

CHAPTER – 4

ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 IDENTIFICATION OF IMPACTS

Various sources of pollution with respect to wastewater, the flue gas / process emission, hazardous waste and noise generation along with their qualitative and quantitative analysis as well as measures taken to control them are discussed herein with details.

4.2 PREDICTIONS AND EVALUATION OF IMPACTS

Evaluation is an absolute term used for assessment and prediction by means of numerical expression or value. Assessment is the process of identifying and interpreting the environmental consequences of the **significant actions**. Prediction is a way of mapping the environmental consequences of the significant actions.

Significant action depicts direct adverse changes caused by the action and its effects on health of biota including flora, fauna and man, socio-economic conditions, landforms and resources, physical and cultural heritage properties and quality of bio-physics surrounds.

Prediction requires scientific skill drawn from many disciplines. Prediction of ecological components is often uncertain, because their response to environmental stress cannot be predicted in absolute terms. The assessor (one who does the assessment) and decision maker (one who take the decision after adequate analysis of assessment report) is expected to be aware of the degree of uncertainty. The assessor generally uses the following methods and resources for impact assessment.

- ◆ Field surveys and monitoring
- ◆ Guideline and modeling
- ◆ Literature surveys and interviews
- ◆ Qualification and experience

An impact can be defined as any change in physical, chemical and biological, cultural and or socioeconomic environment that can be attributed to activities related to alternatives under study for meeting the project needs. Impact methodology provides an organized approach for prediction and assessing these impacts.

Impact assessment is based on conceptual notions on how the universe acts that is intuitive and/or explicit assumption concerning the nature of environmental process. In most of cases the predictions consists of indicating merely whether there will be degradation, no change or enhancement of environment quality. In other cases, quantitative ranking scales are used. The selection of indicator is crucial in assessment because impacts are identifies and interpreted based on impact indicator. An impact indicator is a parameter that provides a measure (in atleast some qualitative or numerical sense) of the significance and magnitude of the impact. In India indicator is developed by the Central Pollution Control Board (CPCB) in the form of primary water quality criteria, biological water quality criteria, and national ambient quality criteria for air and noise.

The impact of the proposed project on the environment has been considered based on the information provided by the proponents and data collected at the site. The environmental impacts have been categorized as long or short term and reversible or irreversible. Primary impacts are those, which are attributed directly by the project while secondary impacts are those, which are indirectly induced. These typically include the associated investment and changed pattern of social and economical activities by the proposed action. The operational phase of the proposed project comprises several of which have been considered to assess the impact on one or another environmental parameters.

Scientific techniques and methodologies based on mathematical modeling are available for studying impacts of various project activities on environmental parameters.

The nature of the impacts due to said project activities are discussed here in detail. Each parameter identified in proceeding chapters, is singularly considered for the anticipated impact due to various activities listed. The impact is quantified using numerical scores 0, 1, 2, 3, 4 and 5 in increasing order of activity. In order to assess the impact accurately, each parameter is discussed in detail covering the following:

- 1) Project activities like to generate impact
- 2) Quantification and prediction of impact

Minor and temporary impacts are expected due to the construction activities. All the impacts of construction phase will be short term only and it is very limited as minor construction work is anticipated for requirement of project.

Operation of the project may potential to affect quality of life, air, noise, water, land and flora, fauna and human by increase in air, noise and water pollution, by increase in hazardous waste generation, by pollution from spillage/surface run-off, by disturbance to flora and fauna, by loss of trees resulting from increased assess, by increase in land values threatening agriculture, etc.

During the operation phase, the following activities are considered significant.

- Air emission (Marginal)
- Noise generation (Minor)
- Hazardous waste generation (Minor)
- Water use and waste water discharge (Minor)
- Employment Generation (Significant)

The operation of the project will involve discharge of pollutants. There will be wastewater generation, air emissions, hazardous waste generation and mechanical noise. An assessment of the quantitative changes in the various environmental components is therefore essential for predicting the impact. Operational phase activities will have impacts, either short terms or long term and reversible or irreversible on ambient air and noise, surface and ground water, land, socio-economics and cultural environment.

4.3 AIR ENVIRONMENT

4.3.1 CONSTRUCTION PHASE IMPACTS AND MITIGATION MEASURES

Dust will be the main pollutant affecting the ambient air quality of the surrounding area during the construction phase. Motor vehicle transportation (to, from and around the site) particularly the traffic of trucks at the site, material movement into the site will introduce particulates and other exhaust gases into the local ambient air and there is some likelihood that during the construction period local air quality may be temporarily affected by these emissions. To reduce air pollution during this phase following mitigation measures shall be implemented.

- Suitable surface treatment to ease the traffic flow and regular sprinkling of water shall be carried out to control dust/fugitive emission.
- Construction material shall be stored in covered shed.
- Condition of all vehicles, generators and compressors shall be maintained and regularly serviced.

4.3.2 OPERATION PHASE IMPACTS AND MITIGATION MEASURES

The dispersion of pollutants in the atmosphere is a function of several meteorological parameters viz. temperature, wind speed and direction, mixing depths, inversion level, etc. With respect to operation phase impact, Air emission from the proposed project of M/s. Numaligarh Refinery Limited will be mainly from stack of Utility which will generate considerable amount of particulates Matter, Sulphur dioxide, Nitrogen dioxide and Carbon monoxide. Details of existing and proposed stack emission are presented in table-4.1. D. G. set will be installed as standby to be used during emergency.

4.3.2.1 ASSESSMENT OF GROUND LEVEL CONCENTRATION

A number of models have been developed for the prediction of pollutant concentration at any point from an emitting source. The Industrial Source Complex – Short Term (ISCST3) dispersion model is a steady-state Gaussian plume model. It is most widely accepted for its interpretability. It gives reasonably correct values because this obeys the equation of continuity and it also takes care of diffusion, which is a random process. For the present study, this model is used for the prediction of maximum ground level concentration (GLC).

To compute ground level concentration (GLC) due to proposed project, proposed stack, site specific and monitored details are considered as input data for the software “ISC-AERMOD View” by Lakes Environmental, Canada for prediction of impact on air environment.

Mixing Height (MH) is the vertical extent through which the contaminant plume can be mixed. Forecasting of mixing height is done with the aid of the vertical temperature profile. The MH is a function of stability. In unstable air the MH is higher and in stable air the MH is lower. With a lower MH, there is a smaller volume of air in which the pollutant can be dispersed, resulting in higher concentrations in the ambient environment. There is a seasonal variation of MH. During summer daylight hours, MH can be few thousand feet whereas for winter it can be a few hundred feet. It varies also in the course of a day. It is lowest at night and increases during the day. Secondary information has been used to determine the mixing height over the study region for the study period (Oct 2014-Jan 2015) and it varies from 100-2500 meters (As pre IMD).

Model Options Used For Computations:

- Stack tip down-wash is not considered.
- Calms processing routine is used by default.
- Simple terrain is used for computations.
- It is assumed that the pollutants do not undergo any physio-chemical transformation and that there is no pollutant removal by dry deposition.
- Washout by rain is not considered.
- Cartesian co-ordinate system has been used for computations.

The air pollution caused by the gaseous emissions from a single or small group of stacks is a local phenomenon. Its impacts will occur at a distance ranging from within the immediate vicinity of the stack to several kilometers away from the stack. Maximum ground level concentration will occur within this range. All plumes at more downwind distances from the source by stack emission become so diluted by diffusion in the ambient atmosphere, that concentrations of pollutants become negligible.

The results of maximum incremental concentration, Baseline concentration and predicted baseline concentration due to proposed project are presented in table 4.2 while values of maximum ground level concentration (24 hourly) found for different parameters are given in table-4.3. Equal concentration contour plots for the SPM, SO₂, and NO₂ are given in figure-4.1.

TABLE - 4.1 DETAILS OF EMISSION FROM STACKS

Stack No.	Stack Name	Stack Ht. (m)	Stack Dia (m)	Flue Gas Exit velocity (m/s)	Gas Temp. (K)	Emission Conc. Mg/Nm ³		
						PM	SO ₂	NO ₂
Existing								
1.	CDU Furnace	60	2.74	8.8	428	7.0	160	206
2.	VDU Furnace	60	1.88	15.6	428	7.0	160	206
3.	DCU Furnace	60	1.85	9.5	568	10.0	173	165
4.	H2U Furnace	60	2.55	9.2	503	<4	24	17
5.	HCU-1/2 Furnace	60	1.96	9.7	488	4.0	20	22
6.	HCU-3 Furnace	60	1.94	8.6	508	4.0	25	34
7.	SRU(Inc.)	60	0.914	8.76	609	9.0	37	12
8.	CCU(Inc.)	77	3	8.76	613	8.5	170	210
9.	U/Boiler	60	1.6	5.5	643	<4	20	143
10.	HRSG	60	3.5	22.2	618	<4	21	23
11.	NHT + CRU	60	1.65	6	473	5.0	15	18
Proposed								
1.	CHP	60	2.4	10	400	50	130.9*	94.7

* SO₂ emission (mg/Nm³) concentration considering actual concentration of 50 ppm (max) as provided by licensor.

FIGURE-4.1(A) SPATIAL DISTRIBUTION OF 24-HOUR AVERAGE PM CONC. - DUE TO PROPOSED PROJECT

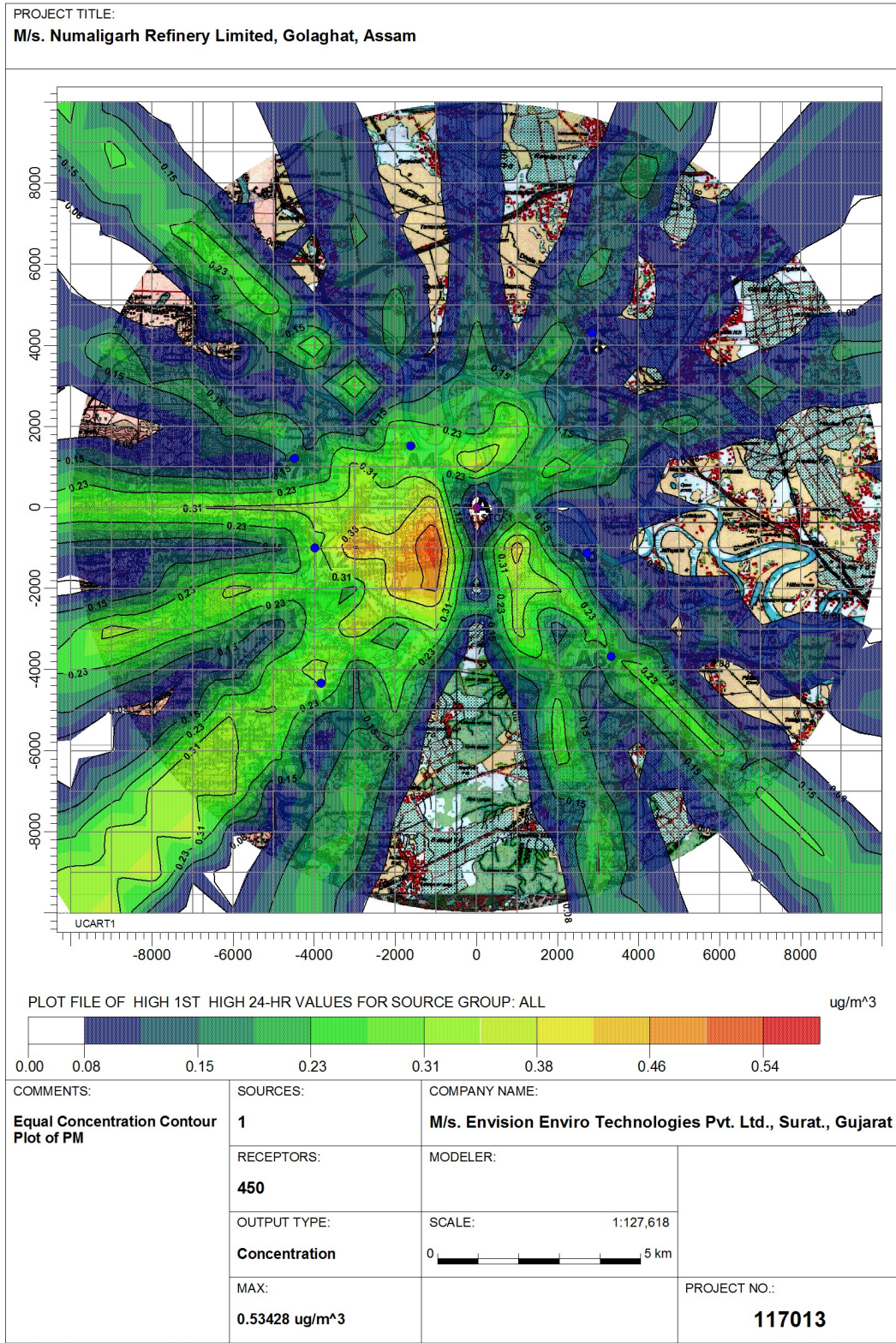


FIGURE-4.1(B) SPATIAL DISTRIBUTION OF 24-HOUR AVERAGE SO₂ CONC. - DUE TO PROPOSED PROJECT

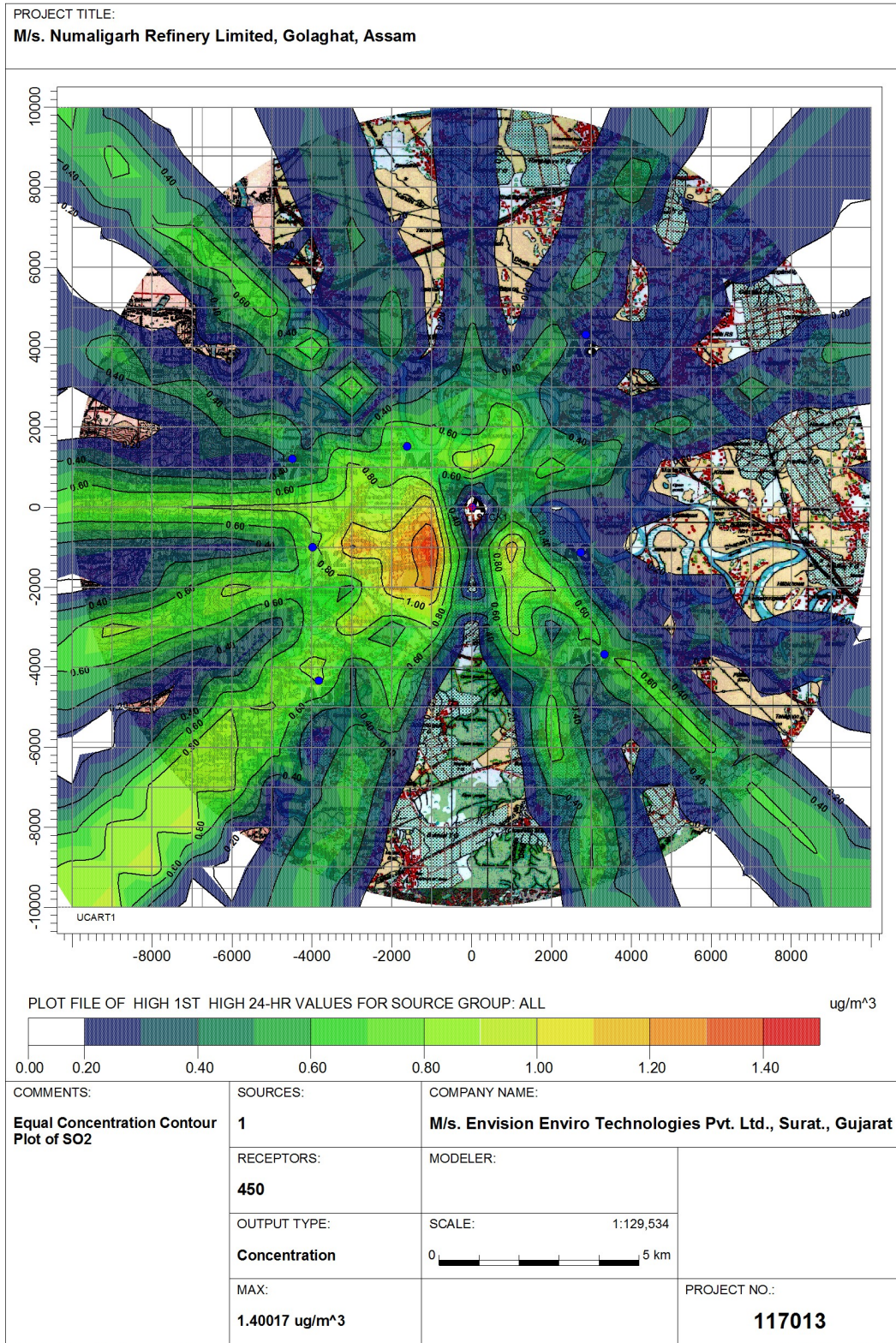
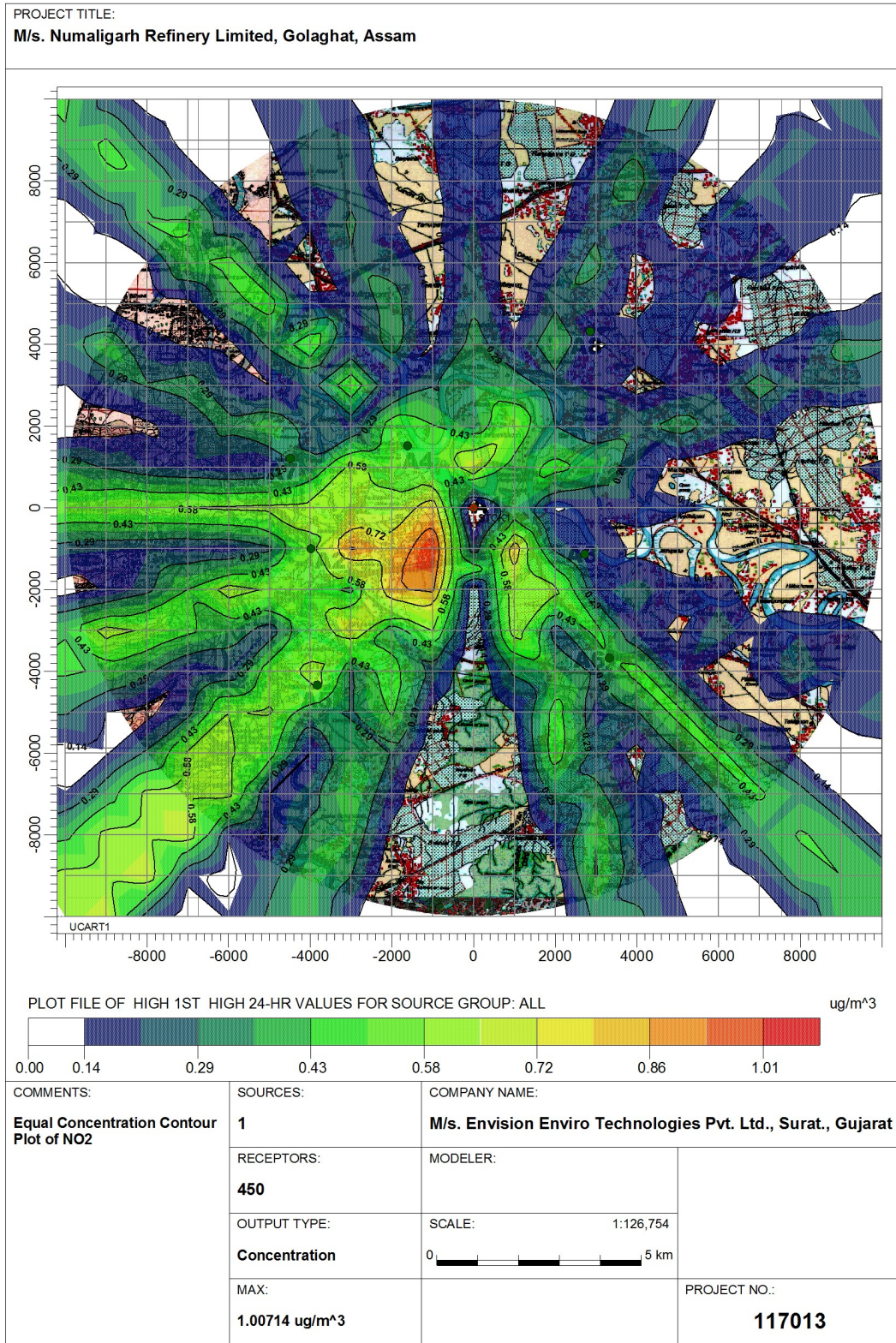


FIGURE-4.1(C) SPATIAL DISTRIBUTION OF 24-HOUR AVERAGE NO₂ CONC. - DUE TO PROPOSED PROJECT



ISC-AERMOD View - Lakes Environmental Software

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TABLE-4.2 SUMMARY OF ISCST3 MODEL OUTPUT (DUE TO PROPOSED PROJECT)

NO.	LOCATIONS	Incremental Conc. due to proposed project ($\mu\text{g}/\text{m}^3$)			Baseline AAQM Results ($\mu\text{g}/\text{m}^3$)			Predicted AAQ due to proposed project ($\mu\text{g}/\text{m}^3$)		
		PM ₁₀	SO ₂	NO ₂	PM ₁₀	SO ₂	NO ₂	PM ₁₀	SO ₂	NO ₂
1.	Near Main gate of Distillery (A1)	0.0	0.0	0.0	55.6	6.8	17.1	55.6	6.8	17.1
2.	Telgram (A2)	0.3	0.8	0.6	51.9	6.0	16.1	52.2	6.8	16.7
3.	Lattakonjan (A3)	0.1	0.3	0.2	43.5	4.6	14.6	43.6	4.9	14.8
4.	Bishnupur Village (A4)	0.3	0.7	0.5	49.3	5.1	15.1	49.6	5.8	15.6
5.	No. 3 Rong Bong Pathar (A5)	0.4	0.9	0.7	49.2	5.4	15.2	49.6	6.3	15.9
6.	Pura Bangla (A6)	0.2	0.6	0.4	52.4	5.5	15.7	52.6	6.1	16.1
7.	Numaligarh Dhaba (A7)	0.2	0.4	0.3	51.6	5.7	15.5	51.8	6.1	15.8
8.	Sankala Gaon (A8)	0.1	0.2	0.2	41.2	4.5	13.4	41.3	4.7	13.6
9.	At Agartoli village near Kaziranga Wildlife Sanctuary	0.2	0.5	0.4	32.7	4.6	13.4	32.9	5.1	13.8

TABLE-4.3 MAXIMUM GROUND LEVEL CONCENTRATION

No.	Parameters	Maximum Ground Level Concentration Due to Proposed Project	Distance and direction
1.	PM	0.5	At 1.4 km in South West direction (-1,000 m, -1,000 m)
2.	SO ₂	1.4	
3.	NO ₂	1.0	

Result and discussion: When incremental concentration due to proposed project, superimposed on existing baseline status, observed slightly increase in PM, SO₂ and NO_x concentration, but it will remain be within NAAQM standards.

4.3.2.2 CUMULATIVE IMPACT OF AIR EMISSION ON KAZIRANGA NATIONAL PARK

To identify cumulative impact of air emission from proposed Bio refinery unit along with Numaligarh Refinery on Kazairanga National Park all the existing stacks as well as proposed stack were considered and resultant concentration obtained is presented in following table-4.4.

TABLE-4.4 SUMMARY OF ISCST3 MODEL OUTPUT (DUE TO CUMULATIVE IMPACT)

NO.	LOCATIONS	Pollutants ($\mu\text{g}/\text{m}^3$)			
		PM ₁₀	SO ₂	NO ₂	
1.	Incremental Conc. due proposed biorefinery project	0.2	0.5	0.4	
2.	Baseline AAQM Results ($\mu\text{g}/\text{m}^3$)	Due to existing NRL complex	0.05	1.7	2.1
		Due to other external sources	32.65	2.9	11.3
3.	Incremental Conc. due existing NRL complex and proposed biorefinery project	0.25	2.2	2.5	
4.	Predicted AAQ due to existing NRL complex and proposed biorefinery project	32.9	5.1	13.8	

Result and discussion: Predicted concentration of PM, SO₂ and NO₂ are found 32.9 $\mu\text{g}/\text{m}^3$, 5.1 $\mu\text{g}/\text{m}^3$ and 13.8 $\mu\text{g}/\text{m}^3$ respectively, due to Cumulative impact of air emissions from proposed unit along with Numaligarh Refinery on Kaziranga National Park.

MITIGATION MEASURES SUGGESTED BASED ON AIR QUALITY MODELING:

1. Electro static precipitator as pollution control equipment will be installed to CHP plant.
2. Adequate height will be provided to the stack
3. Regular stack and fugitive emission mentoring will be carried out to ensure proper functioning of APC equipments
4. Online monitoring system will be installed to main stacks as applicable.

4.4 CONTROL OF FUGITIVE EMISSION/ODOUR POLLUTION

Fugitive emission is air pollutants released to the air other than those from stacks or vents; typically small releases from leaks in plant equipment such as valves, pump seals, flanges, sampling connections, etc. Looking to nature of the proposed project it may generate fugitive emissions during usage, handling and transportation of raw materials & finish product, following mitigation measures shall be taken to control or prevent fugitive emission.

- All the equipment and tanks in the acidic part of the process are closed and connected to a vent gas collection system.
- Leaks are eliminated by maintaining a slight vacuum inside the equipment and tanks.
- The vent vapors are collected, condensed and washed with a scrubber (e.g. a packed-bed scrubber/absorber). The condensed water and acids are returned to the process.
- Closed vent gas collection systems will be used for example drum washers or twin rolls, are commonly equipped with closed hoods.
- All treatment vessels, distillation vessel agitator and process pumps shall be mechanically sealed.
- All process pumps shall be provided trays to collect probable leakage.

4.5 WATER ENVIRONMENT

With respect to water environment three aspects are generally considered in EIA, the raw water availability, consumption and wastewater generation that will be disposed. The first priority in water quality assessment is to maintain and restore the desirable level of water quality in general.

4.5.1 CONSTRUCTION PHASE IMPACTS AND MITIGATION MEASURES

During the construction phase of the project, water requirement will be mainly for construction activities, growing plants and developing lawns as well as for domestic water requirement for the construction work force. The daily water requirement will vary based on the project activities.

All the domestic wastewater generated from the construction site will be sent to septic tank followed by soak pit, so that it shall not contaminate the ground water or surface water in the nearby areas. Thus, there would not be any significant effect on surface water quality and quantity during construction phase.

4.5.2 OPERATION PHASE IMPACTS AND MITIGATION MEASURES

During operation phase, water requirement for the proposed project shall be 93 KL/hr. Presently, raw water is sourced from Dhansiri River for existing refinery operation purposes. The additional raw water requirement of Bio-refinery will be tapped from existing refinery system which is within permissible withdrawal limit.

The company will follow zero discharge effluent concept wherein waste water from process, boiler Blow down, cooling tower blow down, etc. shall be treated in existing effluent treatment plant of Numaligarh refinery and reused for cooling tower make up, greenbelt development and dust suppression after confirming norms prescribed by Pollution Control Board. Hence, no significant impact on water environment due to the proposed activities is envisaged.

4.5.3 GROUND WATER ABSTRACTION AND ITS IMPACT ON WATER SOURCE

As stated earlier entire water requirement of proposed project will be sourced from surface water i.e. from Dhansiri River and no ground water will be utilized. Hence there will be no impact on ground water availability of the area due to proposed project.

4.6 SOIL ENVIRONMENT

The main source of impact on land and soil environment will be due to solid waste generated during construction and operation activities. In addition to this accidental spillage of chemicals and effluent can also degrade the soil environment.

4.6.1 CONSTRUCTION PHASE IMPACT AND MITIGATION MEASURES

The proposed project activity will be located on flat terrain no significant topographical change is expected due to construction activities. The construction of building will help in fixation of soil, thereby reducing the soil erosion. Some construction operations shall disturb the soil profile, but the impact will be insignificant. The plant site is suitably located considering availability of transportation, communication, residence and manpower. The project did not involve displacement of any population. Electricity, water, roads, all basic amenities and infrastructure are available at the site.

4.6.2 OPERATION PHASE IMPACT AND MITIGATION MEASURES

Main source of solid waste is boiler bed ash & fly-ash, approximately 21.6 Ton/day. Ash shall be trapped and will be utilized in fertilizer and cement production.

4.7 NOISE ENVIRONMENT

4.7.1 CONSTRUCTION PHASE IMPACT AND MITIGATION MEASURES

Noise level in and around the plant site was measured. These values represent status of Noise levels. Adequate noise control measures such as mufflers, silencers at the air inlet/outlet, anti vibration pad for equipment with high vibration, earmuff and earplugs to the operators etc. would be provided. Housing / casing shall be provided for all noise generating machines. Pump operators are generally exposed to higher noise level for short duration. The noise level within plant would be kept less than 75 dBA. Transport and communication requirement increases due to operation of a plant.

4.7.2 OPERATION PHASE IMPACT AND MITIGATION MEASURES

The main sources of noise pollution in the plant would be boiler, air blower, cooling system, diesel generator and other noise generating units. Vehicular movements during operation phase for loading/unloading of raw and finished materials and other transportation activity may increase noise level. Adequate noise control measures such as mufflers, silencers at the air inlet/outlet, anti vibration pad for equipment with high vibration, earmuff and earplugs to the operators etc. will be provided. Housing / casing will be provided for all noise generating machines. The noise level within plant is kept less than 75 dBA. Transportation and communication requirement increases due to operation of plant.

However, the proposed green belt will help to reduce noise. The adverse impact on occupationally exposed workers will not envisaged, as noise protection devices will be provided.

4.8 INFRASTRUCTURE AND SERVICES

4.8.1 Impact of existing road network:

Transport requirements will arise during the construction phase due to the movement of both the personnel and materials.

The site is well connected to direct road.

a) Transport of Personnel: Transport of the managerial personnel is likely to increase the vehicular traffic on the roads connecting the proposed site to the city. The incremental traffic for the additional people would be about 10 cars.

(b) Transport of construction materials: The transport of construction materials to the project site will result in increased traffic in the impact area. The constructions of capital intensive structures such as reactors and columns require iron and steel, heavy construction equipment and other construction materials. They will have to be transported to the site using trucks. Roughly, on an average of approximately 10 trucks per day will be needed for transporting the construction materials.

(c) Effect on local traffic due to operation phase: In existing scenario of Numaligarh refinery complex around 60 no. of trucks per hour (1,440 trucks/day) is required and due to proposed project, it will be increased by 5 trucks per/hr (120 trucks/day) for the transportation ('to and fro' movement) of raw material, finish products and other. 120 trucks/day is equivalent to 360 PCU per day considering PCU factor of 3 per vehicle will be added into existing road traffic.

Mitigation measures:

- Monitoring speed and route of project-related vehicles
- Determining safe, legal load limits of all bridges and roads that will be used by heavy vehicles and machinery.
Determining allowable traffic patterns in the affected area throughout the work week will be made based on community use, include a consideration of the large turning requirements of certain vehicles/machineries that might increase congestion and traffic hazards.
- Consolidating deliveries of materials and personnel to project sites, whenever feasible, to minimize flow of traffic.

- Minimizing interruption of access to community for use of public infrastructure
- Providing prior notice to affected parties when their access will be blocked, even temporarily.
- Preventing use of drugs and alcohol in project-sites
- Preventing possession of firearms by project-personnel, except those responsible for security.

4.9 ENVIRONMENTAL HAZARD

Raw material and finish product shall be transported by road and shall be stored in the plant premises. On site emergency plan shall be prepared for storage and handling of Ethanol and submitted to Government. This report shall be prepared with the consideration of hazards associated with the Ethanol and care should be taken for all aspects of environmental hazards. The project proponent shall consider all the safety aspects in planning, designing and operation of the plant as per standard practices. Hence, no adverse impact is anticipated. Potential impacts and mitigation measures are given in following table-4.4.

TABLE - 4.4 POTENTIAL IMPACTS & MITIGATIVE MEASURES

ENVIRONMENTAL COMPONENTS	POTENTIAL IMPACTS	SOURCES OF IMPACT	MITIGATIVE MEASURE	REMARKS
Water Quality	Deterioration of water quality	Construction activity & abstraction of water for construction requirement and sanitation in housing for workers.	Proper management of surface water runoff shall be made Effluent treatment plant (ETP) Rain water harvesting	No waste water shall be discharge outside the premises. Positive impact on ground water table
Air Quality	Increase in SO ₂ , NO ₂ , & SPM concentrations in ambient air	Process emissions, Fugitive emissions, Utility stack emissions	Adequate stack height with APC equipment and use of Control of fugitive emissions	Regular monitoring of stack will be carried out Minor adverse impacts on ambient air quality
Socio-Economic	Overall growth & development of area, increased employment, improvement in infrastructure and growth of downstream industries	Project activities	-	Beneficial Impact
Terrestrial Ecology	Minor loss of habitat-flora & fauna, Aquatic life	Project activities	Green belt, Proper, management of air emission, solid waste and liquid effluent	Insignificant impact
Noise	Increased noise level	Project operation	Noise abatement at generation point & green belt before receptor	Marginal impact
Infrastructure & Services	Improved communication, transport, housing, educational & medical facilities	Social activities of company	Development has been gradual	Beneficial impact

ENVIRONMENTAL COMPONENTS	POTENTIAL IMPACTS	SOURCES OF IMPACT	MITIGATIVE MEASURE	REMARKS
Environmental Hazards	Risk to environment & neighboring population	Handling and storage of chemicals, Ethanol & fuels	On site & off site Disaster management plan & Safe practices	Insignificant adverse impact

4.10 ECOLOGY

The impact due to construction phase and operation phase of the project and its activities on the ecological parameters like natural vegetation, cropping pattern, fisheries and aquatic life, forests and species diversity.

Ecological Impact Assessment considered the following stages:

- Identification of the likely **zone of influence** arising from the whole lifespan of the project;
- **assessment of the ecological impacts** of the project and definition of the significance of these impacts;
- Identification and evaluation of **ecological resources and features** likely to be affected
- Identification of the **biophysical changes** likely to affect **valued ecological resources and features**;
- Assessment of whether these biophysical changes are likely to give rise to a significant ecological impact, defined as an impact on the **integrity of a defined site or ecosystem**
- The **conservation status of habitats or species within a given geographical area**, including cumulative impacts;
- Refinement of the project to incorporate **ecological enhancement** measures, **mitigation measures** to avoid or reduce negative impacts, and **compensation measures** for any residual significant negative impacts;
- Provision for **monitoring** and following up the implementation and success of mitigation measures and **ecological outcomes**, including feedback in relation to predicted outcomes. (Already covered in Post Project monitoring section)

When describing changes/activities and impacts on ecosystem structure and function, reference have been made to the following parameters and presented in following table,

- Magnitude of Impact;
- Extent;
- Duration;
- Reversibility; and
- Timing and frequency.

A detail of ecological impact assessment is discussed below:

ECOLOGICAL CRITERIA	IDENTIFIED IMPACTS	ECOLOGICAL SIGNIFICANCE OF IMPACT	MAGNITUDE	DURATION /TIMING/ FREQUENCY	REVER-SIBILITY	MITI-GATION	CUMULATIVE IMPACT
Construction Phase							
Zone of Influence	Project site habitat Due to Site clearance	As the site is already occupied for the industrial purpose and privately owned, no ecological impact associated with vegetation clearing or disturbances to the existing vegetation is anticipated from this project	No impact	-	-	-	No impact
Zone of Influence	Ecological Impact Surrounding habitat due to fugitive emission	Not much impact on the surrounding habitat is envisaged due to the construction activity except some fugitive emission. The Reserve Forest located nearby may have some impact due to the fugitive emission. Dust emission during monsoon period will be very less.	In significant impact	Only during the construction activity	Reversible	As given in EMP chapter	No impact
Accessibility	Ecological Impact due to road construction	Approach road of around 50 m from nearest road will be construction to assess the project site.	In significant impact	-	-	-	No Impact
Operation Phase							
Zone of Influence	Ecological Impact on Surrounding Eco sensitive habitat due to emission from process and utility emission Major Pollutants are PM, SO ₂ , NO ₂ , and HC. The increase in GLC of PM, SO ₂ NO ₂ and CO during the operation phase.	There is no major habitat within 500 m radius from the project site. The predicted pollution load after the incremental increase is within the stipulated standard limit prescribed by CPCB for the concerned parameters.	In significant impact	-	-	Green belt development in the premises considering the predominant wind direction will further reduce the impact emission with respect to the magnitude and distance. Adequate EMP measures will be provided to the	No impact

ECOLOGICAL CRITERIA	IDENTIFIED IMPACTS	ECOLOGICAL SIGNIFICANCE OF IMPACT	MAGNITUDE	DURATION /TIMING/ FREQUENCY	REVER-SIBILITY	MITI-GATION	CUMULATIVE IMPACT
						stack attached boiler will reduce the pollution load.	
Zone of Influence	Ecological Impact on Surrounding Eco sensitive habitat due to waste water generated from the project activity. The generated waste water will be reused & recycled utilized for process, ash quenching and gardening after treatment.	No impact on the surrounding habitat are envisaged due the waste water generated from the project activity as it is utilized for process, ash quenching and gardening in the premises itself. No waste water will be disposed outside the premises. This will also reduce the ground water withdrawal meant for gardening.	No impact	-	-	ETP design and Efficiency as given in the EMP chapter	No impact
Zone of Influence	Ecological Impact on Surrounding Eco sensitive habitat due to Noise generated from the project activity	The impact on ambient noise level will be restricted only on the factory premises and may not have any significance increase in the surroundings due to the project activity	No Impact	-	-	As given in The EMP section	No impact
Conservation status of Habitat and species encountered	Impact due to the emission from the project activity	Two aquatic water bodies with ecological importance and reserve forests were observed in the study area. As the location of most of the reserve forests far away from the zone of influence of the project activity, no impact on this species is envisaged.	In significant Impact	-	-	-	-

4.11 IMPACT ON SOCIO-ECONOMIC ASPECT

Positive Impacts

- During the construction phase, the major socio-economic impact will be in the sphere of generation of temporary employment of very substantial number of personnel. Persons from nearby locality have been given preference to engaged in various types of jobs. It is understood that sufficient construction labourers (floating, if not locals) are already available in the impact area who can be utilise during the construction phase of the proposed plant.
- Due to operation phase of the proposed project, employment opportunities will be generated which will improve the local economy.
- Local community infrastructure will be improved through the proposed CSR activities.

Negative Impacts

- Due to the proposed project, impact can be assumed on human health due to marginal increase in pollution load due to industrial as well other activities.
- Increase in population/population density of the area.

Mitigation measures

- Use of adequate pollution control measures to control environmental pollution
- Regular Monitoring of environment
- people friendly CSR activities and ensure extending reach of the activities to the surrounding villages will be planned
- Possible extend local people will be employed

4.12 PLACES OF ARCHAEOLOGICAL/HISTORICAL/RELIGIOUS/TOURIST INTEREST

Deopahar archaeological site located within 6.5 km from the project site in the district of Golaghat, Assam. Deopahar known for its ancient monuments and ruins. Mythology often relates this place with the Kingdom of Jarasanda, in ancient Assam. With a total area of about 135 hectares, the region has been recently declared as a reserved forest of Assam and is one of the most famous tourist spot of the state. Due to proposed project, there will be insignificant impact on Deopahar archaeological site.

4.13 MATRIX REPRESENTATION

The parameters discussed are presented in the form of a matrix in table-4.5. The impact matrix relating to the activities during operation phase is presented.

The quantification of impact is done using numerical scores 0 to 5 as per the following criteria.

Score	Severity criteria
0	No impact
1	No damage
2	Slight/ Short-term effect
3	Occasional reversible effect
4	Irreversible/ Long-term effect
5	Permanent damage

The scores for various parameters and activities are presented in table 4.6.

4.13.1 CUMULATIVE IMPACT CHART

The total negative impact of various activities on any one parameter is represented as a cumulative score and the cumulative scores of various parameters are given in the form of a cumulative impact chart presented in table-4.7. Any particular parameter having an individual score greater than 4 or cumulative score of 20 implies serious effects due to the project and calls for suitable mitigation measures.

It is evident from the matrices that the resultant impact is beneficial to the local population and due to export (and import substitution) the resultant impact is beneficial to our country.

TABLE - 4.5 IMPACT IDENTIFICATION MATRIX (OPERATION PHASE)

Activities	Air Quality	Noise & Odor	Water Quality	Land Requirement	Infrast- ructure	Env. Hazards	Terrestrial Ecology Landuse	Socio-Economic Status	Aquatic Ecology	Resource Depletion
Water Requirement	-	-	✓	-	✓	-	-	-	✓	✓
Raw material Storage/Transport	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Raw Material Handling	✓	✓	✓	✓	✓	✓	✓	-	✓	✓
Utilities	✓	✓	-	✓	-	-	✓	-	-	✓
Effluent Discharge	✓	✓	✓	-	-	✓	-	-	✓	-
Gaseous Emissions	✓	✓	-	-	-	✓	✓	-	-	-
Fugitive Emissions	✓	✓	-	-	-	✓	✓	-	-	-
Solid & Hazardous Waste Disposal	-	-	-	-	✓	-	-	-	-	-
Product Storage/ Handling	✓	✓	✓	✓	✓	✓	✓	-	-	✓
Spills & Leaks	✓	✓	✓	-	-	✓	✓	-	✓	-
Shutdown/ Startup	✓	✓	✓	-	✓	✓	-	-	-	✓
Equipment Failures	✓	✓	✓	-	✓	✓	✓	-	-	✓
Plant Operations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Transport of Workers	✓	✓	-	-	✓	-	-	-	-	✓
Movement of Vehicles	✓	✓	-	-	✓	-	✓	-	-	✓
Housing Needs	-	-	-	✓	✓	-	✓	-	-	-
Medical & Other Needs	-	-	-	✓	✓	-	-	-	-	-
Resource Consumption	✓	✓	✓	✓	✓	✓	✓	-	✓	✓

TABLE - 4.6 ENVIRONMENTAL IMPACT MATRIX (OPERATION PHASE)

Activities	Air Quality	Noise & Odor	Water Quality	Land Requirement	Infrast- ructure	Env. Hazards	Terrestrial Ecology Landuse	Socio-Economic Status	Aquatic Ecology	Resource Depletion
Water Requirement	0	0	2	0	1	0	0	0	1	2
Raw material Storage & Handling	2	1	1	1	1	2	1	1	1	2
Utilities	2	2	0	1	0	0	1	0	0	2
Effluent Discharge	0	1	2	0	0	2	0	0	2	0
Gaseous/ Fugitive Emissions	2	1	0	0	0	1	1	0	0	0
Solid & Hazardous Waste Disposal	0	0	0	0	1	0	0	0	0	0
Product Storage/ Handling	1	2	1	1	1	1	1	0	0	1
Spills & Leaks	2	2	1	0	0	1	1	0	1	0

Activities	Air Quality	Noise & Odor	Water Quality	Land Requirement	Infrast-structure	Env. Hazards	Terrestrial Ecology Landuse	Socio-Economic Status	Aquatic Ecology	Resource Depletion
Shutdown/ Startup	2	2	1	0	1	1	0	0	0	1
Equipment Failures	2	2	2	0	1	1	1	0	0	1
Plant Operations	2	2	2	2	1	2	2	1	2	2
Movement of Vehicles	2	2	0	0	1	0	1	0	0	2
Medical & Other Needs	0	0	0	1	1	0	0	0	0	0
Resource Consumption	2	1	1	1	1	1	1	0	2	3

TABLE - 4.7 CUMULATIVE IMPACT CHART

ENVIRONMENTAL PARAMETER	TOTAL CUMULATIVE SCORE
Air Quality	19
Noise and Odour	18
Water Quality	13
Land Requirement	7
Infrastructure	10
Environmental Hazards	12
Terrestrial Ecology / Land use	10
Socio Economic Status	2
Aquatic Ecology	9
Resource Depletion	16