fines	Screening of raw limestones / dolomite in raw materials handling yard / lime plant / dolomite calcinations plant		Not Applicable
	Lime / Calcined Dolomite Fines	Screening of calcined lime / dolomite in lime /dolomite calcination plant		Not Applicable
	Pollution control dust	Collected after cleaning in bag filter of kiln flue		Not Applicable
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

Shop	Type of waste	Source of Generation	Typical Chemistry (%)	Waste Characterization as per Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules, 2008 & its amendments
Hot Strip Mill	Mill Scales	Relatively coarse mill scale is collected from reheating furnaces and dry processing areas like cooling beds, straightness, 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
CRM Mill	Mill sludge	Sludge generated from ETP		Not Applicable
Coke Oven Plant	Spent Refractory's	miscellaneous repairs in coke ovens		Not Applicable
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
	BOD Plant Sludge	Sludge from BOD Plant		As per Category 34.3 of Schedule – I

Shop	Type of waste	Source of Generation	Typical Chemistry (%)	Waste Characterization as per Hazardous Wastes (Management, Handling & Trans-boundary Movement) Rules, 2008 & its amendments
Mineral Oil/synthetic oil used as lubricants in hydraulic operations	Spent / Wash / Lubricant			As per Category 5.1 & 20.2 of Schedule – I

Impacts

Solid waste generated from different units and its re-utilization and disposal is given in **Table 4.10**.

Table 4.10: Solid Waste Generation and Disposal at 10.0 MTPA

Item	Quantity Per Annum			Unit	Distance from site	Mode of Transport	Method of Disposal
	Present (5 MTPA)	After Expansion (5-10 MTPA)	After Amendment (Configuration of Pellet & Sinter)				
Industrial Waste – Blast Furnace							
Slag	1190882	2701132	2701132	T/Year	-	Internal movements from Tippers	BF slag converted to Granulated slag and used in Cement Plant
Dust catcher	26638	164538	164538	T/Year	-	Internal movements from Tippers -	Reused in Sinter.
WWTP Sludge/Dust	5195	9000(No Wet GCP)	14195(No Wet GCP)	T/Year	-	Internal movements from Tippers	Reused in Sinter.
Coke Fines	259706	700706	700706	T/Year	-	Internal movements from Tippers	Reused in Sinter.
Oxides Fines	102460	732460	732460	T/Year	-	Internal movements from Tippers	Reused in Sinter.
Sinter Fines	658142	1458142	1458142	T/Year	-	Internal movements from Tippers	Reused in Sinter and Pellet.
BF Scrap	94500	216000	216000	T/Year	-	Internal movements from Tippers	Reused in BF
Industrial Waste – Hot Strip Mill Plant(SMS+HSM)							
Steel Slag	1108459	1108459	1108459	T/Year	-	Internal	Used for Land

Item	Quantity Per Annum			Unit	Distance from site	Mode of Transport	Method of Disposal
	Present (5 MTPA)	After Expansion (5-10 MTPA)	After Amendment (Configuration of Pellet & Sinter)				
						movements from Tippers	Reclamation after processing
GCP, Shop & De-Dusting System dust	187253	187253	187253	T/Year	-	Internal movements from Tippers	Reused in Sinter plant
Filtration Plant Sludge	6948	6948	6948	T/Year	-	Internal movements from Tippers	Reused in Sinter plant
HSM Scale	40600	40600	40600	T/Year	-	Internal movements from Tippers	Reused in Sinter plant
Skull	43750	43750	43750	T/Year	-	Internal movements from Tippers	Reused in Plant
Refractory	24500	24500	24500	T/Year	-		Landfill
Lime Dust	6650	6650	6650	T/Year	-	Internal movements from Tippers	Reused in Sinter plant
Lime Stone Fines	98350	98350	98350	T/Year	-	Internal movements from Tippers	Reused in Sinter plant
DRI dust	42350	85000	85000	T/Year	-	Internal movements from Tippers	Reused in Sinter plant
Industrial Waste – Steel Melting Shop-2							
Steel Slag	0	1000000	1000000	T/Year	-	Internal movements from Tippers	
SMS Fines		16560	16560	T/Year	-	Internal movements from Tippers	Reused in Sinter plant
GCP, Shop & De-Dusting System dust		119700	119700	T/Year	-	Internal movements from Tippers	Reused in Sinter plant
SMS WWTP Sludge		75000	75000	T/Year	-	Internal movements from Tippers	Reused in Sinter plant
Tundish Skull		141427	141427	T/Year	-	Internal movements from Tippers	Reused in Plant
Ladle Skull		25914	25914	T/Year	-	Internal movements from Tippers	Reused in Plant
Industrial Waste – Sponge Iron Plant							
Oxide Fines	102321	204642	204642	T/Year	-	Internal movements	Reused in Sinter plant

Item	Quantity Per Annum			Unit	Distance from site	Mode of Transport	Method of Disposal
	Present (5 MTPA)	After Expansion (5-10 MTPA)	After Amendment (Configuration of Pellet & Sinter)				
						from Tippers	
Process Water Sludge	112033	224066	224066	T/Year	-	Internal movements from Tippers	Reused in steel plant
Industrial Waste – Sinter Plants							
Sinter Fines	1003445	1748445	1748445	T/Year	-	Internal movements from Tippers	Reused in steel plant
ESP Dust	38630	30000	68630	T/Year	-	Internal movements from Tippers	Reused in Sinter plant
Industrial Waste – Coke Oven Plant							
Coke breeze	126612	274047	274047	T/Year	-	Internal movements from Tippers	Reused in Sintering Process
Coke and Coal Dust	5508	35508	35508	T/Year	-	Internal movements from Tippers	Reused in Coke Oven
Industrial Waste – Pellet Plant							
ESP and Bag Filter Dust	230784	560000	790784	T/Year	-	Internal movements from Tippers	Reused in Plant
Industrial Waste – Lime Calcination Plants							
Lime Stone Fines	16200	50000	66200	T/Year	-	Internal movements from Tippers	Reused in sintering
Hazardous waste Generation							
Sludge and filters	1156.32			T/Year	<300 km	Road	Disposal to TSDF of authorised parties
Used or spent oil	135000	265000	265000	litres/ Year	<300 km	Road	Disposal to Authorised Recyclers
Wastes or residues containing oil	26.3	38.3	38.3	T/Year	<300 km	Road	Disposal to Authorised Recyclers
Spent pickling liquor	0	24000	24000	T/Year	<300 km	Road	Regenerated
Empty barrels/ containers/liners contaminated with hazardous chemicals /wastes contaminated with oil	5000	5000	10000	Nos/ Year	<300 km	Road	Disposal to Authorised Recyclers

Item	Quantity Per Annum			Unit	Distance from site	Mode of Transport	Method of Disposal
	Present (5 MTPA)	After Expansion (5-10 MTPA)	After Amendment (Configuration of Pellet & Sinter)				
Chemical Sludge from waste water treatment	1000	4500	4500	T/Year			Reused in Process

Mitigation Measures

Micropellet Plant: All attempts shall be made to utilize solid wastes as per the guidelines given in CREP. In order to avoid leaching of materials to ground water, all stocks will be stock piled on slag/clay lined surface. It is intended to set up a 0.6 MTPA micro pellet plant to utilize all the wastes generated in the processes.

Steam box weathering technology: A new technology for accelerated weathering of BOF slag is proposed in the expansion of the steel plant at an estimated expenditure of Rs 22 Cr. The BOF slag after weathering to comply with the expansion limits will be used as aggregate in variety of applications like roads, blocks, tetrapod etc. A typical sketch of steam box technology is given in **Figure 4.9**.

Figure 4.9 : Steam Box Technology

The advantage of this technology over conventional processes are:

æ Reduction in slag size due to controlled water quenching and pressurized steam treatment.

- Easy handling and reduced crushing during metal separation process as the interface between the metal and slag is loosened by expansion reactions.
- Reduction in free lime by steam treatment resulting in ready to use material in construction and Roads.
- Reduction in dust emissions and clean shop floor environment.

The processed steel slag will be used for use in the following coast based applications. JSWSL is taking support from JFE in implementing these measures.

Road Aggregates

Tetra Pods

Marine Mineralization

4.1.3.5 Hazardous Waste Generation and Disposal

Impacts

Hazardous waste generation and its utilization for the expansion plan is given in **Table 4.11**.

Table 4.11: Net Increase Expected for Hazardous Waste Generation and its Disposal

Sl. No	Category	Quantity KL or tpy	Proposed disposal
1	Waste oil & Used oil	278,000	Sold to authorized parties
2	Tar sludge from Coke oven	400	Used back in Coke oven
3	Water treatment & WRP sludge	13944	Sent to hazardous waste land fill

Mitigation Measures

All hazardous wastes shall be disposed as per statutory norms.

4.1.3.6 Noise Levels

Impacts

During normal operation 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.

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 through job rotation. The following measures will be undertaken:

Technological Measures

- 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.

Management Measures

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 outside the plant premises.

4.1.3.7 Ecological Features

Impacts

- æ Change in the condition of the soil structure, e.g. compaction of soil, erosion, contamination, soil salinisation due to land irrigation.
- æ There will be Pollution and waste contamination.
- æ Degradation of the surrounding environment (noise, vibration, dust, etc.).
- æ Increased demand for water and pressure on water supplies in the local area will give pressure on water treatment facilities.
- æ Emissions of carbon dioxide, carbon monoxide, nitrous oxides (NOx), sulphur oxides (SOx), dust, polyaromatic hydrocarbons (PAHs) and particulate matter (PM).
- æ Consumption of fossil fuels for energy production contributes to greenhouse gas emissions and other polluting emissions into the air.
- æ Health effects on local inhabitants (real or potential, in the event of an incident) e.g. electromagnetic radiation from telecommunication pylons.

Mitigation Measures

- æ The project site is on Industrial land with operating industry and green belt and all care will be taken to avoid cutting the vegetation.
- æ All technological measures to limit air emissions, waste water discharges and noise generation are envisaged in the proposed plant expansion design and hence no further mitigation measures envisaged.
- æ An elaborate green belt / cover already exists which will be further enhanced within and around the plant to ameliorate the fugitive emissions and noise from the project operation.
- æ The proposed project is designed for maximum re-circulation of water and no wastewater will be allowed to be discharged out of plant premises in normal circumstances. The excess water will be used for gardening purpose and dust suppression on 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 will be erected all around the project so that no animals stay into 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 outside 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 nearby 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 spread outside the plant boundary.

Socio-economic Impact Assessments

The expansion plan of JSW Raigad, Maharashtra will bring different types of impacts in the study area. Impacts assessed by the help of survey and focus group discussion with villagers are presented below **Table 4.12.**

Table 4.12 : Prediction of Socio-economic Impact

Aspect	Impact		
	Pre - construction phase	**Construction phase**	**Operation phase**
Land clearing	During pre - construction phase land clearing and other tiny works will generate short term employment.	Direct indirect employment opportunities in the form of skilled, unskilled and semi skilled. Surrounding village workforce will be benefited due to the employment generation.	It is expected (skilled) labour force will be employed for the maintenance of plant.(Electrician, Fitter, Technician, Engineers, Managers etc.) All workforces will be local. Employment opportunities will help to increase quality of life of the workers.
Migration	Local labour will be taken.	Special skilled labour requirement may possible migration of workers from other places	Special skilled labour requirement may possible migration of workers from other places
local Market benefit	No impact	During construction phase, contractors will purchase hardware material, cement etc. from local traders. Local market will be benefited due to the proposed project	In operation phase expansion of the project will fulfill the steel demand in market, it will help for growth of the steel industry
Labour camp	No impact	No impact	No labour camp will be required in the operation phase
Pollution	No impact	Dust generation during construction activities like clearing site, digging etc. Noise generation from different equipment may affect the surrounding villages.	Steel production has a number of impacts on the environment, including air emissions, waste water contaminants, hazardous wastes, and solid waste. Due to these changes, nearby villagers may affect by various causes like health problems, decrease crop production etc.

Aspect	Impact		
	Pre - construction phase	**Construction phase**	**Operation phase**
Transport	No impact	Transportation activities may increase at the project location for loading, unloading of site material etc. Heavy vehicles for land clearing purpose will come at project site, frequent trips of vehicle are possible and village roads will be used for transportation.	Loading, unloading of transported material from the plant in different locations will increase the heavy vehicles transportation on the village roads which are connected to main roads.
Change in QOL	No impact	Short term improvement	Expansion in the project plant will bring overall development in the surrounding villages. Development in infrastructural facilities, indirect employment opportunities will improve quality of life in the surrounding villages

Socio-Economic Impact Matrix

The assessment of the impact of the general activities on the below parameters of socio-economic indices can be done by establishing a prediction of likely impacts matrix. Predication impacts, on socio-economic environment presented in **Table 4.13.**

Table 4.13 : Predication of likely Impacts on Socio-Economic Environment

Parameter	Local	Regional	Direct	Indirect
Employment	+	●	+	+
Income	+	●	+	+
Transport	-	●	-	+
Education	+	●	+	●
Medical facilities	+	●	+	●
Communication	+	●	+	●
Availability of power	+	+	+	+
Sanitation	+	●	+	●
Housing	+	●	+	●
Health	-	●	-	●
Recreation	●	●	●	●
Agriculture	-	●	-	-
Cost of living	-	●	-	●
Business	+	+	+	+
Pollution	-	●	-	-

+=Positive Impact, **- =Negative Impact**, õ =**Insignificant**

After primary data collection and impact assessment its necessary to provide mitigation measures. In order to mitigate the adverse impact likely to arise in social, cultural and economic aspects in the surrounding region and the expansion of the project is expected to contribute towards enlistment of local people quality of life; certain line of action should be adopted related to:

- æ Training to local youths on skills which will needed in expansion phase. Preference shall be given to local people for employment, considering their skills and abilities
- æ Health camps in surrounding villages, Health services through mobile dispensary, free medicine to BPL, vulnerable population
- æ Timely valued different awareness programs(sanitation, health, education) must be arranged by the project proponent based on the common health problems caused in the region that may help to reduce the lower status of the study area
- æ Try to minimize the disturbance to the local community by the construction activities, Apply safe measures during loading-unloading of the construction material

- Try to minimize the transportation activities in day time, ensure roads would not be affected due to heavy transportation
- Appoint local workers in both construction and operation phase as much possible, proper training to workers about safety and technical issues during operation
- Regular meetings, discussions with village Sarpanch, Villagers by Project Proponent in line with village development

Chapter 5
Analysis of Alternatives

5.1 Alternative Site

The 5 MTPA integrated steel plant at Dolvi is advantageously located on the West coast of Maharashtra. In the expansion of the steel plant to 10 MTPA, the 8 MTPA sinter plant and 4 MTPA pellet plant was supposed to be located within the existing areas. With the changed configuration, the same areas will be used for installing larger pellet plant and a smaller capacity sinter plant. The present expansion includes setting up of 9.0 MTPA pellet plant and 4.0 MTPA Sinter Plant. The proposed expansion is within the existing industry. Hence, alternative site is not required.

5.2 Alternate Technologies Proposed in the Expansion to 10 MTPA

5.2.1 Process Route

The existing process of steel manufacture is through DRI/BF for iron making followed by electric CONARC furnaces for steel making. The coke requirement is being met from Recovery type Coke ovens and agglomeration through sinter and pellets. The existing DRI unit utilises pellets and natural gas for produced sponge iron, an input to the CONARC furnaces. The combination of DRI & Blast furnaces helps in optimising the use of scrap/DRI for steel making.

In the proposed expansion the steel making is through the proven BF-BOF route. The BOF process offers many advantages over the DRI-CONARC route of steel making. These are

- Large capacity process equipment for large scale of manufacture for scale of operations
- has capability to produce high quality steel products required for the auto sector, which is not possible in the arc furnaces.
- the availability of natural gas for DRI making is gradually coming down for steel making.
- there is a gradual deterioration in the quality of iron ore for steel making through DRI route.

Advantages: The proposed BF-BOF addresses all these issues and the improvements proposed in the expansion as compared to the existing technologies at Dolvi are:

- Large capacity blast furnace of 5500 m3
- DRI making using a mixture of coke oven gas and natural gas in DRI Plant to reduce dependence on natural gas

- Increased pellet burden to exploit low grade(in terms of its size) iron ores 65% pellet, 25% Sinter & balance iron ore, as opposed to the existing burden of 75% sinter & 25 % pellet
- High productivity from large scale BF & BOF Converters.
- Higher rate Pulverised Coal injection at 200 kg/thm
- Desulphurisation of hot metal to improve the productivity in the BOF converters
- 100% continuous casting of liquid steel
- Ladle furnaces to adjust the metallurgy for production of special stall products.
- Granulation of hot metal in place of pigs
- Steam box technology of steam aging for processing steel slag for use as aggregates.
- LHF briquetting to recycle wastes and use the briquettes in steel making.
- Cold rolling mill complex to produce value added products.
- Water conservation measures like
  - Dry GCP for BF & BOF
  - Coke dry quenching using nitrogen in place of water
  - **Waste heat recovery system from waste gases from Coke oven, waste gas recycle in sinter plant to utilise the Carbon values, Sinter coolers**, BF waste gases, BOF Converters, Reheating furnaces in mills area etc.
  - High efficiency TRT in Blast furnaces
- Environment control measures like:
  - HPLA system with CGT car
  - Separate Coal charging and coke pushing emission control
  - 100% desulphurisation of Coke oven gas for recovering sulphur in elemental form for manufacture of fertilisers.
  - High efficiency bag filters
  - Water recovery Plant to ensure zero water discharge
  - Large capacity fume extraction in BF & BOF shops to keep the work area environment clean.

5.2.2 Alternate Technology for Agglomerate to Blast Furnaces

The burden to Blast furnaces consists of Sinter, pellet and iron ore. The existing blast furnace-1 in the 5 MTPA plant operates primarily on the sinter route. However the new BF-2 of larger capacity will operate primarily on pellet.

The availability of good quality raw materials for steel making is gradually reducing. The deteriorating quality of iron ore is one of the main reasons for steel makers installing ore beneficiation units to operate their iron making facilities. In ore beneficiation, the iron ore is finely ground to liberate the impurities. The concentrate obtained from the ore beneficiation is very fine and not suitable for sinter making. However, these fines are suitable for making pellets. This is one of the main reasons that more and more pellet plants are being installed in the country.

In view of this, and possibility of sourcing beneficiated iron ore from Orissa, it has been proposed to install a larger pellet plant instead of a Sinter plant.

Accordingly, the capacity of pellet plant is being enhanced from 4 MTPA to 9 MTPA and the capacity of sinter plant is reduced from 8 MTPA to 4 MTPA.

Chapter 6
Environmental Monitoring Program

Based on the baseline data collected on various environmental parameters and with the prediction of impacts, it is desirable to have an environmental monitoring program to establish the trend of various environmental parameters and their compliance with the emission/ discharge limits specified by the regulating agencies. The details of the proposed environmental monitoring program are summarized below:

6.1 Monitoring Schedule and Parameters

To evaluate the effectiveness of environmental management program, regular monitoring of the SPCB stipulated environmental parameters as per the schedule should be done. Monitoring of various environmental parameters will be carried out on a regular basis to ascertain the following;

- æ Pollution status within the industry and in its vicinity
- æ Generate data for predictive or corrective purpose in respect of pollution
- æ Effectiveness of pollution control measures and control facilities
- æ To assess environmental impacts
- æ To follow the trend of parameters which have been identified as critical.

Monitoring is as important as pollution control since the efficiency of the control measures can only be determined by monitoring. The schedule, duration and parameters are to be monitored as per SPCB/MoEF directives. A table showing environmental parameters proposed to monitor are given in **Table 6.1**.

The various components of the environment need to be monitored on regular basis as per the requirements of regulating agencies as well as for trend monitoring of the pollutants levels in various environmental matrices. The Environmental Management System (EMS) in the industry needs to be followed and a schedule for monitoring will be decided based on the EMS. Regularly meetings will review the effectiveness of the EMP implementation. The data collected on various EMP measures would be reviewed and if needed corrective action will be formulated for implementation. EMS will form short term and long-term plans for environmental issues, which require monitoring and effective implementation.

The environmental quality-monitoring program will be carried out in the impact zone with suitable sampling stations and frequency for environmental parameters with respect to different environmental components. Conventional parameters will be monitored by industry and analyzed at industry's laboratory and also

other laboratories approved by MoEF/NABL will be consulted for third party study. For conventional pollutants, the standard methods prescribed in "Standard Methods for Water and Wastewater Analysis" published by APHA (American Public Health Association), AWWA (American Water Works Association) & WPCF (Water Pollution Control Federation) will be adhered with and will follow procedures prescribed by SPCB/CPCB.

6.2 Air Quality Monitoring

The following measures needs to be practiced in industry and the same procedures, time schedule and monitoring would be followed for air quality monitoring as per the CPCB guidelines, on a regular basis:

- Ambient Air Quality needs to be monitored at 5 locations in and around the industry complex for all the parameters stipulated in MoEF Notification, 2009
- Two Continuous Ambient Air Quality Monitoring Stations should be installed in the industry premises for monitoring real time data of various pollutants round-the-clock.
- Sampling and monitoring of gaseous pollutants effluents as per the requirements of State Pollution Control Board (SPCB/CPCB).
- Ambient air quality monitoring for conventional pollutants such as Particulate Matter 2.5 ($PM_{2.5}$), Particulate Matter 10 (PM_{10}), Oxide of Sulfur (SOx) and Oxides of Nitrogen (NOx) and hydrocarbons as per the requirements of SPCB/CPCB.
- Monitoring of micrometeorological data such as wind data, air temperature, relative humidity, rainfall at site should be followed.

6.3 Water Quality Monitoring

- Ground and surface water quality is being monitored in and around industry complex jointly along with State Pollution Control Board (SPCB) on monthly basis.
- As per the locations selected during EIA studies six surface water sampling locations and nine ground water sampling locations, and the predetermined parameters, the monitoring needs to be carried out on monthly basis.

6.4 Noise Monitoring

Noise monitoring is being carried out inside the industry area once in six months and outside the industry premises on monthly basis to ascertain the prevalent noise levels as per the CPCB and OSHA guidelines, identify the noise generation sources and if required, take suitable measures to mitigate the noise generation.

6.5 Solid and Hazardous Wastes

Hazardous waste is being disposed/sold only to the SPCB/CPCB authorized Coprocessors, Recyclers, Incinerators or TSDF in compliance with the provisions of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. The following is to be practiced at industry:

- æ The Hazardous Waste generated in the industrial units should be segregated, collected in proper containers and stored in the Hazardous Waste Shed till it is sent for disposal.
- æ Manifest system in From-10 is to be followed.
- æ Monthly Record in Form-3 should be maintained.
- æ Annual Returns in Form-4 is to be prepared and submitted to SPCB before 30th June of every year.

6.6 House Keeping

The house keeping at the project site and residential complex will be effective and monitored on a regular basis.

6.7 Environmental Management Cell

A full-fledged Environment Management Cell should be created in the industry with multidisciplinary team of professionals, technical staffs and all necessary infrastructures; and the Cell is headed by Group Manager. This team will be also responsible for all environment management activities including environmental monitoring, greenbelt development, ensuring good housekeeping, ensuring statutory compliance as well as creating environmentally aware work forces in the proposed industry project.

The said team will be responsible for:

- æ Monitoring and Analysis of air quality, noise levels, meteorology, water quality and other environmental parameters.
- æ Implementation and monitoring of the pollution control and protective measures/ devices etc.
- æ Co-ordination of the environment related activities within the project as well as with outside agencies.
- æ Green belt development.
- æ Monitoring the progress of implementation of the environmental management program.
- æ Identifying measures to prevent or reduce the wastes itself in the industry area.

- Compliance to statutory provisions, norms of State Pollution Control Board, Ministry of Environment Forests and Climate Change (MoEF&CC) the conditions of the environmental clearance as well as the consents to establish and consents to operate.

6.8 Budgetary Provisions

The budgetary provisions towards environmental monitoring program for the proposed project shall be maintained. The details of the same are provided in the **Chapter 10**.

6.9 Submission of Monitoring Reports to SPCB/ MoEF&CC

As per the requirements, the status of environmental clearance stipulation implementation will be submitted to MoEF&CC in hard and soft copy as per the prescribed period. The conventional pollutants will be monitored on monthly basis and reports will be submitted to SPCB, as per the requirements.

Table 6.1 : Environmental Monitoring

Sr. No.	Environmental Component	Parameters to be Analyzed
1	Meteorology	Wind Speed, Wind direction, Temperature, Relative Humidity, Rainfall
2	Ambient Air Quality	Parameters as per MoEF&CC notification 2009
3	Fugitive Emission	PM, SO_2, NO_X, CO
4	Water quality of surface and ground water	Physical and chemical parameters as per SPCB norms
5	Liquid effluents	Parameters as per SPCB consent
6	Noise	Sound Pressure Levels (Leq) as per CPCB guidelines

Chapter 7
Additional Studies - Risk Assessment

7.1 Introduction

Risk assessment involves identification of potential hazardous events that eventually lead to loss of life, property and ecological imbalances. The hazardous event may cause fire, explosion or toxic release scenarios. The extent of these scenarios needs to be analyzed at different atmospheric conditions by considering failure probability of equipment and in-plant and surrounding population data. The risk mitigative measures are suggested based on the outcome of these scenarios.

7.1.1 Objectives of the Study

Following are the objectives of the study:

- Study of past accident information to identify worst scenarios
- Hazard identification through computation of fire, explosion and toxicity indices (FETI)
- Generation of credible and worst case scenarios for accidental release of hazardous chemicals in the proposed expansion of the steel plant
- Computation of damage distances through consequence analysis for various heat loads at different atmospheric conditions
- Recommendations for risk mitigation measures based on the outcome of consequence analysis
- Delineation of Disaster Management Plan (DMP) comprising on-site and off-site emergency scenarios

7.2 Past Accidental Data Analysis

Analysis of events arising out of the unsafe conditions is one of the basic requirements for ensuring safety in any facility. The data required for such an analysis has either to be generated by monitoring and/or collected from the records of the past occurrences. This data, when analysed, helps in formulation of the steps towards mitigation of risk from handling of hazards. Trends in safety of various activities can be evaluated and actions can be planned accordingly in order to improve the overall safety of the facility.

Data analysis helps in correlating the causal factors and the corrective steps to be taken for controlling the accidents. It is, therefore, of vital importance to collect the data methodically, based on potential incidents, sections involved, causes of failure and the preventive measures taken. This helps to face future eventualities with more preparedness. Following are a few accidents occurred in the past at the industries.

Buncefield Oil Storage and Transport Incident, UK, 11 December 2005

On Sunday 11 December 2005, a series of explosions and subsequent fire destroyed large parts of the Buncefield oil storage and transfer depot at Hemel Hempstead in UK. The main explosion took place at around 6:00 AM followed by a large fire that engulfed 23 large fuel storage tanks over a high proportion of the Buncefield site. No fatalities were reported, however, more than 43 people were injured. More than 2000 people had to be evacuated from their homes and sections of the M1 motorway were closed. The accident caused widespread damage to neighbouring properties. The fire burned for five days, destroying most of the site and emitting a large plume of smoke into the atmosphere that dispersed over southern England.

Lanzhou Petrochemical Company Accident, June 28, 2006

On June 28th, 2006 an explosion broke out in CNPC Lanzhou Petrochemical Company Refinery Plant, Gansu province, China. The accident caused one death and ten injuries. The preliminary investigation showed that the accident was caused due to leakage of gas from fluid catalytic cracking unit.

Oil Storage Depot Accident, Indian Oil Corporation Limited, Jaipur, October 29, 2009

A massive fire broke out on 29th October at an oil storage depot in the western state of Rajasthan state killing eleven people and injuring more than 135. The continuous oil leakage for 80 mins formed a huge vapour cloud which exploded before the fire ignited and spread. The fire broke out around 19:30 local time at the oil storage depot run by Indian Oil Corporation (IOC) Ltd. and was visible from over 25 kilometres away.

Explosion in Tank Storage Station in Binhai, Tianjin, China, August 12, 2015

Two explosions within 30 seconds of each other occurred at a container storage tank station at the Port of Tianjin in the Binhai New Area of Tianjin, China 173 people died as a result. The cause of the explosions was not immediately known, but an investigation concluded in February 2016 that an overheated container of dry nitrocellulose was the cause of the initial explosion. The final casualty report was 165 deaths, 8 missing, and 798 non-fatal injuries.

Jetty Accident of the Vessel in Chittagong Port, Bangladesh, July 26, 2017

Two workers died while working in a log-laden vessel, both were working in the night shift alongside others unloading logs from the vessel at a jetty in Chittagong port. After the two went missing during work, fellow workers began a search and found them senseless at the bottom of the iron-stairs of a service tunnel of one of the five hatches. They two might had mistakenly tried to enter that tunnel and died after inhaling toxic gas, explained that hatches containing logs are kept closed for weeks that could create toxic gases in them. Both bodies bore marks of injuries in head, they

suspect that the men might have fallen down in the dark while getting down the narrow staircase.

IOCL Refinery Accident, Panipat, January 2, 2018

Accidentally released propylene gas from naphtha cracker unit exploded killing one worker and seriously injuring more than two maintenance staff personnel. The workers were engaged in maintenance of a valve from which propylene gas was leaked causing a high volume blast at 12.50 pm. A major fire broke out in the unit. The explosion blew off the roof of the plant.

Pharmaceutical Company, Boisar, Mumbai. March 10, 2018

Three people were killed and 15 injured when a series of blasts and a fire ripped through a chemical plant of a pharmaceutical company in Maharashtra's Boisar near Mumbai. The blasts occurred in 25 drums containing 200 litres each of solvent. The unit did not follow any safety precautions and due to heavy exothermic reaction, the blast occurred in the solvent drums.

7.3 Hazard Identification

Identification of hazards is an important step in risk assessment study as it leads to the generation of accidental scenarios. Once a hazard has been identified, it is necessary to evaluate the risk to plant personnel and neighbouring community arising due to handling of identified hazards. The following points are taken into account while identifying hazards.

- Location of process unit facilities involving hazardous chemicals
- The types and design of process units
- The quantity of hazardous chemical that could be involved in an airborne release and
- The properties of the hazardous chemical

7.3.1 Fire and Explosion Index (FEI)

The Fire and Explosion Index (FEI) is useful in identifying hazardous materials and risks arising due to the handling of hazardous materials. The FEI estimates the global risk associated with a unit in which hazardous materials are processed and classifies the units according to their general level of risk. The FEI covers aspects related to the intrinsic hazard of materials, the quantities handled and operating conditions. This factor gives index value for the area which could be affected by an accident. The method for evaluation of FEI involves following stages.

- Selection of pertinent process unit which can have serious impact on overall safety of the plant

- Determination of Material Factor (MF): The factor for a given substance in the process unit gives intrinsic potential to release energy in case of fire or an explosion. Material Factor can be directly obtained from Dow's Fire and Explosion Index Hazard classification Guide of American Institute of Chemical Engineers, New York. The factor can also be evaluated from NFPA indices of danger, health, flammability and reactivity
- Determination of Unit Hazard Factor: The Unit Hazard Factor is obtained by multiplication of General Process Hazard (GPH) factor and Special Process Hazard (SPH) factor. The GPH factor is computed according to presence of exothermic reactions and loading and unloading operations. The penalties due to each of these reactions / operations are summed up to compute GPH factor. Similarly, the SPH factor can be evaluated for the operations close to flammable range or operating pressures different from atmospheric pressure. Penalties of these operations for both factors can be obtained from Dow's EFI index form.

Fire and explosion index is then calculated as the product of Material Factor (MF) and Unit Hazard Factor. Degree of hazards based on FEI and TI is given in the following **Tables 7.1** and **7.2**.

Table 7.1 : Degree of Hazards Based on FEI

FEI Range	Degree of Hazard
0 – 60	Light
61-96	Moderate
97 - 127	Intermediate
128 - 158	Heavy
159 and Above	Severe

Table 7.2 : Degree of Hazards Based on TI

TI Range	Degree of Hazard
0 – 5	Light
5 – 10	Moderate
Above 10	High

Preventive and protective control measures are recommended based on degree of hazard. Therefore, FEI indicates the efforts to be taken to reduce risks for a particular unit. The fire and explosion indices computed for various process equipment in proposed expansion of steel plant are given in **Table 7.3**.

Table 7.3 : Fire and Explosion Index

Sr. No.	Unit Name	FEI	Category
1	Diesel Storage Tank	99.96	Intermediate

7.4 Maximum Credible Accidents (MCA) Analysis

The MCA analysis encompasses defined techniques to identify the hazards and compute the consequent effects in terms of damage distances due to heat radiation, toxic releases, vapour cloud explosion etc. A list of probable or potential accidents of the major units in the facility arising due to use, storage and handling of the hazardous materials are examined to establish their credibility. Depending upon the effective hazardous attributes and their impact on the event, the maximum effect on the surrounding environment and the respective damage caused can be assessed. Flow chart of accidental release of hazardous chemicals is presented in **Figure 7.1**.

Hazardous substances can cause damage on a large scale if they are accidentally released. The extent of the damage is dependent upon the nature of the release and the physical state of the material. In the present study, the consequences for flammable hazards are considered and the damages caused due to such releases are assessed at different combinations of weather conditions to simulate worst possible scenario.

The following steps are involved in the MCA analysis:

- Identification of potential hazardous sections and representative failure cases
- Visualisation of release scenarios with recourse to consequence analysis
- Damage distance computations for the released cases

The flammable substances on release may cause fire and/or explosion causing possible damage to the surrounding area. The extent of damage depends upon the nature of the release. The release of flammable materials and subsequent ignition result in heat radiation wave or pressure waves depending upon the flammability and its physical state. Damage distances due to release of hazardous materials depend on atmospheric stability and wind speed. It is important to visualize the consequence of the release of such substances and the damage caused to the surrounding areas. Computation of damage distances are carried out at various atmospheric stability conditions for various wind velocities and the result is tabulated. Pasquill-Giffard atmospheric stability classes with corresponding weather conditions are listed in **Table 7.4**. The probable worst case scenarios for the proposed expansion facility can be an accidental release from a small hole (25 mm or 50 mm in size) of process equipment, storage tank or from a pipeline. The hole sizes of 25 and 50 mm have been considered as per CPR 18 E (Guidelines for quantitative risk assessment - Purple Book) standards.

Table 7.4 : Pasquill – Giffard Atmospheric Stability

Sr. No.	Stability Class	Weather Conditions
1	A	Very unstable – sunny, light wind
2	A/B	Unstable - as with A only less sunny or more windy
3	B	Unstable - as with A/B only less sunny or more windy
4	B/C	Moderately unstable – moderate sunny and moderate wind
5	C	Moderately unstable – very windy / sunny or overcast / light wind
6	C/D	Moderate unstable – moderate sun and high wind
7	D	Neutral – little sun and high wind or overcast / windy night
8	E	Moderately stable – less overcast and less windy night thand
9	F	Stable – night with moderate clouds and light / moderate wind
10	G	Very stable – possibly fog

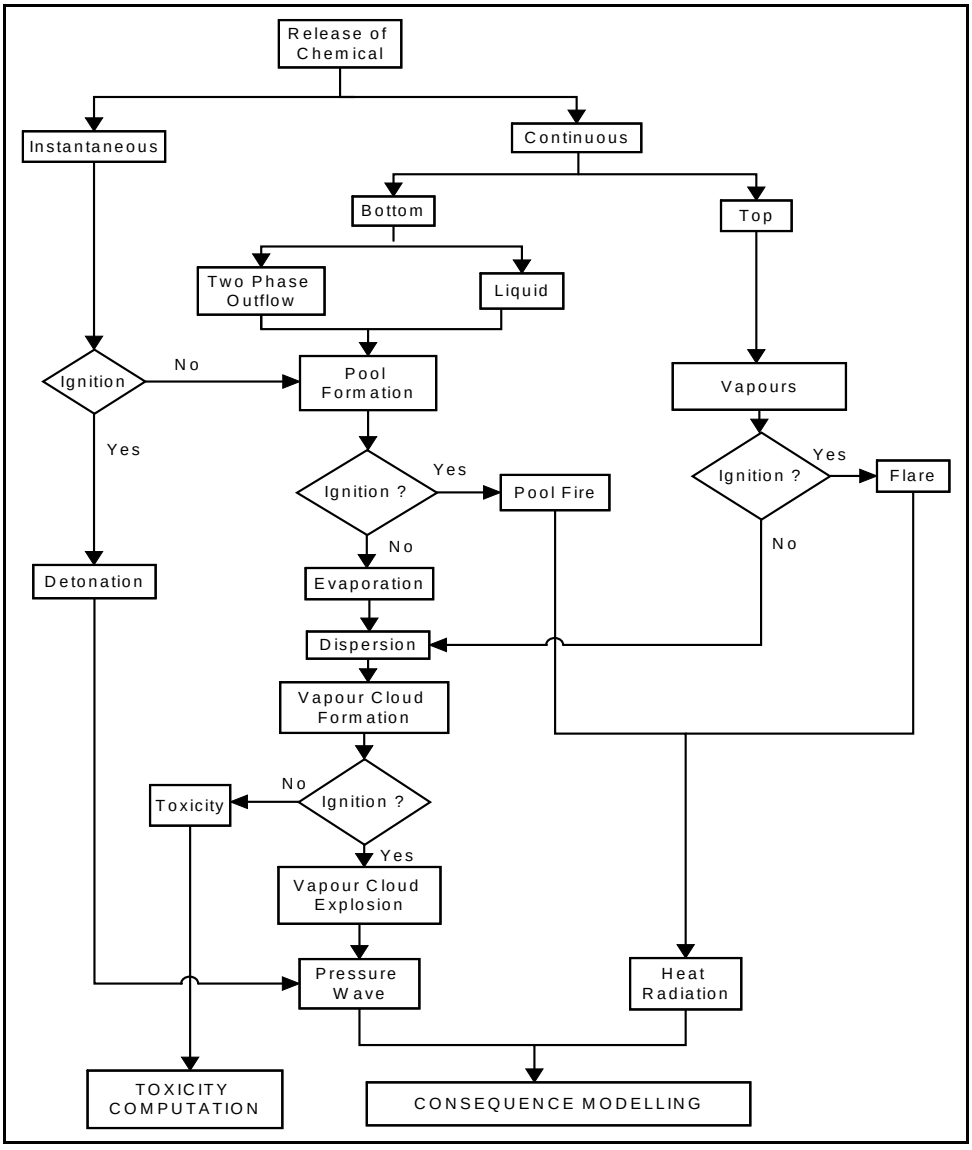


Figure 7.1 : Accidental Release of Chemicals: A Scenario

7.4.1 Fire and Explosion Scenarios

Combustible materials within their flammable limits may ignite and burn if exposed to an ignition source of sufficient energy. On process plants, this normally occurs as a result of a leakage or spillage. Depending on the physical properties of the material and the operating parameters, the combustion of material in a plant may take on a number of forms like jet fire, flash fire, pool fire, vapour cloud explosion and BLEVE.

Jet Fire

Jet fire occurs when flammable material of a high exit velocity ignites. In process industries this may be due to equipment failure or an accidental. Ejection of flammable material from a vessel, pipe or pipe flange may give rise to a jet fire and in some instances the jet flame could have substantial "reach". Depending on wind speed, the flame may tilt and impinge on pipeline, equipment or structures. The thermal radiation from these fires may cause injury to people or damage equipment some distance from the source of the flames.

Flash Fire

A flash fire is the non-explosive combustion of a vapour cloud resulting from a release of flammable material into the open air, which after mixing with air, ignites. A flash fire results from the ignition of a released flammable cloud in which there is essentially no increase in combustion rate. The ignition source could be electric spark, a hot surface, and friction between moving parts of a machine or an open fire.

Flash fire may occur due to its less vapour temperature than ambient temperature. Hence, as a result of a spill, they are dispersed initially by the negative buoyancy of cold vapour and subsequently by the atmospheric turbulence. After the release and dispersion of the flammable fuel the resulting vapour cloud is ignited and when the fuel vapour is not mixed with sufficient air prior to ignition, it results in diffusion fire burning. Therefore the rate at which the fuel vapour and air are mixed together during combustion determines the rate of burning in the flash fire.

The main dangers of flash fire are radiation and direct flame contact. The size of the flammable cloud determines the area of possible direct flame contact effects. Radiation effects on a target depend on several factors including its distance from the flames, flame height, flame emissive power, local atmospheric transitivity and cloud size. Most of the time, flash combustion lasts for no more than a few seconds.

Pool Fire

Releases of hydrocarbons in the absence of immediate ignition would form an unconfined pool, which on ignition would result in a pool fire. Radius of pool depends upon mass flow rate, ambient temperature; heat of vaporization of material released, vapour pressure of material released and discharge duration. Emissive power

generated from the pool surface depends upon pool burning rate, heat of combustion of release material, atmospheric transitivity and area of pool.

The pool fire being either tank or bund fire consists of large volumes of flammable material at atmospheric pressure burning in an unconfined space. The flammable material will be consumed at the burning rate depending on factors including the prevailing winds. During combustion heat will be released in the form of thermal radiation. Temperature close to the flame centre will be high but will reduce rapidly to tolerable temperatures over a relatively short distance. Any plant building or persons close to the fire or within the intolerable zone will experience burn damage with the severity depending on the distance from the fire and the time exposed to the heat of the fire. In the event of a pool fire the flames will tilt according to the wind speed and direction. The flame length and tilt angle affect the distance of thermal radiation generated.

Vapour Cloud Explosion

The Vapour Cloud Explosion (VCE) begins with a release of a large quantity of flammable vaporizing liquid or gas from a storage tank, transport vessel or pipeline producing a dangerous overpressure. These explosions follow a well-determined pattern. There are basically four features, which must be present for an effective vapour cloud explosion to occur with an effective blast. These are:

- First, the release material must be flammable and at a suitable condition of temperature and pressure which depends on the chemical. The materials which come under this category, range from liquefied gases under pressure (e.g. butane, propane); ordinary flammable liquids (e.g. cyclohexane, naphtha) to non-liquefied flammable gases (e.g. ethylene, acetylene)
- Second, before the ignition, a cloud of sufficient size must have been formed. Normally ignition delays of few minutes are considered the most probable for generating the vapour cloud explosions
- Third, a sufficient amount of the cloud must be within the flammable range of the material to cause extensive overpressure
- Fourth, the flame speed determines the blast effects of the vapour cloud explosions, which can vary greatly
- The flammable content of a gas cloud is calculated by three-dimensional integration of the concentration profiles, which fall within the flammable limits. If the gas cloud ignites, two situations can occur, namely non-explosive combustion (flash fire) and explosive combustion (flash fire followed by explosion)

BLEVE

If the liquid is stored under pressure at a temperature above its boiling point, the initial physical explosion that breaks the receptacle produces a sudden decompression giving rise to a massive evaporation of the saturated liquid. This kind of evaporation is known as BLEVE. The explosion is of great destructive power due to the high increase in pressure caused by the sudden incorporation of liquid into the gas phase. The ignition of BLEVE produces a mass of gases at high temperature known as 'fireball' with significant thermal effects. Historically, BLEVEs have been produced with some frequency and have almost caused human casualties.

Lower and Upper Flammability Limit

In case of any spillage and leakages of hydrocarbons / flammable material, probability of getting ignited is depending on whether the air borne mixture is in the flammable region. The lower flammability limit corresponds to minimum proportion of combustible vapour in air for combustion. The upper flammability limit ccorresponds to maximum proportion of combustible vapour in air for combustion and the concentration range lying between the lower and the upper limit is called as flammable range.

7.4.2 Models for the Calculation of Heat load and Shock Waves

If a flammable gas or liquid is released, damage resulting from heat radiation or explosion may occur on ignition. Models used in this study for the effects in the event of the ignition of a gas cloud will be discussed in succession. These models calculate the heat radiation or peak overpressure as a function of the distance from the torch, the ignited pool or gas cloud. The physical significance of the various heat loads is depicted in **Table 7.5**.

Table 7.5 : List of Damages Envisaged at Various Heat Loads

Sr. No.	Heat loads (kW/m^2)	Type of Damage Intensity	
		Damage to Equipment	Human Injury
1	37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10 sec
2	25.0	Minimum energy required to ignite wood	50% Lethality in 1 min. Significant injury in 10 sec
3	19.0	Maximum thermal radiation intensity allowed on thermally unprotected equipment	--
4	12.5	Minimum energy required to melt plastic tubing	1% lethality in 1 min
5	4.0	--	First degree burns, causes pain for exposure longer than 10 sec
6	1.6	--	Causes no discomfort on long exposures
Source: Techniques for assessing industrial hazards by world bank			

7.4.3 Model for Pressure Wave

A pressure wave can be caused by gas cloud explosion. The following damage criteria are assumed as a result of the peak overpressure:

- æ 0.03 bar overpressure wave is taken as the limit for the occurrence of wounds as a result of flying fragments of glass
- æ Following assumptions are used to translate an explosion in terms of damage to the surrounding area:
  - Within the contour area of the exploding gas cloud, Casualties are due to burns or asphyxiation. Houses and buildings in this zone will be severely damaged
  - In houses with serious damage, it is assumed that one out of eight persons present will be killed as a result of the building collapse. Within the zone of a peak over pressure of 0.3 bar the risk of death in houses is 0.9 × 1/8 = 0.1125, and in the zone with a peak over pressure of 0.1 bar the probability of death is 0.1 × 1/8 = 0.0125, i.e. one out of eighty people will be killed

The significance of the peak over pressures 0.3 bar, 0.1 bar, 0.03 bar and 0.01 bar are depicted in **Table 7.6**.

Table 7.6 : Damage Criteria for Pressure Waves

Human Injury		Structural Damage	
Peak Over Pressure (bar)	**Type of Damage**	**Peak Over Pressure (bar)**	**Type of Damage**
5-8	100% lethality	0.3	Heavy (90% damage)
3.5-5	50% lethality	0.1	Repairable (10% damage)
2-3	Threshold lethality	0.03	Damage of Glass
1.33-2	Severe lung damage	0.01	Crack of windows
1-1.33	50% Eardrum rupture	-	-
Source: Marshall, V.C. (1977)' How lethal are explosives and toxic escapes'.			

7.4.4 Computation of Damage Distances

Damage distances for the accidental release of hazardous materials have been computed at 2F, 3D and 5D weather conditions. In these conditions, 2, 3 and 5 are wind velocities in m/s and F and D are atmospheric stability classes. These weather conditions have been selected to accommodate worst case scenarios to get maximum effective distances. DNV based **PHAST 6.51**, software has been used to carryout consequence analysis. The computed damage distances for diesel storage tank for pool fire scenario is given in **Table 7.7**.

Table 7.7 : Computed Damage Distance for Diesel Oil Storage Tank

Equipment	Source Strength (kg/sec)	Leak Size (mm)	Weather	Damage Distance (m)		
				Pool Fire		
				37.5 kW/m²	12.5 kW/m²	4.0 kW/m²
Diesel Storage Tank Leak	0.033	10	2F	3	5	7
			3D	4	6	8
			5D	4	6	8
	0.207	25	2F	4	8	13
			3D	5	9	13
			5D	6	10	14
	0.828	50	2F	4	15	24
			3D	5	16	24
			5D	6	17	25
Diesel Storage Tank Full Rupture	-	-	2F	-	61	124
			3D	-	61	132
			5D	-	62	142

7.5 Risk Mitigation Measures

The risk mitigation measures to minimize occurrence of hazardous event for proposed expansion of steel plant have been incorporated in this section. Specific recommendations for particular facility as well as general recommendations are detailed.

7.5.1 Specific Recommendations

Following are specific recommendations based on the outcome of MCA analysis:

7.5.1.1 Flammable Oil Storages

Following are mitigation measures for the storage of flammable materials like diesel:

- æ Shut off and isolation valves should be easily approachable in emergencies
- æ Escape routes should be provided at strategic locations and should be easily accessible
- æ Necked flame, welding, hot surfaces or any other ignition source should not be permitted in storage area

- Gas and hydrocarbon detector should be provided in storage area to detect leakage
- The fire proofing material/coating resistant to weather effects such as chalking and erosion having adequate adhesion, strength and durability should be applied
- The separation /space between the storage tanks in the storage areas should be according to the OISD guidelines and sufficient to escape in case of any emergency
- The inspection and checking of fire fighting facilities should be done periodically
- All storage facility have been provided with water spray cooling system and foam pourer system
- A wind direction pointer should be installed at storage site, so that in an emergency the wind direction can be directly seen and downwind population cautioned
- Signboards including phone numbers, no smoking signs and type of emergencies should be increased to cover all the locations of the plant

7.5.1.2 Pipeline

- All process piping should be complied with ASME B31.3 guidelines
- Inspection of piping should be carried out at regular interval to assess the corrosion / erosion in the pipelines
- Pressure/flow indication, hydrocarbon/smoke/toxic gas detectors should be available for early detection of any leakage and quick response
- Overhead power lines should not be allowed to cross directly over the process piping
- Gasket used in piping should have sufficient strength to resist crushing under the applied load and defy rupture under pressure. Gaskets should be chemically resist to fluid under all temperatures and pressures conditions
- Selection of the valve type for process piping should be based on service experience. For example - Ball, Globe, Poppet vales should be used for high pressure and temperature pipelines
- Proper lubricant should be used for threads of bolts and nuts during maintenance. Low or no chloride content lubricants should be used
- Leakage detected in welded joints shall be repaired by draining, repair welding, non-destructively examining in accordance with original requirements, and re-tested to the original test pressure

7.5.1.3 Furnace Header or Tube Rupture Fire

A header box fire is normally the result of a radical operating change. Injection of steam into the header box will usually extinguish a fire. If it is of significant size and cannot be extinguished with steam, this fire must be treated as a tube rupture fire. Following precautions are to be considered in case of tube rupture fire.

- Take necessary action to remove hydrocarbon by isolating and/or depressurising
- Inject steam into furnace tubes. Inject steam into fire box and header box
- Protect structural members outside the fire box threatened by flame with water spray
- Do not use foam. It is ineffective on this type of fire and will result only in waste

7.5.1.4 Control Room

Following are the facilities to be provided at the control room to tackle the emergency scenarios:

- Fire detection system should be installed in the control room
- VHF base station with a range of 25 km and VHF handsets of range 5 km should be installed for ready communication in emergency
- Public address system should be installed to ease the communication to various corners of the site
- Note pads, pens and pencils should be available to record any messages received and to send messages during emergency
- Addresses of the employees and the contact numbers of the employees and their family members should be available
- The duties and responsibilities of different co-ordinators of Onsite Disaster Management Plan should be displayed in the Emergency Control Room

7.5.1.5 Preventing Flammable Dust Suspensions

It is difficult to keep the flammable dust cloud concentrations below certain levels in order to prevent an explosion because the minimum explosive concentration is usually far below the economic operational conditions. The following measures are effective in suppressing dust concentration

- In cases where high dust concentration may be unavoidable, it would be appropriate to work with smaller piles of dust than with one large one

- Situations such as the free fall of dust from a height into a hoper, which may encourage dust cloud formation, should be avoided
- The dust removal process must be done at early stage for process considerations permit in order to avoid dust suspensions
- Equipment handling flammable dusts should be appropriately designed to minimize the accumulation of dusts. Cleaning of dusts collected in places like ducts should be facilitated as often as permissible

Safe housekeeping practices can be implemented to limit the presence of dust to controlled locations thereby reducing the potential for the formation of hazardous dust clouds. NFPA 654 guidelines on housekeeping practices are described below:

a) Dust layers 1/32 in. (0.8 mm) thick can be sufficient to warrant immediate cleaning of the area

b) This thick dust layer can create a hazardous condition if it covers more than 5% of the building floor area, with 1000 ft of dust layer as the upper limit for large facilities

c) Dust accumulations on other surfaces, such as overhead beams and joists, ductwork, conduit and cabling, piping, light fixtures, or tops of equipment, can also contribute significantly to the secondary dust cloud potential, and should be considered in estimating the dust loading in a room. Dust adhering to walls and other vertical surfaces should also be considered.

It is also recommended that all penetrations of floors, walls, ceilings, and partitions defining such barriers be dust tight. The standard also stipulates that all surfaces where dust might accumulate be designed and constructed to minimize dust accumulations and to facilitate cleaning (for example, interior window ledges can be sloped, beams can be boxed in, and concrete walls can be painted to limit dust adherence). The standard also requires sealing of spaces that may be inaccessible for cleaning and the installation of localized dust collection systems to limit dust migration. Such systems, however, must be carefully designed, operated, and maintained to control their own inherent dust explosion hazards.

One of the most effective ways of limiting the spread of dust through a facility is to keep it inside the equipment. Proper design, maintenance, and operation of equipment to minimize dust emissions is, therefore, of prime importance. Unsafe housekeeping such as vigorous sweeping or the use of steam or compressed air to blow down equipment in dusty areas may lead to the formation of combustible dust clouds.

Other commodity-specific standards generally are parallel to the requirements in NFPA 654. More restrictive requirements, however, may exist for certain commodities; for example NFPA 484 (combustible metals, metal powders, and metal dusts) addresses the ease with which aluminum dust can be ignited.

7.5.1.6 Failure of Environment Control Equipment

The environment control equipment are intended to mitigate the emissions and discharge of pollutants to the receiving bodies. It is also intended that these operate continuously, perform as per their design so that the emission levels are maintained at the lowest levels. Although, there are no reported incidents of any disaster leading to loss of life or property due to the failure of the pollution control equipment, it is necessary to evaluate the impact on the emissions and discharges in case of malfunctioning of these critical equipment so that suitable action can be taken in time. The following subsection evaluates the worst case scenario in terms of the impact on the environment in case of failure of the air and water pollution control systems.

Air Pollution Control Equipment

The failure of air pollution control systems like electrostatic precipitators, bag filters and scrubbers have been considered.

Electrostatic Precipitator

The electrostatic precipitators works on the principle of % reduction and is very sensitive to variation in the inlet dust loading. The ESPs in the expansion phase are designed to meet a stringent norm of 30 mg/Nm3 in normal conditions and 50 mg/Nm3 in case of failure of one field (N-1). The possible scenario of failures are:

- Power failure to the ID fan of the ESP
- Failure of one electrical field

The ESPs are proposed in the following areas:

Sinter Plant and Pellet Plant: The ESPs are installed in the waste gases generated in the agglomeration process and are integral with the plant operations. In case of power failure, the complete plant will come to a standstill condition. Since the ESPs are designed to meet 50 mg/Nm3 even in case of failure of a field, the emissions will be minimal.

BOF shop: The ESPs are installed to clean the crude gases from the Converter so that the LD gas can be used as a fuel. These ESPs are also designed to limit the outlet dust content to < 50 mg/Nm3 with one field not in operation. Further, since the LD gas is recovered and used as a fuel after mixing with BF gas, the failure of a field has no impact on the environment. On the other hand, the power failure will lead to stoppage of the whole BOF operation and suitable actions will be taken for a smooth shut down.

Bag Filters

Bag filters work on a principle of filtration of dust over a fabric and are not sensitive to variation in the inlet dust loading. However, in case of failure of some bags, the dirty gas can bypass the bags and dust emission can take place through the chimney. The bag filters are also designed to comply a limit of 30 mg/Nm^3 , so that even in case

of failure of bags, the emission level of 50 mg/Nm^3 can be met. However the failure of the bags is a gradual process and can be easily detected during regular inspection. The bag filters are the main air pollution control equipment in the expansion phase and some of the critical ones are given below:

SMS FE System: This bag filter with a capacity of 4.4 MNm^3/hr is the largest installation catering to the complete SMS-2 shop. All secondary emissions from the shop are collected and treated in the bag filter. In case of power failure, there will be considerable fugitive dust emissions in the SMS area, requiring smooth shut down of all the BOF converters. Considering the importance of this system, the ID fan and systems have been provided with two feeders so that even in case of failure of one field, this system will continue to operate.

BF GCP: The bag filter is provided to clean the crude gas from the blast furnace so that it can be used as a fuel in the furnaces. This bag filter is integral part of the BF gas system. In case of failure, the blast furnace will go for a smooth shut down. In case of failure of bags, the dust content in the clean BFG increase and has no impact on the environment

Coke Ovens: The bag filters are installed for controlling coal charging emissions, coke pushing emission control and CDQ. In case of power failure, the fugitive emissions will take place from the respective operations. In case of failure of bags, there is no impact on the environment.

Other Areas: The bag filters are installed in RMHS to control fugitive dust emissions during material handling. These are non-critical and have no impact on the environment.

Scrubbers

The scrubbers operate on the principle of inertial impaction where the dust particles are settled by water spray. The scrubbers were important and are now being replaced by bag filters due to improved performance. The only application in the expansion phase is the scrubber planned in the desulphurisation of coke oven gas, wherein the sulphur is recovered as elemental sulphur. The scrubber is an integral part of the COG cleaning system. The scrubber and its associated systems have large buffering capacity and the degradation is noticed during daily analysis and corrective action can be planned. However, in case of power failure, the coke ovens will initiate smooth shut down of the plant.

Water Pollution Control System

Water pollution control systems like the BOD plant, Clarifiers in HSM, ETP in CRM areas have large buffering capacities and the deterioration in performance can be measured during regular analysis of treated wastewater. However, in case of power failure, the equalisation tanks provided will store the wastewater till such time the power is restored. There is no impact of failure of the ETPs in case of failure. A summary of such possible scenario and their impact is given in **Table 7.8**.

Table 7.8 : Details of Failure Scenarios, Impacts and Action Plans

Sr. No.	Failure Scenario	Impact	Max Duration in minutes	Action Planned in the proposed expansion	Impact on environment (on a 0-5 rating)		
					Local	Inside Plant	Outside
1.	**Coke ovens**						
	Failure of power to ID fans of bag filters	Fugitive dust emissions	**5**	Alternate source of power	**5**	**3**	**0**
	Failure of up to 10% of bags	Emissions visible	Continuous	Inventory of bags	0	**0**	**0**
	Breaking of coal cake	Visible emission of crude gases	30	Fast evaluation by chain conveyor	5	**3**	**0**
	Failure of exhauster leading to no suction	Visible emission till restoration	30	100% flare of crude gas	5	**3**	**0**
	H2S recovery system - deteriorations	Increased S in COG	Continuous	Shift wise analysis	0	**0**	**0**
2.	**Sinter and Pellet Plant**						
	Failure of one field of ESP	No impact	-	Design for (N-1) basis	0	**0**	**0**
	Power failure	Fugitive emission during shut down	15	SOP for smooth shut down	3	**0**	**0**
3	**Blast Furnace**						
	Failure of bags in GCP	No impact	Continuous	Inventory of bags	0	**0**	**0**
	Power failure	Fugitive emission during shut down	15	SOP for smooth shut down	3	**0**	**0**
	Failure of bags in Cast house & stock house	Emissions visible	Continuous	Inventory of bags	0	**0**	**0**
	Power failure to ID fans	Emissions visible	Continuous	Inventory of bags	0	**0**	**0**
4	**SMS -2**						
	Failure of ESP in GCP	No impact	Continuous	Design for (N-1) basis	0	**0**	**0**
	Power failure	Fugitive emission during shut down	15	SOP for smooth shut down	3	**0**	**0**
	Power failure to	Emissions	Continuous	Inventory	0	**0**	**0**

Sr. No.	Failure Scenario	Impact	Max Duration in minutes	Action Planned in the proposed expansion	Impact on environment (on a 0-5 rating)		
					Local	Inside Plant	Outside
	ID fans of Sy FE System	visible		of bags			
5	**Rolling Mills**						
	Power failure	Fugitive emission during shut down	15	SOP for smooth shut down	3	**0**	**0**
6	**LCP**						
	Failure of bags in GCP	No impact	Continuous	Inventory of bags	0	**0**	**0**
	Power failure	Fugitive emission during shut down	15	SOP for smooth shut down	3	**0**	**0**
7	**RMHS**						
	Failure of bags in GCP	No impact	Continuous	Inventory of bags	0	**0**	**0**
	Power failure	Fugitive emission during shut down	15	SOP for smooth shut down	3	**0**	**0**

7.5.2 General Recommendations

Following are general recommendations to be followed:

- Surrounding population (includes all strata of society) should be made aware of the safety precautions to be taken in the event of any mishap within the plant. This can effectively be done by conducting the safety training programs
- Buildings possibly subjected to external blast waves should be made of reinforced concrete. The windows should be made of blast resistant glass with strong frame
- Air intakes should not be placed at grounds level, to prevent combustible dense gas from entering into building
- Buildings possibly subjected to internal explosion should have a strong frame structure supporting roof and intermediate floors. The walls should be open. If a solid wall is needed, use low weight wall panels to facilitate early explosion venting
- Grating and vent panels should be provided to minimize domino effects
- Critical switches and alarm should be always kept in line

- Fire extinguishers should be tested periodically and should be always kept in operational mode
- Fire detectors should be installed near those units which handle large amount of explosive material and operate under high temperature and pressure
- Periodical mock drills should be conducted so as to check the alertness and efficiency of the DMP and EPP and records should be maintained
- Proper training should be given to staff to handle any emergency situation

7.5.2.1 Fire Protection Systems

The typical firefighting system for the various facilities described under this project is outlined. The exact details of the firefighting systems and capabilities to be installed and developed should be finalised after the completion of detailed engineering in consultation with the concerned process and equipment vendors. It is also to be understood that not all facilities described below will be applicable for every installation. The outline of the fire system proposed is described below.

Fire protection system shall be deigned in accordance with the requirements of OISD, Tariff Advisory Committee (TAC) of India, NFPA standards, design requirements and safe engineering practices and will have full capability for early detection and suppression of fire. The system will primarily consist of:

- Hydrant system
- Foam protection system
- Deluge sprinkler system
- Portable fire extinguisher
- Fire detection and alarm system

Hydrant System

The system should essentially consists of firewater storage, pumping, system pressurisation and all inter connected pipe work and auxiliary firefighting appliances. The water storage and pumping capacity and other features of this system should be finalized after considering TAC recommendations.

Adequate number of diesel engine driven / electric motor driven fire water pumps should be provided. The pumps should automatically start in the event of drop in header pressure. The actuation should be through pressure switches, the setting of which should be staggered to achieve sequential starting of the pumps to meet the system demand. When power supply is available, the electric motor driven pump should start first and in case of further pressure drop the engine driven pump should start. However when electric power is not available, the engine driven pump should

cut-in depending on the system demand. The pumping capacity would meet the simultaneous water demand for foam protection of one oil tank, and supplementary foam hose stream in the oil dyke area, which is the maximum water demand in a single occurrence of fire. The pumping capacity should also meet the guidelines of TAC for this size of plant, considering ordinary hazard occupancy.

The fire water system should be kept pressurised by the hydro-pneumatic tank, which takes care of small leakages from the fire water system. A jockey pump, sized as per the TAC guidelines should, automatically replenish the water level in the hydro-pneumatic tank at periodic intervals. Air required for pressurising the hydro-pneumatic tank should be supplied by an electric motor driven compressor.

The outdoor hydrant system should be provided all over the plant for exterior protection. The hydrant mains should be laid underground. Hose houses, complete with all accessories, should be provided at suitable intervals. The overall plant should be divided in several fire zones, where the fire fighting action can be pursued effectively. The pressurised main should also be connected to Sprinkler/ emulsifier System for protection of transformers and Fuel Oil storage tanks.

Sprinkler System

Automatic deluge sprinkler system should be provided for the protection of power transformer. An array of spray nozzles should be provided all around the protected area. The nozzles should be connected to the automatic deluge valve. A set of heat or smoke detectors, located in the area should sense the fire. Deluge valve should automatically open once two independent detectors sense fire.

Manually initiated water spray system should be provided for exposure protection of oil storage tanks, so that when one tank is on fire, the other tank can be cooled to guard against exposure heating. Pressurized water supply to all sprinkler systems should be tapped from the outdoor hydrant main.

Portable Fire Extinguisher

Besides, fire hydrant arrangement, portable fire extinguishers of suitable categories should be placed at control rooms, electrical switchgear room and various utility buildings for immediate use in the event of fire. Three different kinds of extinguishers i.e. foam, CO_2 and multipurpose dry chemical (MPDC) should be provided. Each type of extinguisher has its own characteristic to fight a particular class of fire. The size and type of extinguishers should be decided as per recommendations of NFPA and should be placed in convenient accessible locations.

7.5.2.2 Electricity Hazard

- æ All electrical equipment shall be provided with proper earthing. Earthed electrode shall periodically tested and maintained
- æ Emergency lighting shall be available at all critical locations including the operator's room to carry out safe shut down of the plant, ready

identification of firefighting facilities such as fire water pumps and fire alarm stations

- æ All electrical equipment shall be free from carbon dust, chemical deposits, and grease
- æ Use of approved insulated tools, rubber mats, shockproof gloves and boots, tester, fuse tongs, discharge rod, safety belt, hand lamp, wooden or insulated ladder and not wearing metal ring and chain
- æ Flame and shock detectors and central fire annunciation system for fire safety should be provided
- æ Temperature sensitive alarm and protective relays to make alert and disconnect equipment before overheating
- æ Danger from excess current due to overload or short circuit should be prevented by providing fuses, circuit breakers and thermal protection
- æ Carbon dioxide, halon or dry chemical fire extinguishers are to be used to extinguish electrical fires

7.5.2.3 Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) provides additional protection to workers exposed to workplace hazards in conjunction with other facility controls and safety systems. The PPE is considered to be a last resort that is above and beyond the other facility controls and provides the worker with an extra level of personal protection. The **Table 7.9** presents general examples of occupational hazards and types of PPE available for different purposes. Recommended measures for use of PPE in the workplace include:

- æ Active use of PPE if alternative technologies, work plans or procedures cannot eliminate or sufficiently reduce a hazard or exposure
- æ Identification and provision of appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors, without incurring unnecessary inconvenience to the individual
- æ Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out. Proper use of PPE should be part of the recurrent training programs for employees
- æ Selection of PPE should be based on the type of hazards to be handled

Table 7.9 : Details of Personal Protective Equipment

Objective	Workplace Hazards	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapours, light radiation	Safety glasses with side-shields, protective shades, etc.

Objective	Workplace Hazards	Suggested PPE
Head protection	Falling objects, inadequate height clearance, and overhead power cords	Plastic helmets with top and side impact protection
Hearing protection	Noise, ultra-sound	Hearing protectors (ear plugs or ear muffs)
Foot protection	Failing or rolling objects, points objects. Corrosive or hot liquids	Safety shoes and boots for protection against moving and failing objects, liquids and chemicals
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures	Gloves made of rubber or synthetic material (Neoprene), leather, steel, insulation materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapours	Facemasks with appropriate filters for dust removal and air purification (chemical, mists, vapours and gases). Single or multi-gas personal monitors, if available
	Oxygen deficiency	Portable or supplied air (fixed lines). Onsite rescue equipment
Body / leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration	Insulating clothing, body suits, aprons etc. of appropriate materials

7.5.2.4 Occupational Health Hazards

Following are measures to tackle occupational health hazards:

- Detect the possible onset of an occupational disease
- Monitor personal exposure with the help of biological monitoring
- Check the effectiveness of preventive and control measures on regular basis
- Where there is potential for exposure to substances poisonous by ingestion, suitable arrangements are to be made for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances
- Adequate supplies of potable drinking water should be provided from a fountain with an upward jet or with a sanitary means of collecting the water for the purposes of drinking
- Water supplied to areas of food preparation or for the purpose of personal hygiene (washing or bathing) should meet drinking water quality standards
- Periodic medical hearing checks should be performed on workers exposed to high noise levels
- Preventing spread of communicable diseases through food handlers

- Provisions should be made to provide orientation training to all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees
- Contractors that have the technical capability to manage the occupational health and safety issues of their employees should be hired, extending the application of the hazard management activities through formal procurement agreements
- Two ambulances and full fledge first aid treatment facilities should be available at all times

7.5.2.5 Falling Objects

- Provide safety helmets to protect workers below against falling objects
- Barriers like a toe boards or mesh guards should be provided to prevent items from slipping or being knocked off the edge of a structure
- Secure objects to the structure like lashing of scaffold boards
- Ensure that there are no loose objects and all tools are properly secured
- Create an exclusion zone beneath areas where work is taking place
- Danger areas should be clearly marked with suitable safety signs indicating that access is restricted to essential personnel wearing hard hats while the work is in progress.

7.6 Approaches to Disaster Management Plan (DMP)

Disaster is an undesirable occurrence of events of very high magnitude that adversely affects activities. In spite of various preventive and precautionary measures taken in works, the possibility of a mishap cannot be totally ruled out. An emergency could be the result of malfunction or non-observance of operating instructions. It could, at times, be the consequences of acts outside the control of residents / employees like severe storm, earthquake, flooding, or deliberate acts of arson or sabotage. Hence, the need to prepare emergency plan for dealing with the incidences, which may still occur and are likely to affect life and property in and around the proposed expansion, has been identified in this plan.

The DMP is prepared to meet any grave emergency which can occur due to natural disasters such as floods, earthquakes, tsunami, cyclone and heat wave. Man-made disasters such as acts of war (terrorism), fire and explosion have also been considered. This study has focused on the possible hazards confined within the premises and the corresponding action plan. The DMP presents a clear organizational structure and lists responsibilities and actions expected from the Government departments during an emergency.

7.6.1 Objectives of DMP

The purpose of DMP is to give an approach to detail organizational responsibilities, actions, reporting requirements and support resources available to ensure effective and timely management of emergencies associated to production and operations in the site. The overall objectives of DMP are to:

- æ Identify natural and human induced hazards and provide guidance towards rapid and timely disaster prevention, preparedness, response and recovery.
- æ Ensure safety of people, protect the environment and safeguard commercial considerations
- æ Immediate response to emergency scene with effective communication network and organized procedures
- æ Obtain early warning of emergency conditions so as to prevent impact on personnel, assets and environment
- æ Safeguard personnel to prevent injuries or loss of life and evacuate them from a facility when necessary
- æ Provide a framework of coordinated arrangements for the emergency management operational procedures in the event of disaster or emergency

7.6.2 Causes of Disaster

Various causes that can lead to the above-referred disaster are as follows:

(a) In-plant emergencies due to deficiencies in system / malfunctioning / improper handling in:

- Operations
- Maintenance
- Equipment failure
- Design

(b) Natural calamities like

- Cyclone/Storm/Gale/Flood
- Lightning
- Earthquake

(c) Deliberate acts of man like

- Sabotage
- Riot
- War

(d) Projectile hitting the facility

7.6.3 Different Phases of Disaster

Following are different phases of disaster:

Warning Phase

Many disasters are preceded by some sort of warning. For example, with the aid of satellites and network of weather stations, many meteorological disasters like cyclones, hurricanes, heavy rains and floods can be predicted and preventive actions can be taken to eliminate / reduce their effect.

Period of Impact Phase

This is the period when the disaster actually strikes and very little can be done to reduce the effects of disaster. The period of impact may last for a few seconds (like fire, dust explosion, gas leak) or may prolong for days. This is the time to bring the action plan in force. The coordinators in organization structure will perform the responsibilities assigned to them. Needless to emphasize that prompt and well organised rescue operations can save valuable lives.

Rescue Phase

The rescue phase starts immediately after the impact and continues until necessary measures are taken to rush help and combat with the situation.

Relief Phase

In this phase, apart from organization and relief measures internally, depending on severity of the disaster, external help should also be summoned to provide relief measures like evacuations to a safe place and providing medical help, food, shelter clothing etc. This phase will continue till normalcy is restored.

Rehabilitation Phase

This is the final and the longest phase. It includes rebuilding damaged property, estimating the damages, payment of compensation, etc. Help from revenue/insurance authorities need to be obtained to assess the damage, quantum of compensation to be paid etc.

7.6.4 Key Elements of DMP

Following are the key elements of Disaster Management Plan:

- æ Basis of the plan
- æ Accident/emergency response planning procedures
- æ On-site Disaster Management Plan
- æ Off-site Disaster Management Plan

7.6.4.1 Basis of the Plan

Identification and assessment of hazards is crucial for on-site emergency planning and it is therefore necessary to identify what emergencies could arise in production of various products and their storages. Hazard analysis or consequence analysis gives the following results

- Hazards from spread of fire or release of flammable and toxic chemicals from process and storage units
- Hazards due to formation of pressure waves due to vapor cloud explosion of flammable gases and oil spill hazards

7.6.4.2 Emergency Planning and Response Procedures

Emergency rarely occurs; therefore activities during emergencies require coordination of higher order than for planned activities carried out according to fixed time schedule or on a routine day-to-day basis. To effectively coordinate emergency response activities, an organizational approach to planning is required. The important areas of emergency planning are organization and responsibilities, procedures, communication, transport, resource requirements and control centre. The offsite emergency requires additional planning over and above those considered under onsite plans, which should be properly integrated to ensure better coordination.

The emergency planning includes anticipatory action for emergency, maintenance and streamlining of emergency preparedness and ability for sudden mobilization of all forces to meet any calamity.

7.6.4.3 On-site Disaster Management Plan

Onsite disaster is an unpleasant event of a magnitude which may cause extensive damage to life and property due to plant emergencies resulting from deficiencies in operation, maintenance, design and human error, natural calamities like flood, cyclone and earthquake; and deliberate and other acts of man like sabotage and riot. The purpose for the on-site disaster management plan is:

- To protect persons and property of processing equipment in case of all kinds of emergencies
- To inform in-plant and surrounding people about emergency if it is likely to adversely affect them
- To inform project site authorities and helping agencies like doctors, hospitals, fire, police transport in advance and also at the time of actual happening
- To identify, assess, foresee and work out various kinds of possible hazards, their places, potential and damaging capacity. It can be possible

to review, revise, redesign, replace or reconstruct the process, plant vessels and control measures, if so assessed.

In order to handle emergency situations, an organizational chart showing the involvement of key personnel of the project site and coordination among them are shown in **Figure 7.2**.

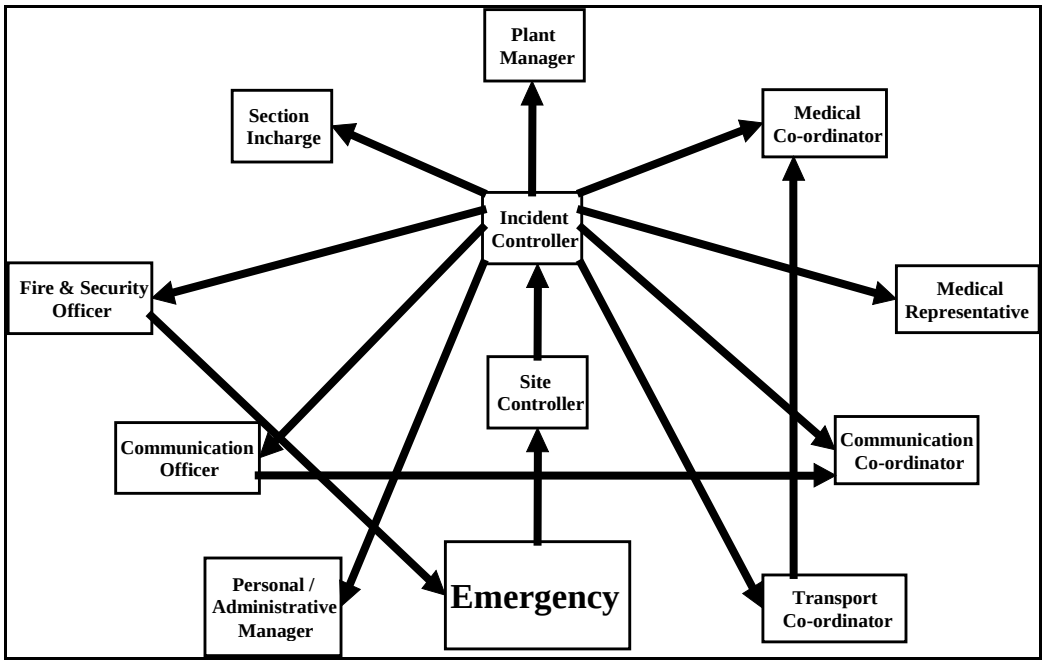


Figure 7.2 : Onsite DMP - Disaster Control / Management System

Before Crisis

The following activities should always be available to tackle any kind of emergency effectively

- A detailed plan of the project site highlighting the probable areas of various hazards which may lead to like fire, explosion, toxic releases. The location of assembly points, fire station or equipments room, telephone room, first aid or ambulance room, emergency control room, main gate, emergency gates, normal wind direction, outside fire station, hospital and other services. Their distances from proposed activities should also be mentioned.
- The fire protection equipment shall be kept in good operating condition at all the time and it should be periodically tested for people functioning logged for record and corrective action.
- The fire fighting training shall be provided to all officers, truck drivers and other employees who are likely to be present at the project site
- There should be regular mock fire drills once a month and a record of such drills shall be maintained

- Every employee or authorized person working at the project site shall be familiarized with the fire alarm signal and shall know the location of fire alarm point nearest to place of work
- Identification key plant personnel who can take immediate actions in case of any emergency
- Risk associated with each operation should be known to all plant personnel involved

During Crisis

Following actions need to be taken during the emergency:

- Monitor the extent of the emergency and evacuate the project site accordingly
- Perform no other duties that may interfere with their primary responsibilities
- Notify the attendant if they experience any warning signs or symptoms of exposures or detect a dangerous condition
- Exit the permit space when instructed by attendant
- Reporting procedure for the person seeing the accident is
- Will dial the nearest telephone
- Will state his name and exact location of emergency
- The person will remain near the accident location to guide the arriving emergency crew
- The person can also activate the nearest available push button type instrument which will automatically sound an alarm in fire control room indicating the location of fire

After Crisis

Following actions should be taken after crisis:

- Report injuries or blood or body fluid exposures to the appropriate supervisor immediately
- Wash wounds and skin sites that have been affected with soap and water
- Workers should be seen as soon as possible by a health professional
- Provide information to the relevant public authority and community including other closely located facilities regarding the nature of hazard and emergency procedure in event of major accident
- Record and discuss the lessons learned and the analysis of major accidents and misses with employees and employee representative

Emergency Organization Structure

Following are the key personnel of the plant which are responsible to take appropriate actions during emergencies.

Site Main Controller

President/SSM - (the senior most functionary available at site).

The President/Site Shift Manager (SSM) will be designated as the Site Main Controller at the time of an emergency and report at the Emergency Control Centre (ECC) which will be the Primary Command Post. He will be the Chief Co-ordinator and take overall command of the emergency management. He will be assisted by other co-ordinators as designated for various functions. The Site Main Controller will provide all decisions support and resources support to the Site Incident Controller at the incident site for initiating appropriate actions for emergency control. He will also liaise with mutual aid members and all outside agencies including Local Crisis Management Committee, District Contingency Plan Committee (District Collector), Police, Civil Defence, Factories Inspectorate, etc. to seek assistance/help and provide necessary information to them.

Normally, the SSM is available on round the clock duty at the site to co-ordinate overall manufacturing activities and management of emergency. In the event of an emergency, the Site Shift Manager (SSM) will assume the charge of the Site Main Controller till the Executive or the President arrives.

Site Incident Controller

AVP/GM/DGM/Sr. Manager/Manager - The next lower to senior most functionary of operation available at site will be Site Incident Controller. On receiving information about the emergency, he will report at the incident site and take over from the Deputy Incident Controller (shift-in-charge). He will take overall command of the emergency control operation as the Site Incident Controller and will take decisions in co-ordinations with Site Main Controller for controlling emergency situation. He will co-ordinate with all the key personnel, firefighting and rescue team leaders and other support services and provide necessary information and advice to them for effectively managing control measures / actions.

Deputy Incident Controller

The shift-in-charge is available on round the clock duty in every plant. He is competent for plant operation and responsible for all activities related to production / maintenance including prevention / control of incidents and handling emergencies (if any) in the plant. He will be designated as the Deputy Incident Controller. In the event of an emergency in the plant, he will immediately assume the charge of the Site Incident Controller and take decisions in consultation with the Site Main Controller. He will initiate immediate actions for controlling/mitigating emergency situation at the incident site till the Site Incident Controller arrives.

Coordinators

The senior most functionaries available at site in the respective services will be the co-ordinators at the time of an emergency. They will report at the Emergency Control Centre (ECC), known as the Primary Command Post, unless and otherwise instructed by the Site Main Controller. They will assist and advise the Site Main Controller in all matters for effectively managing control measures and mitigating operations.

Emergency Control Centre (The Primary Command Post)

In the event of an emergency, SSM Office will be designated as the Emergency Control Centre, which will be known as the Primary command Post. If, the SSM office is likely to be affected due to unfavourable wind direction or any other reasons, the Emergency Control Centre will be shifted to a room which will be having necessary facilities to connect communication links as provided in the SSM Office.

Role and Responsibilities of Key Personnel

Roles and responsibilities of various key personnel are outlined below

Site Main Controller

The Site Main Controller will be the chief co-ordinator and shall be assisted by other co-ordinators (senior most functionaries in the respective divisions). He will take overall command of the emergency management and his duties and the responsibilities are

- Report at the Emergency Control Centre as soon as he gets information about the emergency at site and will assume overall responsibility of taking decisions and directing actions as necessary for mitigating the situation and managing the emergency effectively with due consideration and priorities for personnel safety, safety to the plant's property and the environment
- Assess the magnitude of the situation in co-ordination with the Site Incident Controller / Dy. Incident Controller and decide whether major emergency exists or is likely to develop, requiring external assistance. Accordingly, he will decide to inform local/district emergency chief and other emergency control groups for help and the nature of help required including assistance from mutual aid members and declare on-site emergency
- Decide the safe route of entry for external assistance/help to reach at site of the incident considering wind direction and the place of the incident and also the place of reporting such assistance. He will also direct the security to guide them properly
- Ensure that the key personnel and co-ordinators are called in

- Ensure that all non-essential workers, visitors, contractors are safely moved to assembly points and direct for search and rescue operation within the affected areas, if necessary
- Be in constant communication with the Site Incident Controller to continuously review and assess the situation and possible developments
- Direct actions for safe shut down of plant(s) or section of the plant and evacuation of plant personnel and other necessary action is in consultation with the other co-ordinators
- Exercise direct operational control over areas in the complex other than those affected in consultation with other co-ordinators
- To liaise with the local meteorological office to receive early notification of changes in wind direction and weather conditions
- Liaise with the senior officials of police, fire brigade, medical and factory inspectorate and pass on information on possible effects to the surrounding areas outside the factory premises and necessity of evacuating the area and moving the people to safe places
- Liaise with various co-ordinators to ensure that various teams are functioning well, casualties are receiving attention and traffic movement within the works is well regulated
- Arrange for a log of the emergency to be maintained in the Primary Command Post
- Release authorized information to press through the media co-ordinator

Site Incident Controller

The Site Incident Controller is the key personnel for operations function reporting at the incident site and will take the overall command of actions for emergency control operation on his arrival at the incident site. He will be supported by other key personnel representing various emergency services and initiate emergency control actions under the direction of the Site Main Controller (Primary Command Post). The duties and the responsibilities of the Site Incident Controller include the following:

- Report at the incident site immediately after getting information about an emergency. Upon his arrival at the site, he will assess the scale of emergency in consultation with the Deputy Incident Controller and evaluate, if a major emergency exists or is likely to develop and inform Emergency Control Centre Primary Command Post) accordingly asking for assistance and indicating kind of support needed
- Take overall control of handling the emergency at site and take action for isolation of source of containment loss to the extent feasible.

Simultaneously, in case of fire organize appropriate fire response in co-ordination with key personnel (fire & safety) to get the situation under control and to prevent it's escalation

- æ Set up effective communication pathway and establish contact with Site Main Controller and keep him informed about the development
- æ Keep on assessing the emergency situation at the site and communicate to the Site Main Controller and keep him informed about the development
- æ Co-ordinate the activities of other key personnel reporting at the Field Command Post, under his overall command
- æ Direct all operation with the affected areas giving due priorities for safety of personnel and to minimize damage to environment, plant and property
- æ Provide advice and information to fire fighting and rescue personnel, external fire services and other emergency services/teams as and when they arrive at the incident site and co-ordinate with them for effective control actions
- æ Ensure that all non-essential workers and staff within the affected area are evacuated to appropriate assembly points and that areas are searched for casualties
- æ Organize rescue teams for search of casualties in the affected areas (if any) and send them to safe areas / medical centre for first aid and medical relief
- æ Seek additional support and resources as may be needed through Primary Command Post
- æ Send decision support from the Primary Command Post for decision such as precautionary shut down of neighbouring facilities, precautionary evacuation of people in the neighbouring facilities, activating mutual aid plan, etc.
- æ Be in constant liaison with the Site Main Controller and keep him informed about the situation at the incident site
- æ Preserve all evidences so as to facilitate any inquiry into the cause and circumstances, which caused or escalated the emergency (to arrange photographs, video, etc.)
- æ Arrange for head count after the emergency is over with respect to the personnel on duty in the affected areas

Deputy Incident Controller

Normally, the Shift-in-charge of a plant being always available at the plant site and well aware of the plant operating conditions at all times will be designated as the Deputy Incident Controller and assume the charge of the Site Incident Controller at the time of an emergency till the Site Incident Controller arrives at the incident site. He will assist the Site Incident Controller on his arrival and work under his direction in emergency control operation. The responsibilities and duties of the Deputy Incident Controller will be as defined for the Site Incident Controller. In addition he will ensure the following:

- In the event of an emergency, caused due to any incident in the plant, he will immediately activate plant level emergency siren (hooter) to warn the field personnel, contractors' employees, etc. and also arrange for announcement about the emergency and necessary instruction for them for assembling at the safe assembly point or evacuation, etc.
- Ensure that the SSM and senior plant personnel have been informed about the emergency

Medical Coordinator

The Chief Medical Officer (or the next in command available at site) will be the Medical Co-ordinator and perform the following duties:

- He will contact the Site Main Controller immediately after receiving the information about the emergency
- He will report immediately at the Emergency Control Centre (Primary Command Post) or Occupational Health Centre (OHC) as instructed by the Site Main Controller and contact the Key personnel (Medical) and take stock of the situation
- He will assist and advise the Site Main Controller in all critical decisions in the area of health/medical services to the affected persons and keep constant liaisons with him
- Organize rescue and first aid arrangements for the affected persons at the site, as may be necessary with essential staff/equipment and post additional ambulance for transporting seriously injured persons
- Ensure that adequate paramedical staff, equipment and medicines are available at the OHC. He will mobilize additional resources from neighbouring industries, if necessary
- To liaise with the local medical authorities and city hospitals, if the causalities are more and situation demands treatment at additional medical centres

- To co-ordinate with the Transport Co-ordinator for transporting victims to various hospitals
- To arrange for additional ambulances from other hospitals/ Municipal Corporation
- The Medical Co-ordinator should ensure the upkeep of agreed medical supplies, antidotes and equipment that should always be kept in stock for treating victims of burns and hazardous chemicals. The medical authorities should be aware of the type of treatment to be administered
- He will liaise with the media co-ordinator for release of news to the press

Security Co-coordinator

The Chief of Security or the next in command available at site shall be the Security Co-ordinator. He will have the following duties / responsibilities:

- He will instruct and deploy plant security personnel to ensure that the law and order is maintained ; and unnecessary gathering of the personnel at the scene of emergency is prevented and ensure control of traffic movement in and out of the factory areas
- He will instruct the security personnel / Security Gates to direct and guide external emergency vehicles (Fire tenders/ambulances etc.) called for assistance/help from neighboring industries/Local administration, to the scene of incident
- He will instruct security personnel who could be spared to assist Site Incident Controller/Key Personnel (fire and Safety) in fire fighting and evacuation of personnel, at the Incident Site
- He will take action to regulate traffic movement and prevention of traffic jams inside the works as well as outside the factory gates for proper and speedy movement of the emergency vehicles, ambulances, other vehicles carrying outside resources, etc.
- He will mobilize additional security force for help, as necessary
- He will liaise with the police and other local authorities for external help, as necessary for evacuation of the neighbouring areas outside the factory premises in consultation with the Site Main Controller
- If necessary, he will arrange for announcement through the mobile P.A. system for alerting and instructing the population in the surrounding areas as directed by the Site Main Controller

Engineering Coordinator

- æ He will report to the Site Main Controller at the Emergency Control Centre (Primary Command Post) immediately after receiving information about On-site emergency
- æ He will take stock of the situation and assist/advise the Site Main Controller in deciding control strategies
- æ He will mobilize the team from the Maintenance Dept. to assist the Site Incident Controller in control operation at the Field Command Post
- æ Arrange isolation of electrical lines from distribution point/substations as required by the Site Incident Controller by calling the Electrical Engineer / Electricians
- æ Provide all other engineering support, as may be required
- æ Liaise with Key Personnel (Eng./Maintenance) and co-ordinate with other groups

Communication Coordinator

Communication Co-ordinator plays very important part at the time of an emergency particularly when extensive disruption of services takes place. He has the following duties and responsibilities:

- æ To ensure all available communications links remain functional
- æ To quickly establish communication links between the Field command Post and (if this happens to be in remote off site area) and the Primary Command Post
- æ To arrange for announcement on the public address system and maintain contacts with congregation points like canteen, main gate, control rooms etc.
- æ To ensure that previously agreed inventory of various types of communication equipment is maintained in working condition and frequent checks are carried out and records maintained
- æ To maintain voice record of significant communications with timings received/passed from the Primary Command Post
- æ To provide additional/alternate communication facilities as required at the site

Transport Coordinator

The Transport Co-ordinator shall perform the following duties

- æ Mobilize all available company's vehicles for emergency use alongwith the drivers

- Arrange for transport of victims to hospitals/dispensaries
- Arrange for duty rotation of the drivers to meet the emergency situation
- To direct refueling of the vehicles
- To co-ordinate with the neighbouring industries for additional vehicles / ambulances as may be required
- To co-ordinate with the neighbouring industries for additional vehicles / ambulances as may be required
- To arrange for vehicles from outside local transport agencies, if required
- To keep in contact with the Site Main Controller for evacuation of personnel and transportation of victims

Media Coordinator

The Media Co-ordinator will co-ordinate the following under the direction of the Site Main Controller:

- He will liaise with various media and release written statements to the press through prior concurrence of the Chief Co-ordinate
- He will handle media interview with various media groups make arrangements for televising the information about the incident, the number of casualties, etc
- He will inform State and Central Government and the statutory bodies of the nature and magnitude of the incident, the number of casualties, etc.
- He will locate himself such that media persons/third parties do not need to go past the complex security gates and that adequate communication links exists
- Media personnel often insist on visiting incident scene. He will escort media team(s) If such visits are approved by the Chief Co-ordinator
- He will be in constant contact with the Medical Co-ordinator, and other co-ordinators to be aware of latest development and closely liaise with the Chief Co-ordinator

7.6.4.4 Off-site Disaster Management Plan

Emergency is a sudden unexpected event, which can cause serious damage to personnel life, property and environment outside the boundary wall of the project site as a whole, which necessitate evolving off-site emergency plan to combat any such eventuality. In offsite disaster management plan, many agencies like revenue, public health, fire services, police, civil defence, home guards, medical services and other voluntary organization are involved. Thus, handling of such emergencies requires an organized multidisciplinary approach.

Evacuation of people, if required, can be done in orderly way. The different agencies involved in evacuation of people are civil administration (both state and central), non-Govt. organizations, factory inspectorate and police authorities.

Before Crisis

This will include the safety procedure to be followed during an emergency through posters, talks and mass media in different languages including local language. Leaflets containing do's/ don'ts before and during emergency should be circulated to educate the people in vicinity.

- æ People in vicinity of hazardous installation, and others who are potentially affected in the event of an accident, should be aware of the risks of accidents, know where to obtain information concerning the installation, and understand what to do in the event of an accident
- æ Non-governmental Organizations (NGOs) such as environmental, humanitarian and consumer group should motivate their constituents and others, to be involved in risk reduction and accident prevention efforts. They should help to identify specific concerns and priorities regarding risk reduction and prevention, preparedness and response activities
- æ NGOs should facilitate efforts to inform the public and should provide technical assistance to help the public analyze and understand information that is made available
- æ Public authorities and management team of hazardous installation should establish emergency planning activities/ programs for accidents involving the hazardous substance
- æ Emergency alert system should be in place to warn the potentially affected public in the surrounding area
- æ The system chosen should be effective and provide timely warning. Suitable warning system could include or a combination of for e.g.: sirens, automatic telephone message, and mobile public address system

During Crisis

- æ **Central Control Committee:** As the off-site plan is to be prepared by the Government authorities, a central control committee should be formed under the chairmanship of area head. Other officers from police, fire, factory, medical, engineering, social welfare, publicity, railway, transport and requisite departments shall be incorporated as members. Some subject experts will also be included for guidance. The functions of committee should be:
  - To work as main co-coordinating body constituted of necessary district heads and other authorities with overall command,

coordination, guidance, supervision, policy and doing all necessary things to control disaster in shortest times

- To prepare, review, alter or cancel this plan and to keep it a complete document with all details
- To take advice and assistance from experts in fields to make plan more successful
- To set in motion all machineries to this plan in event of disaster causing or likely to cause severe damage to public, property or environment
- The incident control committee, traffic control committee and press publicity committee will first be informed as they play important role during initial hours of emergency

æ **Medical Help, Ambulance and Hospital Committee:** This committee consisted of doctors for medical help to the injured persons because of disaster. Injuries may be of many types. As such doctors are rarely available we have to mobilize and utilize all available doctors in the area. Functions and duties of the committee include:

- To give medical help to all injured as early as possible
- Civil surgeon is the secretary who will organize his team
- On receiving information to rush to spot he will immediately inform his team and will proceed with all necessary equipment
- First aid and possible treatment shall be provided at the spot or at some convenient place and patients may be requested to shift to hospitals for further treatment
- All efforts shall be made on war basis to save maximum lives and to treat maximum injuries
- Continuity of the treatment shall be maintained till the disaster is controlled

æ **Traffic Control, Law and Order Committee:** The committee is headed by District Superintendent of Police. Functions and duties of this committee should be:

- To control traffic towards and near disaster , to maintain law and order
- To evacuate the places badly affected or likely to be affected
- To shift the evacuated people to safe assembly points

- To rehabilitate them after disaster is over
- Necessary vehicles, wireless sets and instruments for quick communications shall be maintained and used as per need

After Crisis

æ At the time of disaster, many people may badly be affected. Injured people shall be treated by medical help, ambulance and hospital committee, but those not injured but displaced kept at assembly points, whose relative or property is lost and houses collapsed shall be treated by the welfare and restoration committee. Functions and duties of the committee are:

- To find out persons in need of human help owing to disastrous effect. They may give first aid if medical team is not available
- They will serve the evacuated people kept at assembly points. They will arrange for their food, water, shelter, clothing, sanitation, and guidelines to reach any needful places
- They will look for removal and disposal of dead bodies, for help of sick, weak, children and needy persons for their essential requirements
- The team will also work for restoration of detached people, lost articles, essential commodities etc.
- The team will also look after the restoration of government articles
- The team will also ensure that the original activities, services and systems are resumed again as they were functioning before the disaster

Responsibilities of Various Government Departments

Local authorities and Government departments are important functionaries for expedition of DMP. The plant authorities are responsible in providing exact details of accidents to local authorities and Government departments. The actions and responsibilities expected from concerned departments are listed below:

Police Department

æ Warning and advice in the affected area. Use mike fitted van. Get ready with the message to be announced

æ Regulating and diverting traffic

æ Maintaining law and order in the area

æ Ensuring security of the belongings of the evacuees

- Co-ordination with the transport authorities
- Co-ordination with civil defence and home guards
- Co-ordination with army, navy, air force as required
- Co-ordinate with state fire services
- Arrange for post-mortem of dead bodies
- Establish communication center

Medical Department

- Set up temporary medical camp
- Ensuring medical facilities at the emergency site and neighbourhood areas
- Arranging for casualties to be sent to government /private hospitals
- Co-ordinate the activities of primary health centers and municipal dispensaries to ensure required quantities of drugs and equipment
- Securing assistance of medical and paramedical personnel from nearby hospitals/institutions
- Temporary mortuary and identification of dead bodies

Revenue Department

- Evacuation of personnel from the affected area
- Arrangements at rallying posts and parking yards
- Rehabilitation of evacuated persons
- Co-ordination with other agencies such as police, medical, animal husbandry, agriculture, electricity board, fire services, home guards - civil defence
- Nominate a press officer
- Establishing shelters for rescue, medical, firefighting personnel, etc.

Fire Services Department

- Assist in firefighting by mobilizing required number of fire engines
- Rendering assistance for fire fighting

Factory Inspectorate

The officer of factory inspectorate shall, within 72 hours of the closure of the incident, schedule a debriefing to all concerned agencies. This debriefing shall include, but not be limited to

- Analysis of the incident including type of scenario, type of fire, impact distance, casualties and injuries etc.
- Problem areas identified
- Revisions to the emergency plan, if needed
- Factors that caused the incident
- Upon completion of the debriefing, open discussion for questions and answers should be allowed

7.6.5 Natural Disasters

The emergency plan to tackle natural disasters like earthquake, flood, cyclone, tsunami and heavy rain has been detailed below:

Earthquake

An earthquake is the perceptible shaking of the surface of the earth resulting from the sudden release of energy in the earth's crust that creates seismic waves. It has significant impact on property as well as population. Hence, prompt actions in managing earthquake are important in minimizing its effect. All structures at plant site shall be designed with appropriate/internationally accepted safety margins. Following are measures to be taken in case of earthquake

- Facilitate selective strengthening and seismic retrofitting of proposed structures
- Strengthen the emergency response capability in earthquake-prone areas
- Keeping records of vulnerable areas, monitoring of rescue and relief operations deciding response, managing the data base etc.
- Introduce appropriate capacity development interventions for effective earthquake management through education training, research and development and documentation

Flood

Floods are the most common and widespread of all natural disasters. Following are measures to be taken in case of floods

- Focus resources on minimizing the spread of water into other areas of the plant
- Protect property and records by removing items from floors and /or covering with water resistant coverings.
- Attempt to move items of value to "higher ground" if possible.
- Evacuate personnel as needed. Utilize the fire alarm system if an immediate evacuation is required.

- Mitigation measures can be structural or non-structural. Structural measures use technological solutions, like flood levees. Non-structural measures include legislation, land-use planning (e.g. the designation of nonessential land like parks to be used as flood zones), and insurance.
- The response phase includes the mobilization of the necessary emergency services and first responders in the flood area. This is likely to include a first wave of core emergency services, such as fire-fighters, police and ambulance crews. They may be supported by a number of secondary emergency services, such as specialist rescue teams

Cyclones

Cyclones are considered as one of the most damaging natural disasters. Cyclone refers to any spinning storm that rotates around a low-pressure center. They make impact by killing people and damaging property. Following are measures to be taken in case of cyclones and severe storms:

- Land use management should provide protection from wind and storm surge
- Engineering of structures should withstand wind forces and water damage (including storm surge)
- Plant buildings should be constructed with higher wind-resistant capacity
- Securing of elements such as metal sheeting, roofing, and fences should be done to avoid severe damages
- Safety shelters are to be arranged to tackle cyclones and storms
- Cyclone and severe weather warning systems should be installed
- Community awareness regarding cyclone risk and evacuation plan should be properly addressed

Heavy Rain

Heavy rainfall can lead to flooding. It can also trigger landslides which can threaten human life, disrupt transport and communications, and cause damage to buildings and infrastructure. A number of landslides had occurred due to heavy rains causing loss to property and killing people. Hence the risk from heavy rains is high. Early warning system for the predication of heavy rains should be made available. The people should be informed through SMS, loudspeaker etc. regarding the possibility of heavy rains. The necessary precautions to be taken during and after heavy rains should also be informed.

Heat Wave

In recent years, excessive heat has caused more deaths than other weather events. A heat wave is a prolonged period of excessive heat, often combined with

excessive humidity. Generally temperatures are 10 degrees or more above the average high temperature for the region during summer months, last for a long period of time and occur with high humidity as well. The heat waves are seasonal and lasts from April to June, the chances of getting a heat stroke are high during this period. Heat stroke (also known as sunstroke) is a life-threatening condition in which a person's temperature control system stops working and the body is unable to cool itself.

7.6.6 Man-made Disasters

Man-made disasters like terrorist attack, fire and explosion have been detailed in this section.

Fire and Explosion

Fire or explosion is a common hazard that may arise from the use of flammable liquids or gases that are easily ignited. The presence of large quantities of dry fabric or paper can also increase the risk and spread of fires. Faulty electrical wiring can also cause fires. Another source of risk is corrosive chemicals which can cause serious burns and may react dangerously with other chemicals. Few measures to tackle fire scenarios are listed below:

- Probable ignition sources like open flame and welding sparks, which may trigger fire, should be avoided to the extent possible at the plant site
- Firefighting systems should easily accessible to minimize the impact of fire
- Fire alarms should be installed in order to raise early warning so that immediate actions can be taken.
- Training comprising causes of fire, firefighting methods and equipment, response procedures etc. to all plant personnel should be provided

War Attack / Terrorist Attack

No solution can be offered to eliminate either terrorist threats or planted bombs, but one can be well or badly prepared to cope with them when such incidents happen. It is essential for organizations to design and implement both good physical security and a comprehensive bomb threat response plan. Following measures are recommended

- Safe evacuation of all staff would be ensured at the site in small groups but away from normal assembly points.
- Care would be exercised to distribute the staff in small groups preferably away from known assembly points. This is required as terrorists may send bomb scare at site and then explode devices by remote at assembly points to inflict greater damage.
- Bomb snuffing and diffusing squad would be requested from the police.

- All transport vehicles incoming and outgoing would be checked for unidentified objects.
- No personnel would be allowed to remain at site until site is declared safe
- In case of any terrorist attack at plant area, efforts would be made to protect life of the people. No action should be taken in haste by anyone as it could be misread by the terrorists. Police and other agencies would be informed and all support would be extended to them.

7.6.7 Assembly Points

Assembly points shall be set up farthest from the location of likely hazardous events, where pre-designed persons from the works, contractors and visitors would assemble in case of emergency. Up-to-date list of pre-designed employees shift wise must be available at these points so that roll call could be taken. Pre-designated persons would take charge of these points and mark presence as the people come into it. Two alternate locations for safe assembly points should be earmarked at all the operating plants. These locations are designated for assembling non-essential workers, visitors, and other persons who are not required in the plant site at the time of emergency but they are to be moved to safer places. These locations have been provided with sign boards displaying "Assembly Points" for easy identification.

The persons required to be assembled at the assembly point should choose safer assembly point out of the two, considering the wind direction at that time. The plant control room will also announce the same on the plant PA system, if possible. The person assembled at the assembly point shall follow the instruction for evacuation of the plant area and move to safe locations as directed. They should move in the cross wind direction or up-wind direction, whichever is more safer.

7.6.8 Mock Drills

Mock drills are very important in order to handle emergency scenarios in an effective way. It should be ensured that mock drills of the on-site emergency plan are conducted every six months. A detail report of the mock drill conducted shall be made immediately available to the concerned plant authority. Additionally, major fire and minor fire mock drills are conducted once in three months and one month respectively. Performances during the mock drills should be reviewed by top plant authorities. Observations / shortcomings should be reviewed and recommendations for improvements should be made. The action points from the mock drill observations should be circulated to all concerned for liquidation.

Chapter 8
Project Benefits

The setting up of the steel industry significantly contributes to economic growth of a nation as it generates employment both directly and also indirectly due to development of ancillary industries. Further, peripheral economic development takes place due to need of industrial production activities, increased population due to associated activities of the steel plant and due to cascaded economic development in the area, which will improve the overall importance of the area thereby the infrastructure. The benefits due to the change in the configuration of pellet and sinter plants is marginal as the major benefit is accrued due to the expansion of the steel plant to 10 MTPA, at substantial expenditure.

8.1 Improvement in the Physical Infrastructure

Road

The improvement in infrastructure is being executed by the NHAI at substantial expenditure. The facilities Improvement and extension of the existing network of national highways is being taken up by NHAI. The earlier two lane highway from Panvel to Goa is being converted to four lane with widening of roads, which will not only improve the movement of vehicles, but also ensures safety of the passenger traffic. The construction of the road which was started in 2014 is expected to be complete by 2020. Similarly the upgradation of road towards Alibagh with several bypass and fly overs, over bridge at the Konkan railway line are under final stages of construction. These expenditure made by the Government will help in accelerated development of the population along the highway

Rail Network

Railways provide an important mode of transportation in the industrialization spreading over the entire country. It contributes to the country's economic development by catering to the needs of large-scale movement of freight as well as passenger traffic and is a major source of promoting integration among the masses. Railway provides transport facility to people and handles freight of over 600 million tons annually. The Indian railway is intended to modernize the vast railway network, keeping both the economic and social dimensions in mind. A railway network connecting the steel plant with the Konkan railway has been constructed, which will help in transportation of steel products by rail. This will help in reducing the movement of heavy traffic thereby reducing fugitive dust emissions.

8.2 Income Generation Due To The Manufacture Of Steel Products:

With the setting up of 5 MTPA additional capacity of the steel plant to produce special products, there will be an additional annual revenue generation by about Rs 20,000 Cr, resulting in an additional income of about Rs 3600 Cr by way of

taxes and duties. In addition, there will be additional income to the state and central government due to taxes and duties collected towards purchase of raw material and consumables.

8.3 Improvement In the Social Infrastructure

JSWSL is continuing to launch Social welfare schemes in the surrounding villages through its CSR activities by JSW Foundation to meet the needs of the local population. A super specialty hospital is being constructed by JSW Steel near the steel plant which will not only help the employees of the steel plant, but also the nearby villages in accessing superior health care facilities nearby.

8.4 Employment Potential

The expansion proposal implementation shall generate employment both directly and also due to development of ancillary industries. During the construction period, the project is going to create substantial employment and income. A large portion of these is likely to trickle down to the local people. Besides this, many persons from the nearby area have got employment on permanent basis for operation of the new plant facilities, in the form of skilled or semi-skilled, or unskilled labour. Thus, substantial amount of employment and income are expected to be generated for the local people. Hence, it can be ascertained that the project is going to have significant employment and income effects. The estimated manpower requirement at the operational stage of the integrated steel complex is 5000, . From 2015 onwards, nearly 1250 persons have been employed directly by JSWSL for steel plant operations.

In the case of indirect employment also, the effect is quite strong and widespread. Besides direct employment, the project is expected to generate substantial indirect employment in other sectors. Nearly 1500 employees are involved in construction activities and another 2000 are employed in other locations for supplying equipment and materials to the steel plant in its expansion.

So far as indirect employment after the commissioning of the plant is concerned, the effect is very strong and widespread specifically, in ancillary industries, services and transport sectors. In view of the above, it can be seen that the expansion of integrated steel plant shall have tremendous positive employment and income effects which is being witnessed. Overall assessment of the employment and income effects indicates that the creation of additional capacity shall have strong positive direct as well as indirect impact on employment and income generation.

8.5 Other Benefits

8.5.1 Corporate Environment Resposibility (CER)

Under the Corporate Environment Responsibility (CER) program of the company, JSWSL has already initiated several welfare schemes to take care of the aspiration of the surrounding population as expressed earlier in the public consultation for the project for which EC has been accorded. One of the major activity which has been taken up is the 60 bed super specialty hospital which will cater to the health needs of the surrounding village and employees of JSWSL Besides other measures include skill development, drinking water and sanitation and tree plantation etc. The total expenditure works out to Rs 118 Cr and the list is enclosed in **Table 8.1**.

Table 8.1: Expenditure Planned under CER for the Expansion to 10 MTPA

S. No	Programme	Program details	Total	2017-18	2018-19	2019-20	2020-21	2021-22
1	**Health**	Construction of a new Multi speciality Hospital Jindal SanjeevaniDolvi Hospital (70 beds) located near the plant on the road to Wadkhal. The hospital will serve the healthcare needs of the local community and employees at affordable costs making healthcare accessible to the local community.	65	10	20	25	10	-
2	**Water**	Provision of drinking water to 45 villages along the makeup water line to the steel plant.	15	2	8	5		
		Construction of Rain Water Harvesting at roof top of nearby villages and nearby schools.	0.76	0.17	0.14	0.15	0.15	0.15
		Renovation of community ponds nearby villages	0.45	0.08	0.07	0.1	0.1	0.1
3	**Infrastructure**	Construction of internal village roads, pathways, Drainage and installation of solar street lights	16.35	1.75	3.4	3.6	3.8	3.8
4	**Skill development**	Supporting Infrastructure facilities at Industrial Training Institutes (ITIs) at Nagothae and Pen. JSW Skill school at Wadkhal, Pen for tailoring, fish, hand gloves, vegetable shop, other livelihood options.	8	1.5	1.25	1.75	1.75	1.75
5	**Agricultural and Scientific support**	Support of better farming practices, market linkages and create awareness about Agri allied business	4.25	0.65	0.9	0.9	0.9	0.9
6	**Plantation**	Mangrove plantation within 10 KM area from the plant. (345 Acres). Tree Plantation at Forest land of nearby plant area (Dolvi, Khakarav). Avenue Plantation at NH in the plant area.	9	1.25	1.75	2	2	2
		TOTAL	**118.81**	**17.4**	**35.51**	**38.5**	**18.7**	**8.7**

8.5.2 Community Development Plan & CSR Activities:

In addition to the infrastructure created under the CER projects, JSWSL to continue the existing activities and take up other activities which will help in long term income generation and economic development in the region. Towards this, the company has the following schemes which are currently in operation, as a part of its ongoing CSR activities. These will get additional allocations due to additional income generated by sale of steel products. The other tangible benefits will accrue in the form of support services due to construction of a township, good schooling facilities as well as Community Development plan of JSWSL which will also help local population to enjoy the fruits of development

JSWSL has a history strong commitment towards the surrounding community, where ever it operates in the country.. It has already adopted 10 villages surrounding steel plant for community development. A substantial amount has been allocated and schemes are being implemented for the social upliftment of surrounding villages. The activities undertaken are as follows:

- Medical facilities along with Ambulance for health check-up of peripheral villagers
- Organization of Annual Eye camps for local population
- Drinking water facilities with overhead tanks at each peripheral village
- Community center, temples, ponds, connecting roads for peripheral villages

The various activities are the implemented in the above fields as following:

Education

- Distribution of school uniforms every year to the poor students of local schools.
- Distribution of notebooks every year to the poor students of local schools.
- Educational tours to students of schools.
- Training of teachers to enhance their skill sets.
- Computer Institute in each Gram Panchayat. The four Gram Panchayats comprise 17 villages and 2 adivasi wadis.
- Training can be imparted in basic MS packages, MSCIT certification.
- Educational aids to provide infrastructure and extracurricular activities to increase the quality of education.
- Balwadi classes for adivasis. Aims at exposing unreached children from low-income adivasi families to early childhood education.
- Anganwadi classes for school dropouts
- Targets children in the 6-12 years age group who have never attended school or have dropped out using informal methods of education, gradually moving towards a structured set-up and then placing the children in a formal school.

- Targets children who are identified by teachers as lagging behind academically. With a little extra help these children make substantial progress in basic math and language skills.

Community learning centers

- Four centers - One in each Gram Panchayat.
- Aims at providing cross section of creative & learning activities – from science & Computer classes to English speaking courses to women self-help groups, training & leadership skills.
- Tie-ups with ITI's to improve the standards of technical education as per the requirement of the Industry.
- To impart multi-tasking / skilling as per market requirements in new areas (additional courses).

Farming, Animal-Husbandry And Aqua Farming

- Training of villagers in multi-farming, horticulture, fish breeding & agro tourism providing extension education activities for all round development of villages.

Health

- Full year program for Medical camp in the nearby villages.
- Various specialized medical camps have been identified as follows:

Sports & Cultural Activities

Activity	Details
Sponsorship of sports & cultural activities	Sponsorship of Kabaddi and Cricket tournaments. Also sponsoring individuals excelling in various sports, Bhajans, Kirtans, Dindi Yatras, Jayanti's, and Cultural activities in schools etc from time to time in Gram Panchayats surrounding Dolvi Complex.
Marathon race	The Marathon is held annually at Alibaug with an aim to nurture an interest in sport among the youth. The races are handled by the officials of the district sports office.

- The above measures will be continued with additional focus for the issues on need based assessment.
- On CSR activities, the company meets an expenditure of approximately Rs. 150 lakh per annum towards providing water supply to surrounding villages and spends another Rs.50 lakh per annum towards other activities.

It is proposed to keep provision for training of women folks (sewing, stitching etc.) of surrounding villages for their economic upliftment.

The plan for CSR activities proposed by JSWSL under enterprise social commitment is indicated along with proposed budgetary allocation in **Table: 8.2.**

Table 8.2 : Estimate of Expenditure Towards CSR Activities

Programme Wise	2016-17	2017-18	2018-19	2019-20 (Plan for the year)
	Rs in Lacs	Rs in Lacs	Rs in Lacs	Rs in Lacs
Rural Infrastructure	276.48	156.63	330.80	234.2
Environment	7.77	85.7	59.54	0
Health	27.28	15.38	20.89	70
Edcuation	63.52	105.92	69.84	208.5
Water	33.28	6.6	83.23	329
Livelihood	29.69	0	37.07	176
Sports	0.7	0	0.00	0
Sanitation	0	114.45	67.40	55
Agriculture	0	0	8.85	90.5
Skill Dev	0	0	167.84	0
Mangroves	32.78	76.3	80.15	119.8
Total	471.5	560.98	925.61	1283

8.6 Greenery in the Surrounding Areas

Green vegetal cover is not only pleasing to the eyes but also beneficial in many ways such as conservation of bio-diversity. retention of soil moisture. recharge of groundwater and moderation of micro-climate in the region. It also plays an important role which relates to containment of pollution, besides acting as a carbon sink, also absorbs noise. It is also known that certain species of plants can even absorb the pollutants, while others can thrive even in polluted atmosphere.

Enhancing green cover with native species, not only mitigates pollution but also improves the ecological conditions / aesthetics and reduces the adversities of extreme weather conditions. By using suitable plant species, green belts can be developed in strategic zones to provide protection from emitted pollutants and noise.

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:

Prevent the spread of fugitive dust outside the plant, generated due to project and allied activities.

Compensate the damage to vegetation due to setting up and operation of the proposed plant expansion.

Attenuate noise generated inside the project.reduce soil erosion, Increases green cover and improve aesthetics.

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

The tree plantations will be done in consultation with the local forest department personnel who have necessary knowledge on the plantation of local species of plants. 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.

Green Belt is being developed as per recommendation by Expert appraisal Committee (EAC) in 19th and 20th meeting dated 8^{th} -9^{th} June, 2017 & 11^{th} -12^{th} July, 2017 on the request of project proponent vide letter no JSWSL-DCPL-JSW Cement/ENV/MoEFCC/2017 dated 21.5.2017 to Chairman EAC. Project proponent was advised for 50% of the mandated plantation (of 33% of the total project area) shall be carried within the steel plant premises and for remaining 50% of the plantation, the same shall be done double the area around the steel plant site, within 10 Km from the project boundary.

In view of the above, a total coverage of 600 acre of plantation(33% of 1800 acres) has been planned for the steel plant in the proposed expansion at JSWSL with 300 acres of greenery within the plant and another 300 acres outside the plant. It may be noted that along the periphery of the steel plant boundary, about 152 acres of thick mangrove plantation exists, which also acts as a green belt. Of the 300 acres of greenery within the plant, a total area of 295 acres has been identified for greenery and the plantation activity is in progress, which will enhance the overall green area to 447 acres. In line with the recommendation, additional plantation has been taken up within 10 Km, outside the steel plant and the progress of plantation over 775 acres, against 600 acres mandated, is as under;

- 345 acres under the one million tree program vicinity of Vashi & Vadhav villages (~60% complete)
- 120 acres denuded forest land of Dolvi and Kharkarav (~75% complete)
- 310 acres over private land Mahalmeria (planned in 2019-21)

Further, 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 plant boundary
3. Vacant areas in plant
4. Around office buildings, garage, stores etc. and along road sides

The greenery plantation being done in the surrounding areas in and around the steel plant is shown in **Figure 8.1.**

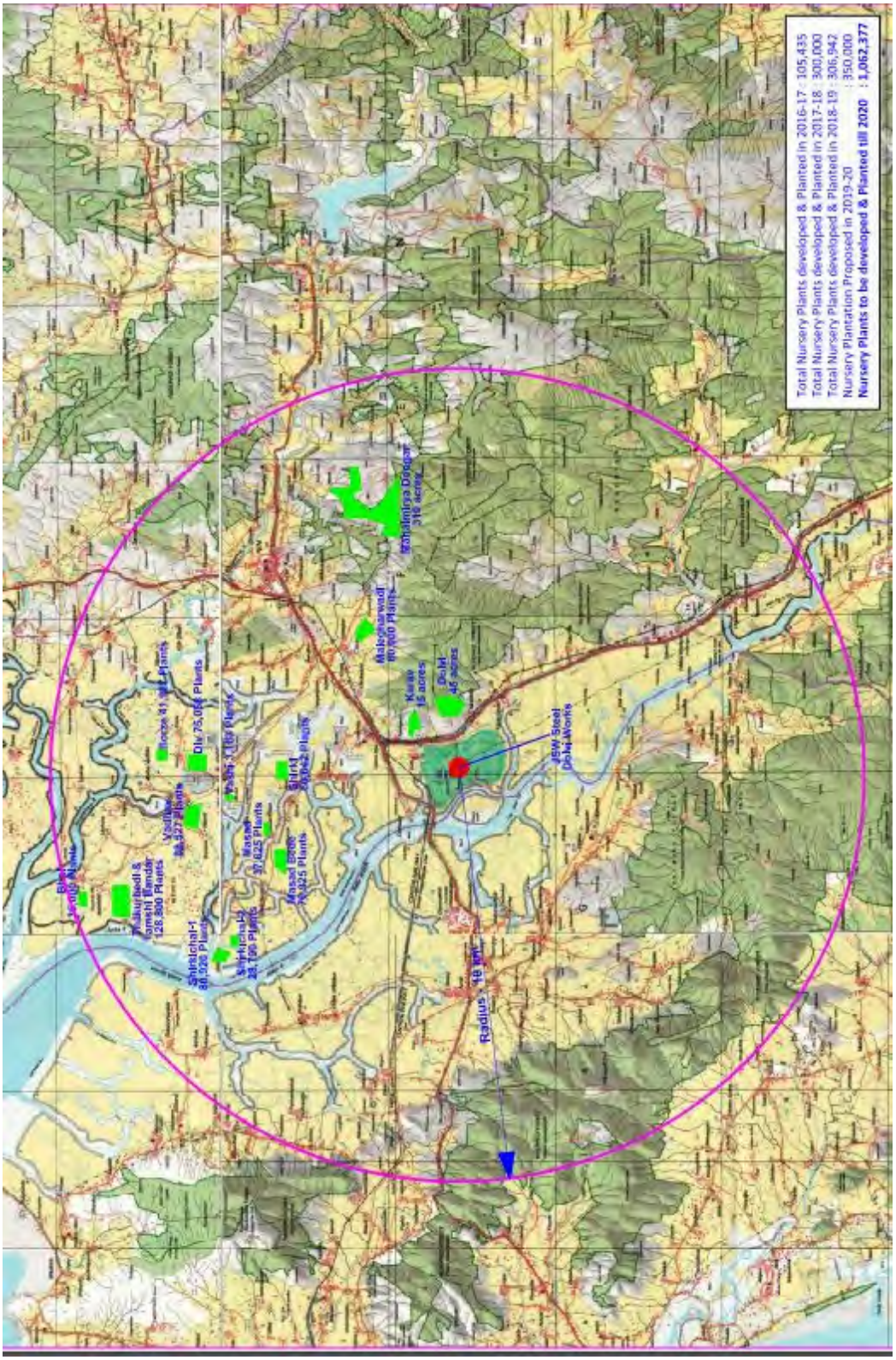


Figure 8.1 : Proposed Plantation Locations (Shown in green colour)

Chapter 9
Environmental Cost Benefit Analysis

The cost of the environmental investments to reduce air pollution below the maximum allowed under CPCB guidelines consists of the capital and operating costs of the pollution control equipment and of other improvements in the plant. Benefits consist of less raw material and personnel recruitment costs, lower health costs, increased forestry and agricultural production and lower pollution impacts. The reduction of dust concentration gives benefits that are more than twice the capital and operating costs. The largest benefit is derived from the reduction of emissions, the impact of which extends over an area substantially larger than Dolvi. Cost savings in raw materials and energy are substantial and more than offset the operating and maintenance costs of the pollution control equipment. Health benefits are also substantial, and may be underestimated because intangible factors such as the value of well-being were not included. There is no doubt that the environmental investment has significantly high returns. Some of the environmental impacts which affect the Dolvi area directly, also affect the whole region indirectly. For example, improved health or increased steel production activity in the Dolvi region generates national benefits in the form of economic growth or in terms of budget allocations for public health. It is significant that an investment concentrated in a single factory has substantial environmental and socioeconomic impacts not only for the local community but also for Dolvi region.

During project construction and operational phases, there is a potential for temporary employment of skilled, semi-skilled and unskilled people. It would be expected that the immigration of workers from nearby villages will lead to a growth in the commercial activities in the area.

Chapter 10
Environmental Management Plan

10.1 Introduction

In **Chapter 4** of this EIA report, impacts expected from the construction and operations phases of the proposed project have been identified, predicted and evaluated. Where potential sources of environmental aspects and impacts could not be managed in line of international standards, (additional) mitigation measures are required to control the impacts. This chapter on the Environmental Management Plan lists those measures; they are either of an organization, procedural or technical/instrumental in nature.

Environmental Management Plan (EMP) is the key to ensure a safe and clean environment. The desired results from the environmental mitigation measures proposed in the project may not be achieved without a management plan to assure its proper implementation and function. The EMP envisages the plans for the proper implementation of mitigation measures to reduce the adverse impacts arising out of the project activities. EMP has been prepared addressing the issues like:

Pollution control/mitigation measures for abatement of the undesirable impacts caused during the construction and operation phase of the project.

- Details of management plans (air pollution control devices/measures, utilization of treated effluents, solid waste management plan etc.).
- Institutional set up identified/recommended for implementation of the EMP.
- Post project environmental monitoring programme to be undertaken
- Expenditures for environmental protection measures and budget for EMP.

The environmental management plan is prepared for construction phase and operational phases of the project. The environmental management plan has to be implemented to minimize the adverse impact on environment such as reduction in atmospheric emissions, liquid effluents, solid wastes and noise generation.

10.2 Environmental Management for Construction Phase

Environmental impacts during the construction phase can be attributed to the site preparation, civil construction, erection & mechanical fabrication, welding operations, waste disposal, non-destructive testing, etc. and provision of civic amenities to the construction workforce. The potential for environmental impact during construction phase on most of the environmental components, except land use, is temporary, and the environment returns back to its previous status on completion of the construction. However, the land use change and any associated loss of flora, is permanent.

The environmental management plan for the construction phase is described below:

- During construction phase, it is suggested that the earthen stock piles may be stabilized to prevent washout during rainy season. During dry weather conditions, it is necessary to control the dust nuisance caused by earth work, levelling and transportation activities (vehicular movement) by water sprinkling (dust suppression).
- Instructions/conditions related to compliance of all prescribed regulatory limits related to exhaust as well as noise generation for all construction machinery and vehicles used by contractors should be included in all bid documents
- Efforts should be made to prevent accidental spillage of any oil, wastes from construction equipment.
- It shall be ensured that, workers working in noise prone area or operating noise producing equipment (e.g., jack hammer, drilling machines etc.) shall wear ear-muff/ ear plugs.
- The runoff water from the construction area shall be channelled through sedimentation tanks to remove suspended solids.
- Suitable water supply and sanitation facilities shall be provided to the labour colonies housing the construction work force. The sanitary waste from these areas shall be accorded suitable treatment measures such as septic tanks & soak pit.
- Safety equipment such as earplugs and earmuffs, helmet, face shields, safety goggles etc. shall be provided to workers engaged in high risk areas.
- The medical facility shall be adequate to provide immediate medical aid to the workers and their family members. An ambulance provision to be made to transport injured workers to nearby hospitals.
- Development and maintenance of green belt and green cover shall be undertaken.
- Required fuels, acetylene cylinders, compressed gases, paint materials etc. shall be stored as per accepted safety standards.
- Strict instructions will be given to contractor/construction agency to maintain construction vehicles and other materials transport vehicles with minimal pollution with proper/ up to date PUC certification. Vehicles carrying solid raw materials / fuels should be covered to avoid fugitive dust.
- The responsibility for each of the above actions shall be assigned and reviewed by the top management every week.

10.3 Environmental Management for Operational Phase

General: Several control measures are already in place for the process technology to minimize the generation of wastes and subsequent environmental

impacts during the operational phase of the existing facilities at JSW Steel plant and the similar technologies will be followed by JSW for the proposed project. Strict adherence to these pollution prevention and control measures shall moderate the environmental impacts to the minimum possible level during operational phase. In general, the EMP during operational phase of the plant shall be directed to the following:

- The adequacy of all the pollution control/environment management systems shall be ensured for the proposed project as part of main steel plant equipment, before the commencement of operation of the project.
- Regular performance evaluation of the control systems shall be undertaken to ensure their optimum performance.
- Preventive maintenance schedule of the control systems will be matching with that of the respective operational unit.
- Regular monitoring for various components of environment shall be undertaken to ensure effective functioning of pollution control measures as well as to safe guard against any unforeseen changes in environment.
- Transport vehicles and construction machinery should be checked and properly maintained so as to control air emissions and noise generation and comply the statutory limits (set by CPCB for that vehicle/equipment type and mode of operation)
- Truck parking area and the approach roads should be paved to reduce fugitive/entrainment dust emissions.
- Personnel Protective Equipment (PPE) like dust filters gasmasks, earplugs/earmuffs etc. should be provided to construction workers with strict instructions to use the same when they are on duty.

10.3.1 Air Environment

The Iron and steel industry generate emissions from material handling, operations of main production processes and support systems. The air emissions include PM, SO2, NOx, and CO. Suitable control mechanisms have been planned in the proposed expansion to reduce the impact and to comply with the applicable standards. The following measures are to be adopted/extended for mitigation of air pollution impacts during operational phase of the proposed project:

- Conveyors carrying raw materials shall be covered. Local dedusting systems shall be provided at the junction points.
- Raw materials like coal, coke which are likely to be entrained due to wind shall be covered.
- The process emissions shall be controlled by installing ESPs/Bag filters to comply with emission norms.
- Continuous emission monitoring instruments shall be installed in critical operations for effective control.

The baseline ambient air quality status around JSW Steel plant (within the study area) monitored during study period depicts the concentrations of PM_{10}, $PM_{2.5}$, due to large fugitive dust emissions mainly from construction activities taking place

both within the plant for the expansion project and outside the plant by NHAI for road construction. The levels of SO2 and NO2 are under control. The ambient air quality shall be monitored regularly to assess the impact of the construction activity.

NERRI is separately carrying out a Carrying Capacity study for the region to assess the assimilative capacity of the surrounding environment. The study, being done at a critical juncture is expected to come out with recommendations on improving the environment quality, including actions taken by JSWSL to reduce impact of its operations on the surrounding areas. JSWSL shall be responsible for implementing the recommendations.

The over all EMP implementation cost breakup is presented in **Table 10.1**. The list of air pollution control systems envisaged is summarized below in **Table 10.2**.

Table 10.1 : EMP Implementation Cost Breakup

Sl. No.	UNIT	Investment in Cr
1	**RMHS**	
a	Covered shed 4 nos. For covering of coal yard inside the plant & jetty, Iron ore fines & fluxes at jetty yard, iron ore fines of pellet yard.	216.35
b	Dust Extraction system For product conveyor route from various phase 2 units like SP2 ,PP2 Coke oven 2.	45.05
c	Dry Fog Dust Suppression For raw material conveyor route	27.24
d	Plain Water Dust Suppression For wagon loading system	
e	Yard Sprinklers For raw material stock piles inside yards	
f	Cold Fog Dust Suppression For raw material conveyor route	1.08
2	**Coke ovens**	
a	BOD Plant for Coke #3 For waste water treatment	60
b	CDQ - 2 Nos To generate 70 MW Power	740
c	HPLA in all battreries For Effective control of Coal charging emission	40
d	GDS for set of 4 Batteries. For Effective control of Coke pushing emission	40
e	Waster Heat Recovery from Waste gases For generation of 10 TPH of Low Pressure Steam	10
3	**Blast Furnaces**	
a	Metal granulation Plant Granshot is a separate Project of cost Rs. 62.00 Crs handling by BF#1.	35
b	Modification of existing BF systems in BF-1	15
c	Dry GCP for BF-2	65
d	Stock house (Bag House)	
4	Sinter Plant	
a	Sinter Plant 1 & 2 (MEROS) For efficient De-Dusting	110
b	Sinter Plant 3 (MEROS)	75

Sl. No.	UNIT	Investment in Cr
5	Pellet Plant	
e	ESP for Dust Control For efficient De-Dusting	35
6	**BOF Converter**	
a	Dry GCP For Energy Reduction	112
b	For Processing Steel slag as aggregates	20
c	BOF slag processing	35
7	**LCP**	
a	Process Bag filters (03 nos.) Supplies For work area improvement	5.70
b	Lime/Product handling (5 nos. Supplies	9.30
c	Services	2
8	**HSM 2**	
a	Waste water treatment	20
9	**UTILITY**	
a	WRP Plant (RO & ZLD)	350
b	GCP- ETP For Blast Furnace-1 waste water treatment	12
c	STP For Sewage treatment	4
d	Marine Discharge of treated wastewater	44
10	**Environment Monitoring**	
a	OCEMS For Compliance monitoring	20
11	0.6 MTPA micro pellet plant fir recycling fines	**45**
12	Activities listed in CER	**113**
	Total	**2327**

Table 10.2 : List of Air Pollution Control Equipment

Sl. No	Area of operations	Air pollution control measures to be adopted	Design limits
1	**Raw material handling**		
	Fugitive emissions in material handling	• Dust suppression systems (dry fog type) • Water sprinklers • DE systems with bag filters in case of conveyors, lime handling	Work area (PM_{10}) = 3.0 mg/Nm3 Stack: 30 mg/Nm3
2	**Coke ovens**		
	Coal & Coke handling	• DE systems in material handling	Stack: 30 mg/Nm
	Coal charging	• On main charging with HPLA aspiration • CGT car for aspirating gas	As per MOEF norms applicable for coke ovens

Sl. No	Area of operations	Air pollution control measures to be adopted	Design limits
		into adjacent 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 followed by high efficiency bag filter**	**10 mg/Nm3**
	Raw material preparation and handling	• **Centralized De-dusting system with ESP/bag filter common for both areas**	**30 mg/Nm3**
	Sinter screening and transport		
4.	**Pellet Plant**		
	Raw material preparation and handling	• **Dust suppression system**	**Work area (PM_{10}) = 3.0 mg/m3**
	Mixed material drying unit (rotary kiln)	• **Multicyclone-Scrubber based de-dusting**	**30 mg/Nm3**
	In-duration unit system (grate-kiln-cooler)	• **ESP**	**30 mg/Nm3**
5.	**SIP Plant**		
	Off gas system de-dusting	• Scrubber	30 mg/Nm3
6.	**Blast Furnaces**		
	Sinter, coke and flux handling in stock house	• Bag filters	30 mg/Nm3
	BF processes	• Dry GCP	5 mg/Nm3
	Cast house	• FE systems with Bag filter	30 mg/Nm3
	Stoves heating	• Use of lean gas	30 mg/NM3
7.	**BOF**		
	Material handling operations	• Bag filters	30mg/NM3
	Converters	• Primary (ESP) & Secondary fume extraction system	30 mg/Nm3
	De-sulphurisation, RHFs, LHFs etc	• Spark arresters followed by Bag filters	
8.	**Slab/Billet casters**	• Use of low sulphur gases for SO2 control	
9.	**Rolling mills**	• Use of low sulphur gases for SO2 control • Low NOx burner	30 mg/NM3
10.	**Cement grinding unit**	• Bag filters	30 mg/NM3
11.	**Power Plant**	• Gas based • Low NOx burners	30 mg/Nm3

10.3.2 Noise

- During operational phase noise monitoring shall be carried out at all the noise producing units within the plant, at boundary of JSW and human settlements in the vicinity of JSW as per details given in Environmental Monitoring Program
- Acoustic laggings, enclosures and silencers should be provided wherever necessary for high noise generating equipment
- Sound proof glass panelling should be provided for all the proposed operation / control rooms, if any as well as for shift rooms at critical places
- Strict implementation/compliance of all statutory norms w.r.t. noise generation, occupational exposure etc.
- Either Acoustic barriers or shelters shall be developed in noisy workplaces
- Regular health check-up with respect to hearing of workers shall be carried out.

10.3.3 Water Environment

JSWSL has planned implementation of technologies which will use less water, which will reduce the requirement of makeup water. JSWSL has developed plans to install rainwater harvest structures to collect rain water and use it in cooling applications/ gardening etc. These include:

- Dry gas cleaning in BF and BOF. Dry quenching of coke
- Rainwater structures to collect rainwater from Rolling mills, Canteens, Buildings etc. A detailed plan for rainwater harvesting shall be prepared and implemented.

Though the treated wastewater from different units conforms to the marine discharge standards stipulated by the MSPCB for JSWSL for most of the parameters; however, it is suggested to carryout

- optimization and recirculation studies to arrive at appropriate combination to achieve treated effluent conforming to the discharge standards.
- Bench mark the water usage in different units for continual improvements.
- Recovery of water by the installation of water recovery plant for full utilisation of water.
- JSW will establish water foot print bench mark by the use of best practices or best available technologies or by selecting the water foot print achieved by best performers in the steel sector.
- Feasibility study of zero liquid discharge is being proposed and will be completed in due course of time. Based on the study, action plan will be derived and implemented for minimizing water discharge from the steel plant.

The over all EMP implementation cost breakup is presented in **Table 10.1**. The list of water pollution control systems envisaged is summarized below in **Table 10.3**.

Table 10.3 : 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 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
Slab 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

With the above measures planned in the expansion, JSWSL shall work towards reducing the makeup water consumption to < 2.5 m3/tcs. JSWSL shall carry out a detailed assessment after commissioning of al projects and prepare a plan and implement it in phases.

Water Recovery Plant

In the proposed units under 10 MTPA expansion, the wastewater treatment systems shall be decentralized so that only treated wastewater complying to the norms are blown down from the plant to the central collection system.

The treated wastewater shall be discharged from this central collection tank into the sea. However, at a later stage after commissioning of al units, it is planned to have a final water recovery plant (WRP) of 1047 m3/hr to ensure zero liquid discharge from the plant premises

The WRP would comprise of Polishing of residual organic waste water streams in MBR and water recover like a series of Reverse Osmosis units (RO). It is proposed to utilize the HERO process for maximizing permeate recovery.

The RO rejected will be further treated in an evaporator to obtain salts. The permeate water of high purity will be reused in different sections of the plant as per the quality requirement. The salt obtained dafter the evaporation will be disposed to authorized agencies. The tentative process of water recovery plant is given in **Figure 10.1a** and **10.1b.**

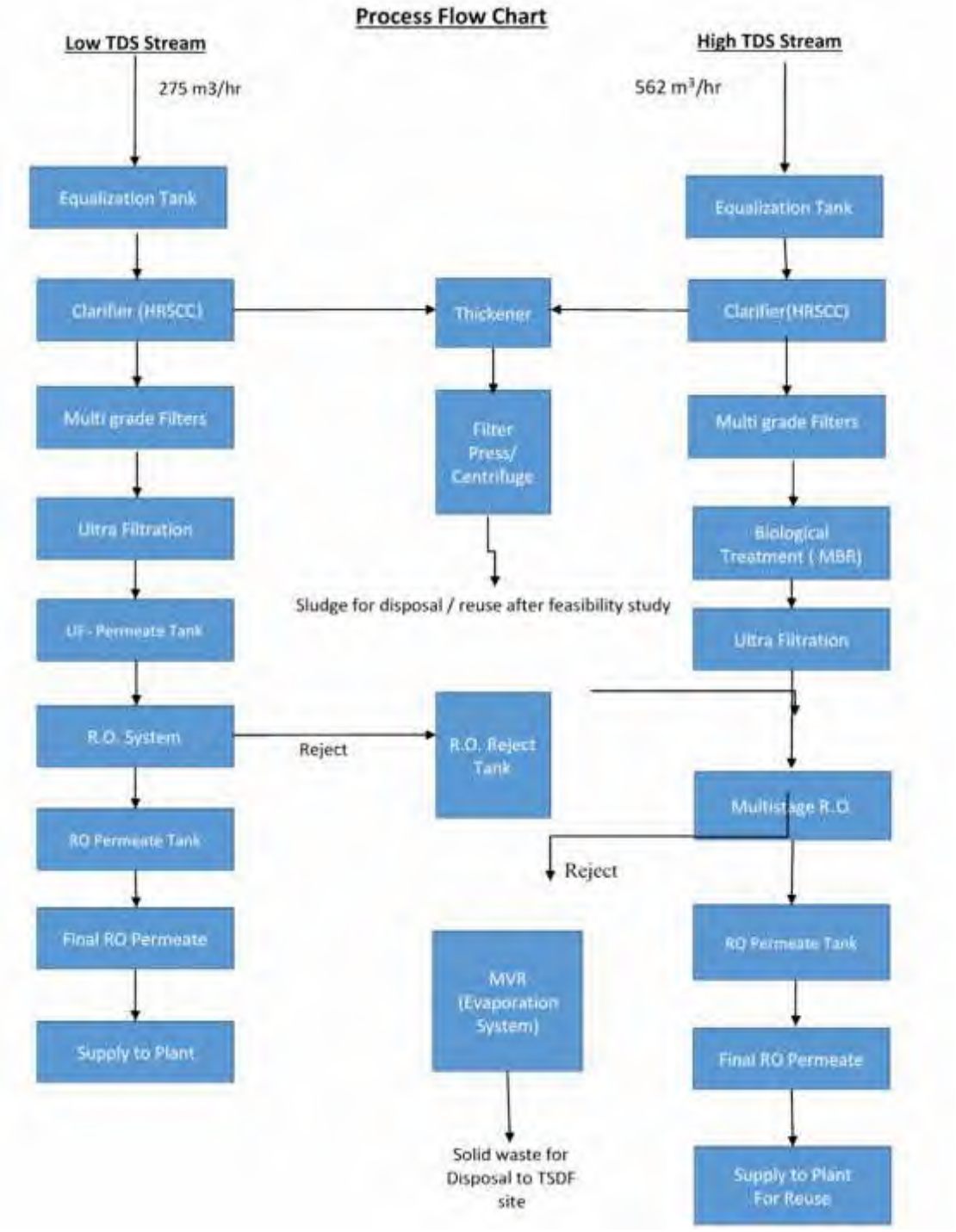


Figure 10.1a : Process Flow Chart : Details of Post Treatment – Phase 2 (837 m^3/hr)

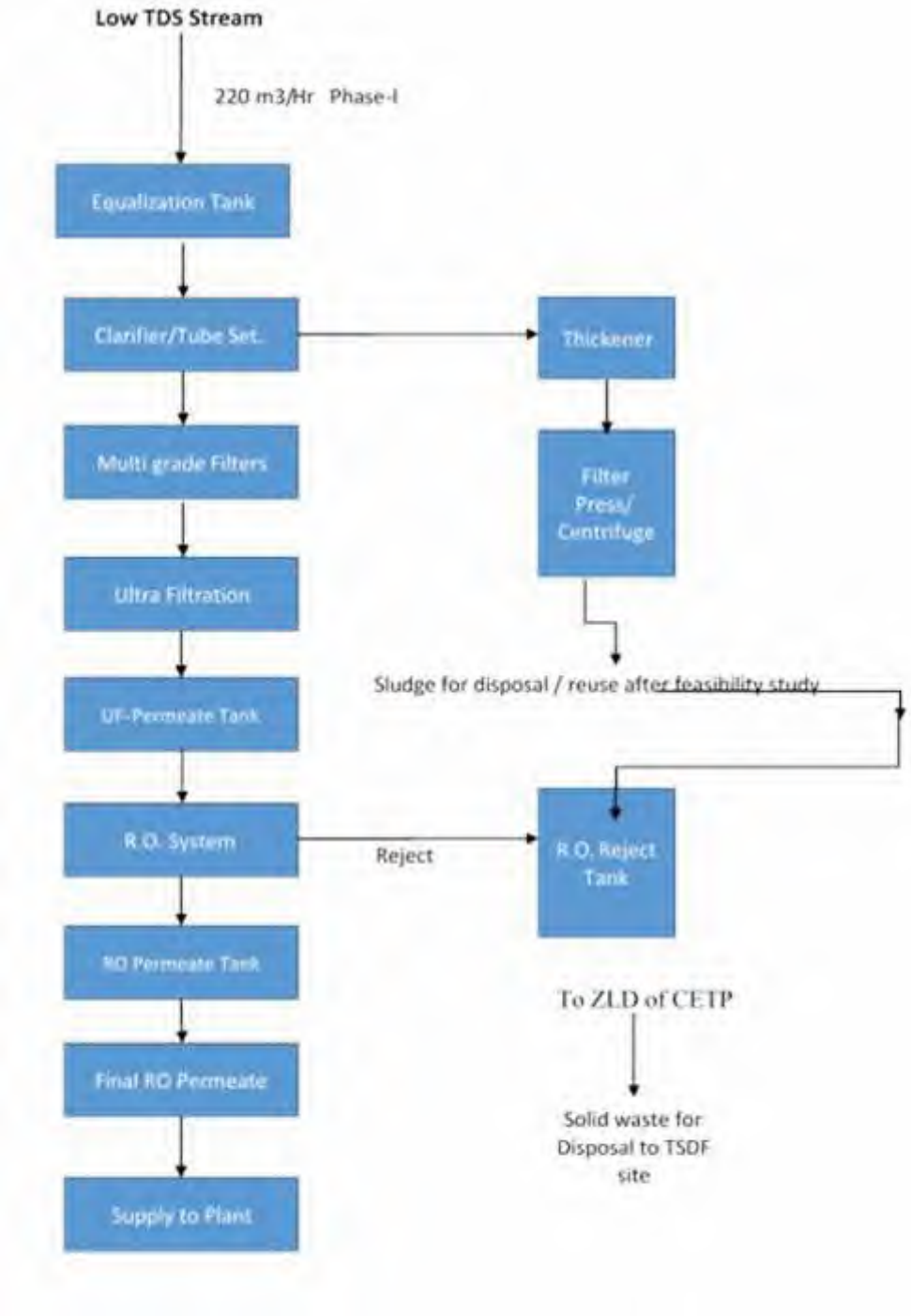


Figure 10.1b : Process Flow Chart : Proposed Effluent Treatment Plant 220 m^3/hr (5280 m^3/day) – Phase 1

10.3.4 Land Environment

- JSWSL plans to utilise all solid by products by recycling or reuse. The plan for maximum utilisation of solid wastes shall be implemented . Necessary collection and storage facilities shall be developed for it

effective implementation. The plan of solid waste utilisation is given in **Table 10.4.**

Table 10.4 : Plan of Solid Waste Utilization

Sl. No.	Solid waste	Proposed disposal
1	**Slag**	
a.	Iron Making slag	Granulated and sold to Cement plants
b.	Steel making slag	BOF slag is granulated , metallics separated and used in construction as aggregates
2	**Sludge**	
a.	**Iron making sludge**	**Used in Pellet plant after dewatering**
b.	**Steel making sludge**	**Used in Sinter plants after dewatering**
3	**Mill scales**	
a.	**Steel making shop**	**To micro pellet plant**
b.	**Rolling mills**	**To micro pellet plant**
4	**Dusts**	
a.	**Flue dust from Blast furnace**	**To micro pellet plant**
b.	**Dust from bag filter**	**To micro pellet plant**
5	**Lime / Dolo dusts**	**To micro pellet plant**
6	O.6 Mtpa micro pellet plant	Used in Sinter making

- Hazardous wastes should be properly stored before sending it to the MSPCB/CPCB authorized agencies. Appropriate storage facilities with impervious liners shall be constructed to avoid leaching of pollutants from wastes.
- A detail studies related to impacts of use of steel slag as construction material and for land filling is examined by NEERI under the carrying capacity study. The recommendation of the study shall be implemented by JSWSL.
- A record with reference to quantity, quality and treatment/management of solid/hazardous waste shall be maintained at environmental monitoring cell for different process units (sources).

10.3.5 Ecology and Biodiversity

Green Belt Development

The greenbelt captures the fugitive emissions, attenuates the noise generated and improves the aesthetics of the area. It also protects the land around larger urban centers from urban sprawl, improves soil quality and binds soil particles and maintains the designated area for forestry and agriculture as well as provide habitat to wildlife. Therefore, green belt development should be taken up as per CPCB norms suitably 50 m width by planting the perennial indigenous species. It is proposed to develop greenbelt surrounding the plant area, along the roadside, storage yards and also in the open area to minimize dust, air pollutants and noise pollution.

The General Consideration Involved while Developing the Greenbelt are:

- Trees growing up to 10 m or above in height with perennial foliage should be planted around various appurtenances of the proposed project
- Planting of trees should be undertaken in appropriate encircling rows around the project site
- Generally fast growing species should be planted
- In the front row, shrubs will be grown. Since the trunks of the tall trees are generally devoid of foliage, it will be useful to have shrubs in front of the trees so as to give coverage to this portion
- The species should be adapt to site and should be able to produce optimum harvest. e.g. *Ficusreligiosa, Ficusbengalensis, Ficuselastica* and *Artocarpusheterophyllus*
- The plant species whose leaf litter is decomposed quickly should be planted, e.g. Species like *Acacia farmesiana, Delonixregia, Acacia nilotica, Azadirachtaindica, Melia azadirachta*, etc.
- The plant species should preferably be capable of enriching soil through nitrogen fixation like members of Leguminaceae family such as *Luceanaleucophloea, Acacia farmesiana* (Vilayatikikar) have better nitrogen fixing capabilities

Particular Species used in Green Belt

- Plants which counteract odour are: Bushes with mild but active fragrance
- *Acacia farnesiana* (Mexican plant): It is a type of bush with yellow coloured fragrant flowers. It does not have rich canopy but very effective for counteracting smell. Its limitation is seasonality and thorny nature.
- *Melaleuca* species: It has sweet fragrance and thin canopy
- *Eucalyptus*species: It can be used as very good belt and can also be used as per odour source.
- Hedges, Herbs (Tulsi, Turmeric etc.) can also be used for counteracting odour.
- *Vetiver species*: This plant is a king of perfumes for inactivating other odours. It affects the nervous system and relieves fatigue. It is used as key species in aromatherapy.
- Plants which tolerate pollution-*Neriumindicum* (Kaner), this plant may or may not have a thick canopy but has excellent results with vehicular pollution experimented at National Botanical Research Institute, Lucknow.

Other than these, plant species such as Polyalthealongifolia, Derris indica, Thespepsiapopulnea, Acacia auriculiformis, Alstoniasoholaris, Ficusbenghalensis, Madhucaindica, Pongamiaglabra and Bombaxceiba have good efficiency in removing particulate matter **(Table 10.5 to 10.7)** and hence, can be planted in the vicinity of the plant and construction site to minimize fugitive dust emitted due to construction activities. The green belt plantation programme of the indigenous species should be taken up in consultation with the forest department. So also Mangrove plantation

should be taken up using indigenous species such as Avicennia sp. at suitable places to increase the mangrove belt. The maintenance of the plantation area will also be done by the project proponent.

Table 10.5 : Plant Species Recommended for Greenbelt Development

Sr. No.	Name of Species	Common Name	Family
A. Along the Roadside			
1	*Alstoniascholaris*	Chatin, Saptaparni	Apocynaceae
2	*Albiziachinesis*	Siris	*Mimosaceae*
3	*Bauhinia purpurea*	Kanchan	Fabaceae
4	*Cassia fistula*	Golden shower tree	Caesalpiniaceae
5	*Juglansregia*	Walnut	Juglandaceae
6	*Pinusroxburghii*	Chirpine	Pinaceae
7	*Populuseuphratica*	Poplar	Salicaceae
8	*Prunuspersica*	Beach	Rosaceae
9	*Thujaorientalis*	Thuja	Cupressaceae
B. Along the Infrastructure			
1	*Aegle marmelos*	Bel	Rutaceae
2	*Alnusnepalensis*	Utis	Betulaceae
3	*Artocarpuschaplasa*	Sangri-Ass	Moraceae
4	*Mangiferaindica*	Mango	Anacardiaceae
5	*Mallotusphilippensis*	Kamala Tree	Euphorbiaceae
6	*Malus sylvestris*	Apple	Rosaceae
7	*Pierisovalifolia*	Shak sheng	Ericaceae
8	*Pyruspashia*	Mehal	Rosaceae

Table 10.6 : Plants Suitable for Noise Pollution Attenuation that can be used in Upcoming Green Belt or Avenue Plantation Activities

Sr. No.	Name of Species	Common Name	Family
1	*Alstoniascholaris*	Milkwood-pine, white cheesewood	Apocynaceae
2	*Azadirachtaindica*	Neem	Meliaceae
3	*Butea monosperma*	Palas	Fabaceae
4	*Erythrinavariegata*	Indian coral tree	Fabaceae
5	*Grevillea robusta*	Silver oak	Proteaceae
6	*Pterospermumacerifolium*	Kanak Champa	Malvaceae
7	*Tamarindusindica*	Imli	Fabaceae
8	*Terminalia arjuna*	Arjun	Combretaceae

Sr. No.	Name of Species	Common Name	Family
9	*Acer negundo*	Box alder	Sapindaceae
10	*Alnusindica*	Common alder	Betulaceae
11	*Betula pendula*	Silver birch	Betulaceae
12	*Cornus alba*	Red-barked, white or Siberian dogwood	Cornaceae
13	*Juniperuschinensis*	Juniper	Cupressaceae
14	*PopulusBerolinensis*	Poplar	Salicaceae
15	*Syringa vulgaris*	Common lilac	Oleaceae
16	*Viburnum lantana*	Wayfarer or wayfaring tree	Adoxaceae
17	*Albizzialebbek*	Siris	Fabaceae
18	*Cassia fistula*	Golden shower tree	Caesalpiniaceae
19	*Ficusreligiosa*	Peepal	Moraceae
20	*Delonixregia*	Gulmohar	Caesalpiniaceae
21	*Pongamiapinnata*	Karanj	Fabaceae
22	*Tectonagrandis*	Teak	Lamiaceae
23	*Eucalyptus citradora*	Nilgiri	Myrtaceae
24	*Lagerstroemia duperreana*	Jarul	Lythraceae

Table 10.7 : List of Plants Suitable for Dust, Smoke, Wind and Draught Tolerance

Sr. No.	Common Name	Scientific Name	Family
Plants Captured Higher Amounts of Dust			
1.	Mango	*Mangiferaindica*	Anacardiaceae
2.	Ashoka	*Polyalthealongifolia*	Annonaceae
3.	Indian beech	*Derris indica*	Fabaceae
4.	Indian tulip tree	*Thespepsiapopulnea*	Malvaceae
Wind Resistant Trees			
1.	Jaman	*Eugenia jambolana*	Myrtaceae
2.	Peacock Flower	*Caesalpiniapulcharima*	Caesalpiniaceae
3.	Yellow Flame	*Peltophorumpterocarpum*	Caesalpiniaceae
Drought Resistant Trees			
1.	Parrot Tree	*Butea monosperm*	Fabaceae
2.	Pulque Tree	*Acacia species*	Mimosaceae
3.	Siris	*Albizzialebbek*	Mimosaceae
4.	Whistling Pine	*Casuariaequisetifolia*	Casuarinaceae

Sr. No.	Common Name	Scientific Name	Family
5.	Three-leaved caper	*Crataevareligiosa*	Capparaceae
Plants Tolerant to Dust and Smoke			
1.	Earleaf acacia	*Acacia auriculiformis*	Mimosaceae
2.	Devil tree	*Alstoniasoholaris*	Apocynaceae
3.	Banyan tree	*Ficusbenghalensis*	Moraceae
4.	Mahua	*Madhucaindica*	Sapotaceae
5.	Indian Beech	*Pongamiaglabra*	Fabaceae
6.	Silk Cotton Tree	*Bombaxceiba*	Bombacaceae
7.	Arjun	*Terminalia arjuna*	Combretaceae

Landscaping and beautification Plan

Open Space Network

One of Dolvi's spatial qualities is its leafy streets and large green spaces, like the beach and the mangroves all within a short distance of the Town. The natural environment of creeks, beaches and wetland / mangroves offer some of the best natural open spaces in Dolvi.

An important part of the Master Plan Strategy for the JSW plant Industrial area is to create a **sustainable and attractive network of open green spaces**, which will offer all staff and visitors a variety of inviting, green spaces for all kinds of active and passive recreation. The JSW plant consists an exsisting greenbelt**(Plate..)** and by planting more trees it can become a true green surrounding when it plays on its strengths it has to offer in terms of spacious open green areas.

Occupational Health and Safety

The periodic health monitoring is an essential part of environment management plan, as it helps in understanding long term impact of steel plant operations on the workmen. This also helps in taking corrective remedial actions in time.

The recommended OHS monitoring is given in the **Table 4.8**.

Table 4.8 : Occupational Health Monitoring

Occupational diseases	Recognized occupational factors	Health monitoring
1. Occupational cardio vascular diseases	Physical activity CS2 dynamite solvents aerosol propellants stress type A behaviour hypertension and cardio myopathy	1.Known CHD cases to be excluded from exposure to these 2.Biological monitoring 3.Regular CHD screening
2. Occupational reproductive system disorders	Lead, organic mercury, polychlorinated biphenyls, chlordeconedibromochloropropane, ionising radiation, anaesthetic	1.Conception to be advised against (while exposed) 2.Reproductive age group

Occupational diseases	Recognized occupational factors	Health monitoring
	gases, cytotoxic drugs, VCM, dioxin, ethylene oxide	to be cautioned 3.Biological monitoring
3. Occupational lung diseases	Fibrogenic dusts manmade mineral fibres	Standardised respiratory questionnaire lung function evaluation X ray chest physician collaboration monitoring.
4. Occupational cancers of respiratory system	Arsenic, hexavalent Cr ,Asbestos, wood dusts, nickel, Isopropyl alcohol	No published guidelines monitoring stringent environmental control.
5. Occupational liver diseases	Polychlorinated dibenzofuransdibenzodioxiins, hexachloro benzene methylenediamine and VCM	Liver function tests lipid profile urinary porphyrins (All in conjunction with Clinical Picture)
6. Occupational neuro psychiatric disorders	Lead org mercury thallium organic solvents manganese trichlorocresyl phosphate (TOCP) MBK acryl amide	1.Visual evoked response (VER Test) 2.Nerve conduction study 3.Neurobehavioral core test battery
7. Occupational kidney disorders	Lead mercury cadmium gold thallium uranium arsine benzidine beta naphthylamine	1.Measurement of beta micro-globulin in urine for cadmium 2.Simple renal function tests 3.Exfoliative cytology of urine

Compliance to CREP:

JSWSL is one of the signatory for implementing the voluntary program CREP for the steel industry. JSDWSL shall keep these requirements, while planning the expansion of the steel.

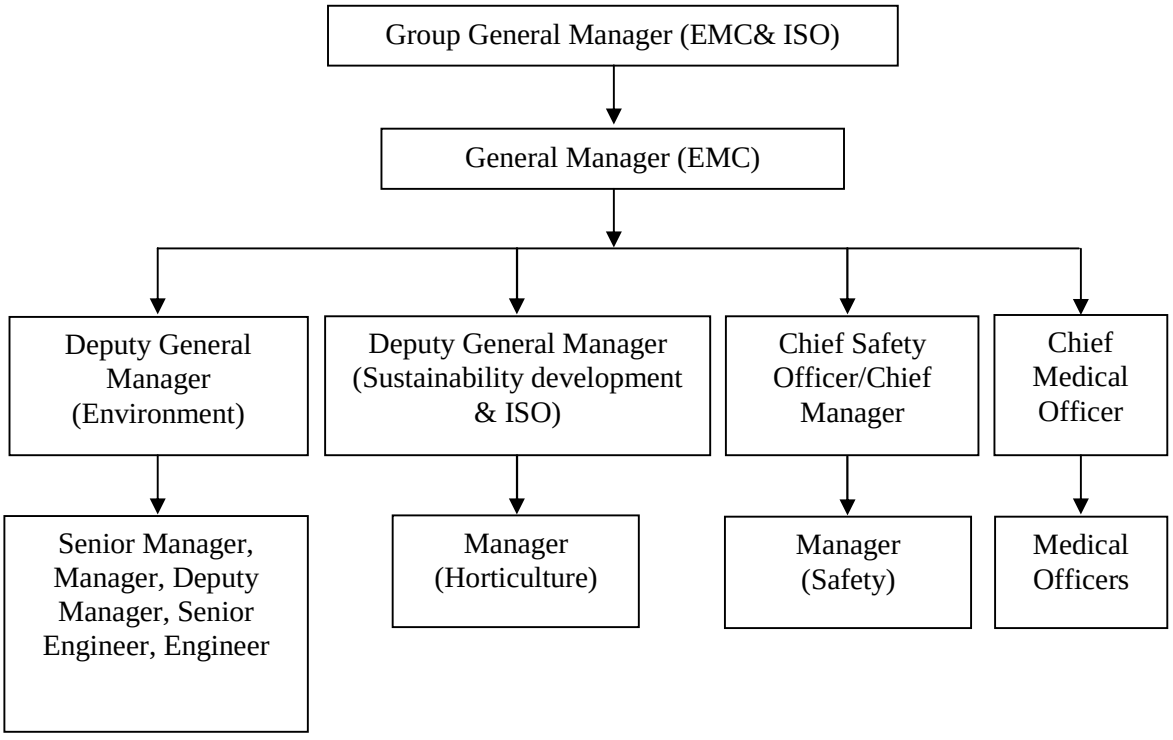
Table 4.9 : Management Initiatives for Compliance with CREP

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 de-dusting system	secondary de-dusting facility envisaged/refurbished 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	Utilization of SMS and BF Slag	100 % utilization of BF slag will be planned. While SMS slag utilization to the

SN	Unit / Item	Responsibilities	Extent of fulfillment
			maximum extent will be explored
5.	Coke Oven	Charging of Tar sludge / ETP sludge to coke oven	Possibility to the maximum extent will be explored
6.	Water conservation / pollution	Reduce specific water consumption to <8 m^3/t for flat products.JSW Steel Limited only produces flat products. Operation of COBP Effluent Treatment Plant efficiently to achieve notified discharge standards	The statutory norms will be complied.

10.4 Environmental Management Cell

A full-fledged Environment Management Cell is already present with a team of multidisciplinary professionals, technical staffs with the necessary infrastructures. This team will be also be responsible for all environment management activities including environmental monitoring, greenbelt development, ensuring good housekeeping, ensuring statutory compliance as well as creating environmentally aware work forces for proposed project. The organizational chart of Environment Management Cell is shown in **Figure 10.2**.



The said team will be responsible for:

- Monitoring and Analysis of air quality, noise levels, meteorology, water quality and other environmental parameters.
- Implementation and monitoring of the pollution control and protective measures/ devices etc.
- Co-ordination of the environment related activities within the project as well as with outside agencies.
- Green belt development.
- Monitoring the progress of implementation of the environmental management programme.
- Identifying measures to prevent or reduce the wastes itself in the factory.
- Compliance to statutory provisions, norms of State Pollution Control Board, Ministry of Environment and Forests and the conditions of the environmental clearance as well as the consents to establish and consents to operate.

Training

The Environment Management Cell, who would be responsible for the implementation of the EMP, needs to be trained on the effective implementation of the environmental issues. 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 specialized pollution control equipment to specific personnel.
- Field monitoring, maintenance and calibration of pollution monitoring instruments.
- Laboratory testing of pollutants.
- Repair of pollution monitoring instruments.

10.5 Budget Allocation for EMP

- The capital expenditure planned for implementation of the environment control facilities in the expansion units including SP-3 & PP-2 is given below:

The annual revenue expenditures for environment management is given in **Table 4.10**.

Table 4.10 : Annual Revenue Expenditures for Environment Management

Estimated Annual Expenditure for Environment Control Facilities	Amount (In Lakh Rs.)
Environmental Quality Monitoring	
AAQ monitoring	85
Manual Stack Monitoring, Water quality, Noise, Laboratory expenses etc	200
Total	**285**
Environmental Studies	
Environment Audit & Consultancy charges, CTO etc	1200
Operating Cost incurred for Environment protection	
Electrical power – estimated (85 MW)	32500
Waste Water Treatment Plant (WWTP)	2500
Water Recovery Plant	8500
Green Belt Development	600
Total	**44100**
Total (A+B+C)	**45585**

Chapter 11
Summary and Conclusion

11.0 Introduction

JSW Steel Limited(JSWSL), Dolvi works is expanding its crude steel capacity from 5 MTPA to 10 MTPA for manufacture of special steel products. MoEFCC has granted Environment Clearance 25th Aug 2015, for this expansion, after carrying out an Environmental Impact Assessment (EIA) followed by public consultation. The construction of some facilities of the proposed expansion is in progress.

In the meanwhile, due to policy changes in procurement of iron ore and deteriorating quality of iron ore, the proportion of pellet and sinter in the blast furnace burden was changed to maximize the productivity in the large blast furnace.

Accordingly a request for amending the EC for changes in configuration of pellet and sinter was submitted under Clause 7(ii) of EIA notification. The change involves setting up of 9 MTPA pellet plant and 4 MTPA sinter plant in place of 4 MTPA pellet plant and 8 MTPA Sinter plant, planned earlier and for which EC was issued. There was no change in the configuration and capacities of other production units.

The expert appraisal committee in its meeting 10-12th Dec 2018, felt the need to reassess the environmental impacts of the project without public hearing and issued a TOR with additional conditions. NEERI has carried out the reassessment of the proposed expansion to 10 MTPA, with the recent updates including the change in configuration of sinter and pellet plants.

The proposed expansion from 5.0 MTPA to 10.0 MTPA of integrated steel plant and additional 300 MW gas based (CO+ BF+LD gas based) CPP of JSWSL at Dolvi, Raigad (M.S.) is based on the BF-BOF process, a proven route of steel making .

While designing the expansion of steel plant, care has been taken to install latest state of art technology in steel making and environment protection has been envisaged, to achieve the desired air emissions and noise levels from plant operation. The maximum recirculation of waste water has been envisaged to reduce fresh make-up. The wastewater generated in individual shop is treated in dedicated wastewater treatment units and efforts are made to reuse them in a cascaded manner. It is proposed to initially go for a marine discharge of the treated wastewater complying to the norms and later for water recovery from the treated wastewater to ensure full utilization of water once all units are commissioned. Further, maximum re-use and re-utilization of generated solid waste within steel plant has been envisaged. Steel slag, whose utilization has been a major problem is proposed to be weathered for use as aggregate.

The Primary and secondary baseline data has been used to assess the environmental impacts of the proposed expansion on surrounding environment. The potential environmental impacts associated with different phases of the expansion have been assessed in a comprehensive manner.

The study indicates that environmental impacts identified are manageable through appropriate mitigation measures. The implementation of environmental mitigation measures 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 the art clean technology (including the technological mitigation measures) during the design has limited the environmental impacts related with the expansion. The implementation and monitoring of effectiveness of the environmental mitigation measures during the operation phase will be assigned to the Environmental Management Department (EMD) of JSWSL. An EMD, comprising of senior management level officers will periodically review and monitor the implementation of mitigation measures, and will tackle the management bottle necks of implementation of mitigation measures and environmental monitoring programme.

The proposed expansion project of additional 5.0 MTPA capacity is categorized as Category **"A"** project as per Environmental Impact Assessment (EIA) Notification: SO 1533, of 14-09-2006, which necessitates obtaining the Environmental Clearance from the Ministry of Environment and Forests (MOEF).

11.1 Need for the Project

In view of growing demand of steel by prospective consumers in the country and abroad considering the increased requirement of special steel for different consumers, JSWSL envisages to expand the steel plant to 10.0 MTPA and surplus gases generated shall be utilized to produce 300 MW of additional power at Dolvi, in Raigad (MS).

11.2 Plant Capacity, Cost and Implementation Schedule

The project will be commissioned in a phased manner with the major production facilities being commissioned by March 2020. The downstream units for value added steel products like HSM and CRM will be commissioned later by 2025. 'Zero date'. The cost for this proposed expansion has increased from Rs 17,000 Cr. to Rs 17240 Cr due to the changes in configuration of pellet and sinter plants and upgradation of facilities as per the Corporate strategy of the Group.

11.3 Project Site and its Environs

JSWSL is located at 0.6 km from Geetapuram-Dolvi village, Raigad District, (MS). The Steel Plant is located on the bank of River Amba. Bhogeshwar River is at 7.7 km from the plant complex in NE direction and is the tributary of Dharamtar River.

The National Highway [NH-17] connecting Mumbai-Goa is passing adjacent to the plant area. The nearest international & national airport is Mumbai at 80 km from the steel plant. There are two Reserved Forests at 0.7 km (E) and 5.0 km (SW) within 10 km radius of steel plant.

11.4 Site Selection

The most of the units of expansion will be located within the land area of approx. 1800 acres, under the possession of JSW Steel.

11.5 Salient Features of the Project

The production of steel has been envisaged through coke oven-pelletisation-Sintering-DR-BF-BOF–LF–VD/VOD followed by vacuum degasser-slab/billet caster-HSM/Plate mill/Bar Mill, CRM route. The plant will be equipped with coke oven complex, pellet plant complex, sinter plant, blast furnace, BOF complex, ladle furnace, vacuum degasser, continuous casting facility, plate mill, HSM, Bar Mill for the production of hot rolled coil/plates/bars. Supporting facilities upto production of finished products will also be set up in the plant based on the state-of-the-art clean technology.

11.6 Land

JSWSL steel complex is located in an area of approx. 1800 acres.

11.7 Water

The present water consumption of the JSWSL complex is 1438 m3/h. The water requirement of proposed expansion is estimated to be 2413 m3/h making the total water requirement as 3851 m3/h.

The raw water is lifted from River Amba by means of vertical turbine pump sets located in Nagothane Pump house and pumped to the existing SIP reservoir having 2 compartments and a total water storage capacity of about 35,880 m3 and HSM Reservoir having a storage capacity of 225,000 m3 approximately.

JSWSL has obtained necessary permission from Irrigation of GOM for 113.66 MLD of water.

11.8 Environmental Impact Assessment Study

11.8.1 Baseline Status

As part of Environmental Impact Assessment study, baseline environmental monitoring was carried out for winter season Nov 2018 to Jan 2019 .

Meteorology

The predominant wind directions during this period were NE to East to SE sector. Wind speed during this period was mostly varying from 0.8 m/s to 3.6 m/s, and some of the time beyond 4 m/s. The calm condition was varying from 16.29% to 28.09%.

Air Environment

Ambient Air Quality (AAQ) of the study area has been assessed through a network of 8 ambient air quality locations in 10 km radius of steel plant.

The Ambient Air Quality wrt the gaseous pollutants SO2 and NO2, in the study area was found to be well within the limits of NAAQ standards prescribed for Residential, Rural & Other Areas and ranging between 1.6 µg/m3 to 9.3 µg/m3

However, the Ambient Air Quality wrt dust viz PM-10 in the study area was found to be exceeding limits of NAAQ standards prescribed for Residential, Rural & Other Areas and ranged from 149 µg/m3 to 307 µg/m3 for PM10. The higher levels of particulate in air is primarily due to the cumulative effect of the construction activity of the expansion of steel plant and the NHAI roads.

Noise Environment

Eleven monitoring locations were selected to assess the noise levels in the study area. The day time noise levels are in the range of 55.8-96.4 dB(A) and night time in the range of 41.7 to 77.2 dB(A). The high levels of noise is due to large vehicular movement

Water Environment

Twenty-five water samples (seventeen - surface water and eight - ground water) have been collected from in and around the steel plant site within 10 km radius. The parameters thus analysed were compared with IS:10500 and other prevalent norms. The water quality was found to be well within the drinking water standards except for Amba River quality which is saline due to tidal effect.

Soil Environment

Thirteen samples were collected to assess the soil quality in the 10 km study area of steel plant site and it revealed soil of medium fertile quality.

Biological Environment

A study was undertaken to list out Flora & Fauna in the study area. From the study it was observed that there are no endangered, endemic or threatened species in the study area.

Environmental Impacts And Management Plan

The proposed project may influence the environment in two distinct phases namely:

a. During construction phase which is temporary and of short term

b. During operation phase which may have long term effects

Environmental Impacts And Management Plan

Construction Phase

The impacts during construction phase are for the short term. Hence, the construction impacts are expected to be minimal.

The project will have large-scale construction activities, mostly mechanized related to foundations, RCC structures, roads, structures equipment etc. The construction equipment such as dozers, concrete -mixers, welding / cutting machines are likely to be used.

JSWSL will extend the existing infrastructure facilities available at the existing plant for the construction labor during the installation of the proposed expansion.

Environmental Impacts and Management plan Operation Phase

Air Environment

In the expansion project, state of the art air pollution control technology has been adopted to meet 30 mg/Nm3. Further, the sinter plants are being upgraded to limit the dust levels to < 10 mg/Nm3.

In order to evaluate the impact of air emission, the following activities are separately considered.

- From the stacks of the proposed units of 10 MTPA expansion.
- Due to changes in configuration of sinter and pellet plants and
- Upgradation of some of the pollution control units

The analysis carried out by dispersion modelling shows that the major contribution of dust in AAQ is due to vehicular movement on unpaved portion of the roads, which is currently under construction. The contribution of dust from steel plant operations in the surrounding environment is insignificant. JSWSL will install necessary pollution control equipment to meet the norms stipulated by the MPCB and CPCB. JSWSL will adhere to the new guidelines issued by CPCB for control of fugitive dust.

Noise Pollution Control Measures

The major noise generating equipment will be provided with acoustic enclosures and would be located in a closed building which considerably reduces the noise.

The proposed greenbelt development will further reduce the noise levels. With encasement of the noise generating sources and greenbelt, JSWSL will comply with ambient noise standards.

All operations and maintenance personnel working near noise prone areas would be provided with earmuffs & earplugs.

Water Environment And Control Measures

Water Consumption

The water requirement of the proposed expansion plant is estimated to be about 2413m3/h. This requirement will be met from Amba River.

Wastewater Generation

The total wastewater generation from the steel plant is envisaged to be about 827 m3/h. The wastewater from individual process is treated in distributed wastewater treatment facilities to comply with applicable norms. In the initial stage of the plant operations, it is proposed to adopt marine discharge of the treated wastewater. However, once all production facilities are installed, a water recovery plant will be set up to ensure full utilization of make up water. In addition rain water harvesting will be adopted to conserve rainwater.

Water Pollution Control Measures

Seggregation Of Waste Water

The wastewater will be segregated as process waste and non-process wastewater for adopting different treatment and disposal methods.

Wastewater generated from the different areas of the plant will be treated to the desired level and recycled as far as possible for secondary applications.

Domestic Wastewater Treatment & Disposal

Wastewater arising from sanitary and drinking water use will be treated in 300 m3/d STP and shall be used for green belt development.

Land Environment And Control Measures

The most of the units of proposed expansion will be located within the existing steel plant complex of 1800 acres.

The site preparation for the expansion plant will slightly alter the environmental conditions resulting in air and noise pollution. However this scenario is of short duration. Therefore, the overall impact on land environment will be minimal.

Solid Waste Generation

Major solid wastes will include slag and sludge from various additional units and the same shall be utilized as per the plan given in Chapter-4.

Social Welfae Measures

Socio Economic Status in the study area is found to be moderate with respect to livelihood, amenities etc. The management of JSWSL has provided employment to 4580 persons. An additional 5000 persons will be employed in the proposed expansion plant.

No rehabilitation or resettlement is envisaged due to the proposed expansion.

Drinking water supply is provided by JSWSL in all the villages along the water pipeline in the study area. In most of the villages, water supply is either through tap water or well water. Hand pumps have been provided wherever tap water or well water is not provided.

As for the other community services such as postal and electric power supply, information is provided. Postal services are available in most of the villages through the Post Office. Also, most of the villages in the study area are provided with electricity supply.

The common mode of transportation in the study area is through State transport buses. Pen is the nearest station on the Konkan railway line connecting Mangalore-Mumbai. Tar roads connect the villages in the study area. The project site is connected to the Mumbai-Goa National Highway No. NH 17 by a State Highway road. Locals in this area use bicycles, two-wheelers and auto rickshaws for internal transportation. The site is accessible by road from the State Highway connected to NH 17.

Mumbai airport is the closest operating airport to the site. JSWSL also provides transportation facility to its employees with their Regular bus service.

Occupational Health Center

Inside the industry premises JSWSL has Occupational Health Center which is manned round the clock by a shift duty doctor, a male nurse, house keeper and ambulance driver.

Occupational Health center has been provided with consultation room for the doctor, one reception cum waiting area, one treatment room with two beds, separate rooms for X-Ray (with dark room) and pathology.

Statutory health check-up is conducted every six months for employees and contract workers working in core areas.

A multi specialty hospital with 60 beds is being constructed for use by the villagers.

Budget for implementation of Environmental Management Plan:

JSWSL will incur an amount of Rs 2327 Cr for implementation of Environmental Management Plan. The revenue expenditures for operation of the environment control facilities are Rs 635 Cr per annum. The estimated expenditure for CER is RS 118 Cr.

Post Project Monitoring Plan

Environmental monitoring will be taken up to as per MPCB /CPCB guidelines.

Conclusion

JSWSL has complied with all the standards stipulated by various statutory bodies for maintaining environmental quality within the norms. JSWSL has received ISO 14001 certification for implementing the Environmental Management System from TUV Germany. JSWSL shall implement the system for the proposed expansion plan too.

Chapter 12
Disclosure of Consultants Engaged

12.1 CSIR-NEERI Profile

CSIR-NEERI (National Environmental Engineering Research Institute) is a Constituent Laboratory of CSIR (Council of Scientific & Industrial Research), India (Website: www.neeri.res.in) was established in 1958.

12.1.1 CSIR-NEERI Mission and Vision

CSIR-NEERI Mission:

The Institute dedicates itself in the service of mankind by providing innovative and effective solutions to environmental and natural resource problems. It strives to enable individuals and organizations to achieve productive and sustainable use of natural resources on which all life and human activity depend. Highly skilled and motivated, the Institute strives for excellence in environmental science, technology and management by working hand in hand with its partners.

CSIR-NEERI Vision:

CSIR-NEERI envisions a world in which;

- All individuals and Institutions have capacity to act in a manner that ensures achievement of sustainable environmental and economic goals.
- The natural balance is no longer threatened and all share the benefit of a healthy environment.

CSIR-NEERI would continue to strive for;

- Leadership in environmental science, technology and management domestically and worldwide.
- Strong and effective working relationship with its partners in ensuring ecological health of all regions in India.

12.1.2 Mandate of CSIR-NEERI

- To conduct R&D studies in environmental science and engineering.
- To render assistance to the industries of the region, local bodies etc. in solving the problems of environmental pollution.
- To interact and collaborate with academic and research institutions on environmental science and engineering for mutual benefit.
- To participate in CSIR thrust area and mission projects.

12.1.3 CSIR-NEERI Activities

R&D Thrust Areas:

- Environmental Monitoring
- Environmental Modeling
- Environmental Impact & Risk Assessment
- Environmental System Design
- Environmental Biotechnology
- Environmental Genomics
- Environmental Policy Analysis

Advisory:

- Central Govt. Ministries
- State Govt. Ministries
- Industries
- Judiciary

12.1.4 CSIR-NEERI Services and Goods

Research Intensive Areas:

- Air, Water, Wastewater, Soil (Land), Solid & Hazardous Waste
- Environmental Biotechnology & Genomics
- Environmental Materials

Public and Strategic Areas:

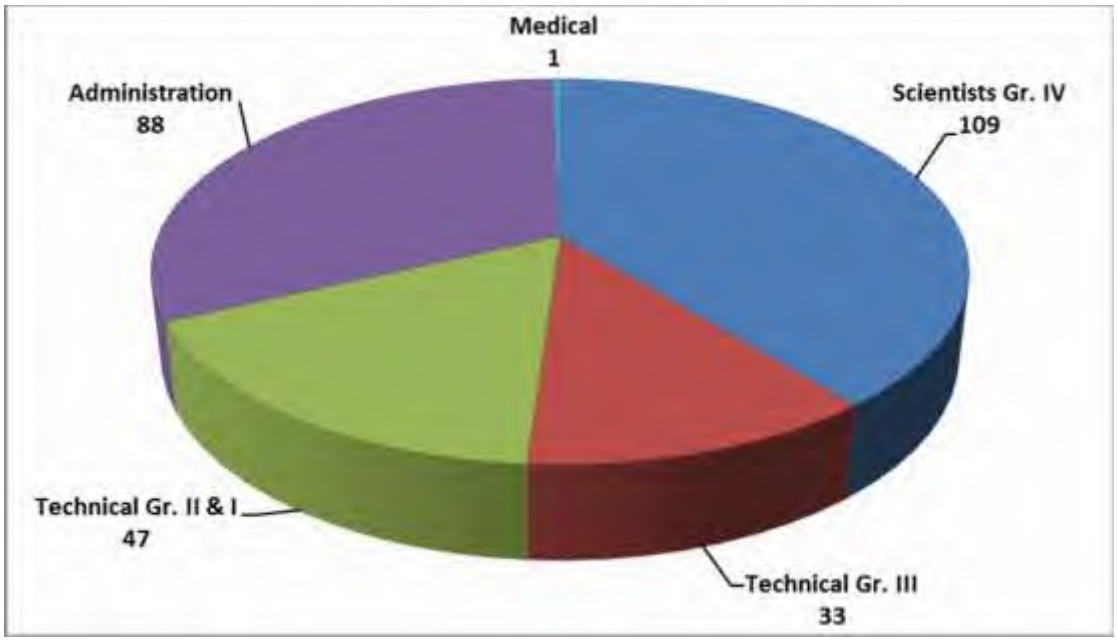
- Environmental Monitoring
- Environmental Policy Analysis

Socio-economic Areas (Urban & Rural):

- Drinking water
- Clean Air
- Environment & Health
- Advice to Central & State Government Agencies
- Judiciary

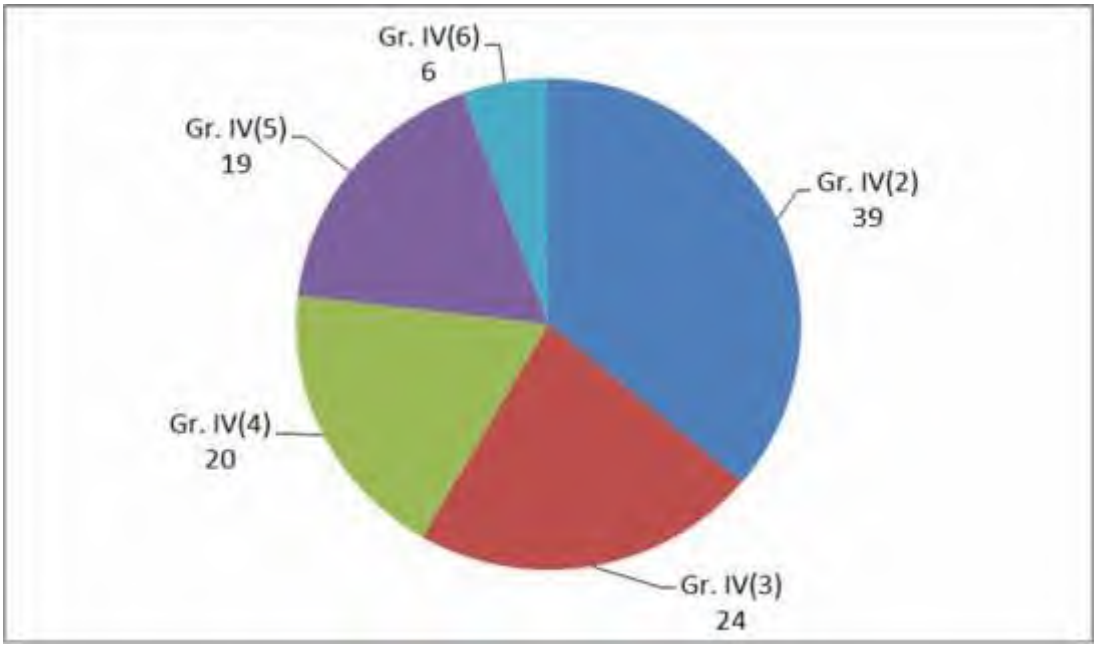
Industry Focus:

- Environmental Monitoring, Management and Audit
- Environmental Technology Assessment
- Environmental Impact & Risk Assessment



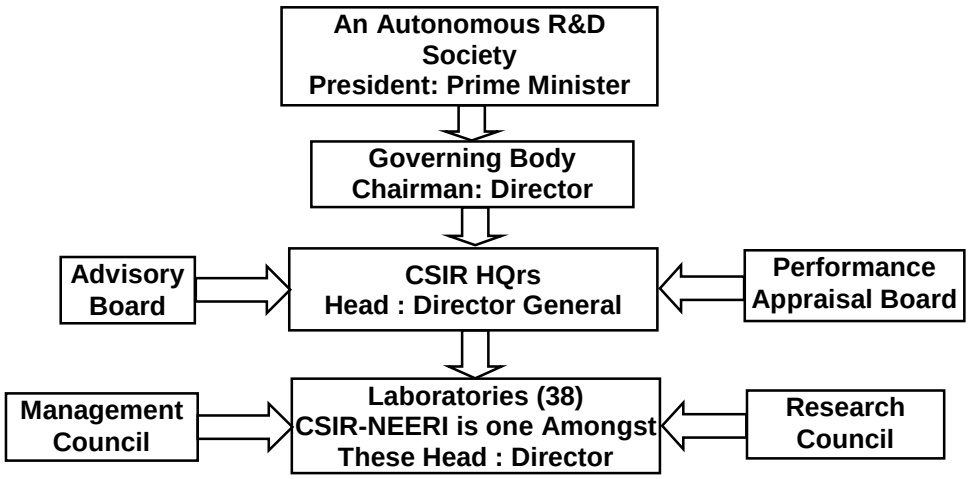
CSIR-NEERI: Human Resources (Total Manpower)
Total : 278 (As on December 31, 2018)

12.1.5 CSIR-NEERI Human Resources

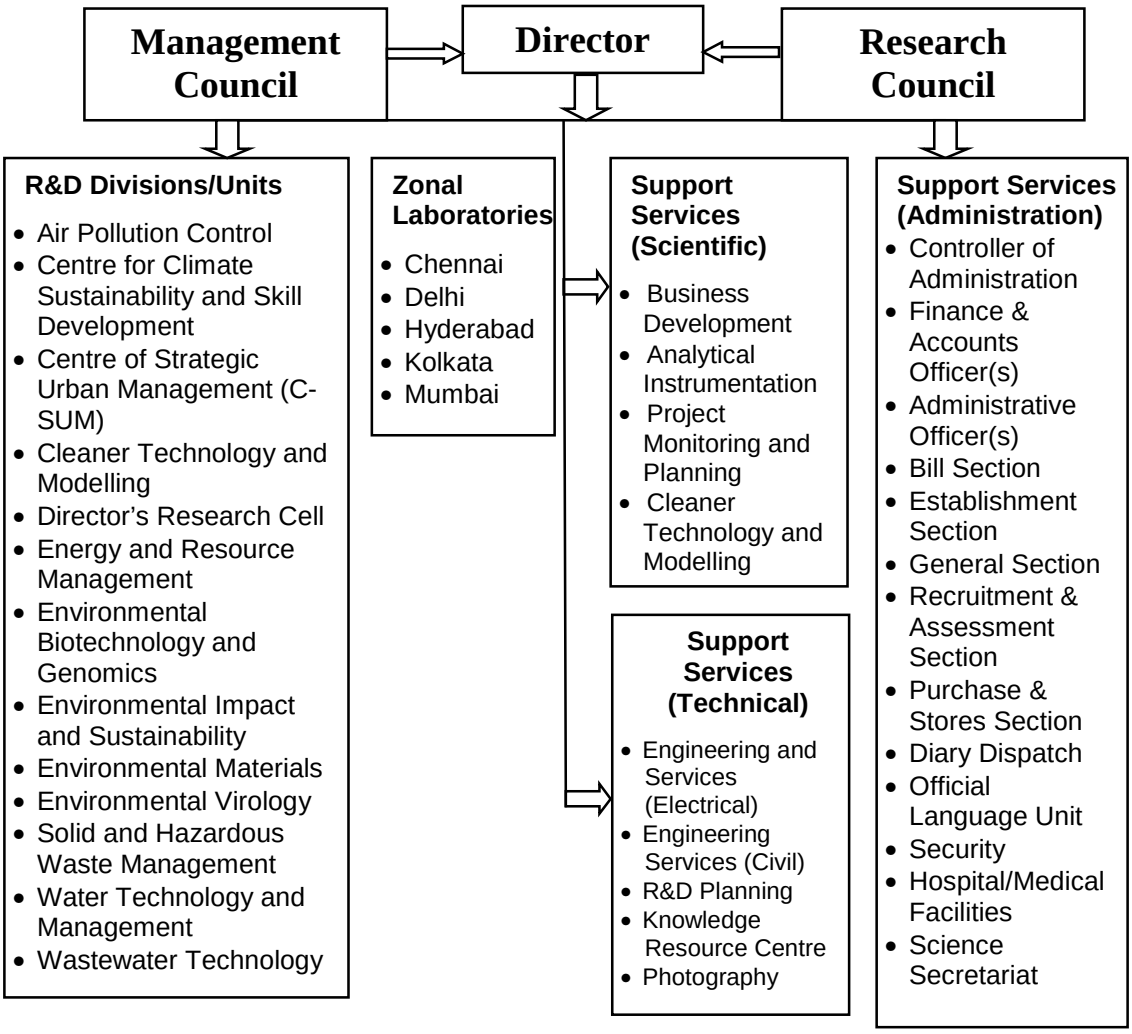


CSIR-NEERI: Human Resource – Scientific Staff
Total: 108 (As on December 31, 2018)

12.1.6 Organizational Chart of CSIR and CSIR-NEERI

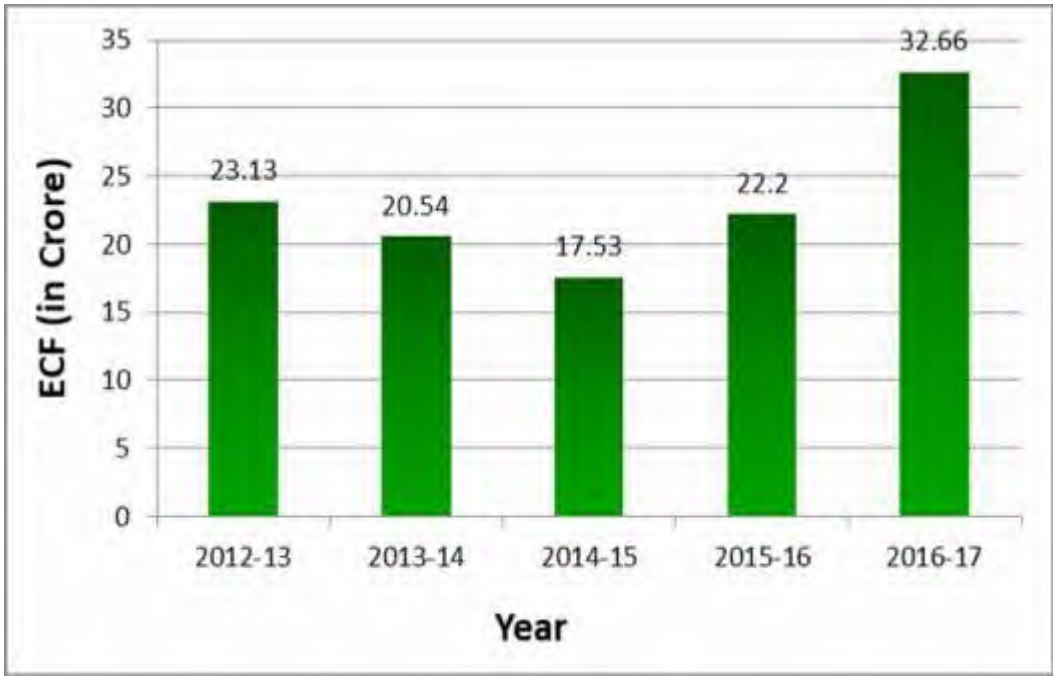


CSIR, India (Organizational Chart)



CSIR-NEERI: Organization Chart

12.1.7 Financial Resources of CSIR-NEERI



Financial Resources (2012- 2017) (in Crore) (ECF- External Cash Flow)

12.1.8 Analytical Instruments, Computer Systems and Software at CSIR-NEERI

12.1.8.1 Analytical Instrumentation Resource

- UV-VIS-NIR Spectrophotometer: Hitachi 330
- Atomic Absorption Spectrophotometer: GBC 904 A
- Fluorescence Spectrophotometers: Hitachi F-4000 & Hitachi F-4500
- Mercury Analyzers: Perkin Elmer MAS-50 A and MAS-50 B
- Gas Chromatographs: Perkin Elmer Autosystem – 5 nos.
- High Performance Liquid Chromatographs: Waters 204 and 501; Shimadzu-LC10
- Gas Chromatograph-Mass Spectrometer: Varian Saturn III
- Liquid Chromatograph-Mass Spectrometer-Mas Spectrometer: Quattro Ultima
- Ocean related studies: ADCP, CODAR, GPS, Ekmen Dredge, Reversible sampler, (Nishkin type) DRDF, Reversible thermometer, Tide Gauges
- Doppler SODAR
- Mini Sonde
- Microscopes
- Biolistic particle delivery system with accessories
- Gene Pulser II System with accessories & consumables
- Membrane Bioreactor Assembly

- Wet air Oxidation High pressure reactor
- Ground Penetrating Radar
- Multi Electrode resistivity Imaging system
- Ambient Ozone Analysers
- Eight Stage Cascade Impactor
- Microwave Furnace
- CHNS Analyser Vario ELIII
- Porosimeter Quanta Chrome PM33-7
- Mercury Analyser – Milestoen DMA80
- FTIR Spectrometer – Bruker Vertex 70

12.1.8.2 Computer Hardwares & Peripherals

Computer Hardware

- High performance computer systems configures around RISC workstations
- Sun Ultra Sparc Computer Station: Sun Ultra 1 Model 170
- Silicon Graphics 02 Workstations
- Silicon Graphics 2000 Workstations
- HP APOLLO 90001730 Workstations
- Personal Computers
- Laptop Computers
- Local Area Network

12.1.8.3 Supporting Software

- Geographic Information Systems – ARC INFO, MAP INFO
- Knowledge Based System – Prokappa
- Digital Image Processing – ERDAS, EASIPACE, PCI WORKS
- INGRES
- CADCORE
- SPSS
- IMSL
- COMPLIERS
- GRAPHICS
- MATLAB
- DIVAST

12.1.8.4 Software for Mathematical Modeling (Available at CSIR-NEERI)

Air Environment:

Model	Used for Predicting Impacts due to
PAL-DS	Point (stacks), area (quarry) and line (vehicular) sources in short range
ISCST-3	Point and area sources in short range
CALINE 4	Vehicular sources close to road
RTDM3.2	Point and area sources existing at rough terrain in short range
VALLEY	Point and area sources existing in valley in short range
MESOPUFF	Point and area sources in long range
CDM	Point and area sources in short range
RAM	Point and area sources in short range
BLP	Point and line sources in short range
SDM	Point and area sources existing in coastal region in short range
CAL3QHC	Vehicular sources close to road for Hydrocarbon Levels
ADAM	Point and area sources in long range
ADMS-3	Point and area sources in long range
PANACHE	Meteorological data and point, area & line sources in any range
MTDDIS	Point and area sources in long range
TAPM	Meteorological data and impacts due to point, area and line sources in short and long range

Noise Environment:

Model	Used for Predicting Impacts due to
FHWA	Vehicular sources
Wave Divergence	Stationary sources

Aquatic Environment – Ground Water:

Model	Used for Predicting Impacts due to
GMS	Flow, direction, contaminant transport in saturated and unsaturated zones, subsurface solute transport with aerobic and sequential anaerobic bio-degeneration, remediation
FEMWATER/ LEWASTE	Stable contaminant transport & pollution, groundwater pollution and remediation
PATRIOT	Hydrology, stable contaminant transport & pollution and landuse management
PRZM3	Stable contaminant transport & pollution and landuse management, consequence of surface water pollution on groundwater
WhAEM2000	Risk of groundwater contamination, hydrology, stable contaminant transport & pollution

Aquatic Environment – Surface Water:

Model	Used for Predicting Impacts due to
MIKE 11	One dimensional model for dam break analysis, sediment transport, ecological and water quality assessments in rivers and wetlands
MIKE 21	Two dimensional model for Environmental Impact Assessment of marine infrastructure, sediment and mud transport, spill analysis
MIKE 3	Three dimensional model for various applications in different water bodies for water pollutions studies
MIKE SHE	Integrated surface and groundwater modeling
ECO LAB	For ecological modeling in rivers wetlands, lakes, reservoirs, estuaries, coastal waters and sea
CORMIX	Software for simulation for fluid-flow mixing in different water bodies
EXAMS	Aquatic Chemistry & Biology in streams and sea
GCSOLAR	Photolysis, half life
HSCTM2D	Hydrology, sediment & contaminant transport in river and estuary
HSPF	Aquatic chemistry and biology sediment transport and deposition in rivers
OXYREF	Dissolved oxygen, respiration, ventilation
PLUMES	Available dilution, design of marine outfall
PRZM3	Hydrology, metals and pesticides prediction in surface water
QUAL2EU	Water quality in stream, planning, non-point sources
SED3D	Hydrodynamics, sediment transport, 3-D, lakes, estuary, harbour, coastal
SMPTOX3	Toxic-chemicals in streams, aquatic biology, combined sewers
SWMM	Aquatic biology, combine sewers, community discharge, rivers, streams
TMDL USLE	Soil and sediment loss, watershed management
Visual Plumes	Surface water, contaminant transport
WASP	Hydrodynamics, aquatic biology, toxicant dispersal, hydrology

Surface Water Runoff:

Model	Used for Predicting Impacts due to
HEC-5	Flood hydrography, runoff estimation, catchment area treatment
HSPF	Hydrologic simulation in reservoir, nutrient growth
STORM	Urban watershed, storage/reservoir routing, sedimentation, erosion, reservoir chemistry

Ecology:

Model	Used for Predicting Impacts due to
ECOMOD	Estuary linked reservoirs, tidal action, saltwater intrusion, in-stream and in-reservoir dissolved oxygen primary and secondary productivity estimation
LAKE-I	Thermal stratification primary and secondary productivity

Food Chain:

Model	Used for Predicting Impacts due to
EGETS	Exposure levels and effects of contaminants on organisms which make food chain
LC50	Lethal concentration, LC50 toxicity levels

Multimedia:

Model	Useful for Predicting Impacts due to
3MRA	Multimedia pathway, receptor exposure, risk assessment
MINTEQA2	Aquatic biology, multimedia pathway
MMSOILS	Multimedia pathway, exposure assessment
MULTIMED (1.01)	Environmental effects of waste disposal in one media to another surface & ground water

Dam Break Analysis:

Model	Useful for Predicting Impacts due to
DAMBRK	Downstream flow simulation consequent to dam break

Risk Assessment:

Model	Useful for Predicting Impacts due to
SAFETI 6.21 & 6.42V	Complete package for consequence analysis and risk analysis in onshore process engineering
PHAST 6.21 V & 6.42V	Complete package for consequence analysis in onshore process engineering

12.1.9 Clients of CSIR-NEERI

12.1.9.1 Clients: International

- The World Bank
- Asian Development Bank
- United Nations Development Programme
- United Nations Environment Programme
- World Health Organization
- International Union of Conservation for Nature
- Danish International Development Agency
- Global Scan Technologies, Dubai
- Global Tech Safety & Environmental Consultancy, Dubai
- Dept. of Public Works and Highways (DPWH) / Environment and Social Services Office (ESSO), Philippines

12.1.9.2 Clients: Central Government

- Atomic Energy Regulatory Board
- Bharat Oman Refineries Limited
- Bharat Petroleum Corporation Limited
- Department of Science and Technology
- Gas Authority of India Limited
- Hindustan Organic Chemicals Limited
- Hindustan Petroleum Corporation Limited
- Indian Navy, Ministry of Defence
- Indian Oil Corporation Limited

- Indian Petrochemicals Corporation Limited
- Jawaharlal Nehru Port Trust
- Madras Refineries Limited
- Mangalore Refinery and Petrochemicals Limited
- Mumbai Port Trust
- National Aluminium Corporation Limited
- National Hydroelectric Power Corporation
- National Thermal Power Corporation Limited
- Nuclear Power Corporation India Limited
- Numaligarh Refineries Limited
- Oil India Limited
- Oil and Natural Gas Corporation Limited
- Rashtriya Chemicals & Fertilizers Limited
- Tuticorin Port Trust
- Western Coal Field

12.1.9.3 Clients: State Government

- Gujarat Industrial Development Corporation Limited
- Gujarat Narmada Valley Fertilizers Company Limited
- Gujarat State Petroleum Corporation Limited
- Gujarat State Petronet Limited
- Kudremukh Iron Ore Company Limited
- Maharashtra State Electricity Board
- Maharashtra Pollution Control Board
- Tamilnadu Industrial Development Corporation
- Chattisgarh State Electricity Board
- Narmada Water Resources, Water Supply & Kalpasar Deptt.
- Karnataka State Industrial Infrastructure Development Corporation Ltd.
- Steel Authority of India

12.1.9.4 Clients: Private Industries (National)

- ABG Cement
- Adani Ports and SEZ Limited
- Alembic Pharmaceuticals Ltd.
- Amanora Park Town

- Asian Paints India Ltd.
- Andhra Sugars
- Ballarpur Industries Ltd.
- Chhindwara Plus Developers Ltd.
- Cochin Port Trust
- Dighi Port Pvt. Ltd.
- Dony Polo Petrochemicals Ltd.
- Electrosteel Castings Ltd.
- ESSAR Oil Ltd.
- Grasim Industries Ltd.
- Green Environment Services Co-op. Soc. Ltd.
- Gujarat Pipavav Port Ltd.
- Gujarat Positra Port Infrastructure Ltd.
- Hazira Port Pvt. Ltd.
- Hindustan Oil Exploration Company Ltd.
- Hindustan Waste Treatment Pvt. Ltd., Goa
- Jindal Vijaynagar Steel Pvt. Ltd.
- Khemani Distilleries Pvt. Ltd.
- Lavasa Corporation Ltd.
- Nagarjuna Fertilizer and Chemicals
- NCTL Pvt. Ltd.
- Paradeep Phosphates Ltd.
- Paradip Port Trust
- Pipavav Ship Dismantling & Engineering Ltd.
- Reliance Petrochemical Ltd.
- Reliance Industries Ltd.
- Sahara India Pvt. Ltd.
- Saint-Gobain India Pvt. Ltd.
- Saurashtra Chemicals Ltd.
- Saurashtra Cement Limited, Gujarat
- Search Chem Industries Ltd.
- Tata Petrodyne
- United Phosphorus Ltd.
- Zuari Industries Ltd.

12.1.9.5 Clients: Private Industries (Multi-National)

- õ British Gas International (India)
- õ Cairn Energy India Pty. Limited
- õ Command Petroleum, Australia
- õ Enron Oil & Gas India Limited
- õ Hindustan Oil Exploration Company Limited
- õ Hindustan Oman Petroleum Company Limited
- õ Niko Resources Limited
- õ Petro Energy Products Company India Limited
- õ Rio Tinto Orissa Mining Limited
- õ Shell India Private Limited
- õ South Asia LPG Company Ltd., (a JV of M/s Total Gas & Power India)
- õ Mitsui & Company, Japan
- õ OAO Gazprom, Russia
- õ Mosbacher India L.L.C

12.1.10 Studies with International Funding

- õ Construction of Middle Vaitarna Dam for Augmentation of Water Resources and Irrigation near Mumbai (WB) (1990-1993)
- õ Augmentation of Chennai Water Supply – a Project at New Veeranam, Tamilnadu (WB) (1994-1995)
- õ Construction of Aerated Lagoons and Selection of Marine Outfall Location (Worli) off Mumbai Coast (WB) (1994-1995)
- õ Water Quality Studies for Hyderabad Water Supply and Sanitation Project (WB) (1995-1990)
- õ Oceanographic Modeling Studies for Sewage Outfall Location (Bandra) off Mumbai Coast (WB) (1995-1998)
- õ Strengthening EIA capacity and environmental legislation in India (ADP) (1998-2000)
- õ Implementation off Master Tourism Plan in Andaman Islands (UNDP) (1999-2000)
- õ Design & Implementation of Information Network for Indian Centre for Cleaner Technologies (WB) (1999-2002)
- õ Planning for Coastal and Marine Environment under Gujarat State Environmental Action Programme (WB) (1999-2000)
- õ Development of National Guidance Manual & Support Manual on EIA Practices for Enhancing the Quality & Effectiveness of Indian EIA's (WB) (2002-2004)
- õ Water needs of Brahmani & Sabrmati river basins (ICID) (2002-2004)
- õ Technical Assistance to ESSO to Enhance the Management of Social and Environmental Safeguards for DPWH Projects, Manila, Philippines (WB) (2005-2007)

12.1.11 US-AEP AWARD TO CSIR-NEERI


UNITED STATES - ASIA ENVIRONMENTAL PARTNERSHIP

ENVIRONMENTAL LEADERSHIP AWARD

This award recognizes outstanding contributions made through working in partnership to improve the environment and quality of life for the people of Asia.

PRESENTED TO:

NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INSTITUTE

US-AEP

USAID | ASIA

12.1.12 Conformity to ISO 9001:2008

DNV·GL

MANAGEMENT SYSTEM CERTIFICATE

Certificate No: 30987-2008-AQ-IND-RvA | Initial certification date: 11, January, 2005 | Valid: 11, January, 2017 - 15, September, 2018

This is to certify that the management system of

CSIR-National Environmental Engineering Research Institute (NEERI)
Nehru Marg, Nagpur - 440 020, Maharashtra, India
and the sites as mentioned in the appendix accompanying this certificate

has been found to conform to the Quality Management System standard:
ISO 9001:2008

This certificate is valid for the following scope:
Design, develop and undertake R&D programmes for improvement in quality of environment through various activities leading to scientific and technological innovations, technical solutions, sharing knowledge & expertise for enabling government, industry and society

Place and date:
Chennai, 19, January, 2017

IAF MGMT. SYS. RvA C 004

The RvA is a signatory to the IAF MLA

For the issuing office:
DNV GL – Business Assurance
ROHA, No. 10, GST Road, Alandur,
Chennai - 600 016, India

Sivadasan Madiyath
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.

12.1.13 NABET Accreditation

Quality Council of India

National Accreditation Board for Education & Training

CERTIFICATE OF ACCREDITATION

National Environmental Engineering Research Institute

CSIR-NEERI, Nehru Marg, Nagpur 440020

Accredited as **Category - A** organization under the QCI-NABET Scheme for Accreditation of EIA Consultant Organizations: Version 3 for preparing EIA-EMP reports in the following Sectors:

Sl. No.	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Offshore and onshore oil and gas exploration, development & production	2	1 (b)	A
2	River Valley projects	3	1 (c)	A
3	Thermal power plants	4	1 (d)	A
4	Petroleum refining industry	10	4 (a)	A
5	Chlor-alkali industry	13	4 (d)	B
6	Chemical fertilizers	16	5 (a)	B
7	Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)	18	5 (c)	A
8	Manmade fibers manufacturing	19	5 (d)	B
9	Oil & gas transportation pipeline (crude and refinery/ petrochemical products), passing through national parks/ sanctuaries/coral reefs / ecologically sensitive areas including LNG terminal	27	6 (a)	A
10	Industrial estates/ parks/ complexes/areas, export processing Zones(EPZs), Special Economic Zones(SEZs), Biotech Parks, Leather Complexes	31	7 (c)	A
11	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	32	7 (d)	A
12	Ports, harbours, break waters and dredging	33	7 (e)	A
13	Common Effluent Treatment Plants (CETPs)	36	7 (i)	B
14	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (ii)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in QA AC minutes dated Feb. 02, 2019 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/18/0592 dated March 15, 2018.The accreditation needs to be renewed before the expiry date by National Environmental Engineering Research Institute, Nagpur following the process of assessment

Sr. Director, NABET
Dated: Mar. 15, 2018

Certificate No.
NABET/ EIA/1720/ RA 0088

Valid till
17-02-2020

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

12.1.14 Contact Persons

DIRECTOR	**:**	Dr. Rakesh Kumar
Phone	**:**	+91 712 2249999
Fax	**:**	+91 712 2249900
Email	**:**	director@neeri.res.in
NABET Coordinator	:	Dr. M. Suresh Kumar
Phone	**:**	+91 712 2247844
Fax	**:**	+91 712 2249896
Email	**:**	ms_kumar@neeri.res.in

भारत सरकार
GOVERNMENT OF INDIA
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
MINISTRY OF ENVIRONMENT, FORESTS
& CLIMATE CHANGE

Regional Office (WCZ)
Ground Floor, East Wing
New Secretariat Building
Civil Lines, Nagpur - 440001
E-mail: apcefcentral-ngp-mef@gov.in

F.No.5-71/2015(ENV)/ 4529

Date: 26.10.2018

To,

Director
Member Secretary
IA Division (Industry-I)
Ministry of Environment, Forest & Climate Change
Indira Paryavaran Bhawan,
Aliganj, Jorbagh Road,
New Delhi-110003

Sub:

1. Environmental clearance for the environmental clearance granted for expansion of Integrated Steel Plant from 5 to 10 MTPA and Power Plant from 300 MW to 600 MW (Gas Based) of M/s JSW Steel Limited at Geethapuram, Village Dolvi, Tehsil Pen, District Raigarh
2. 3.5 MTPA Coke Oven and By-product plant- Transfer of 1.0 MTPA Coke Oven and from EC of 3 to 5 MTPA and 2.5 MTPA Coke Oven with by-product plant from EC of expansion of Integrated Steel Plant from 5 to 10 MTPA and Power Plant from 300 MW to 600 MW (Gas Based) of M/s JSW Steel Limited at Geethapuram, Village Dolvi, Tehsil Pen, District Raigarh in Maharashtra to M/s. Dolvi Coke Projects Limited

Ref:

1. MoEF& CC letter F. No. J-11011/76/2013-IA II(I) dated 25.08.2015
2. MoEF &CC letter no. F. No. J-11011/76/2013-IA II(I) dated 23.01.2018
3. MoEF &CC letter no. J-11011/497/2017-IA.II(I) dated 01.02.2018
4. MoEF &CC letter no. J-11011/497/2017-IA.II(I) dated 02.02.2018

Sir,

I am directed to invite your kind attention on the above subject and letter under reference. Monitoring report of compliance to conditions stipulated in Environment Clearance accorded for expansion form 5.0 MTPA to 10 MTPA and Power Plant from 300 MW to 600 MW (Gas Based) at Geethapuram, Village Dolvi, Tehsil Pen, District Raigad in Maharashtra M/s JSW Steel Limited & 3.5 MTPA Coke Oven and By-product plant- Transfer of 1.0 MTPA Coke Oven and from EC of 3 to 5 MTPA and 2.5 MTPA Coke Oven with by-product plant from EC of expansion of Integrated Steel Plant from 5 to 10 MTPA and Power Plant from 300 MW to 600 MW (Gas Based) of M/s JSW Steel Limited at Geethapuram, Village Dolvi, Tehsil Pen, District Raigarh in Maharashtra to M/s. Dolvi Coke Projects Limited along with

the monitoring datasheet (as submitted by project) is enclosed herewith. Site inspection has been carried out on 12.10.2018. Following observations were made during the site inspection:

Ministry vide letter dated 21.11.2012 granted environmental clearance for the 3.0 MTPA to 5.0 MTPA Integrated Steel Plant along with installation of Pellet Plant - 4.0 MTPA and 300 MW Captive Power Plant.

MoEF&CC vide letter dated 25.08.2015 granted environmental clearance for the expansion of integrated steel plant from 5 to 10 MTPA and captive power plant from 300 MW to 600 MW.

MoEF&CC vide letter dated 23.01.2018 amended the environmental clearance by splitting the environmental clearance granted vide letter dated 25.08.2015 into 3 parts. Environmental clearance (part) for the 3.5 MTPA coke oven and by-product plant has been transferred to M/s. Dolvi Coke Projects Limited vide letter dated 01.02.2018. Environmental clearance (part) for the 10 MTPA slag & clinker grinding unit has been transferred to M/s. JSW Cement Limited vide letter dated 02.02.2018.

ESP, bag filters, dust extraction systems have been provided for air pollution control from various plants. Continuous stack emission monitoring systems have been provided for 22 process stacks. 5 no.s of continuous ambient air quality systems have been provided for the monitoring of ambient air quality within the plant. Wastewater generated at the project is being treated in the effluent treatment plant and being reused in the process. Zero discharge is being implemented.

Following conditions were partially complied:

Specific Condition no. v:

PA did not submit detailed time bound action plan for spending the 5% of cost of the project on CSR activities in the surrounding area. PA submitted that CSR budget of 2.5% of the project cost will be allocated for CSR activities. PA did not upload the CSR plan to company website.

Specific Condition no. xii:

Bag filters and scrubbers and cyclones have been provided for controlling the fugitive emissions at conveyor and transfer points, product handling, loading and unloading points. However fugitive emissions generated from the vehicle movement within the plant area needs to be controlled.

This issues with the approval of APCCF (Central), Regional Office, Nagpur.

A. Suresh/Cen
26/10/18

Suresh Kumar Adapa
Scientist 'D'

Encl: as above

Copy to:

1. Director RO HQ, Ministry of Environment, Forest & Climate Change, Government of India, 1st Floor Agni Wing, Indira Paryavaran Bhawan, Jorbagh Road, New Delhi-110 003
2. Director (Monitoring Cell), Ministry of Environment, Forest & Climate Change, Indira Paryavaran Bhawan, Aliganj, Jorbagh Road, New Delhi-110003
3. M/s JSW Steel Limited, JSW Centre, Bandra-Kurla Complex, Bandra (East), Mumbai-400051
4. Guard file

A. Suresh Kumar
26/10/17

Suresh Kumar Adapa
Scientist 'D'

Monitoring the Implementation of Environmental Safeguards
Ministry of Environment, Forest & Climate Change
Regional Office (West Central Zone), Nagpur

Monitoring Report

Part – I

DATA SHEET (SUBMITTED BY PA)

1.	Project Type: River-valley / Mining / Industry /Thermal / Nuclear / Other (Specify)	Industry
2.	Name of the Project	Expansion of Integrated Steel Plant from 5.0 to 10.0 MTPA & BF+CO Gas based CPP from 300 to 600 MW
3.	Clearance Letter (s) / OM No. and date	F No. J-11011/76/2013-IA II (I) - 25th August 2015
4.	Location	
	a. District (s)	Raigad
	b. State (s)	Maharashtra
	c. Latitude	18^{O} 40'00" - 18^{O} 45'00"
	d. Longitude	73^{O} 00'00" - 73^{O} 05'00"
5.	Address for correspondence	
	a. Address of concerned Project Chief Engineer (with Pin Code & Telephone/ Telex/ Fax Numbers) :	JSW Steel Ltd., Dolvi, Geetapuram (Vil), Taluka Pen, Raigad Dist, Maharashtra, India. Pin- 410207, Tel: (91)2143277501 to 15, Fax: (91) 2143277533/42
	b. Address of Executive Project Engineer / Manager (with pin code/fax numbers)	JSW Steel Ltd., Dolvi, Geetapuram (Vil), Taluka Pen, Raigad Dist, Maharashtra, India. Pin- 410207,Tel: (91)2143277501 to 15, Fax: (91) 2143277533/42
6.	Salient features	
	a. Of the Project	1) India's largest Blast Furnace with 5358 m3 volume and 4.5 MTPA capacity 2) SMS 2 with BOF technology, for faster processing time and hence more heats in a specified than EAF technology. 3) HSM 2 mill with Pair Cross Technology, patented by M/s Mitsubishi, Japan, to control shape and crown of the coils.
	b. Of the Environmental Management Plan	b) Environment Management 1) All Dust Extraction systems to be designed to meet 10 mg/Nm3 and European Norms, which is way beyond the norms prescribed. 2) Common Effluent Treatment Plant of 20 MLD capacity with MBR, Ultra Filtration, RO and evaporator to achieve Zero Liquid Discharge. 3) Coke Oven Plant with Single Stamping, Charging and Pushing Car to control visible emission during the operation. Coke Dry Quenching for Coke Oven to recover heat and turn to electricity. 4) Blast Furnace with Dry Type GCP, first time in India to avoid water usage and conserve the energy of Blast Furnace Gas. 5) LD Gas collection from SMS after Dry Type GCP. 6) Scrubber for HSM Rollers. 7) Utilization of Coke Oven gas and Blast Furnace gas as fuels in various processes. 150 MW Captive Power Plant with Blast Furnace Gas as Fuel.
7.	Breakup of the Project area	

	a. Submergence Area: Forest & Non Forest	No Forest Area
	b. Others	NA
	a. Total Plot Area	382 Acres (Area of 5.0 to 10.0 MTPA)
	b. Built - Up Area (Including Road)	264 Acres (Area of 5.0 to 10.0 MTPA)
	c. FSI area	NA
	d. Non – FSI Area	NA
8.	Breakup of the Project affected population with enumeration of those losing houses/dwelling units only, agricultural land only, both dwelling units & both dwelling units & agricultural land & landless laborers/artisan a. SC, ST/Adivasis b. Others (Please indicate whether these figures are based on any scientific and systematic survey carried out or only provisional figures, if a survey carried out gives details and years of survey.)	NA
9.	Financial Details a. Project costs as originally planned & subsequent revised estimates and the year of price reference.	17000 Crs
	b. Allocations made for Environmental Management Plan with item wise & year wise breakup.	Attached as Annexure A2
		Attached as Annexure A2
	c. Benefit Cost Ratio / Internal rate of Return and the year of assessment.	Not Available
	d. Whether (c) includes the cost of Environmental Management as shown in the above.	NA
	e. Actual expenditure incurred on the Project so far	2624 Crs (Incl. Environment Management) for 5-10 MTPA expansion project Rest of the Budget is in ordering process.
	f. Actual expenditure incurred on the Environmental Management Plan so far	132 Crs
10.	Forest land requirement	
	a. The status of approval for diversion of Forestland for non-forestry use	No Forest land is required
	b. The Status of clearing felling	No Forest land is required
	c. The status of compensatory Afforestation programme in the light of actual field experience	No Forest land is required
11.	The status of clear felling in non-forest areas (such as submergence area of reservoir, Approach roads), if any with quantitative information	Not Applicable
12.	Status of construction	
	a. Date of commencement (Actual and/or Planned)	April 2017

	b. Date of completion (Actual and/or Planned)	Planned: March 2020, After completion of Project, we will intimate to Regional office, MoEFCC, Nagpur
13.	Reasons for the delay if the project is yet to start	-
14.	Dates of site visits	
	a. The dates on which the Project was monitored by Regional Office on previous occasions, if any	03.08.2017
	b. Date of site visit for this monitoring Report	12.10.2018
15.	Details of correspondence with project authorities for obtaining action plan / information on status of compliance to safeguards other than the routine letters for logistic support for site visit. (The monitoring report may obtain the details of all the letters issued so far but the later reports may cover only the letters issued subsequently)	-

MoEF granted environmental clearance granted for the expansion of integrated steel plant from 3.0 MTPA to 5.0 MTPA along with installation of pellet plant - 4.0 MTPA and 300 MW captive power plant vide letter no. J-11011/166/2011-IA-II (I) dated 21st November 2012.

MoEF&CC vide letter dated 25.08.2015 granted environmental clearance for the expansion of integrated steel plant from 5 to 10 MTPA and captive power plant from 300 MW to 600 MW. The status of execution of the facilities for which EC has been granted vide letter dated 25.08.2015 is enclosed as **Annexure-1**.

MoEF&CC vide letter dated 23.01.2018 amended the environmental clearance by splitting the environmental clearance granted vide letter dated 25.08.2015 into 3 parts. Environmental clearance (part) for the 3.5 MTPA coke oven and by-product plant has been transferred to M/s. Dolvi Coke Projects Limited vide letter dated 01.02.2018. Environmental clearance (part) for the 10 MTPA slag & clinker grinding unit has been transferred to M/s. JSW Cement Limited vide letter dated 02.02.2018.

Compliance status of conditions stipulated in environmental clearance granted for expansion of Integrated Steel Plant from 5 to 10 MTPA and Power Plant from 300 MW to 600 MW (Gas Based) of M/s JSW Steel Limited at Geethapuram, Village Dolvi, Tehsil Pen, District Raigarh in Maharashtra granted by Ministry of Environment, Forest & Climate Change(MoEF&CC) vide letter no. J-11011/176/2013-IA-II(I) dated 25/08/2015

Specific Conditions:

S. No.	Condition	Compliance status
i	The project proponent should install 24x7 air and water monitoring devices to monitor air emission and effluent discharge, as provided by CPCB and submit report to Ministry and its Regional Office.	**Complying with.** As per the information provided, 22 no.s of continuous emission monitoring systems have been installed for the process stacks for monitoring of $PM_{2.5}$, PM_{10}, SO_2 & NO_X. The systems have been connected to CPCB and MPCB servers. Monitoring reports are being submitted along with the six monthly compliance reports. PA submitted that no effluent is being discharged from the plant. Treated wastewater is being reused for cooling purposes. Water balance details submitted by project are enclosed as **Annexure-2**. PA submitted that one PTZ camera will be installed as per CPCB guidelines as the project is following zero discharge.
ii	The PP should ensure treatment of effluent particularly from Blast Furnace (BF) and Coke Oven plant. The plant should be designed to meet the cyanide	**Complying with.** Biological oxidation and de-phenolisation plant has been provided for the treatment of wastewater from blast furnace and coke oven plant. Treated

	standards stipulated by MoEF&CC under EP Act 1986.	water is being reused in the process. As per the monitoring data, the cyanide levels found to be within prescribed standards.
iii	The commitment made by the PP for plantation of the green belt to the tune of 655 acres should be expedited. Three rows of green belt, 12-15 meters wide, all along the periphery of the plant should be planted.	**PA agreed to comply with.** Expansion of plants as per the environmental clearance granted vide letter dated 25.08.2015 is in progress. PA submitted that 33% green belt shall be completed in and outside premises in the next 5 years. As per the information provided 20276 trees of different species along with 530831 no.s of shrubs have been planted within and outside the project over an area of 70 ha. till date. Details are enclosed as **Annexure-3**.
iv	The CSR plan as submitted by the PP in the area of health care, rural infrastructure development, education, sports and cultural activity, Swachh Bharat Abhiyan with respect to the earlier projects and the ongoing project at Dolvi site are very slow in implementation. The CSR activities should be implemented expeditiously and simultaneously with the implementation of the project, and annual report on CSR activity should be submitted to the Ministry.	**PA agreed to comply with.** PA submitted that JSW foundation is carrying out CSR activities in the surrounding area. As per the information provided an amount of Rs.1440.26 lakhs have been spent on CSR activities from 2016-17 to till date. Details are enclosed as **Annexure-4**.
v	At least 5 % of the total cost of the project should be earmarked towards the Enterprise Social Commitment (ESC) based on local needs. The proponent should prepare a detailed CSR Plan for every next 5 years for the existing-cum-expansion project, which includes village-wise, sector- wise (Health, Education, Sanitation, Health, Skill Development and infrastructure requirements such as strengthening of village roads, avenue plantation, etc) activities in consultation with the local communities and administration. The CSR Plan will include the amount of 2% retain annual profits as provided for in Clause 135 of the Companies Act, 2013 which provides for 2% of the average net profits of previous 3 years towards CSR activities for life of the project. A separate budget head should be created and the annual capital and revenue expenditure on various activities of the Plan should be submitted as part of the Compliance Report to RO, at Bhopal. The details of the CSR Plan should also be uploaded on the company website and should also be provided in the	**Partly complied.** PA did not submit detailed time bound action plan for spending the 5% of cost of the project on CSR activities in the surrounding area. PA submitted that CSR budget of 2.5% of the project cost will be allocated for CSR activities. As per the information provided, JSW foundation is carrying out CSR activities in the surrounding area. As per the information provided an amount of Rs.1440.26 lakhs have been spent on CSR activities from 2016-17 to till date PA did not upload the CSR plan to company website.

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	Annual Report of the company.	
vi	No development should be done on the creek-ward side of the land. Land area between HTL to 100 mts or width of the creek, whichever is less, on the landward side should be kept free from any type of development.	**PA agreed to comply with.** PA submitted that development of plant is beyond 100 meter from HTL. Map showing the plant layout along with CRZ area is enclosed as **Annexure-5.**
vii	Full utilization of slag both BF and SMS should be implemented. The details should be submitted along with 6 monthly compliance reports.	**Complying with.** As per the information provided, slag generated from blast furnace is being used for cement manufacturing in the cement plant installed within the project. Part of the blast furnace slag and SMS slag is being used for landfilling within the project area. Slag utilisation details are enclosed as **Annexure-5A.**
viii	No waste water will be discharged outside the plant boundary during normal operation. In case it become necessary to discharge effluent meeting norms fit to the marine environment, permission of the relevant authority should be obtained.	**Complying with.** Wastewater is being treated in the effluent treatment plant and the treated water is being reused in the process.
ix	No untreated effluent should be reused for any process.	
x	Measures should be taken to reduce PM levels in the ambient air. Stack of adequate height & diameter with continuous stack monitoring facilities for all the stacks should be provided and sufficient air pollution control devices viz. Electrostatic precipitator (ESP), bag house, bag filters etc. should be provided to keep the emission levels below 50mg/Nm3 and installing energy efficient technologies in the Plant	**Complying with.** Electrostatic precipitators (ESP) and bag filters have been provided for controlling the particulate matter emissions from the plants. Details of air pollution control equipment are enclosed as **Annexure-6.** Continuous stack emission monitoring is being carried out for 22 process stacks. As per the monitoring data, the particulate matter levels found to be within prescribed standards. PA submitted that necessary pollution control equipment will be provided for the plants to be installed as part of expansion from 5 to 10 MTPA.
xi	On-line ambient air quality monitoring and continuous stack monitoring facilities for all the stacks should be provided and sufficient air pollution control devices. Gaseous emission levels including secondary fugitive emissions from all the sources should be controlled within the latest permissible limits issued by the Ministry vide G.S.R. 414(E) dated 30th May, 2008 and regularly monitored. Guidelines / Code of Practice issued by the CPCB should be followed.	**Complying with.** 22 no.s of continuous emission monitoring systems have been provided for the process stacks. 5 no.s of continuous ambient air quality monitoring systems have been provided for monitoring the ambient air quality within the plant. As per the monitoring data, the ambient air quality levels found to be within prescribed standards.
xii	Dust suppression system and bag filters should be installed to control the fugitive	**Partly complied.** Bag filters and scrubbers and cyclones have been

	dust emissions at conveyor and transfer points, product handling, loading and unloading points,	provided for controlling the fugitive emissions at conveyor and transfer points, product handling, loading and unloading points. However fugitive emissions generated from the vehicle movement within the plant area needs to be controlled.
xiii	Water consumption should not exceed as per the CREP standard prescribed for the steel plants. Additional water, if any, required for the plant project operations. Should be met form rainwater stored in rainwater harvesting structures.	**Complying with**. As per the information provided, water consumption is 3.21 m^3/tonne of crude steel which is less than CREP standard (5 m^3/tonne of crude steel)
xiv	Rainwater harvesting scheme should be prepared so that the rainwater can be collected, re-used and may be used for ground water recharge. The concrete drains should be de-silted and regular supervision of the areas should be carried out so that blocking of drains may be avoided for quick discharge of rainwater. Efforts should further be made to use maximum water from the rain water harvesting sources. If needed, capacity of the reservoir should be enhanced to meet the maximum water requirement.	PA submitted that as the site is located near coast and ground water level is very shallow. Hence, rain water recharge cannot be implemented. As per the information provided, roof top rain water collection systems have been provided for 12 buildings in the plant area with total collection capacity of 16898.085 cu.m. Details are enclosed as **Annexure-7**.
xv	All the effluents should be treated and reused for dust suppression/green belt development. No effluent should be discharged and 'zero' discharge should be adopted.	**Complying with**. Treated effluent is being reused in the process. Domestic wastewater is being treated in the STP and treated water is being used for greenbelt maintenance.
xvi	Full utilization of fly ash should be ensured as per Fly Ash Notification, 1999 and subsequent amendment in 2003 and 2010. All the fly ash should be provided to cement and brick manufacturers for further utilization and Memorandum of Understanding should be submitted to the Ministry's Regional Office at Bhopal.	No fly ash is being generated as the captive power plant is gas based.
xvii	Hazardous materials required during construction phase and in plant operations should be stored properly as per the regulations and reused/recycled as per the E(P)A Rules.	**Complying with**. As per the information provided, used oil, waste residue containing oil, oil filters, empty containers, chemical sludge in wastewater are the main hazardous waste being generated in the plant. MPCB granted authorisation for handling of the above hazardous waste. PA submitted that used oil and empty containers are being sold to authorised vendors. Waste residue containing oil, oil filters are incinerated in the furnace. Chemical sludge is being used as raw material in sinter plant also part of the same is being sent to Common Hazardous Waste Treatment Storage Disposal Facility.

xviii	Vehicles and construction machinery are properly maintained to minimize the exhaust emission as well as noise generation to meet prescribed standards.	**Complying with.** PA submitted that vehicles with valid PUC are being allowed to enter the project site.
xix	Risk and Disaster Management Plan along with the mitigation measures should be prepared and implemented.	PA submitted that risk & disaster management plan has been submitted to MoEF&CC, New Delhi along with EIA.
xx	All the recommendations made in the Charter on Corporate Responsibility for Environment Protection (CREP) for the Steel Plants should be implemented.	**Complying with.** CREP compliance status is enclosed as **Annexure-8.**
xxi	All the commitments made to the public during public hearing/public consultation should be satisfactorily implemented and adequate budget provision should be made accordingly.	**PA agreed to comply with.** Compliance status of commitments made during the public hearing conducted on 28.01.2014 as submitted by PA is enclosed herewith as **Annexure-9.**
xxii	All the permanent workers should be covered under ESI Scheme. The company should hive the provision for treatment of its workers at the local Nursing Homes & Hospitals in case of emergency. Annual Medical Check-up on some medical parameters like Blood test, Chest X-Ray, Eye test, Audiometry, Spirometry etc. should be conducted amongst the employees of the Company.	**Complying with.** PA submitted that health check-up of all the employees is being carried out with 6monthly and yearly frequency based on the age of the employee. Medical records are being maintained as per Factories Act. Health centre has been provided within the plant premises.

General Conditions:

S.No.	Condition	Compliance Status
i	The project authorities must strictly adhere to the stipulations made by the Maharashtra Pollution Control Board and the State Government.	**PA agreed to comply with.**
ii	No further expansion or modifications in the plant should be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).	**PA agreed to comply with.**
iii	At least four ambient air quality monitoring stations should be established in the downward direction as well as where maximum ground level concentration of PM_{10}, $PM_{2.5}$, SO_2 and NO_X are anticipated in consultation with the SPCB. Data on ambient air quality and stack emission should be regularly submitted to this Ministry including its Regional Office at Nagpur and the	**Complying with.** Five (05) continuous ambient air quality monitoring systems have been provided for monitoring the ambient air quality within the project premises. PA submitted that the location of the systems have been decided in consultation with MPCB. Monitoring systems have been connected to CPCB and MPCB servers. Monitoring data is being submitted to Regional Office along with six monthly compliance report.

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	SPCB/CPCB once in six months.	
iv	Industrial wastewater should be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19th May, 1993 and 31st December, 1993 or as amended form time to time. The treated wastewater should be utilized for plantation purpose.	**Complying with.** Wastewater generated from the plants is being treated in the effluent treatment plant. Treated water is being reused in the process. As per the monitoring data, treated water quality found to be confirming to prescribed standards.
v	The overall noise levels in and around the plant area should 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 standards prescribed under EPA Rules, 1989 viz. 75 dBA (daytime) and 70 dBA (night time).	**Complying with.** Ambient noise levels are being monitored at 5 locations within the plant. Work zone noise levels are being monitored at 45 locations. As per the monitoring data the noise levels found to be confirming to prescribed standards.
vi	Occupational health surveillance of the workers should be done on a regular basis and records maintained as per the Factories Act.	**Complying with.** PA submitted that health check-up of all the employees is being carried out with 6monthly and yearly frequency based on the age of the employee. Medical records are being maintained as per Factories Act. Health centre has been provided within the plant premises.
vii	The company should develop rain water harvesting structures to harvest the rain water for utilization in the lean season besides recharging the ground water table.	PA submitted that as the site is located near coast and ground water level is very shallow. Hence, rain water recharge cannot be implemented. As per the information provided, roof top rain water collection systems have been provided for 12 buildings in the plant area with total collection capacity of 16898.085 cu.m. Details are enclosed as **Annexure-7**.
viii	The project proponent should also comply with all the environmental protection measures and safeguards recommended in the EIA/EMP report. Further, the company must undertake socio-economic development activities in the surrounding villages like community development programmes, educational programmes, drinking water supply and health care etc.	**Complying with.** Air pollution control equipment such as ESP, bag filters, scrubbers have been provided for various plants. Continuous stack emission monitoring systems have been provided for 22 no.s of process stacks. 5 no.s of continuous ambient air quality monitoring stations have been provided for monitoring the ambient air quality within the plant premises. Wastewater generated in various plants is being treated in the ETP and treated water is being reused in the process. Slag generated in the blast furnace is being used for cement manufacturing. Green belt has been developed over an area of 70 ha. Environmental quality monitoring is being carried regularly. CSR activities are being carried out in the

		neighboring areas through JSW foundation.
ix	Requisite funds should be earmarked towards capital cost and recurring cost/annum for environment pollution control measures to implement the conditions stipulated by the Ministry of Environment, Forests and Climate Change (MoEF&CC) as well as the State Government. An implementation schedule for implementing all the conditions stipulated herein should be submitted to the Regional Office of the Ministry at Nagpur. The funds so provided should not be diverted for any other purpose.	**Complying with**. PA submitted that an amount of Rs.19705 Lakhs and Rs.58911 Lakhs have been spent for capital and operation expenditure for environmental protection measures till date. Details are enclosed as **Annexure-10**.
x	A copy of clearance letter should be sent by the proponent to concerned Panchayat, Zila Parishad/Municipal Corporation, Urban Local Body and the local NGO, if any, from whom suggestions/representations, if any, were received while processing the proposal. The clearance letter should also be put on the web site of the company by the proponent.	**Complied**. As per the information provided, copy of the EC letter has been submitted to Wadhkal, Dolvi, Sahabaj and Gadab gram panchayats. Also copy of the same has been uploaded to company website.
xi	The project proponent should upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and should update the same periodically. It should simultaneously be sent to the Regional Office of the MOEFCC at Nagpur. The respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; PM_{10}, SO_2, NO_X (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the projects should be monitored and displayed at a convenient location near the main gate of the company in the public domain.	**Complying with**. Six monthly compliance report of the project (for the period October 2017- March 2018) has been uploaded to company website. Criteria pollutant levels are being displayed at main gate of the project.
xii	The project proponent should also submit six monthly reports on the status of the compliance of the stipulated environmental conditions including results of monitored data (both in hard copies as well as by e-mail) to the Regional Office of MOEFCC, the respective Zonal Office of CPCB and the SPCB. The Regional Office of this Ministry at Nagpur / CPCB / SPCB should monitor the stipulated conditions.	**Complying with**. PA submitted six monthly compliance reports regularly since the grant of EC.

xiii	The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, should also be put on the website of the company along with the status of compliance of environmental conditions and should also be sent to the respective Regional Office of the MOEFCC at Nagpur by e-mail.	**Complying with.** PA submitted environment statement for the FY 2017-18 to MPCB. Copy of the same has been uploaded to company website.
xiv	The Project Proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the SPCB and may also be seen at Website of the Ministry of Environment, Forests and Climate Change (MoEF&CC) at http:/envfor.nic.in. This should be advertised within seven days from the date of issue of the clearance letter, at least in two local newspapers that are widely circulated in the region of which one should be in the vernacular language of the locality concerned and a copy of the same should be forwarded to the Regional office at Nagpur.	**Complied.** Advertisement regarding the grant of EC for the project has been made as per the stipulation.
xv	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.	**PA agreed to comply with.**
11	The ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.	**PA agreed upon.**
12	The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.	**PA agreed upon.**
13	The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act 1986, Hazardous Wastes (Management, Handling and Transboundary	**PA agreed to comply with.**

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	Movement) Rules 2008 and the Public (Insurance) Liability Act 1991 along with their amendments and Rules.	

Compliance status of conditions stipulated in environmental clearance granted for 3.5 MTPA Coke Oven and By-product plant- Transfer of 1.0 MTPA Coke Oven and from EC of 3 to 5 MTPA and 2.5 MTPA Coke Oven with by-product plant from EC of expansion of Integrated Steel Plant from 5 to 10 MTPA and Power Plant from 300 MW to 600 MW (Gas Based) of M/s JSW Steel Limited at Geethapuram, Village Dolvi, Tehsil Pen, District Raigarh in Maharashtra to M/s. Dolvi Coke Projects Limited granted by MoEF&CC vide letter no. J-11011/497/2017-IA.II(I) dated 01.02.2018

Ministry vide letter dated 25.08.2015 granted environmental clearance for the capacity of expansion of coke oven plant from 2.0 MTPA to 4.5 MTPA. Only 1.0 MTPA coke oven plant is in operation. Construction of 3.5 MTPA coke oven plant is in progress. Compliance status of conditions stipulated in the environmental clearance dated 01.02.2018 is already covered above as the conditions stipulated in the environmental clearance dated 25.08.2015 already contains approval for 4.5 MTPA Coke Oven Plant. Hence separate report is not prepared.

A. Suresh Kumar 26/10/17

Scientist 'D'

सुरेश कुमार अडापा
SURESH KUMAR ADAPA
वैज्ञानिक 'डी'
SCIENTIST 'D'
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
Ministry of Environment, Forest & Climate Change
क्षेत्रीय कार्यालय (पश्चिम मध्य क्षेत्र)
Regional Office (WCZ)
नागपुर/Nagpur-440001

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Summary Note

1. **Implementation of Conditions:**

Site inspection of the project has been carried out on 12.10.2018. Ministry vide letter dated 21.11.2012 granted environmental clearance for the 3.0 MTPA to 5.0 MTPA Integrated Steel Plant along with installation of Pellet Plant - 4.0 MTPA and 300 MW Captive Power Plant.

MoEF&CC vide letter dated 25.08.2015 granted environmental clearance for the expansion of integrated steel plant from 5 to 10 MTPA and captive power plant from 300 MW to 600 MW.

MoEF&CC vide letter dated 23.01.2018 amended the environmental clearance by splitting the environmental clearance granted vide letter dated 25.08.2015 into 3 parts. Environmental clearance (part) for the 3.5 MTPA coke oven and by-product plant has been transferred to M/s. Dolvi Coke Projects Limited vide letter dated 01.02.2018. Environmental clearance (part) for the 10 MTPA slag & clinker grinding unit has been transferred to M/s. JSW Cement Limited vide letter dated 02.02.2018.

ESP, bag filters, dust extraction systems have been provided for air pollution control from various plants. Continuous stack emission monitoring systems have been provided for 22 process stacks. 5 no.s of continuous ambient air quality systems have been provided for the monitoring of ambient air quality within the plant. Wastewater generated at the project is being treated in the effluent treatment plant and being reused in the process. Zero discharge is being implemented.

Following conditions were partially complied:

Specific Condition no. v:

PA did not submit detailed time bound action plan for spending the 5% of cost of the project on CSR activities in the surrounding area. PA submitted that CSR budget of 2.5% of the project cost will be allocated for CSR activities. PA did not upload the CSR plan to company website.

Specific Condition no. xii:

Bag filters and scrubbers and cyclones have been provided for controlling the fugitive emissions at conveyor and transfer points, product handling, loading and unloading points. However fugitive emissions generated from the vehicle movement within the plant area needs to be controlled.

2. **Review w.r.t. MOEFs letter dated 30.5.2012:**

The above mentioned report is prepared after site visit on 12.10.2018, for the amendment in environmental clearance granted for expansion of of Integrated Steel Plant from 5 to 10 MTPA and Power Plant from 300 MW to 600 MW (Gas Based) of M/s JSW Steel Limited at Geethapuram, Village Dolvi, Tehsil Pen, District Raigarh in Maharashtra. Compliance status is based on the observations made during site inspection.

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3. **Court Cases and show cause/closure notices:**

PA did not provide details regarding court cases, show cause/closure notices.

Consent to Operate Details:

a. MPCB granted consent to operate for Sponge Iron Plant vide letter no. Format 1.0/BO/CAC-Cell/UAN No:-NG-0000034884-17/CAC-1804000348 dated 07.04.2018 with validity upto 31.12.2022.

b. MPCB granted consent to operate for the Hot Rolled Coil, Lime, Calcinated Dolomite, Oxygen plants vide letter dated BO/EIC No. RD-2763-14/CAC-CELL/CAC-6193 dated 25.05.2015 with validity upto 30.06.2018. PA submitted application for renewal of CTO on 27.03.2018. Application is pending with MPCB.

c. MPCB granted consent to operate for Liquid metal/Pig Iron, Pulverised coal, Electric Power from Top Gas Recovery Turbine, Electric power from DG, M.P. Stream, Granulated Slag plants vide letter no. Format 1.0/BO/CAC-Cell/UAN No.0000035084-17/CAC-1804000347 dated 07.04.2018 with validity upto 31.12.2022.

d. MPCB granted consent to operate for Sinter Plants I &II vide letter no. Format 1.0/BO/CAC-Cell/UAN No.0000023804-17/CAC-1802000255 dated 07.02.2008 with validity upto 31.12.2018

e. MPCB granted consent to operate for 55 MW (gas based) power plant vide letter no. Format 1.0/BO/CAC-Cell/UAN No:-NG-0000025212-17/CAC-180300000 dated 01.03.2018 with validity upto 31.08.2022.

f. MPCB granted consent to operate for High Pressure Gaseous Oxygen, Medium Pressure Gaseous Oxygen, Medium Pressure Gaseous Nitrogen, Gaseous Oxygen, Liquid Oxygen , Liquid Nitrogen, Liquid Argon plants vide letter no. Format1.0/BO/CAC-Cell/EIC No:- RD-2781-14/CAC/CAC-7988 dated 20.07.2015 with validity upto 31.03.2019

g. MPCB granted consent to operate for Gaseous Oxygen Plant vide letter no. BO/JD(APC)/EIC No.RD-2259-12/O/CC-334 dated 19.04.2012 with validity upto 31.03.2017. No details provided regarding renewal application.

h. MPCB granted consent to operate for Calcinated Lime Plant vide letter no. BO/EIC No.RD-2993-15/CAC-CELL/CAC-2735 dated 24.02.2016 with validity upto 31.05.2018. PA submitted application for renewal of consent to operate on 10.03.2018. Application is pending with MPCB.

i. MPCB granted consent to operate for Dry Coke Plant vide letter no. Format 1.0/BO/CAC-Cell/UAN No.0000024004-17/CAC-1303000008 dated 01.03.2008 with validity upto 31.05.2022

j. MPCB granted consent to operate for Coke Drying Facility vide letter no. Format 1.0/BO/CAC-Cell/UAN No.0000024582-17/CAC-1803000001 dated 01.03.2008 with validity upto 30.06.2022

k. MPCB granted consent to operate for Billet Caster and Bar Mill vide letter no. Format 1.0/BO/CAC-Cell/UAN No.0000024109-17/CAC-1802000263 dated 07.02.2008 with validity upto 31.05.2022

l. MPCB granted consent to operate for Coke, Tar and Coke Oven Gas Recovery vide letter no. Format 1.0/BO/CAC-Cell/EIC No.RD-3105-15/CAC-2736 dated 24.02.2016 with validity upto 31.05.2017. No details provided regarding renewal application.

m. MPCB granted consent to operate for Pellet Production vide letter no. Format 1.0/BO/CAC-Cell/EIC No.RD-3100-15/CAC/CAC-11087 dated 21.08.2014 with validity upto 30.06.2018. PA submitted application for renewal of consent to operate on 24.03.2018. Application is pending with MPCB.

4. **Uploading of compliance on web site:**

With regard to uploading of EC and compliance of conditions along with analytical reports on the web site of the company, PA did not upload the copies of EC, latest compliance report, analytical reports in company website.

A. Suresh Kr 28/10/17

Scientist'D'

सुरेश कुमार अडापा
SURESH KUMAR ADAPA
वैज्ञानिक 'डी'
SCIENTIST 'D'
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्र
Ministry of Environment, Forest & Climate C
क्षेत्रीय कार्यालय (पश्चिम मध्य क्षे
Regional Office (WCZ)
नागपुर/Nagpur-440001

23/23

JSW Steel Limited

Dolvi Works: Geetapuram,
Dolvi, Taluka - Pen,
Dist Raigad - 402 107, Maharashtra, India.
CIN. : L27102MH1994PLC152925
Phone : +91 2143 277501-15
Fax : +91 2143 277533/42
Website : www.jsw.in

JSWSL/Exp ISP 5-10 MTPA/MoEFCC/2018

November 1, 2018

To

The Regional Officer (WCZ),
Ministry of Environment, Forest & Climate Change,
Ground Floor, East Wing,
New Secretariat Building, Civil Lines,
Nagpur - 440001

Sub. Certificate of compliance on Environment Clearance for Expansion of Integrated Steel Plant from 5.0 MTPA to 10 MTPA and power plant from 300 MW to 600 MW (Gas Based) of M/s. JSW Steel Ltd, Village Dolvi, Raigad District, Maharashtra.

Ref.: MoEF&CC letter vide F.No. 5-71/2015(ENV)/4529, dated 26/10/2018.

Dear Sir,

With reference to above, regarding the Compliance Certificate issued by Regional Officer, MoEF&CC, Nagpur, for the Expansion of 5 to 10 MTPA Integrated Steel Plant at JSW Steel Ltd., Dolvi, following actions were already implemented to comply the Specific Condition number 12 of the Environment Clearance, which was referred as 'partially complied' in the Compliance Certificate.

1) Three Road Sweeping Machines and four water sprinkling tankers are being operated inside the plant to control emission from non point sources. These machines work day to day to control emission from paved & unpaved roads and construction areas.
2) Open areas inside the unit are being converted in to concrete/paved areas and gardens for arresting the dust generation from the source itself.
3) All unpaved roads in new project area will be converted in paved / concrete roads of project after completion.
4) The vehicle speed inside the plant is strictly restricted to 20 kmph to avoid the emission from roads and spillage. Training is started to all drivers for speed limit inside the plant < 20 KM/Hr.

Regarding uploading of compliance on web site, we have already uploaded the copies of ECs, six monthly compliance and Environment monitoring reports on the JSW Steel Website and the screen shot is attached herewith for kind reference.

Thanking you,

Yours faithfully,
For JSW Steel Ltd

1/11/18

Dr. Anand Rai,
General Manager (Head – Environment).

Regd. Office: JSW Centre,
Bandra Kurla Complex,
Bandra(East), Mumbai - 400 051.
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000

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Environmental Clearances

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Six Monthly Env. Monitoring report from Apr 2018 to Sep 2018 for plants under JSW Steel Ltd.	Download
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Quality Policy	Download
Six Monthly EC Compliance Report - Oct 2017 to Mar 2018	Download
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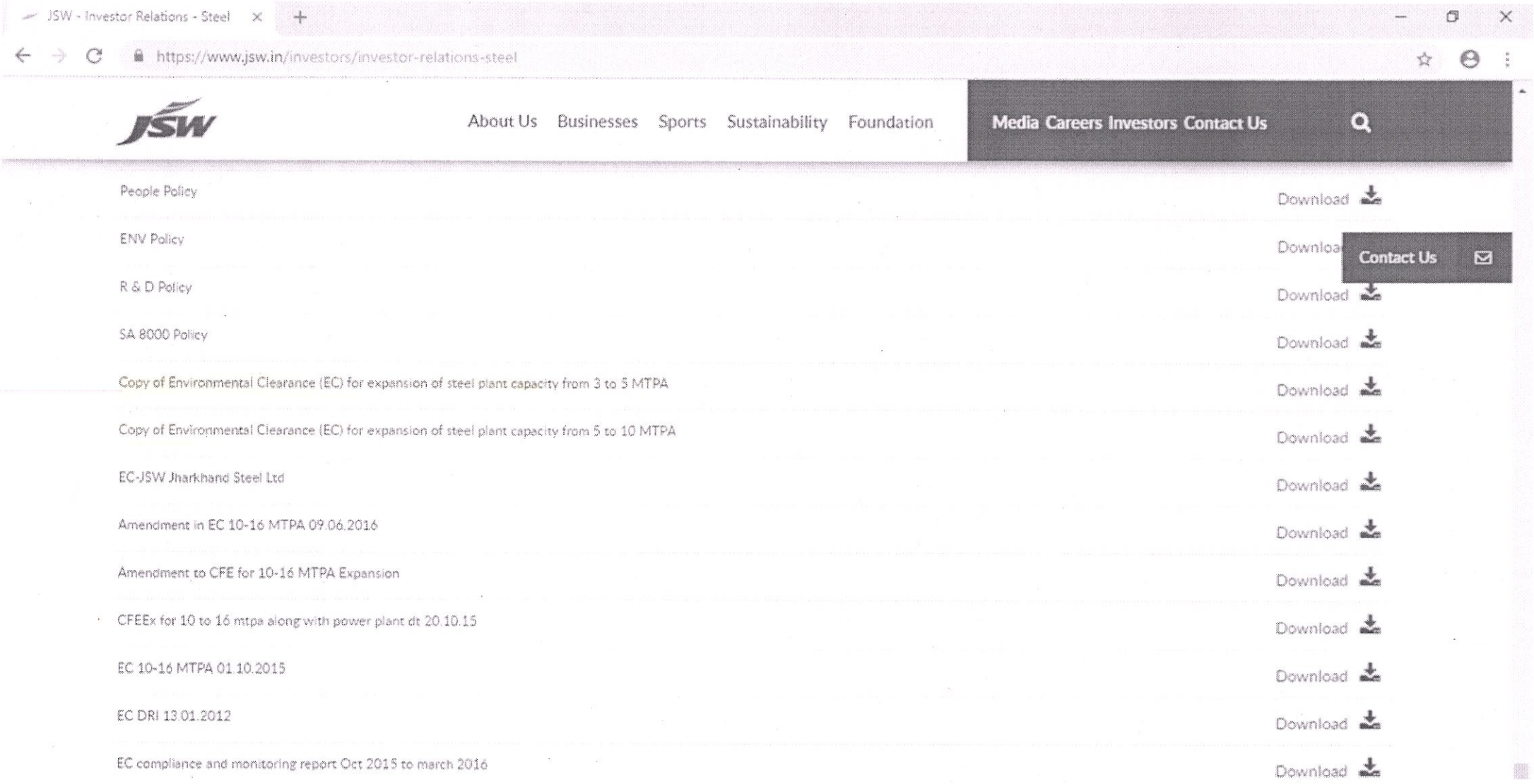
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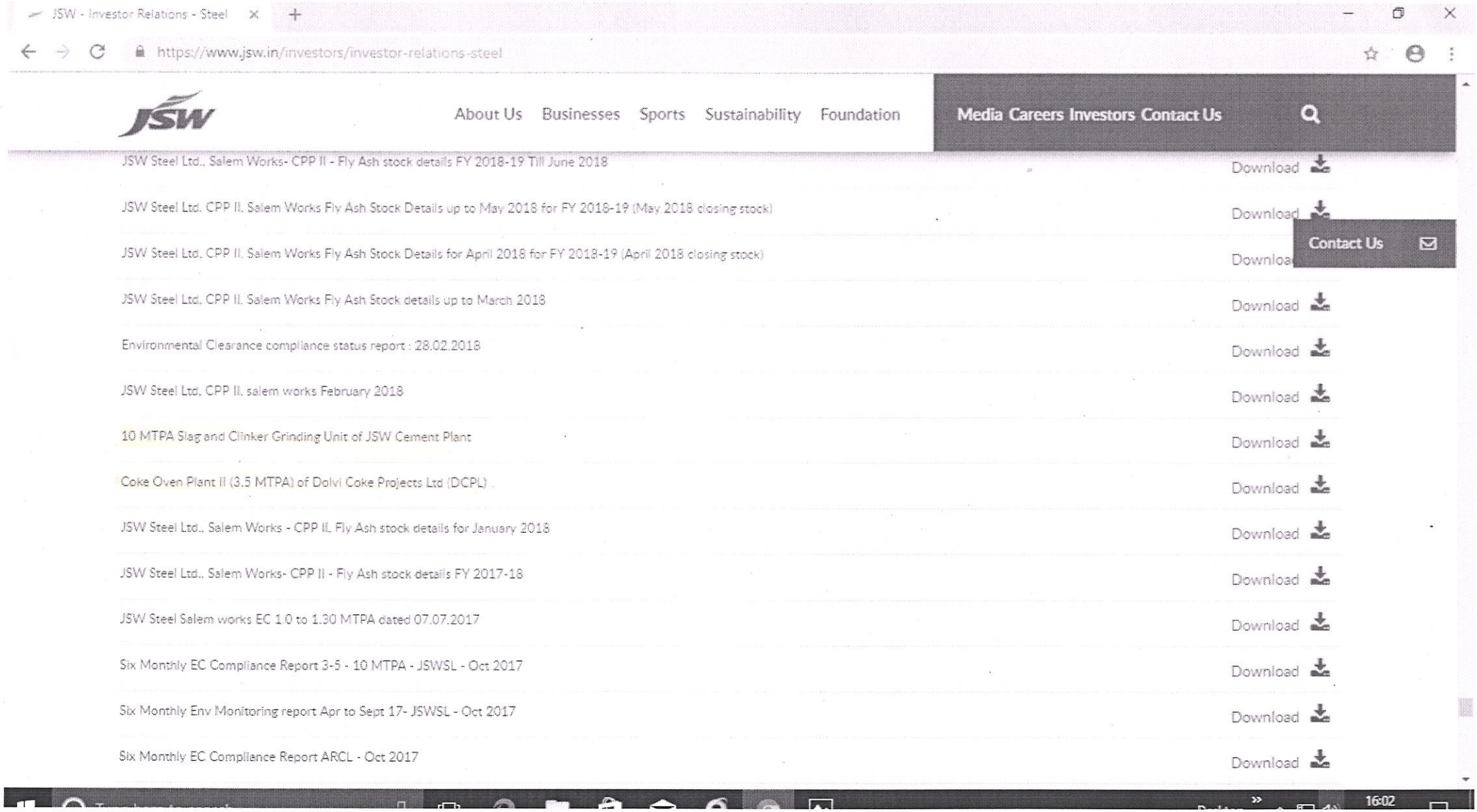
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