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 NS 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 NS 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 NS project and as such there is no deterioration of soil characteristics due to fugitive solids.
- No generation of oily sludge from the proposed project is envisaged.
- No catalyst will be used in the proposed project. So, there will be no generation of spent catalyst.
- The proposed NS project would be established within the battery limit of existing CDU/VDU and as such no acquisition of land is involved. Hence, there is no change in existing land use pattern.
- Generation of waste water from the proposed project is not envisaged.

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 NS 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.

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, CRU (MSP) and NHTU(MSP).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. (0K)	F/Rate Nm^3/hr	Exit Velocity m/s	Con., mg/Nm^3			
							PM	SO_2	NOx	CO
1	CDU	60	2.74	428	128900	8.80	0	11.75	83	28.6
2	VDU	60	1.88	428	107600	15.60	0	16.97	83	30.9
3	DCU	60	1.85	495	54900	9.50	0	45.68	48	27.4
4	H2U	60	2.55	573	87200	9.20	0	58.73	55	26.3
5	HCU-1/2	60	1.96	478	65100	9.70	0	67.34	31	28.9
6	HCU-3	60	1.94	428	63200	8.60	0	85.09	61	23.3
7	SRU(Inc.)	60	0.91	550	11100	8.76	0	119.5	61	25.6
8	CCU(Inc.)	77	1.75	473	47400	8.76	88	92.66	61	30.5
9	U/Boiler	60	1.6	393	120800	5.50	0	7.10	14	24.8
10.	HRSG	60	3.5	358	157100	22.20	49.6	4.55	14	22.3
11.	Flare	60	0.75	973	10000	20.00	0	120.0	150	50.2
12.	NHT	60	1.2	473	15300	6.00	0	5.0	22	40.1
13.	CRU	60	1.81	473	23200	4.00	0	7.1	12	40.5

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	1.377
2	Naphtha	3	15,100	FR	40.0x13.5	0.091
3	ATF	3	1,750	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	12,000	CR	13.0x9.2	0.020
7	Vac. Res.	2	3,500	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-NR	2	5,00	FR	25.5x11.0	0.104
14	Isomerate	1	5,000	FR	25.5x11.0	0.021
15	Reformate	1	5,000	FR	25.1x11.0	0.006
16.	MS-NRMT	1	1000	FR	1.30 x 9.2	0.043

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

4.2.3 Sources of Emission from Proposed NS 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

No direct fuel is required for the proposed project. SO_2 emission from the proposed project is very insignificant. Present SO_2 emission is around 100–120 kg/hr against the prescribed limit of 256 kg/hr.

4.2.3.3 Fugitive Emissions

Fugitive emissions originate from static and dynamic equipment joints and seals used in flanges, pumps, valve packing and connection joint.

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 NS 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 NS project will have only marginal impact on the ambient air quality and it will remain under assimilating and buffering capacity of the environment.

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
01	DM Water Make up	6013
02	Service Water	2669
03	Drinking Water (Refinery)	383
04	Drinking Water (NRL Township)	2422
05	Drinking Water (NRMT/CISF)	515
06	Cooling Water Make-up	1808
07	Treated Water in Storage Tanks	977
	Total	**14787**

Additional raw water requirement for proposed NS project has been estimated to be less than 5 m^3/hr. Additional cooling water requirement is envisaged between 3 to 4 m^3/hr. After implementation of proposed NS project , total fresh raw water requirement would be as follows:

Table-4.6
Details of Water Requirement

Existing Requirement	:	14,787 m^3/day
Additional Water requirement for proposed NS Project	:	120 m^3/day (maximum)
Total water requirement after proposed NS project	:	14,907 m^3/day

Consent for drawing water from Intake well is 1200 m^3/hr whereas the present drawl of water is about 670m^3/hr. Hence, the total water drawl after the proposed project shall be about 675m^3/hr. This additional water requirement is insignificant compared to the current rate of drawl from Dhansiri river.

4.3.2 Prediction of Impacts

<u>During Construction Phase</u>

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.

<u>Operation Phase</u>

Additional raw water requirement is envisaged to be less than 5m^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.

Impact Due to Water Drawl

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.

4.4 SOLID/ HAZARDOUS WASTE

4.4.1 By 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: The generation of spent resin is not regular. Generally, it is replaced once in five to seven years.

4.4.2 By Proposed Project

There would be no generation of solid waste like spent catalyst, sludge, oily sludge etc.

4.5 NOISE ENVIRONMENT

4.5.1 Sources of Noise

The only noise source of the proposed project is pumps.

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	Max. 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

Hydrogen unit (H_2U)	90	680	580	1280	1160
Hydrocraker unit (HCU)	90	640	640	1600	1120
Sulphur Recovery unit	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			
	Day Time		Night Time	
	Min.	Max.	Min.	Max.
Crude Distillation unit (CDU)	44.6	42.4	36.9	37.7
Hydrogen unit (H_2U)	42.9	44.3	37.4	38.3
Hydrocraker unit (HCU)	43.4	43.4	35.5	38.6
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	47.2	51.0	42.5	43.3
Attenuation (Green Belt)	2.9	2.9	2.9	2.9
Net Cumulative Noise	44.3	48.1	39.6	40.4
Existing Noise Level	55.7	67.9	52.8	60.5
Resultant Noise Level	56.1	70.1	53.0	60.7

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.	Minimum	55.7	52.8	56.1	53.0
02.	Maximum	67.9	60.5	70.1	60.7

It is, therefore, concluded that 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 NS 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 and within battery limit of existing CDU & VDU. 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 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 be a positive 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.
- 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.

4.8 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.

4.9 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.

Air Environment: The main sources of impact are emissions. 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 (<5 m3/hr) for proposed project shall also be drawn from Dhansiri river. Generation of wastewater from the proposed project is not envisaged. 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.

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 generating 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 hectrares 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 equipments in the existing area of CDU &VDU of the 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.

4.10 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	Positive 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	(insignific ant *	*			
ii. During operation	(insignific ant *	*			
(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)		

4.11 CONCLUSION

Considering the emission and wastewater generation of the proposed project the impact on air and land is insignificant. No generation of oily sludge and spent catalyst is envisaged from the proposed project. Insignificant noise generation is envisaged

from running of the pumps only during the operation stage. There would be displacement of flora and fauna for the establishment of the project. Thus, it may be concluded that the proposed NS project would impart positive impact by way of providing employment opportunities to the local people though temporally during construction stage.

TABLE – 4.12

CHARACTERISTICS OF EFFLUENT STREAMS BEFORE & AFTER TREATMENT

(All values are express in mg/L except pH)

SL. NO.	PARAMETERS	ETP Inlet	ETP Outlet	ASPCB Limit / MINAS
1	pH	8.6	7.3	
2	Total Alkalinity	192	158	
3	Total Suspended Solids	242	12	16
4	Total Dissolved Solids	830	650	2100
5	COD	1302	80	90
2	BOD	570	8	10
3	Chloride	100	30	1000
4	Sulphate	75	10	1000
5	Sulphides	190	0.1	0.1
6	Oil & Grease	13400	1.5	10
7	Iron	20	0.74	3.0
8	Lead	0.15	0.06	0.1
9	Zinc	0.48	0.01	5.0
10	Copper	0.065	BDL	3.0
11	Nickel	1.41	BDL	3.0
12	Chromium	0.05	0.001	2.0
13	Manganese	0.14	0.004	2.0
14	0.072	BDL	2.0	100

TABLE – 4.13
GENERAL STANDARDS FOR DISCHARGE OF EFFLUENTS

Sl. No	Parameters	Inland Surface Water	Public Sewer	Land for Irrig-ation	Marine Coastal Areas
1	Colour and odour	Note-1	Note-1	Note-1	Note-1
2	Suspended solidsmg/l max	100	600	200	Note-2
3	Particle size of suspended solids	Note-3	-	-	Note-4
4	Dissolved solids (Inorganic), mg/l	2100	-	2100	-
5	pH value	5.5-9.0	5.5-9.0	5.5-9.0	5.5-9.0
6	Temperature	Note-5	-	-	Note-5
7	Oil & grease mg/l max	10	20	10	20
8	Total residual chlorine mg/l max	1.0	-	-	1.0
9	Ammoniacal nitrogen (as N) mg/l max	50	50	-	50
10	Total kjeldahl nitrogen (as NH3) mg/l max	100	-	-	100
11	Free ammonia (as NH3) mg/l max	5	-	-	5
12	BOD (5 days at 20°C) max	30	350	100	100
13	Chemical oxygen demand mg/l	250	-	-	250
14	Arsenic (as As) mg/l max	0.2	0.2	0.2	0.2
15	Mercury (as Hg) mg/l max	0.01	0.01	-	0.01
16	Lead (as Pb) mg/l max	0.1	1.0	-	2.0
17	Cadmium (as Cd) mg/l max	2.0	1.0	-	2.0
18	Hexavalent chromium (as Cr+6) mg/l max	0.1	2.0	-	1.0
19	Total chromium (as Cr) mg/l max	2.0	2.0	-	2.0
20	Copper (as Cu) mg/l max	3.0	3.0	-	3.0
21	Zinc (as Zn) mg/l max	5.0	15	-	15
22	Selenium (as Se) mg/l max	0.05	0.05	-	0.05
23	Nickel (as Ni) mg/l max	3.0	3.0	-	5.0
24	Boron (as B) mg/l max	2.0	2.0	2.0	2.0
25	Percent sodium max	-	-	60	-
26	Residual sodium carbonate mg/l max	-	-	5.0	-
27	Cyanide (as CN) mg/l max	0.2	2.0	0.2	0.2
28	Chloride (as Cl) mg/l max	1000	1000	600	-
29	Fluoride (as F) mg/l max	2.0	15	-	15
30	Dissolved phosphates as P), mg/l max	5.0	-	-	-
31	Sulphate (as SO_4) mg/l max	1000	1000	1000	-
32	Sulphide (as S) mg/l max	2.0	-	-	5.0
33	Phenolic Compd (as C6H5OH), mg/l max	1.0	5.0	-	5.0
34	Bio-assay test	Note-6	Note-6	Note-6	Note-6
35	Manganese (as Mn) mg/l max	2.0	2.0	-	2.0
36	Iron (as Fe) mg/l max	2	3	-	3
37	Vanadium (as V) mg/l max	0.2	0.2	-	0.2
38.	Nitrate nitrogen, mg/l max	10	-	-	20

Note-1 :All efforts should be made to remove colour and odour as far as practicable.
Note-2 : a) For process water - 100.

b) For cooling water effluent, 10% above total suspended matter in influent

Note-3 : Shall pass 850 micron IS Sieve.

Note-4 : a) Floatable solids - max 3 mm; b) Settleable solids - max 850 microns.

Note-5 : Shall not exceed 5oC above the receiving water temperature.

Note-6 : 90% survival of fish after 96 hours in 100% effluent