4.0 IDENTIFICATION AND PREDICTION OF IMPACTS

Major element involved in the process of Environmental Impact Assessment study is the identification of impacts, as it leads to other elements such as quantification and evaluation of impacts. Although, in general, a number of impacts have been identified while describing the baseline environmental status, it is necessary at this stage to identify the critical impacts that are likely due to proposed wax project at Numaligarh Refinery for various components of the environment.

Prediction of impacts is an important component in environmental impact assessment process. Such predictions are superimposed over the baseline status of environmental quality to derive the ultimate scenario of environmental conditions. The quantitative prediction of impacts lead to delineate suitable environmental plan needed for implementation during operational phase in order to mitigate the adverse impact on environmental quality.

The activities at the existing NRL complex and their impact on various environmental components like air, water, noise, land, biological and socio-economic have been assessed and evaluated in this chapter. The evaluation of impacts is done on the basis of the severity of impact on the environmental component. The impact is defined as positive if the environmental consequences of the activity are beneficial and vice versa if they are adverse. The impacts are also defined as reversible if the impacts disappear over a period of time on the ceasing of activity that caused the impact. The impacts are termed as irreversible if the environmental consequences persist in the environment even after the activity ceases. The impacts are also defined in terms of duration over which the impact is expected such as long term or short term impacts.

The evaluation of impacts on various environmental components are done for the existing activities as well as prediction of impacts for the proposed wax project also assessed and enumerated as under:

4.1 LAND ENVIRONMENT

4.1.1 Sources of Impact

In general, one or more of the following activities impart adverse impacts on the land environment:

- Handling of solid raw materials, where from fugitive solids may deteriorate the soil characteristics;
- Handling and disposal of solid wastes, which may deteriorate soil characteristics and change the physical features, drainage, etc;
- Acquisition of land, resulting into change in land use pattern;
- Disposal of liquid wastes on land, thereby deteriorating soil quality;
- Disposal of miscellaneous used/damaged materials and garbage thereby imparting negative impact on aesthetic value.
- Extraction of landfills material, thereby changing the drainage pattern.

An analysis of the above mentioned causes of impact is as follows:

- No solid raw material shall be handled in the proposed wax project and as such there is no deterioration of soil characteristics due to fugitive solids.
- Hazardous /non-hazardous waste generated, if any, due to proposed project, based on their quality, shall be suitably handled and managed complying with the provision of Hazardous Waste (Management & Handling) Rules, Sept 2008 and subsequent amendments, if any.
- The proposed wax project would be established within existing NRL premises and as such no acquisition of land is involved. Hence, there is no change in existing land use pattern.
- Since the proposed project is expected to generate minimal additional liquid effluent, it is proposed to route the same to the existing Effluent Treatment Plant.
- Used/ damaged materials shall be taken to Solid Waste Disposal Yard where they will be kept in their demarcated location. Metallic scraps would be disposed off by selling as scrap materials and the incinerable wastes would be destroyed by Incineration technique.

4.1.2 Prediction of Impacts

The impacts of the proposed facilities during operation stage are as follows:

- No solid raw material shall be used in the proposed wax project. Hence, carry-over of raw material to land or water bodies does not arise at all. Thus, no impact on land environment is envisaged during handling of solid raw material.

- The quantity of wastewater due to proposed project shall be minimal (10 m^3/hr). The waste water generated shall be treated in the existing Effluent Treatment Plant. As a measure of conservation of water, there would no discharge of treated wastewater outside NRL boundary and would be used within the NRL premises for various activities like horticulture, etc. Zero Discharge of treated effluent from NRL has been achieved since October, 2006 and would be continued. Thus, no impact due to disposal of treated wastewater is envisaged.

It is, therefore, concluded that the proposed facilities do not have any impact on land environment.

4.2 AIR ENVIRONMENT

4.2.1 Sources of Impact

The air pollution from a Petroleum Refinery on surrounding air quality would depend on designed capacity, process technology, process units, quality of crude oil, fuels used for combustion, operation and maintenance of process units and air pollution control devices installed. The severity of impacts on air environment is also governed by the surrounding terrain features and the prevailing micro-meteorological conditions in the project region. Generally, a refinery project involves besides process units, several onsite and off-site facilities viz., storage of crude oil, intermediates and marketable products, transportation of liquid/ gaseous petroleum products and their handling (loading & unloading) activities also contribute to air pollution.

The major air pollutants expected from a petroleum refinery are SO_2, NOx, SPM, CO, HCs/VOCs and H_2S in general. Out of which SO_2, NOx and PM are emitted continuously from stacks associated with various fuel combustion as well as process units. The major sources of fugitive emission are hydrocarbons and H_2S through evaporation losses from storage tanks and uncontrolled emission from process units. Such fugitive emissions are also contributed by process vents, leakages from pumps, valves and also from spillages. These are categorized as area source as they are distributed over wide area in storage tank farm and process units. Apart from stacks and fugitive sources the air environment would also get affected by automobile exhaust

emissions at the refinery due to movement of vehicles for transportation of raw material and marketable products.

4.2.2 Existing Sources of Emission

4.2.2.1 Stack Emissions from Stationary Sources

There are about twelve point sources of emission from various process units of the existing refinery viz. CDU/ VDU, H2U,DCU,HCU, MSU, SRU, CCU, Utility and HRSG Boilers.The continuous emissions from these sources shall have their impacts on surrounding air environment depending on the fuel used and meteorological conditions. Among the continuous emissions from various stacks, SO_2 will be of prime concern as it is emitted in large quantity depending on the type of fuel used and is followed by emission of NOx. The main pollutant to be considered is hydrocarbons due to evaporation losses. Some amount of particulate matter (PM) is also emitted through the stack of utility boiler. The details of existing stack emissions at NRL are as given in the Table - 4.1 hereunder:

TABLE- 4.1
Details of Existing Stack Emissions

Sl. No.	Process Units	Stack Height (m)	Tip ID (m)	Flue Gas Temp. (^{0}K)	F/Rate Nm^3/hr	Exit Velocity m/s	Conc., mg/Nm^3			
							PM	SO_2	NOx	CO
1	CDU/VDU	60	2.74	428	128900	8.80	42	255	83	28.6
2	DCU	60	1.85	495	54900	9.50	48	136	75	27.4
3	H2U	60	2.55	573	87200	9.20	53	93	27	26.3
4	HCU-1/2	60	1.96	478	65100	9.70	10	46	216	28.9
5	HCU-3	60	1.94	428	63200	8.60	47	124	147	23.3
6	SRU(Inc.)	60	0.91	550	11100	8.76	10	2723	50	25.6
7	CCU(Inc.)	77	1.75	473	47400	8.76	88	192	356	30.5
8	U/Boiler	60	1.6	393	120800	5.50	51	150	306	24.8
9	HRSG	60	3.5	358	157100	22.20	94	192	356	22.3
10.	MSU	60	1.2	473	15300	6.00	10	48	238	40.1

4.2.2.2 Fugitive Emissions:

The fugitive emissions from different storage tanks at Numaligarh Refinery are mentioned hereunder:

TABLE- 4.2
Details of Hydrocarbon Emissions from Storage Tanks

Sl. No	Source	No. of tanks	Capacity (m^3)	Type	Size (Dia. X Height) in m	HC Emission Rate (g/s)
1	Crude oil	4	50,000	FR	70.0x 14.4	0.0003
2	Naphtha	3	15,400	FR	40.0x13.5	0.091
3	ATF	3	1,750	Fixed & FR	18.0x10.0	0.031
4	Kerosene (SKO)	3	23,100	FR	48.0x14.4	0.233
5	HSD	3	21,500	FR	45.0x14.5	0.0024
6	Fuel oil	3	1100	CR	13.0x9.2	0.020
7	Vac. Res.	2	7,800	CR	20.0X11.2	0.0007
8	RCO	2	7,860	CR	29.0X12.0	0.107
9	Vac. Dist.	2	12,800	CR	34.0x14.0	0.002
10	Cok. Dist.	2	2,800	CR	19.0x10.0	0.037
11	Wet Slop	2	300	CR	8.0x6.0	0.006
12	Dry Slop	3	2,600	FR	20.0x10.0	0.012
13	MS-NRMT	1	700	FR	1.3x9.2	0.104
14	Isomerate	2	5,000	FR	25.5x11.0	0.021
15	Reformate	2	5,000	FR	25.1x11.0	0.006
16.	MS-NRMT	3	3000	FR	25.5 x11.0	0.043

Note: **FR -** Floating Roof
CR - Cone Roof

4.2.3 Sources of Emission from Proposed Wax Project

4.2.3.1 During Construction Phase

During the construction phase, land preparation and civil construction activities will lead to generation of dust. Installation of equipment and mechanical fabrications will also lead to generation of gaseous pollutants mainly from the exhausts of earthmovers and other construction equipment. However, these activities will be for a limited period and will be confined within boundary walls.

4.2.3.2 During Operation Phase

4.2.3.2.1 Stack Emissions from Stationary Source

Only one stack has been proposed for operation of the proposed wax project. This stack will be attached to fuel gas fired heater having design capacity of 2.4 MMKcal/hr. The details of the process emissions from the proposed stack are estimated as under:

Table – 4.3

Proposed Emissions from Fuel Gas Fired Heater

Stack Height	:	60-meters
Material of Construction	:	MS
Shape of Stack	:	Circular
Fuel to be used in the heater	:	Fuel Gas
Fuel Gas Feed Rate	:	240 Kg/hr
Volumetric flow rate, Nm^3/h (approx.)	:	50,000
Exhaust gas temperature, °C	:	150
Concentration of pollutants, mg/Nm^3		
- SO_2	:	5.0
- NOx	:	30
- CO	:	50
Mass Emission rate, Kg/hr		
- SO_2	:	0.25
- NOx	:	1.5
- CO	:	2.5

On the basis of the only stack emissions from the proposed unit, it is observed that the quantity of pollutants discharged in environment is negligible and the resultant concentrations will remain well below the prescribed norms given in Table-4.4.

4.2.3.2.2 Fugitive Emissions

Fugitive emissions originate from static and dynamic equipment joints and seals used in flanges, pumps, valve packing and connection joint. The main sources of fugitive emissions are:

a) HVGO Tank
b) MVGO Tank
c) Methanol Tank
d) MIBK Tank

It is envisaged that the rate of fugitive emission will be negligible and it would not impart any significant negative impact on air environment.

CONCLUSION

It is envisaged that due to operation of proposed wax project, the ambient air quality will remain practically unaffected and the concentration of pollutants shall remain well within the stipulated standards for Industrial Areas. It is, therefore, concluded that the proposed wax project will have only marginal impact on the ambient air quality and it will remain under assimilating and buffering capacity of the environment.

4.2.4 Emission Standards

4.2.4.1 Emission Standard for Furnace & Boilers

Table-4.4

Emission Standard

Parameters	Fuel Type	Concentration in mg/Nm^3	
		Existing Refineries	New Refineries
Sulphur Dioxide (SO_2)	Gas Firing	50	50
	Liquid Firing	1700	850
Oxides of Nitrogen (NOx)	Gas Firing	350	250
	Liquid Firing	450	350
Particulate Matter	Gas Firing	10	5
	Liquid Firing	100	50
Carbon Monoxide	Gas Firing	150	100
	Liquid Firing	200	150
Nickel + Vanadium	Liquid Firing	5	5
H_2S in fuel gas	-	150	150
Sulphur content in liquid fuel, Weight %	-	1	0.5

4.3 WATER ENVIRONMENT

The total water requirement for entire NRL, Marketing Terminal, NRL Township, LPG Bottling Plant and CISF Colony is met from water intake well which is located on the bank of Dhansiri River. This river is a tributary of the river Brahmaputra and is flowing merely at a distance of about 3-kms from Numaligarh Refinery. Dhansiri river is a perennial river with fairly large flow rate of about 2,15,000 m^3/hr. NRL is the only major industrial user of this water. This water is also used for agricultural purpose. There is no competing user other than NRL.

4.3.1 Water Consumption

The water consumption as well as the water balance of Numaligarh Refinery may be summarized as under:

Table-4.5
Details of Water Consumption

Sl. No.	Description of Plants / Utilities	m^3/day (avg.)
01	DM Water Make up	5013
02	Service Water	1669
03	Drinking Water (Refinery)	383
04	Drinking Water (NRL Township)	1922
05	Drinking Water (NRMT/CISF)	515
06	Cooling Water Make-up	1308
07	Treated Water in Storage Tanks	977
	Total	**11787**

Additional Water requirement for proposed wax project has been estimated to be 1440 m^3/day or 60 m^3/hr. to meet all process requirements including DM water, cooling water, service water systems, etc. After implementation of proposed wax project , total fresh raw water requirement would be as follows:

Table-4.6
Details of Water Requirement

Existing Requirement	:	16,054 m^3/day
Additional Water requirement for proposed Wax Project	:	1,440 m^3/day
Total water requirement after proposed wax project	:	17,494 m^e/day

Consent for drawing from Intake well is 1200 m^3/hr whereas the present drawl of water is about 670 m^3/hr. Total water drawl after the proposed project shall be about 730 m^3/hr. This additional water requirement is insignificant compared to the current rate of drawl from Dhansiri river.

4.3.2 Wastewater Generation

Wastewater generation from different sources of NRL may be divided into three main streams as under:

1) Oily Waste water Stream (OWS)
2) Contaminated Rain Water Stream (CRWS)
3) Storm Water Stream

The OWS comprises stripped water, floor wash, process condensate, etc. CRWS comprises cooling tower blowdown, boiler blowdown, DM plant rejects, etc. NRL has comprehensive waste water treatment and management facilities. The design capacity of existing ETP is 220 m^3/hr.

The total waste water generation has been recorded as 2640 m^3/day on an average (around 110 m^3/hr), which includes contaminated oily waste water, sanitary waste water and clean stream. The wastewater generation from different sources is being segregated into Clean Stream of wastewater comprises of de-sludging at raw water treatment plant, DM Plant, Boiler Blowdown, Cooling Tower Blowdown etc.. Oily Wastewater Stream (OWS) comprises of desalter effluent, stripped sour water, process steam condensate, floor washings etc. Contaminated Rain Water Stream (CRWS) comprises of oily effluents including sanitary wastewater etc. Details of existing wastewater generation may be summarized as under:

Table-4.7

Details of Existing Wastewater Generation

Sl. No.	Source	m^3/day
01.	Oily Water System (OWS)	1215
02.	Contaminated Rain Water System (CRWS)	713
03.	DM Plant	422
04.	CT Blow Down	290
	Total Waste Water Generation	**2640**

Thus, the present capacity utilization of existing ETP is about 50%.

4.3.2.1 Wastewater Generation from proposed Wax Project

The estimated wastewater generation from proposed Solvent De-waxing/ De-oiling Unit is summarized as under:

Source	Rate, m^3/hr	Continuous/ Intermittent	Destination
Azeotrop Column	3.1 (Normal) 5.0 (Max.)	Continuous	OWS
Floor Washings	5.0	Intermittent	OWS
Total	**8.1 m^3**		OWS

4.3.2 Prediction of Impacts

During Construction Phase

The water demand during the construction phase will be met through the existing source within the Numaligarh Refinery complex and not likely to have impacts on other users.

Operation Phase

Additional raw water requirement is envisaged to be about 60 m^3/hr and will be drawn from the existing source of raw water supply system from Dhansiri River which is having surplus water reserve and perennial in nature.

Impacts Due to Storage /Transfer of Waste Water

The wastewater generated in the plants are transferred through pipelines and collected in lined tanks and guard pond. Thus, impact on ground water system through seepage of contaminated wastewater into the aquifer is not envisaged. As the concentration of contaminants is below limiting concentrations, no impact on ground water quality is envisaged.

Impact due to additional water requirement

Raw water as well as potable water requirement of the plants and residential complex is met from Dhansiri River. Since there is no drawl of ground water, any impact on ground water due to proposed project is ruled out.

Impact due to discharge of effluents

The waste water generation shall be insignificant and is about 8.1 m^3/hr. The existing ETP is having adequate capacity of 220 m^3/hr. As a measure of conservation of water, Zero Discharge of treated effluent has been achieved since October, 2006. Further, zero discharge of effluent from sewage treatment plant, which had been achieved since April, 2007, is sustained till date. Hence, no effluent will flow from either refinery or township to Dhansiri River. Thus, impact due to discharge of effluents is completely ruled out.

4.4 SOLID/ HAZARDOUS WASTE

4.4.1 Existing Facilities

Major categories of hazardous waste generated from NRL refinery may be summarized as under:

a) Slop Oil from process units and marketing terminal
b) Spent catalysts from process units
c) Oily sludge from ETP
d) Spent Resin

Slop Oil: Slop oil is generated from different process units and during blow down of any vessel or equipment and sent to ETP for treatment/recovery and then slop oil is transferred to Slop Tank for reprocessing.

Spent Catalysts: The generation of spent catalyst is not regular. Generally, it is replaced once in two to five years.

Sludge: Three types of sludge are generated at NRL namely oily sludge, chemical sludge and biological sludge.

Spent Resin: Generation of spent resin is not regular. Generally, it is replaced once in five to seven years.

4.4.2 Proposed Facilities

Identification of Wastes

The hazardous wastes from the proposed facilities are envisaged as Methyl Iso-butyl Ketone (MIBK) and spent catalyst. MIBK would be used as a solvent in the proposed project for de-waxing/ de-oiling of Paraffin Wax and Semi Micro Crystalline Wax. It would be recycled in the process till it remains active. However, the spent solvent (MIBK), if any, shall be routed to existing ETP. It is also envisaged that about 21.0 MT

of spent catalyst would be generated in every five years. This quantity appears to be insignificant in comparison to the existing generation of spent catalysts. The spent catalyst would be disposed off through CPCB approved recyclers.

4.4.3 METHYL ISOBUTYL KETONE (MIBK)

Methyl isobutyl ketone is used as a solvent for gums, resins, paints, varnishes, lacquers, nitrocellulose, etc. Acute (short-term) exposure to methyl isobutyl ketone may irritate the eyes and mucous membranes, and cause weakness, headache, nausea, lightheadedness, vomiting, dizziness, incoordination, narcosis in humans. Chronic (long-term) occupational exposure to methyl isobutyl ketone has been observed to cause nausea, headache, burning in the eyes, weakness, insomnia, intestinal pain, and slight enlargement of the liver in humans. Lethargy and kidney and liver effects have been observed in rats and mice chronically exposed by gavage (experimentally placing the chemical in the stomach), ingestion, and inhalation. EPA has classified methyl isobutyl ketone as a Group D, not classifiable as to human carcinogenicity.

PROPERTIES:

Chemical Formula	$(CH_3)_2CHCH_2COCH_3$
Characteristics	Watery liquid Colorless Mild pleasant odor. Floats and mixes slowly with water. Flammable, irritating vapor is produced.
Emergency Actions	Keep people away. Shut off ignition sources and call fire department. Stay upwind and use water spray to ``knock down'' vapor. Avoid contact with liquid and vapor. Notify local health and pollution control agencies.
Fire Hazard/ Response	FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, alcohol foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.
Exposure Hazard/ Response	CALL FOR MEDICAL AID. VAPOR: Irritating to eyes, nose and throat. If inhaled, will cause dizziness or loss of consciousness.

	Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID: Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.	
Corrective Response Actions	Dilute and disperse Stop discharge Contain Collection Systems: Skim	
Health Hazards	**Personal Protective Equipment** Organic canister or air pack; rubber gloves; goggles or face shield. **Symptoms Following Exposure** Vapor causes irritation of eyes and nose; high concentrations cause anesthesia and depression. Liquid dries out skin and may cause dermatitis; irritates eyes but does not injure them. **Treatment Of Exposure** INHALATION: remove to fresh air, give artificial respiration if needed; call a doctor. SKIN OR EYES: wash eyes thoroughly with water; wash skin with water until irritation stops.	
	TLV-TWA : 50 ppm **TLV-STEL : 75 ppm** **Immediately Dangerous To Life And Health Value (IDLH) : 500 ppm**	
	Chronic Toxicity : None **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.	
Fire Hazards	**Flash Point**	73 deg.F C.C.; 75 deg.F O.C
	Flammable Limits In Air	1.4%-7.5%
	Behavior In Fire	Vapors may travel a considerable distance and ignite
	Ignition Temperature	854 deg.F
	Electrical Hazard	Class I, Group D
	Fire Extinguishing Agents	Alcohol foam, dry chemical, or carbon dioxide
	Fire Extinguishing Agents Not To Be Used	Water may be ineffective
	Special Hazards Of Combustion Products	Irritating vapors are generated when heated
Chemical Reactivity	**Reactivity With Water :** No reaction **Reactivity With Common Materials** : No reaction **Neutralzing Agents for Acids and Caustics:** Not pertinent **Polymerization:** Not pertinent **Stability During Transport :** Stable	
Hazard Classification	**EPA Pollution Category : D**	
Hazard Classification	**Health Hazard (Blue) : 2** - Materials which on intense or continued exposure could cause temporary incapacitation or	

	possible residual injury unless prompt medical treatment is given. **Flammability (Red):** 3 - Liquids and solids that can be ignited under almost all ambient temperature conditions. **Reactivity (Yellow):** 0 - Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.	
Physical & Chemical Properties	**Physical State At 15 Degrees C and 1 ATM**	Liquid
	Molecular Weight	100.16
	Boiling Point at 1 ATM	241.2 ^{0}F = 116.2 = 389.4 ^{0}K
	Freezing Point	-119 ^{0}F = -84 ^{0}C = 189 ^{0}K
	Critical Temperature	568.9^{0}F= 298.3^{0}C= 571.5^{0}K
	Critical Pressure	475 psia = 32.3 atm = 3.27 MN/m^2
	Vapor (Gas) Specific Gravity	Not pertinent
	Freezing Point	-119 ^{0}F = -84 ^{0}C = 189 ^{0}K
	Critical Temperature	568.9^{0}F= 298.3^{0}C= 571.5^{0}K
	Critical Pressure	475 psia = 32.3 atm = 3.27 MN/m^2
	Vapor (Gas) Specific Gravity	Not pertinent
	Specific Gravity	0.802 at 20 ^{0}C (liquid)
	Liquid Surface Tension	23.6 dynes/cm = 0.0236 N/m at 20 ^{0}C
	Liquid Water Interfacial Tension	15.7 dynes/cm = 0.0157 N/m at 22.7 deg.C
	Ratio of Specific Heats Of Vapor (Gas)	1.061
	Latent Heat of Vaporization	149 Btu/lb = 82.5 cal/g = 3.45 X 10(5) J/kg
	Heat of Combustion	(estimated) -10,400 Btu/lb = -5,800 cal/g = -242 X 10(5) J/kg
	Heat of Decomposition	Not pertinent
	Heat of Solution	(estimated) -9 Btu/lb = -5 cal/g = -0.2 X 10(5) J/kg

Safety in Use

Air levels should be kept as low as practicable using suitably designed plant and engineering controls, such as local exhaust ventilation. Respiratory protection should be readily available for use in enclosed spaces, and for certain maintenance operations. Self-contained breathing apparatus should be available for use in emergencies. Skin and eye protection is recommended, when exposure to liquid MIBK is likely to occur.

4.5 NOISE ENVIRONMENT

4.5.1 Sources of Noise

Major noise sources of the proposed project are moving/ rotating equipments like Air Compressors, Feed Pumps, ID Fans, Cooling Towers, FD Fans, etc.

4.5.2 Sound Propagation

Sound propagation from a source to a receiver depends upon the properties of the atmosphere and the presence of any object or barrier in the transmission path. The sound pressure level generated by a noise source decreases with increasing distance mainly due to wave divergence. There is an additional decrease, called excess attenuation, in sound pressure level, with distance from the source due to atmospheric effects or interference with objects in the transmission path.

For a sound source of strength Lw, located above a flat rigid surface, the radiation pattern is approximately hemispherical, and the sound pressure level, Lp, at a distance r from the source is expressed by

$$Lp = Lw - 20 \log r - Ae - 8 \quad \text{------} \quad (1)$$

Often, the sound power of a source is not known, but the sound pressure level Lp1 at a distance r1 from the source is known. The sound pressure level Lp2 at a distance r2 from the source can then be calculated from the equation:

$$Lp2 = Lp1 - 20 \log r2/r1 - Ae1,2 \quad \text{--------} \quad (2)$$

Where Ae1, 2 is the excess attenuation along the path r2-r1 between observers 1 and 2. In environmental noise assessment, Eqn (2) is of more general use since the sound power of a source is seldom known.

4.5.3 Multiple Sound Sources

In environmental noise problems, generally more than one noise sources are encountered, and the total noise at an observer's location due to all the sources is to be evaluated. Since the sound pressure level is logarithmic, decibel values are not additive. To determine the resultant dB level, it is necessary to convert decibel values to sound pressures, add these pressures, and then reconvert the resultant ratio to the decibel value.

4.5.4 Prediction of Impacts

For prediction of noise level in the area surrounding the plants, a maximum noise level of 90 dB has been considered. The distances of boundary walls from the proposed facilities are as under:

Table-4.9

Name of Plants	Maxm. Noise Level dB(A) expected to be generated	Distance w.r.t. boundary walls, m			
		N	S	E	W

Crude Distillation unit (CDU)	90	560	720	1360	1240
Hydrocraker unit (HCU)	90	640	640	1600	1120
Hydrogen unit (H_2U)	90	680	580	1280	1160
Sulphur Recovery unit (SRU)	90	960	360	1000	1440
Captive Power Plant (CPP)	90	880	360	1480	920

For attenuation by the green belt, the width of the green belt has been considered as 50-m. In view of these considerations, the resultant noise levels at the middle of the boundary walls of four sides have been estimated as follows:

Table-4.10

Name of Plants	Noise Levels, dB(A) at Boundary Walls			
	N	S	E	W
Crude Distillation unit (CDU)	44.6	42.4	36.9	37.7
Hydrocraker unit (HCU)	43.4	43.4	35.5	38.6
Hydrogen unit (H_2U)	42.9	44.3	37.4	38.3
Sulphur Recovery unit	39.9	48.4	39.5	36.4
Captive Power Plant	40.7	48.4	36.1	40.3
Cumulative Noise Level	51.0	53.2	44.2	45.4
Attenuation (Green Belt)	2.9	2.9	2.9	2.9
Net Cummulative Noise	48.1	50.3	39.3	42.5
Existing Noise Level at boundary wall				
- Day Time	50	48	53	50
- Night Time	45	42	45	45
Resultant Noise Level				
- Day Time	52.1	52.4	53.2	50.7
- Night Time	49.9	50.9	46.0	47.0

In view of the calculations made above, the resultant noise level at boundary locations may be summarized as under:

Table-4.11

Sl. No.	Location	Noise level, dB(A)			
		Existing		Resultant	
		Day Time	Night Time	Day Time	Night Time
01.	Northern Boundary	50.0	45.0	52.1	49.9
02.	Southern Boundary	48.0	42.0	52.4	50.9
03.	Eastern Boundary	53.0	45.0	53.2	46.0
04.	Western Boundary	50.0	45.0	50.7	47.0

It is, therefore, concluded that the existing noise level near the boundary walls will slightly increase during day time whereas during night hours, there is negligible increase in existing noise level. Thus, insignificant impact on the noise level is foreseen.

4.6 IMPACT ON ECOLOGY

4.6.1 Terrestrial Ecology

The impact of proposed wax plant on the vegetations in the study area may occur through two ways:

- Clearing of vegetative cover for setting up new facilities
- Effects on terrestrial ecosystem due to stack emissions.

Impact on Flora

The area earmarked for proposed project is located within premises of existing refinery. The site bears a barren look and is devoid of any vegetation. Maintaining/ strengthening of existing green belt around NRL complex will have positive impact on flora.

At present the floristic component of the area does not consist of any rare or endangered species. Thus impact on rare and endangered species of flora is not envisaged. The emission of gaseous pollutants from proposed facilities is expected to be well within buffering capacity of the micro-environment.

Impact on Fauna

As the proposed project does not envisage destruction or displacement of any fauna species, direct adverse impact on fauna is ruled out.

The project proposal does not envisage cutting of trees. The existing green belt provides habitat, food and breeding area to birds, small animals and inspect. Thus, a significant positive impact is envisaged.

4.6.2 Aquatic Ecology

The liquid effluent from the proposed plants shall be suitably treated in existing ETP and shall be reused in the operational activities like CT filter backwash, greenbelt, fire fighting system, etc. No effluent is being discharged nor shall be discharged to any outside source. There is zero discharge of effluent from NRL complex since 2006. Thus, no impact on the aquatic ecology from the proposed facilities is foreseen.

4.7 SOCIO-ECONOMIC ENVIRONMENT

The impact on socio-economic environment shall be of varied nature and may be summarized as under:

- The proposed project would generate direct and indirect employment during construction phase. It is envisaged that about 200 to 300 manpower would be

required in construction and transportation activities, supply of materials, auxiliary and ancillary works. Majority of the work force required during construction period shall be engaged from local population. As such it is envisaged there would not be any impact on existing demographic profile.

- There will not be any considerable stress on the existing local infrastructure facilities as the number of persons to be engaged by NRL during and after construction shall be marginal and they can be accommodated in the existing township.
- The proposed project has favourable ranking by majority of the local people and is looked upon as a step towards further development of the area.
- The paraffin wax and micro-crystalline wax is valuable product and has wide range of application in industries such as Tyre and rubber, candles, adhesives, corrugated board, cosmetics, casting and a host of others. This will encourage small scale entrepreneurs to use this as raw material. Thus, the proposed project would generate indirect employment in neighboring areas.
- During construction phase, there may be marginal strain on civic amenities such as drinking water, sanitation, road transport and other facilities to meet the requirements of work force. This impact would be marginal and for a very short duration.

4.7.1 IMPACT ON TRANSPORT & COMMUNICATION

Major portion of raw materials and finished product will be transported through pipeline/ road and rail. The National Highway No-39, connects Guwahati and Dimapur, has adequate capacity to sustain the increased load on road traffic. No new road transportation facilities are envisaged as existing facilities are adequate to meet the requirement for road transportation. Thus, no adverse impact on transport and communication system is foreseen.

4.8 ENVIRONMENTAL IMPACT STATEMENT

Land Environment: No negative impact on land use is envisaged as the proposed project shall be located within premises of existing refinery. Since no natural drain exit within premises of NRL complex, no impact on natural drainage system is envisaged. Adequate precautions would be taken for handling and storage of crude oil and end products to avoid their spillage/carry-over. Thus, no impact on soil characteristics is foreseen.

Air Environment: The main sources of impact are emissions from only one stack attached to furnace of proposed project. Other sources of impact are fugitive emissions during handling of raw material and end products. Adequate control measures are incorporated for compliance with emission standards. Results of air quality survey indicate that the existing air quality has adequate receptive capacity to sustain the proposed development of emission of SO_2 at the rate of <0.1 Kg/hr. Thus, any negative impact on air environment is ruled out.

Water Environment: Raw water requirements of the existing facilities are met from Dhansiri river, which is perennial in nature. Additional water (60 m^3/hr) for proposed project shall also be drawn from Dhansiri river. About 8.1 m^3/hr of wastewater shall be generated from proposed facilities and would be sent to OWS Section of existing ETP. The treated wastewater shall be utilized in horticulture, firefighting system etc. As such no impact on surface water quality is foreseen from the proposed project. As ground water shall not be drawn for operating the plants, no impact on ground water balance is foreseen. Thus, practically no impact on water environment is foreseen.

TABLE – 4.13
CHARACTERISTICS OF TREATED EFFLUENT
(All values are expressed in mg/l except pH)

Sl. No.	Parameters	Effluent quality	Standard (as per MoEF notification dated 18.03.08)
1	pH	6.5-8.0	6.0-8.5
2	Oil & Grease	<2.0	5.0
3	BOD $_{3days,27}{}^{o}c$	8-11	15.0
4	COD	40.0-80.0	125.0
5	Suspended solids	10.0-19.0	20.0
6	Phenols	0.20-0.33	0.35
7	Sulphides	<0.4	0.5
8	CN	<0.02	0.20
9	Ammonia as N	<10.0	15.0
10	TKN	<30.0	40.0
11	P	<1.0	3.0
12	Cr (Hexavalent)	<0.1	0.1
13	Cr (Total)	<0.1	2.0
14	Pb	<0.1	0.1
15	Hg	<0.1	0.01
16	Zn	<1.0	5.0
17	Ni	<1.0	1.0
18	Cu	<1.0	1.0
19	V	<0.1	0.2
20	Benzene	<0.1	0.1

21	Benzo (a) - Pyrene	<0.1	0.2

Ecology: Endangered species of flora or fauna are not reported to exist in the study area. The area does not fall in the path of migratory birds or animals. Thus, no impact on the ecology of the study area is foreseen.

Noise Environment: Noise emissions from construction equipment shall be kept to a minimum by regular maintenance. Heavy and noise construction work shall be avoided during night hours.

As green belt is one of prominent barrier for noise, a meticulously planned 100 metres wide green belt around the refinery and 25-metre wide green belt around marketing terminal has been developed covering a total area of 60 hectares of land. Considering noise propagation calculations and attenuation due to green belt, it is envisaged that the noise level at the boundary walls shall be well below National Ambient Air Quality Standards for commercial areas. Thus, no impact on noise environment is envisaged.

Socio-economic Environment: The proposed project is likely to generate indirect employment during the construction phase and marginal employment during operation and maintenance phase of the project. Work force from nearby areas shall be engaged during construction phase. This will impart positive impact on the economy of the local area.

Since the project involves addition of certain units in the existing refinery, some existing infrastructure such as road, railways, communication etc shall be utilized. Hence, no perceptible impact on existing socio-economic status of the region is expected.

4.9 CHECKLIST OF IMPACTS

A typical checklist identifying the anticipated environmental impacts due to the proposed project activities are shown as under:

Table – 4.12
CHECKLIST OF IMPACTS

Parameter	Negative Impact	No Impact	+ve Impact	Short Term	Long Term
(A) Impact on Land Environment					
i. Change of land use pattern (partial)		*			
ii. Impact on soil quality		*			
iii. Risk due to earthquake	*				
iv. Impact due to excavation of soil from borrow areas		*			
(B) Impact on Water Environment					
i. Impact on water quality during construction		*		*	

ii. Impact on water quality during operation		*			
(C) Impact on Air Environment					
i. During construction	insignificant	*			
ii. During operation	insignificant	*			
(D) Impact on Noise Environment					
i. During construction	*			*	
ii. During operation	*			*	
(E) Impact on Biological Environment	*			*	
(F) Socio-Economic Impact			*		
(G) Impact on Human Use Values					
i. Loss of historical and cultural monuments		*			
ii. Impacts on aesthetics			*		*
(H) Positive Impacts					
i. Employment opportunities			*		*
ii. Enhancement of local economy			*		*
iii. Improvement in aesthetics			*		*
iv. Education, Medical facilities, Sanitation, Recreation, Business, per capita income			(*significant)		

4.10 CONCLUSION

Based on the facts mentioned above, it may be concluded that the proposed wax project will not impart any adverse impact on the components of the environment.