4.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 Introduction

The chapter presents identification and appraisal of various impacts due to the proposed power plant during construction and operational phases. The environmental impacts are categorized as primary or secondary. Primary impacts are those, which are attributed directly to the project and secondary impacts are those, which are indirectly induced and typically include the associated investment and changed pattern of social and economic activities by the proposed action.

The mitigation measures proposed for minimizing the impacts have also been discussed in this chapter. Environment Management Plan (EMP) is developed to minimize adverse impacts and to ensure that the environment in and around the project site is well protected. The EMP has been prepared for both construction and operation phases of the proposed facilities.

The impacts have been assessed for the power plant assuming that the pollution due to the existing activities has already been covered under baseline environmental monitoring and continue to remain same till the operation of the project.

The construction and operational phase of the proposed project comprises various activities each of which may have an impact on some or other environmental parameters. Various impacts during the construction and operation phase on the environment have been studied to estimate the impacts on the environmental attributes and are discussed in the subsequent sections.

4.2 Impacts during Construction Phase

This includes the following activities related to land acquisition, leveling of site, construction of related structures and installation of related equipment.

4.2.1 Impact on Land Use

The land identified for the proposed 3x660 MW power plant is about 1282.2 acres (519.1-ha). About 102 acres (41.296 ha) of the land will be used for ash disposal.

The proposed plant land is 100% private land. There is no forest land or ecological sensitive land within proposed plant site. Hence, no major loss of agricultural productivity is envisaged.

Construction of plant will lead to permanent change in land use pattern at the site as a direct impact. The proposed project involves construction of large scale civil works including levelling within project premises. The earthen material generated during construction of large scale water storage reservoir within the project premises will be used for level rising of plant area.

The environmental pollution impacts during constructional phase would be temporary and are expected to gradually stabilize by the time of commissioning of proposed project.

The buffer zone of the proposed plant site is sparsely distributed villages. There are no sensitive locations such as archaeological monuments, sanctuaries, national parks, critical pollution zones etc within 10-km radial distance around the proposed project site. No major changes in land use pattern of study area (region) will occur due to the project activities.

Hence, no major impact is envisaged on land use pattern of the project site or buffer zone.

4.2.2 Impact on Soil

The construction activities will result in loss of vegetation cover, topsoil and earthen material to some extent in the plant area. However, it is proposed to use the soil and earthen material for greenbelt development and levelling of project site. Greenbelt will be developed in phased manner from construction stage onwards.

Apart from localized construction impacts at the plant site, no adverse impacts on soil in the surrounding area are anticipated.

4.2.3 Impact on Topography

The proposed project premises is a generally plain land with a general elevation of about 330-m above MSL. Most of the buffer zone of the project is flat land.

It is proposed to level the project area and to use the earthen material excavated from the proposed reservoir sites inside the premises. There will be no tall structures except stacks. Also, the contours of natural drainage will not be disturbed. In view of the above, there will be no major adverse impact on topography of the project site.

4.2.4 Impact on Air Quality

The main sources of emission during the construction period are the movement of equipment at site and dust emitted during the leveling, grading, earthwork, foundation works and exhaust emissions from vehicles and equipment deployed during the construction phase is also likely to result in marginal increase in the levels of SO_2, NOx, SPM and CO. The impact will be for short duration and confined within the project boundary and is expected to be negligible outside the plant boundaries. The impact will, however, be reversible, marginal and temporary in nature. Proper maintenance of vehicles and construction equipment will help in controlling the gaseous emissions. Water sprinkling on roads and construction site will prevent fugitive dust.

4.2.5 Impact on Water Quality

Impact on water quality during construction phase may be due to non-point discharges of solids from soil loss and sewage generated from the construction

workforce stationed at the site. However, due to the construction being carried out on generally plain terrain, the soil losses will be negligible. Further, the construction will be more related to mechanical fabrication, assembly and erection; hence the water requirements would be small. The construction water will be available at site from near by area. Temporary sanitation facilities (septic tanks and soak pits) will be set-up for disposal of sanitary sewage generated by the workforce.

The overall impact on water environment during construction phase due to proposed project is likely to be short term and insignificant.

4.2.6 Impact on Noise Levels

Heavy construction traffic for loading and unloading, fabrication and handling of equipment and materials are likely to cause an increase in the ambient noise levels. The areas affected are those close to the site. However, the noise will be temporary and will be restricted mostly to daytime.

The noise control measures during construction phase include provision of caps on the equipment and regular maintenance of the equipment.

4.2.7 Impact on Terrestrial Ecology

The initial construction works at the project site involves land clearance. During construction vegetation may be disturbed. Greenbelt will be developed phase wise during construction to improve the aesthetic value in the area and to screen out the fugitive dust generated during construction. The removal of vegetation from the soil and loosening of the topsoil generally causes soil erosion. However, such impacts will be confined to the project site and will be minimized through paving and water sprinkling.

There are not many existing matured trees in the site. However, greenbelt will be developed surrounding the plant facilities. The existing trees will be preserved to the extent possible. Thus, no major adverse impacts are envisaged on terrestrial ecology.

4.3 Impacts during Operational Phase

The proposed plant operation will involve 1980 MW of power generation. The following activities related to the operational phase will have varying impacts on the environment and are considered for impact assessment:

- Topography and climate;
- Air environment;
- Water resources and quality;
- Land use;
- Soil quality;
- Solid waste;
- Noise levels;
- Terrestrial and aquatic ecology;
- Demography and socio-economics; and
- Infrastructural facilities.

4.3.1 Topography and Climate

Most of the area of the plant site is plain and it will be maintained even during post-project scenario. There will not be any topographical changes during operation of the project.

Heat loss through stack will be about 8 to 10% of the total heat input to the boiler. The quantum of heat so lost to the atmosphere is not significant. The moderate wind speed and rainfall in the region will mitigate the adverse impacts. The vegetation in the region will help to manage the thermal balance.

4.3.2 Impact on Air Quality – Point Emission Sources

Being a coal based power project, Particulate Matter (PM), Sulphur dioxide (SO_2) and Oxides of Nitrogen (NOx) will be the important air pollutants from the proposed project.

Prediction of impacts on air environment has been carried out by employing mathematical model based on a steady state gaussian plume dispersion model designed for multiple point sources for short term. In the present case, **Industrial Source Complex [ISC3]** 1993 dispersion model, designed for multiple point sources for short term and developed by United States Environmental Protection Agency [USEPA] has been used for simulations from point sources.

The model simulations deal with dispersion of three major pollutants viz., Sulphur Dioxide (SO_2), Oxides of Nitrogen (NOx), and Particulate Matter (PM)) emitted from the stacks.

4.3.2.1 Model Input Data

The air pollution modelling has been carried out representing the worst case with the following scenario:-

Coal requirement for the power plant will be 8.51 MTPA @85% PLF with 50% of Indian Coal and 50% Imported coal. For worst case scenario, the sulphur content of 0.7% is considered.

The stack details considered for model computations are summarized in **Table-4.1**.

TABLE-4.1
STACK DETAILS AND EMISSION RATES

Sr. No.	Parameters	Unit	Stack#1		Stack#2
			Flue-1	Flue-2	
1	Flue (Stack) Height	M	275	275	275
1	Top diameter of each flue	m.	7.35	7.35	7.35
2	Flue gas velocity in each flue	m/s	22	22	22
3	Flue gas temperature	^oK	413	413	413
4	Flow rate of gas in each flue	Nm^3/s	617	617	617
5	Coal Consumption in each boiler	TPH	360	360	360

Sr. No.	Parameters	Unit	Stack#1		Stack#2
			Flue-1	Flue-2	
A]	Sulphur dioxide (SO_2) emission (0.7% sulphur content)	g/s	1400	1400	1400
B]	Particulate matter (PM) emission rate in each flue based on design limit of 50 mg/Nm^3	g/s	30.8	30.8	30.8
C]	Oxides of Nitrogen (NOx) (based on design limit of 9 kg/ton)	g/s	900	900	900
D]	Mercury emission rate based on 0.12 mg/kg	g/s	0.01	0.01	0.01

Source: LTPCL, and EIA studies by Vimta Labs, Hyderabad

- ***Meteorological Data***

The hourly meteorological data recorded at site is converted to the mean meteorological hourly data as specified by CPCB and the same has been used in the model. In absence of site specific mixing heights, mixing heights published in 'Spatial Distribution of Hourly Mixing Depths over Indian Region' by Dr. R.N. Gupta have been used. 24-hourly mean metrological data presented in **Annexure-V.**

4.3.2.2 Presentation of Results

The model simulations were carried out for pre monsoon season. For the short-term simulations, the Ground Level Concentrations (GLCs) were estimated around 1200 receptors to obtain an optimum description of variations in concentrations over the site in 10-km radius covering 16 directions.

The maximum incremental ground level concentrations and resultant concentrations for SPM, SO_2, and NOx are given in **Table-4.2** and **Table-4.3** respectively. Similarly, the isopleths for various pollutant concentrations based on coal are enclosed in **Figure-4.1** to **Figure-4.4**. The CPCB permissible ambient air quality standards are given in **Table-4.4.**

TABLE-4.2
PREDICTED 24-HOURLY SHORT TERM INCREMENTAL CONCENTRATIONS

Pollutant	Maximum Incremental GLC's ($\mu g/m^3$)	Distance (km)	Direction
Pre-monsoon season – 2010			
PM	1.1	4.1	SSE
SO_2	52.5	4.1	SSE
NO_x	33.8	4.1	SSE
Hg	0.0005	4.1	SSE

TABLE-4.3
RESULTANT CONCENTRATIONS DUE TO INCREMENTAL GLC's

Pollutants	Concentration ($\mu g/m^3$)			NAAQ Limits
	Maximum Baseline	Incremental	Resultant	
PM	49.5	1.1	50.6	100
SO_2	8.1	52.5	60.6	80
NOx	8.9	33.8	42.7	80
Hg	<0.1	0.0005	<0.1	-

4.3.2.3 Discussions on Results of Assessment

A perusal of previous sub-section reveal that the maximum incremental short-term 24 hourly ground level concentrations for Particulate Matter, SO_2, NOx and Hg likely to be encountered are 1.1 $\mu g/m^3$, 52.5 $\mu g/m^3$, 33.8 $\mu g/m^3$ and 0.0005$\mu g/m^3$ respectively occurring at a distance of about 4.1-km in the SSE direction.

According to the above presented results, it can be stated that the impact of SPM from proposed 3X660 MW power plant would be negligible in core or buffer zone of the project.

Even though, the incremental and resultant concentrations of SO_2 and NOx are significant to certain extent, they are well within the NAAQ limits and hence, the AAQ levels after implementation of the proposed 3X660 MW Power project will remain within the permissible limits.

It is also to be noted that the above concentrations are for worst case scenario of operations only. For indigenous fuel consumption, the concentrations will be much lower. Hence, it can be stated that the AAQ of the area will be within the permissible limits of respective zones.

4.3.3 Impact on Air Quality - Fugitive Emissions

The fugitive dust emissions expected are from coal storage yards, coal conveyor belt area, ash dumping areas, transportation of fuel and solid waste.

In the proposed project, coal handling plant will be properly operated with EMP suggested in this report; no major fugitive dust emissions are envisaged. Similarly, HCSD system of ash stacking will be practiced and hence, no dust emissions are envisaged from ash dump areas. The fuel will be received through rail line and the solid waste will be sent to dyke areas through pipeline. Hence, no dust emissions from transportation are envisaged. However, internal roads are to be asphalted to further reduce fugitive dust emissions.

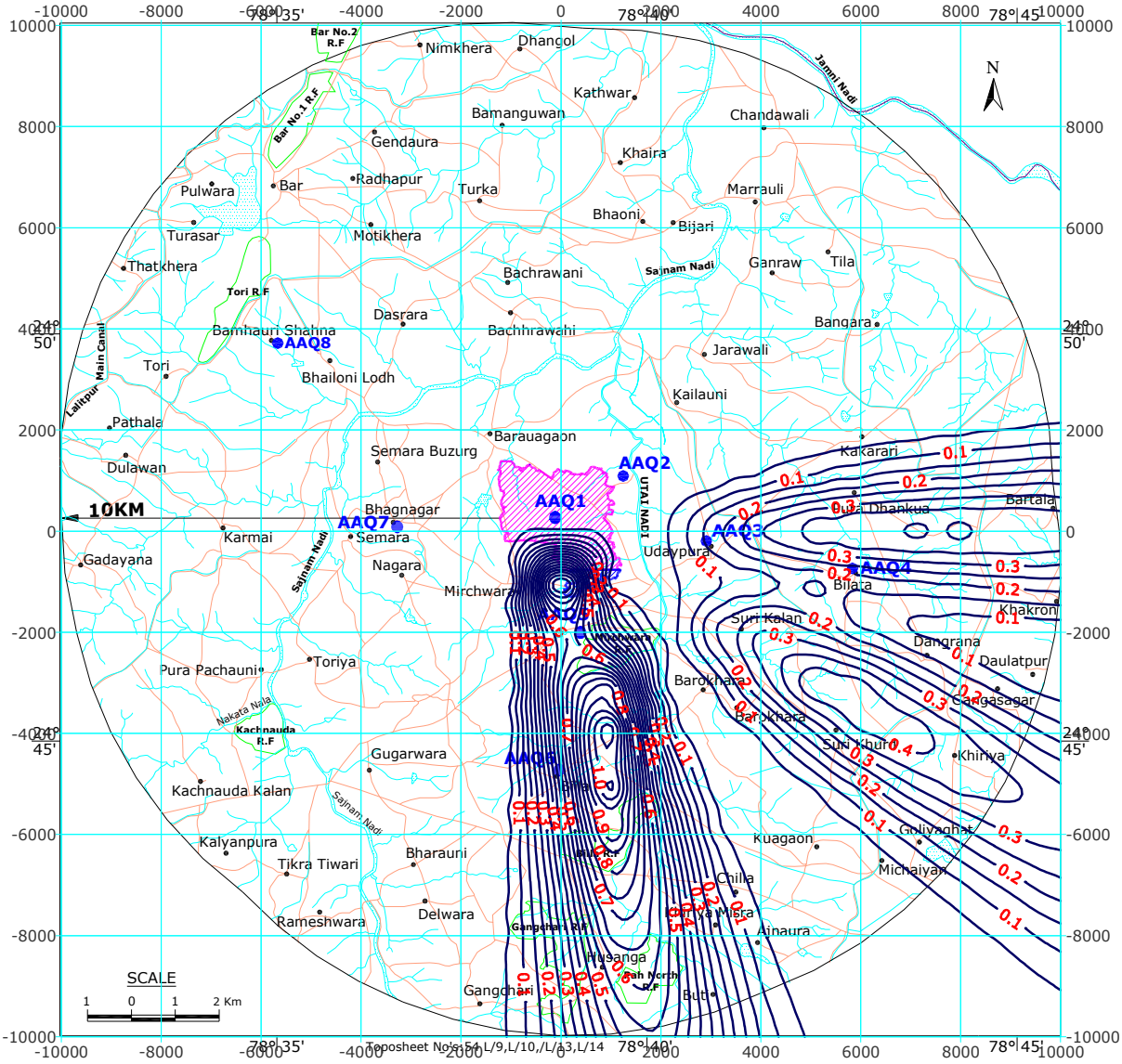
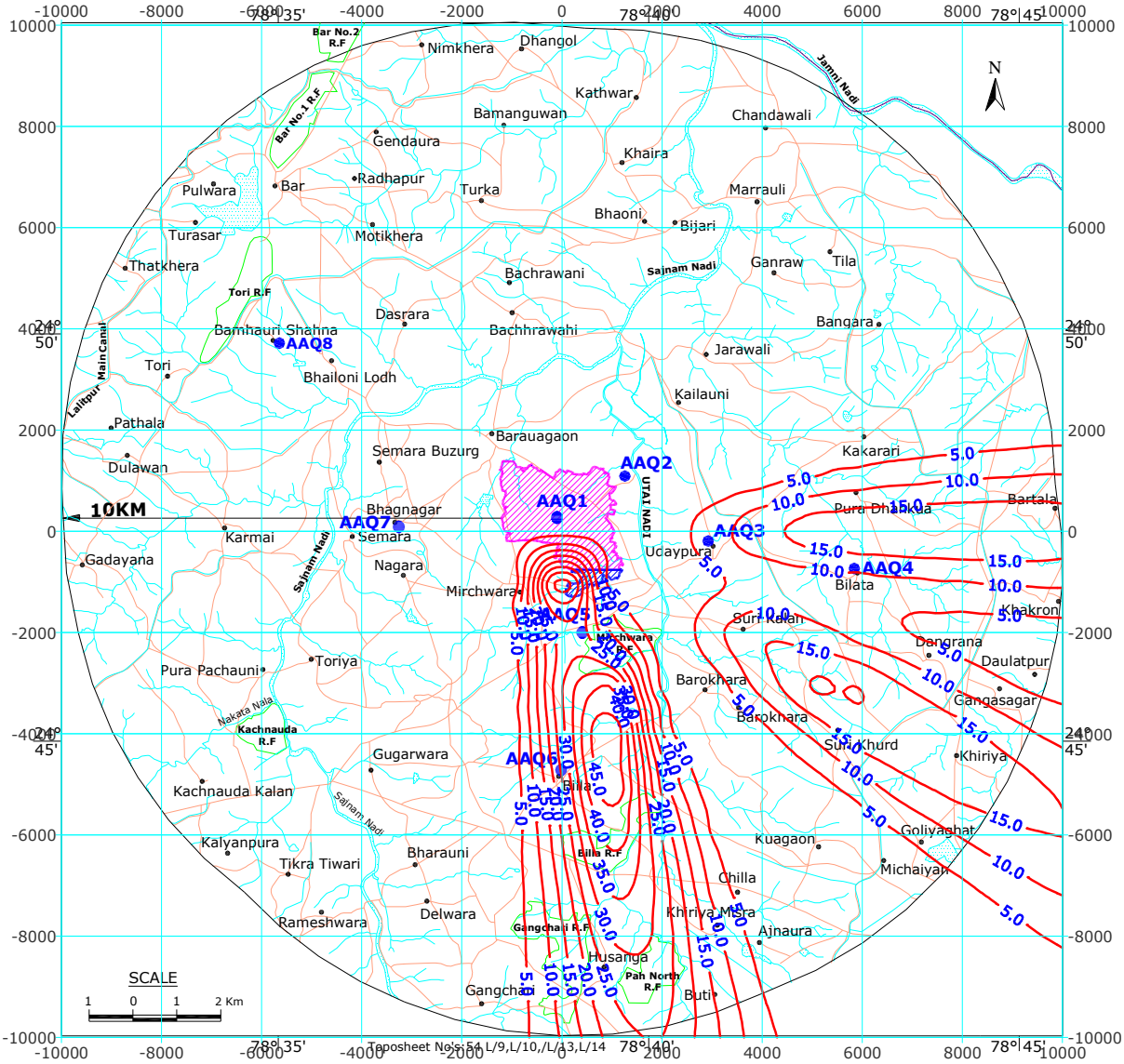


FIGURE-4.1

SHORT TERM 24 HOURLY INCREMENTAL GLCs OF PM



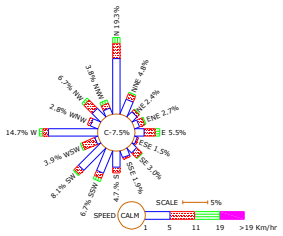


FIGURE-4.2
SHORT TERM 24 HOURLY INCREMENTAL GLCs of SO_2

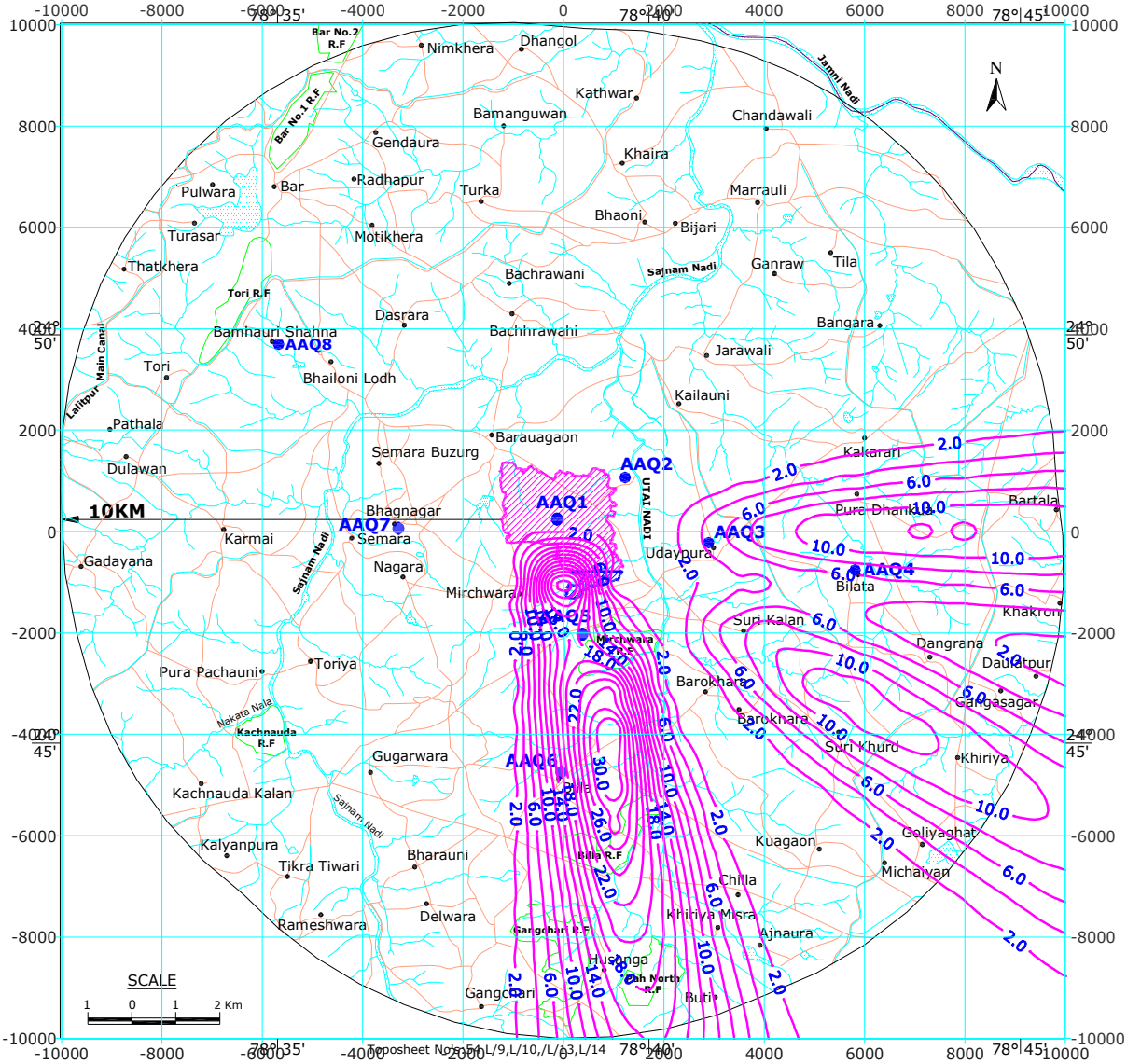


FIGURE-4.3
SHORT TERM 24 HOURLY INCREMENTAL GLCs of NOx

The dust emissions, if any, from the above areas will be fugitive in nature and maximum during pre monsoon season (when the wind velocities are likely to be high) and almost nil during the monsoon season. The dust emissions are likely to be confined to the place of generation only. The quantification of these fugitive emissions from the area sources is difficult as it depends on lot of factors such as dust particle size, specific gravity of dust particles, wind velocity, moisture content of the material and ambient temperatures etc. Also, there is a high level of variability in these factors. Hence, these are not amenable for mathematical dispersion modelling. However, by proper usage of dust suppression measures, dust generation and dispersions will be reduced.

4.3.4 Impact on Water Resources and Water Quality

Water is required for various power plant operations and the water balance has been explained in **Chapter-2**.

No groundwater source will be tapped for meeting the water requirements during operation of the power plant. The water requirement of the project will be met from Rajghat Dam (Betwa Canal System).

4.3.4.1 Impact on Water Resources

LTPCL has already received in-principle allocation of 5556m^3/hr water from up-streams of Betwa Canal has been accorded by Irrigation and CAD of Government of Uttar Pradesh for this project. The copy of the same is given in **Annexure-IV.** As the required water is available even during lean season, no impact on surface water resources is envisaged.

No groundwater source is proposed to be tapped for meeting the water requirements during operation of the power plant, no impacts on groundwater resources is envisaged.

4.3.4.2 Impact on Water Quality

Garland drains around the ash pond site will be provided for the collection of run-off water during monsoon season.

The storm water in the project area will be collected through storm water drains and collected in the storm water tank, which is lined to prevent any contamination of ground water. The stored storm water will be utilized in the plant operation resulting in conservation of fresh water. Suitable rain harvesting pits will be provided along the storm water drain to recharge the ground water table. In case the storm water tank starts overflowing, the same will be discharged into nearby nalla.

Various types of wastewater to be generated in the proposed project with their quantity, expected pollutants and treatment proposed is given in **Table-4.4**.

TABLE-4.4
TYPES OF WASTEWATER GENERATION AND TREATMENT DETAILS

All values are given in m^3/hr

Sr. No.	Units	Water Requirement	Loses/Uses	Waste Water Generated	Usage/ Disposal
1	Cooling tower make up	4815	4011	804	Used in AHS
2	Potable Water	41	10	31	Treated in STP & used for Greenbelt
3	Service water	291	272	19	To Guard Pond
4	Sludge Treatment	276	0	276	Disposal to Ash pond
5	Filtration & DM plant	98	65	33	Disposal to guard pond
7	Fire water make-up	1	1	0	-
8	Transmission losses	34	34	0	-
Total		**5556**	**4393**	**1163**	52 - guard pond 804 - AHS 276- Ash Pond 31 – Greenbelt
Note: 52 m^3/hr (1248 m^3/day) will go to guard pond as waste water. Remaining will be consumed in various usages					

The expected quality of raw and treated wastewater from the power plant including sewage water and discharge limits as specified by environment protection rules is given in **Table-4.5**. The treated wastewater will be mixed in central monitoring basin and finally utilised for ash handling system and green belt development.

TABLE-4.5
EXPECTED QUALITY OF WASTEWATER

Sr. No.	Parameter	Unit	Raw wastewater	Treated Wastewater	Permissible Limits as per GSR 422 (E) for On-land Discharge (Irrigation)
1	pH	-	5.5 to 9.0	6.0 to 8.5	5.5 to 9.0
2	Suspended Solids	mg/l	100 to 500	<100	200
3	Oil & Grease	mg/l	10 to 200	<5	10
4	Total Dissolved Solids	mg/l	500 to 10000	<1000	--
5	BOD	mg/l	250 to 350	<30	100
6	COD	mg/l	450 to 600	<100	-

The wastewater generated in the project will be suitably treated prior to use in ash handling and coal handling facility. The domestic waste generated will be used in greenbelt development after treatment. Therefore, the zero discharge condition will be maintained.

The guard pond will be suitably lined to prevent percolation into ground. The ash pond will be provided with HDPE lining to prevent any kind of percolation into ground. Therefore the impact on surface and ground water will be insignificant.

4.3.5 Impact on Land Use

The land identified for the proposed 3x660 MW power plant is about 1282.2-acre. About 102-acre of the land will be used for ash disposal. Greenbelt including green cover will be developed in an area of about 309 acre.

The greenbelt proposed will have a positive impact on land. There will be minimum changes in land use during the operational phase of the project. Hence, no major impacts are envisaged during operational phase of the project.

4.3.6 Impact on Soil

Most of the impacts of power plant project on soils are restricted to the construction phase, which will get stabilized during operational phase. The impact on the topsoil will be confined to the proposed main plant area only. Further, the greenbelt proposed will have a very positive impact on soil quality.

The probable sources of degradation of soil quality will be due to generation & disposal of ash and fugitive dust emissions. However, the impacts due to disposal of ash are covered under Section-4.3.8.

The airborne fugitive dust from the plant is likely to be deposited on the topsoil in the immediate vicinity of the plant boundary. However, the fugitive emissions are likely to be controlled to a great extent through proposed control measures like water sprinkling and development of greenbelt development. Hence, no major impact is envisaged on soil quality of the project site.

4.3.7 Impact of Solid Waste

Ash is the major solid waste to be generated from the proposed coal based power plant. Coal consumption of 8.51 MTPA was considered (85% PLF)l) for estimation of ash generation. Ash content in coal will be 34%. Ash will be generated as both forms viz. bottom ash and fly ash. About 80% of the total ash generation will be fly ash and remaining 20% comes as bottom ash. The fly ash is the major air pollutant emitted through stacks attached to boilers. ESP's with higher efficiency shall be provided to prevent arrest the ash dispersions into ambient air. The details of the solid waste generation are given in **Table-4.6**.

TABLE-4.6
EXPECTED SOLID WASTE FROM POWER PLANT

Sr. No.	Plant	Quantity of Generation	Mode of Disposal
1	Total Ash Bottom ash Fly ash	2.75 MTPA 0.55 MTPA 2.20 MTPA	Emphasis will be given for supply to potential users in dry from. Remaining ash will be disposed into HDPE lined ash pond.
2	Used Oil	15000 KLPA	Will be supplied to authorized recyclers
3	Domestic Solid waste/Municipal Solid waste	1500 TPA	Organic portion will be dried, composted and used as manure

It is proposed to collect fly ash from ESP hoppers in dry from and provide/supply to potential ash users depending on the demand. The balance unutilized ash will

be disposed off using High Concentrated Slurry Disposal (HCSD) technology. An area of about 102-acre has been identified within the project site for ash pond. In view of the proposed HCSD ash disposal technology, the impact of ash pond supernatant run-off would not be expected and the impacts on surrounding environment would be insignificant.

The sludge from sewage treatment plant will be dried, vermi-composted and used as manure for greenbelt maintenance. Canteen/sanitary waste will be composted and used as manure for greenbelt development. With the implementation of above precautionary measures, the impacts due to solid waste disposal will be minimum.

- ***Impact of Ash Pond on Surface Water***

In ash disposal, High Concentration Slurry Disposal method would be adopted. The bottom ash slurry and fly ash slurry from the both the units will be led to common slurry sump of the combined ash slurry disposal pump house. In view of the proposed HCSD ash disposal technology, the impact of ash pond supernatant run off would not be expected. Hence, the impact of the ash pond on the surface water will be insignificant.

- ***Impact of Ash Pond on Ground Water***

The possibility of groundwater contamination due to the leaching of metals from the ash pond will be examined based on soil investigation study. The study is under progress and initial assessment of geology indicates that the rocks are impervious in nature and have developed secondary porosity composed of fractures and joints. Wells and bore wells yield meager to low discharges of potable quality of water. Alluvium is thin and ground water occurs mainly in hard rocks. Depth to water table is shallow during post monsoon period ranging from 5 to 10 m below the land surface. Depth to water is deep during pre monsoon period ranging from 12 to 18 m.

The dykes around the pond will be constructed with proper compaction at maximum dry density. The co-efficient of permeability will be much less than the natural deposits to further reduce the drainability. However, with the passage of time, more and more fly ash particles will get deposited in the pore spaces of the top soil making it essentially non-porous and impervious and in view of the above, contamination through leaching is not envisaged.

High concentrate slurry disposal (HCSD) system will be adopted, in which case the concentration of ash would be as high as 70%. This solidifies quickly and forms a hard crust; hence there will not be any generation of fugitive fly ash and no pollution of the air in the vicinity. As the quantity of water in the sump is also very little and it gets evaporated, there will not be any pollution of ground water. However, the ash pond will be provided with HDPE liner to prevent any kind of percolation into ground.

In view of the above mitigative measures, no surface water or groundwater pollution is anticipated from the ash disposal area. Similarly, as the other solid wastes also used properly, no impact of solid waste is envisaged.

4.3.8 Impacts on Ecology

Detailed flora and fauna studies were carried out during study period and the details are presented in Section-3.8 of Chapter-3. About 310 plant species were identified and these are commonly growing plant species of the region. As per records of forest department of Lalitpur, literature survey and also from field studies, there are no endangered, threatened and protected plants as per Wildlife Protection Act, 1972.

It is proposed to develop greenbelt with an average width of about 50-m to 100-m around plant site and implementation of eco development along with local people will enhance the greenery of the area. Hence, no significant adverse impact is envisaged on terrestrial ecology.

The impacts on aquatic ecology due to proposed project would be negligible as the treated effluents from the proposed power project will meet the prescribed standards prior to final discharge.

Similarly, as the discharge water will not have much higher temperature than the receiving body, no thermal effects on receiving body due to discharge are envisaged.

Hence, the impacts on ecology of the region will be insignificant.

4.3.9 Impact on Noise Levels

The main noise generating stationary sources from the power plant will be pumps, compressors along with cooling tower and boilers. The noise levels at the source for these units will be in the range of 80-90 dB(A). The noise dispersion from the plant units has been computed based on the mathematical model. The major noise generating sources from the proposed plant are identified and listed in **Table-4.7**. These are considered as input to the noise model.

TABLE-4.7
MAJOR NOISE GENERATING SOURCES

Sr. No.	Sources	Noise Level in dB(A) [1-m away]	Nature of Noise
1	Turbine units	85	Continuous
2	Cooling tower	75	Continuous
3	Air compressors	85	Continuous
4	Transformer	75	Continuous
5	Boilers	85	Continuous

4.3.9.1 Presentation of Results

The incremental noise levels are computed at proposed project site at 100-mX100-m grid intervals over an area of 10-kmX10-km study area. The predicted results of incremental noise levels at each grid points are used to draw noise contours. The predicted noise contours around proposed sources are shown in **Figure-4.4**.

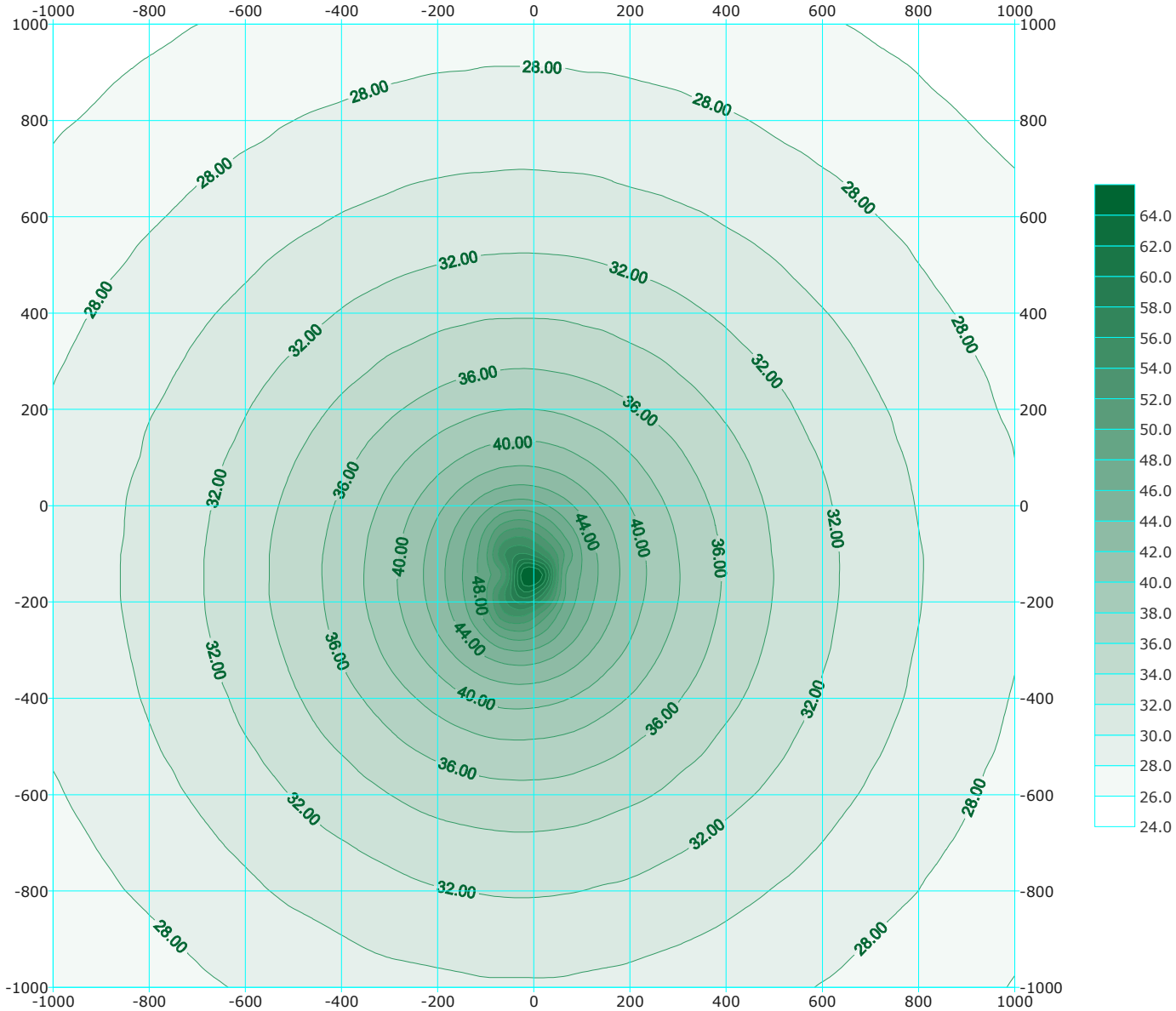


FIGURE-4.4
PREDICTED NOISE DISPERSION CONTOURS

4.3.10 Prediction of Impacts on Socio-Economics

The requirement of unskilled manpower will be met from nearby villages during construction phase. The project will also help in generation of the indirect employment apart from direct employment. This will be a positive socio-economic development for the region. There will be a general upliftment of standard of living in the region.

4.3.11 Impacts on Public Health and Safety

The discharge of waste materials (stack emission, wastewater and solid wastes) from process operations may have potential impact on public safety and health. The wastewater generated from power plant will be treated and utilised for ash handling and green belt development. It is proposed to reuse the wastewater to the maximum extent. Since, the adverse impacts on ambient air and soil quality are predicted to be low it is anticipated that with effective implementation of control measures suggested for pollution control, the impact on public health will be minimum.

4.4 Environment Management Plan during Construction Phase

During construction phase, the construction activities like site levelling, grading, transportation of the construction material cause various impacts on the surroundings. However, the constructional phase impacts are temporary and localised phenomena except the permanent change in local landscape and land use pattern of the project site.

4.4.1 Land Environment Management

Preparation of site will involve excavations and fillings. The earthen material generated during excavations and site grading periods, shall be properly dumped and slope stabilisation shall be taken. The topsoil generated during construction shall be preserved and reused for plantations.

The natural drainage pattern shall not be disturbed.

The approach road to project site shall be appropriately widened and strengthened to facilitate vehicular movement.

The greenbelt area shall be delineated before start-up of earthwork and tree plantation shall be taken up during construction stage itself.

4.4.2 Air Quality Management

The activities like site development, grading and vehicular traffic contribute to increase in SPM and NOx concentrations. The mitigation measures recommended to minimize the impacts are:

- Water sprinkling in construction area;
- Asphalting the main approach road;
- Proper maintenance of vehicles and construction equipment; and
- Tree plantation in the area earmarked for greenbelt development.

4.4.3 Water Quality Management

The soil erosion at site during heavy precipitation contributes to the increase in suspended solids. The wastewater from vehicle and construction equipment maintenance centre will contribute to oil and grease concentration. The wastewater from labour colony will contribute to higher BOD concentrations. The mitigation measures recommended to minimize the impacts are:

- Sedimentation tank to retain the solids from run-off water;
- Oil and grease trap at equipment maintenance centre;
- Packaged STP/Septic tanks to treat sanitary waste at labour colony; and
- Utilizing the wastewater in greenbelt development.

4.4.4 Noise Level Management

Operation of construction equipment and vehicular traffic contribute to the increased noise level. Recommended mitigation measures are:

- Good maintenance of vehicles and construction equipment;
- Restriction of construction activities to day time only;
- Plantation of trees around the plant boundary to attenuate the noise; and
- Provision of earplugs and earmuffs to workers.

4.4.5 Ecological Management

During construction, vegetation in the plant premises is required to be cleared. The measures required to be undertaken to minimise the impact on the ecology are:

- The felling of trees will be kept at minimum; and
- The greenbelt having vegetation density of 2000 trees/ha will be developed.

4.4.6 Social community Management

Constructional activities will generate employment to local and near by villages. For construction work force, temporary sanitation facilities (septic tanks and soak pits) will be set-up for disposal of sanitary sewage. Similarly, rest rooms and canteen facilities will be provided for truck drivers during construction as well as operation phase of power plant.

4.5 Environment Management Plan during Operation Phase

During operation phase, the impacts on the various environmental attributes should be mitigated using appropriate pollution control equipment. The Environment Management Plan prepared for the proposed project aims at minimizing the pollution at source.

4.5.1 Air Pollution Management

Fugitive and stack emissions from the power plant will contribute to increase in concentrations of SPM, SO_2, and NOx pollutants. The mitigative measures recommended in the plant are:

- Installation of higher efficiency ESP to limit the PM concentrations below 50 mg/Nm^3;
- Provision of one bi-flue stack and one single stack of 275-m height for wider and quicker dispersion of gaseous emissions;
- Provision of water sprinkling system at raw material storage yard;
- Asphalting of the roads within the plant area;
- Provision of dust extraction systems at dust generating source;
- Developing of greenbelt around the plant to arrest the fugitive emissions;
- Design of control equipment to meet the standards stipulated by CREP; and
- Online flue gas monitors as well as flue gas flow rates and temperature measurement shall be provided for all stacks.

To control fugitive hydrocarbon emissions, the following measures shall be adopted:

- Provision and periodic inspections of mechanical seals in pumps; and
- Preventive maintenance of valves, flanges, joints, roof vents of storage tanks.

The fugitive dust emissions shall be controlled by installation of closed conveyor system along with suitable dust suppression measures.

4.5.2 Water Pollution Management

Wastewater will be generated from cooling towers, boilers in the power plant. Besides, domestic wastewater from canteen and employees wash area will also be generated. The recommended measures to minimise the impacts and conservation of fresh water are:

- Recycling of wastewater generated in cooling tower into ash disposal, coal handling and service water requirements;

- The plant raw water requirement shall be optimised. The COC in cooling system shall be maximised (such as COC=5);

- The effluent carrying oil spillage in the plant area shall be sent to oil-water separator for removal of oil;

- The RO and DM plant wastewater shall be treated in neutralization tank;

- Coal stock piles and ash ponds shall be provided with garland drains and water shall be treated for suspended / floating solids;

- Adequate treatment of wastewater prior to recycling/reuse to maximum extent;

- Provision of sewage treatment plant to treat domestic sewage generated from plant and township;

- Utilization of treated domestic wastewater in toilet flushing, greenbelt development and dust suppression;

- Lining of effluent pond suitably to prevent any seepage into ground to avoid any groundwater contamination;

- Provision of separate storm water system to collect and store run-off water during rainy season and utilization of the same in the process to reduce the fresh water requirement;

- Final disposal shall be through open channel with natural cascade aeration arrangement to improve DO in treated effluent;
- Treated effluents from all streams should be stored in CMB / Guard Pond having 5 to 6 days detention time and the aquaculture may be practiced with bioassay tests on regular basis;

- The treated wastewater before disposal shall be checked for conformity of Environment Protection rules; and

- Suitable rainwater harvesting structures to be constructed.

The wastewater from various units of the plant shall be appropriately treated and disposed. The proposed waste water treatment is given in **Table-4.8.**

TABLE-4.8
THE PROPOSED WASTE WATER TREATMENT

Type of Wastewater	Treatment Proposed
Cooling tower blow down	Sent to central monitoring basin, CMB
Boiler blow down	Sent to CMB, If any
DM plant regeneration waste	Neutralization pit and sent to CMB
Service water	Treated in ETP (flocculator, settling tank) and sent to CMB
Effluents from fuel storage areas, floor washings, runoff from Oil handling area	Passed through Oil water separator and sent to CMB
Sewage from township and plant	Treated in STP

The flowcharts of Effluent Treatment Scheme and the proposed STP are given in **Figure-4.5** and **Figure-4.6** respectively.

4.5.3 Rainwater Harvesting System

Rainwater harvesting structures shall be provided to recharge the groundwater resources in the region. The run-off water from the roof of the structures and paved areas shall be collected through storm water drainage system and led to rain water harvesting structure. The typical rainwater harvesting structure is shown in **Figure-4.7**.

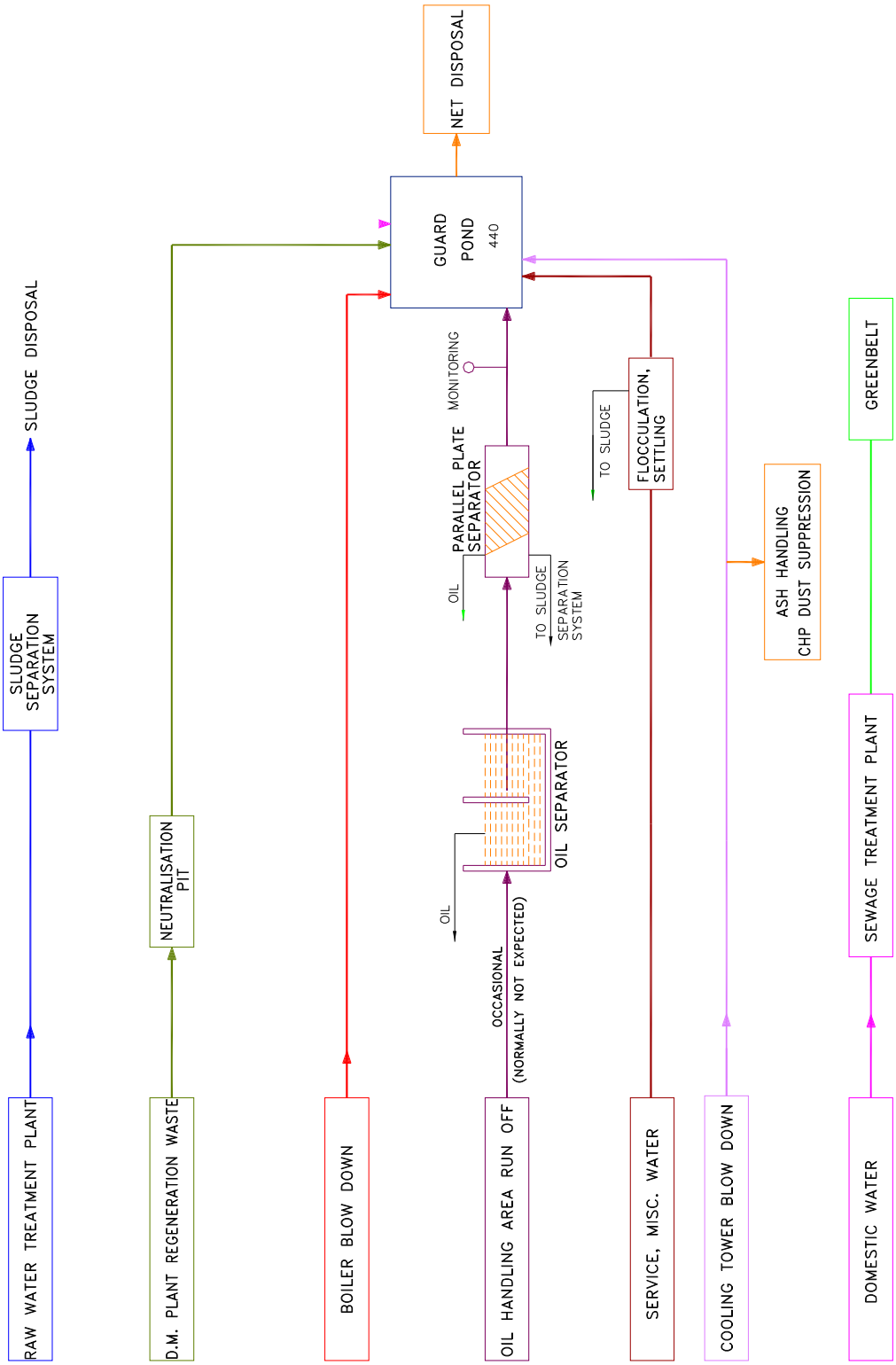


FIGURE-4.5
FLOWCHART SHOWING EFFLUENT TREATMENT SCHEME

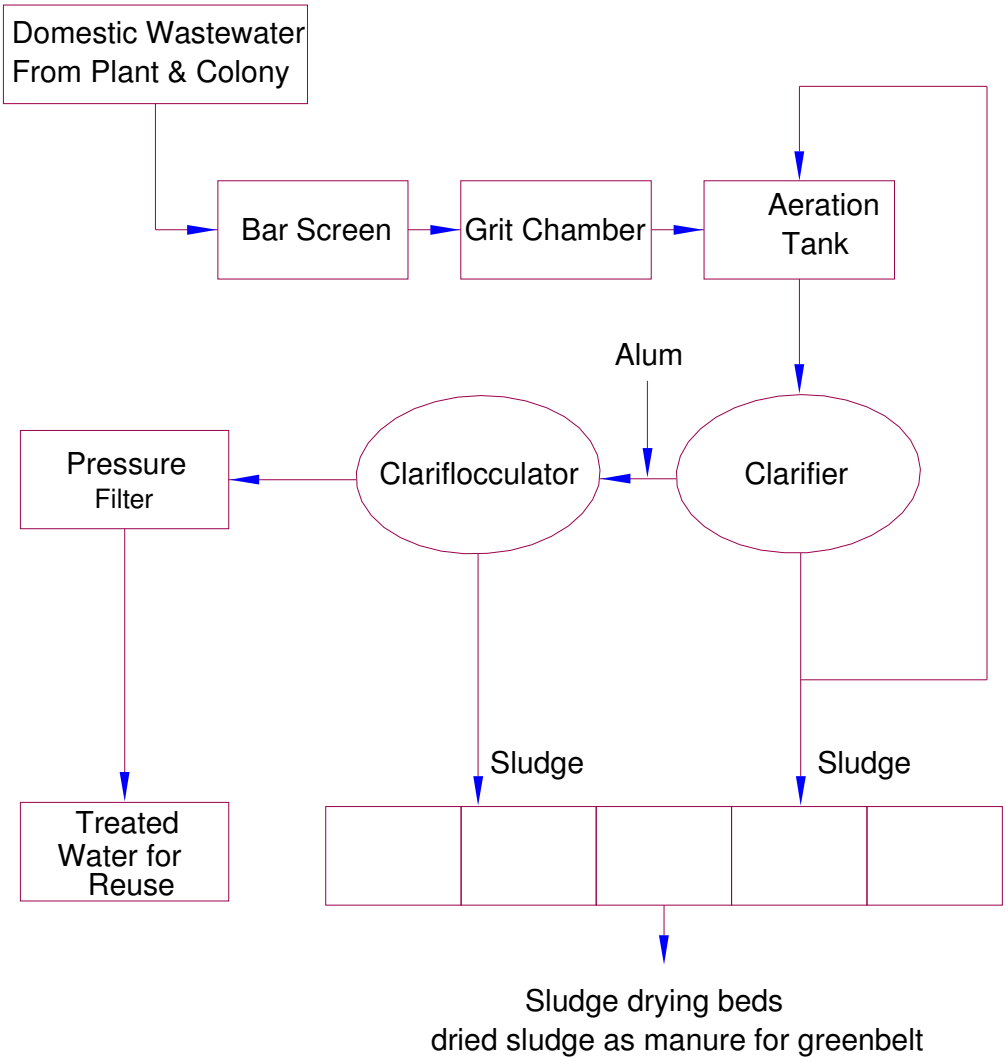


FIGURE-4.6
FLOWCHART SHOWING PROPOSED STP

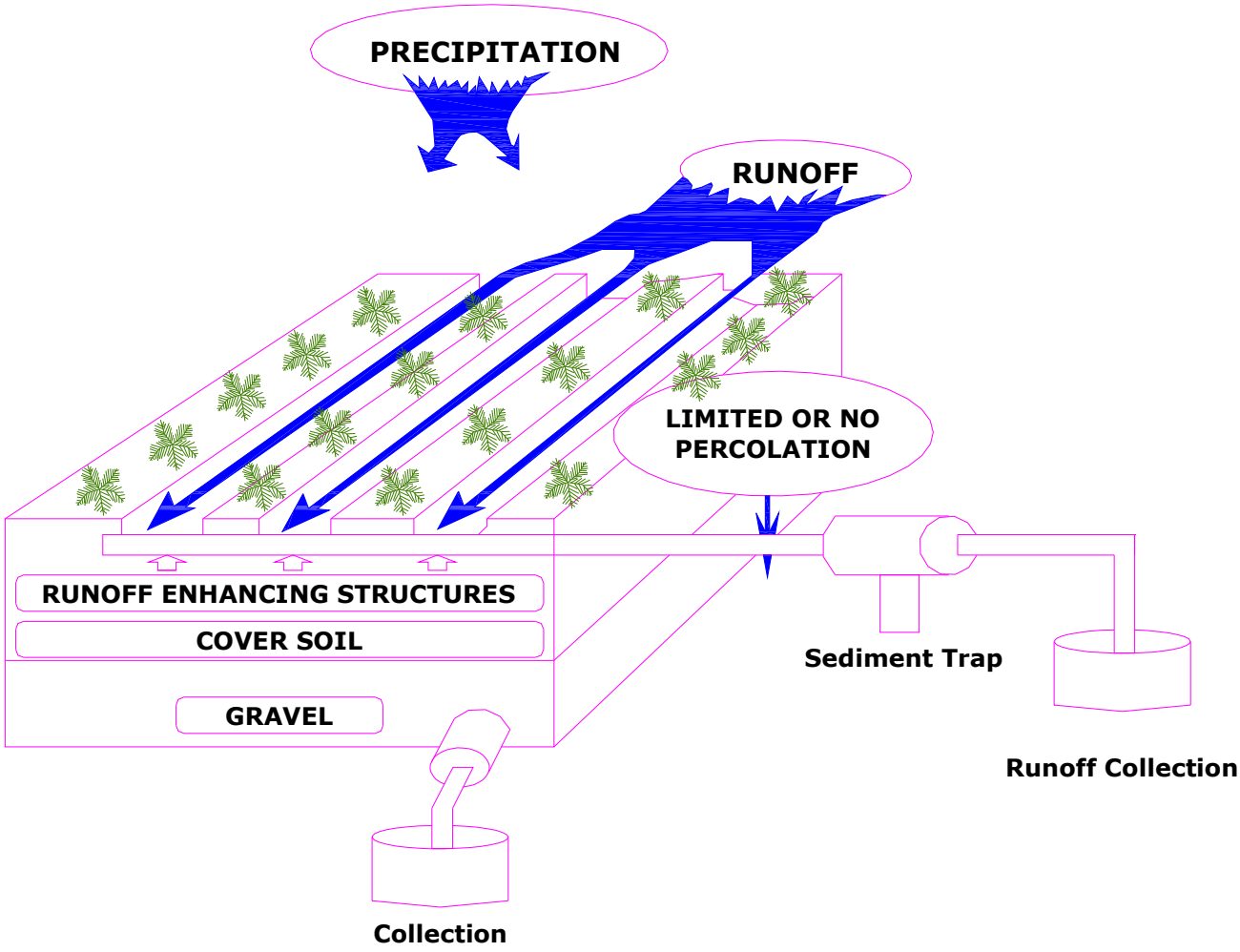


FIGURE-4.7
TYPICAL RAIN WATER HARVESTING STRUCTURE

4.5.3.1 Rainwater Harvesting Facilities

Groundwater Recharge with Rain Water Harvesting

There is generation of surface run-off from the plant facility during monsoon season. The run-off will be of two types, i.e., run-off from the pervious area of the facility site and run-off from the built-up area of the facility.

- ***Run-off from the Built-up Areas***

The run-off from the paved surfaces of the proposed facility will be routed through a carefully designed storm water drainage network and collected in storm water collection sump and excess rainwater will be discharged to bore wells constructed on these internal drains.

- ***Run-off from the Pervious Area***

The run-off from the pervious area will be routed directly to the rainwater harvesting structures constructed at suitable locations as per the contours.

For augmenting the ground water resources in the plant premises, number of rainwater harvesting pits will be constructed and the internal drains where excess rain water flowing in drain will be diverted to these pits. These structures will facilitate percolation of water into the ground and thus augmenting the groundwater sources. The roof top water will be routed to the storm drains. This will result in increase in groundwater tables and to some extent the improvement of ground water quality.

The size and the locations of rainwater harvesting pits will be decided during detailed engineering of the project. Run off from the proposed project site is calculated using rational formula:

Q = C x I X A
Q = Run-off in m^3/hr
A = Catchment Area (ha)
C = Coefficient of Run-off
I = intensity of Rainfall in mm/hr
Total area =524.7-ha
Intensity of Rainfall (I) = 2.5 cm/hr (1 inch/hr)
Run-off co-efficient (C) = 0.7

Q = 0.7 x (2.5/100) m/hr x (524.7 x 10000) m^2
= 91823 m^3/hr

4.5.3.2 Storm Water Management

The power plant water management system will be designed to minimize the potential for storm water contamination occurring at the site. This will be achieved by incorporating the following features into the storm water management system:

- Run-off from upstream areas will be diverted around the plant site;
- The quantity of contaminated run-off generated will be minimized by diverting run-off from areas external to the plant to storm water discharge points;
- Hazardous material and fuel storage areas will be bunded and drains will be provided around these facilities to prevent entering of run-off water; and
- Run-off from area external to process areas of the plant will be contained within a storage system.

4.5.4 Noise Pollution Management

In the process, various equipments like pumps, cooling tower, compressors etc generate the noise. The recommendations to mitigate higher noise levels are:

- Equipments should be designed to conform to noise levels prescribed by regulatory authorities;
- Provision of acoustic barriers or shelters in noisy workplaces;
- Provision of hoods to noise generating equipments like pumps;
- Provision of thick greenbelt to attenuate the noise levels;
- Provision of Personal Protective Equipments (PPE) such as earplugs, earmuffs to the workers working in high noise level area; and
- Implementation of greenbelt, landscaping with horticulture at power block areas to reduce noise impacts.

4.5.5 Solid Waste Management

Solid waste in the form of ash will be generated in a coal based thermal power plant. Ash content in the coal will be 32% in case of worst coal consideration. The total ash generated in the plant will be 2.75 MTPA out of which 80% will be bottom ash i.e. 2.2 MTPA and balance will be fly ash of 0.549 MTPA.

The following measures shall be taken for solid waste management:

- In general ash will be given to potential ash users;
- The excess ash will be disposed off using high concentrated slurry disposal system to impervious lined ash pond;
- The generated waste oil shall be explored to be used in boiler furnace with HFO or shall be given to authorized recyclers;
- The organic portion of solid waste generated in the Sewage Treatment Plant (STP) will be used as manure in greenbelt development; and
- Maintaining the data base on solid waste generation such as quantity, quality, and treatment/management.

4.5.5.1 Literature on Fly Ash Utilization

- ***Fly Ash use in Cement Industries***

Cement mixed with fly ash is known as Portland Pozzolana Cement (PPC). As per the Indian standards, fly ash can be used to replace 25% cement. The fly ash cement is made by grinding with clinker. The fly ash generated from proposed power plant will be supplied to cement plants in the region. The fly ash can be utilized by these cement plants to manufacture PPC cement.

- ***Fly Ash use as Micro-Nutrient in Fertilizer***

Ash is a good fertilizer due to the presence of heavy metal traces, which act as micro-nutrients to the vegetation and give good yield of agricultural produce.

It is estimated that the application of 1 to 2 tonnes of ash per hectare of land will increase the yield of the crops by 30%.

- ***Fly Ash use in Road Construction***

Fly ash can be used as a component in a stabilized aggregate sub-base course. A blend of 84% dense aggregate, 11% pond fly ash and 5% hydrated lime gives maximum dry density, optimum moisture content and unconfined compressive strength.

4.5.5.2 Prospective Ash Utilization

It is very much clear that the ash generated at the power plants can be effectively used for various products. Though the acceptability of the ash-based products may take a long time, it is always better to start on a small scale.

4.5.5.3 Policy on Fly Ash Utilization

Utilization of ash produced by coal based power stations as a thrust area of its activities and all possible actions will be taken to enhance level of ash utilization. In the proposed power plant, various avenues for ash utilization will be explored as delineated in the above sections. In particular, supply of quality ash for manufacture of cement will be taken as there are some cement units. Some of the actions planned for the project are as given below:

- LTPCL will make efforts to motivate and encourage entrepreneurs to set up units for manufacture of ash-based products such as fly ash bricks, lightweight aggregates, cellular concrete products etc as ancillary industries in the region.
- LTPCL would also continue to encourage utilization of available ash based products in all its construction activities; and
- LTPCL will encourage the use of water treated fly ash as a soil ameliorator and as a source of micro-nutrients and secondary nutrients for improving agricultural productivity. The progressive ash utilization plant is presented in **Table-4.9.**

TABLE-4.9
PROGRESSIVE ASH UTILIZATION PLAN

Item Description	1st year	2nd year	3rd year	4th year
Total Production of Ash (MTPA)	2.20	2.20	2.20	2.20
Fly ash bricks, blocks, tiles, etc.	0.50	0.75	1.00	1.10
Paving blocks, paving tiles, roofing sheets etc wherein cement is used as binder	0.05	0.05	0.07	0.07
Cement manufacturing	0.75	1.00	1.20	1.00
Clay based building materials such as bricks, blocks, tiles, etc	0.06	0.08	0.90	0.01
Concrete, mortar and plaster	0.02	0.05	0.07	0.02
Total Consumption	1.38	1.93	3.24	2.20
Utilization (%)	62.73	87.73	147.27	100.00

Note: The figures derived at about the ash utilization in the area are only rough estimates and may be considered as a guideline only.

The amount collected from sale of fly ash and fly ash based products by this power station would be kept in separate account head and shall be utilized for peripheral development.

4.5.5.4 Conclusion

All efforts will be made for maximum utilization of ash. However, after reviewing various proposals of the ash utilization, 40-70% of ash utilization is possible at the initial period and same will be improved over the period of time in future. LTPCL is committed to explore possibilities for ash utilization considering new technologies and avenues and try to achieve the target fixed by MoEF in this regard.

LTPCL *is committed to comply with the Fly Ash Utilization Notification, 1999 and as amended thereof.*

4.5.5.5 Fly Ash Disposal

The balance ash after utilisation shall be disposed in ash pond. Ash disposal system proposed is High Concentrate Slurry Disposal (HCSD). Treated wastewater will be used in ash handling plant. The area provided for ash pond is about 102-acre.

The major advantages of the HCSD method are:

- Very low water consumption;
- The slurry can be self-setting and self limiting so that ash will deposit and dry by itself to form a hard surface;
- Considerably less area is required for ash disposal;
- Specific energy consumption in pumping and transportation will be much lower;
- Pipeline diameter can be much smaller and transportation velocities could also be considerably lower due to the fact that the slurry is non-settling. This could also reduce wear in the pipeline;

- Both bottom ash and fly ash can be disposed together if needed; and
- The trenches will be constructed along the periphery of the ash pond to collect the run-off water during rainy days. The run-off water will be routed through sedimentation tank before discharging into nalla.

The ash will be utilized in various construction materials to the maximum extent and 100% utilization will be achieved.

4.6 Greenbelt Development

With rapid industrialization and consequent deleterious impact of pollutants on environment, values of environmental protection offered by trees are becoming clear. Trees are very suitable for detecting, recognizing and reducing air pollution effects. Monitoring of biological effects of air pollutant by the use of plants as indicators has been applied on local, regional and national scale. Trees function as sinks of air pollutants, besides their bio-esthetical values, owing to its large surface area.

The greenbelt development not only functions as foreground and background landscape features resulting in harmonizing and amalgamating the physical structures of the plant with surrounding environment, but also acts as pollution sink. Thus, implementation of afforestation program is of paramount importance. It will also check soil erosion, make the ecosystem more complex and functionally more stable and make the climate more conducive.

Greenbelt with a width of 50-m will be developed around the plant site. The total greenbelt around the power plant complex will be about 309-acre (125.1-ha).

In the proposed greenbelt about 2,50,000 trees will be planted with a density of minimum 2000 trees/ha inside the plant and vicinity. A total cost of Rs. 12.5 Crores is proposed to be spent for the development of green belt. The plantation schedule will be completed within five years from the construction period of the project. The plantation schedule is given in **Table-4.10**.

TABLE-4.10
GREENBELT DEVELOPMENT SCHEDULE

Sr. No.	Year	Area (ha)	No. Saplings
1	1st Year	25.02	50000
2	2nd Year	25.02	50000
3	3rd Year	25.02	50000
4	4th Year	25.02	50000
5	5th Year	25.02	50000
	Total	**125.1**	**250000**

The layout plan of the greenbelt and tree cover in plant area is shown in **Figure-4.8**.

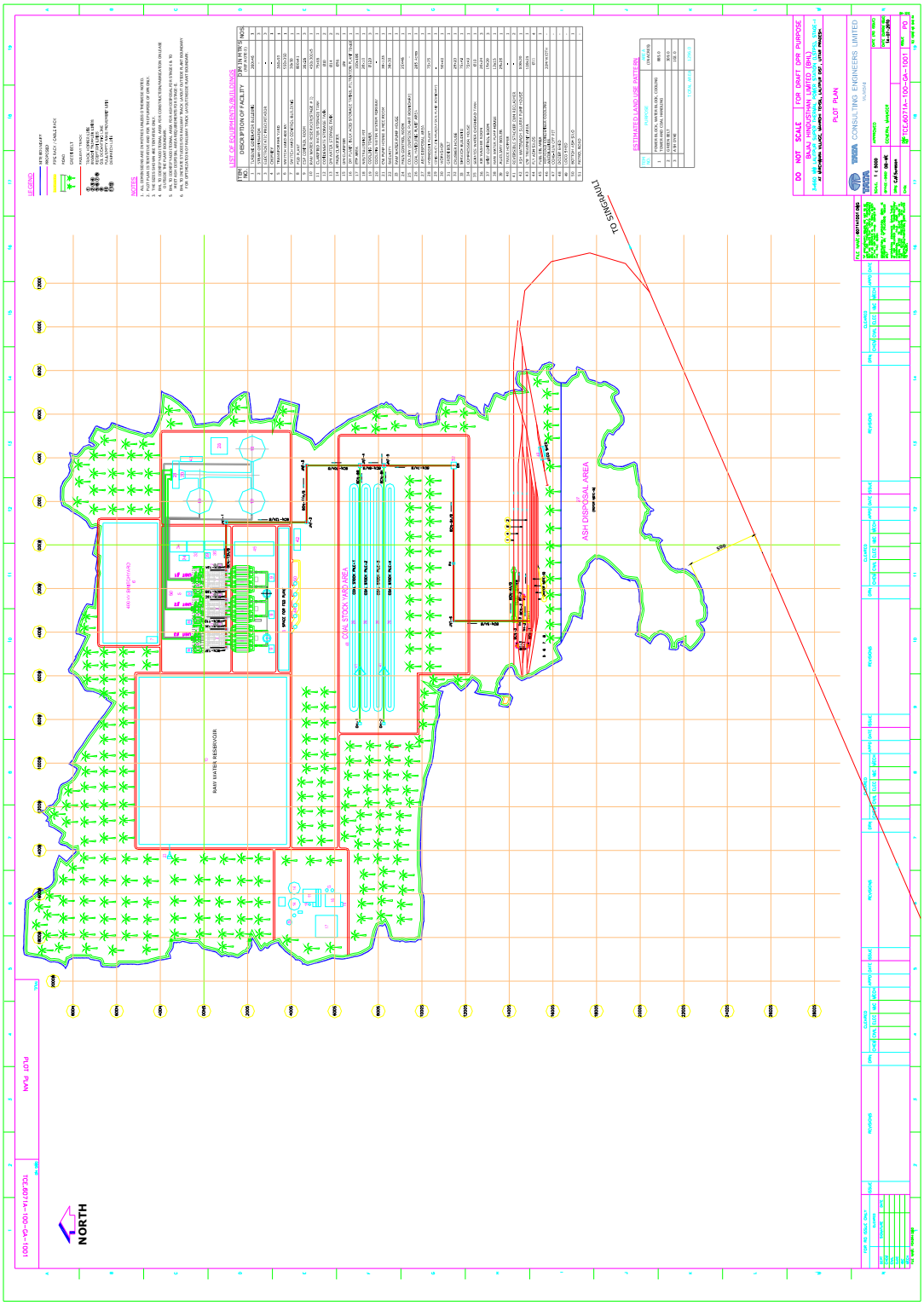


FIGURE-4.8
GREENBELT DEVELOPMENT PLAN

4.6.1 Species for Plantation

The species proposed will have broad leaves. Trees will be selected based on the type of pollutants, their intensity, location, easy availability and suitability to the local climate. They have different morphological, physiological and bio-chemical mechanism/ characters like branching habits, leaf arrangement, size, shape, surface (smooth/hairy), presence or absence of trichomes, stomatal conductivity proline content, ascorbic acid content, cationic peroxides and sulphite oxidize activities etc to trap or reduce the pollutants. Species to be selected will fulfil the following specific requirements of the area:

- Tolerance to specific conditions or alternatively wide adaptability to eco-physiological conditions;
- Rapid growth;
- Capacity to endure water stress and climate extremes after initial establishment;
- Differences in height and growth habits;
- Pleasing appearances; and
- Providing shade.

Based on the above, the recommended species for greenbelt and plantation are given in **Table-4.11**. Further, the already existing / native species will be given preference.

TABLE-4.11
RECOMMENDED PLANTS FOR GREENBELT

Note: S: Small, M: Medium, L: Large

Sr. No.	Botanical Name of the Plant with Height	Hindi Name	Size of Plant Type and Suitable site
1	*Acacia auriculaeformis (Mimosaceae) Height: 5m*	Vilaiti	M; Semi-evergreen fragrant white flowers; suitable in green belts and on road sides
2	*Adina cordifolia (Rubiaceae) Height: 20m*	Haldu	L; deciduous, a light demander, suitable on open areas & near flares
3	*Aegle marmelos(Rutaceae) Height: 12m*	Bael	M; deciduous, good for green belts near temples
4	*Anogeissus latifolia (Combretaceae)*	Dhaura	M; deciduous suitable for green belts
5	*Artabotrys hexapetaius (Annonaceae) Height: 10m*	Hara Champa	S; evergreen shrub with fragrant flowers good for gardens & inside boundary wall and long canals
6	*Averrhoa carambola (Averrhoaceae Oxalidaceae) Height: 5m*	Kamrak	S; semi ever green good in narrow green belts (green belts < 50 m width) Along channels
7	*Azadirachta India (Meliaceae) Height: 20m*	Nim	L; evergreen ; Suitable in green belts and out side office & hospital buildings
8	*Bauhinia variegate (Caesalpiniaceae) Height: 5m*	Kachanar	M; deciduous, good in green belts in garden and as a second row avenue tree
9	*Boswellia serrata*	Kundur	M; deciduous suitable on green belt on

Sr. No.	Botanical Name of the Plant with Height	Hindi Name	Size of Plant Type and Suitable site
	(Burseraceae) *Height: 4m*		shallow soils
10	*Burera serrata (Bureraceae)* *Height: 4m*		M; evergreen, suitable on shallow soil as a green belt or avenue tree
11	*Butea monosperma* *(Fabaceae; Papilionaceae)* *Height: 10m*	Palas	M; deciduous for green belts and as a second row avenue tree
12	*Caesalpinia pulcherrima* *(Leguminosae)* *Height: 4m*	Gulutora	S; a large shrub, suitable for gardens out side offices and along channels
13	*Callistemon lanceolatus* *(Myrtaceae)* *Height: 5m*		M; deciduous for some time, ornamental plant in garden
14	*Careva aroborea* *(Lecythidaceae)*	Kumbi	L; deciduous, good in green belts
15	*Carrisa carandas* *(Apocynaceae)* *Height: 3m*	Karaunda	S; semi evergreen. Large bushy shrub, good as a hedge to protect against noise
16	*Caryota urens (Palmae)* *Height: 5m*	Mari	A lofty palm, good as a windbreak
17	*Cassia fistula* *(Leguminopsaae)* *Height: 12m*	Amaltas	M; deciduous, good ornamental tree in green belts
18	*C. Siamea* *Height: 10-12m*		L; evergreen, good an avenue tree
19	*Cedrela toona* *(Meliaceae)* *Height: 5-8m*	Mahanim	L; deciduous, good in open spaces, in green belts and along ponds
20	*Cestrum diurnum* *(solanaceae)* *Height: 3m*	Din-ka-raja	S; a shrub with white fragrant flowers, suitable around boilers and waste disposal sites
21	*Dalberciasisso (Leguminosae)* *Height: 3-5m*	Shisham	M; deciduous suitable on areas around flare sites and in green belts
22	*Delomix regia* *(Leguninosae)* *Height: 15m*	Gul Mohar	M; deciduous ornamental, suitable on road sides
23	*Dillenia India* *Height: 3-5m*	Chalta	L; evergreen, white fragrant flowers, good in green belts and around waste disposal sites.
24	*D. Pentagyna* *Height: 5-8m*	Aggai	L; deciduous , good in green belts and on site around flare
25	*Emblica officinalis* *(Euphorbiaceae)* *Height: 5m*	Amla	M; deciduous, good as isolated trees in gardens.
26	*Ervthrina suberosa* *(Leguminosae)*	Dauldhak	M; deciduous, good in green belts
27	*E.variegata* *Height: 10m*	Dadap	M; deciduous, good in gardens out side office buildings
28	*Ficus bengalensis* *Height: 20m*	Bargad	L; deciduous, widely spaced avenue tree (15 m apart)
29	*F. religiosa* *Height: 20m*	Pipal	L; deciduous, widely spaced avenue tree also as a single tree in isolated sites
30	*Gmelina arborea* *(Verbenaceae)* *Height: 3-5m*	Sewan	M; deciduous , good in green belts around flare sites
31	*Grewia tiloifolia* *(Tiliaceae)* *Height:3- 5m*	Dhamim	M; good in green belts for use as timber
32	*Hamelia patents*		S; evergreen shrub with dense

Sr. No.	Botanical Name of the Plant with Height	Hindi Name	Size of Plant Type and Suitable site
	(Rubiaceae) *Height: 3m*		attractive foliage of greenish bronze leaves; good in gardens
33	*Hardwickia binata* *(Leguminosae)* *Height: 3-5m*	Anjan	M; deciduous, good for green belts on shallow soils
34	*Hibiscus mutabilis* *(Malvaceae)* *Height: 3-5m*	Sthal kamal	S; large bushy shrub, semi evergreen good in green belts & in gardens, along channels
35	*H. rosa sinensis* *Height: 3m*	Jasut	S; evergreen woody showy shrub good for gardens
36	*Ixora arbprea* *(Rubiaceae)* *Height: 1-2m*	Nevari	S; much branched evergreen; good in green belts and in gardens
37	*Ixora coccinea* *Height: 1-2m*	Rangan	S; much branched evergreen; good in gardens and in green belts
38	*Jasminum sbrahmanir (Oleaceae)*	Moghra	S; much branched evergreen; good in gardens and in green belts
39	*Kydia calycina (Malvaceae)*	Pula	S; deciduous, good along canals and in green belts
40	*Lagerstroemia speciosa* *(Lythraceae)* *Height: 10m*	Jarul	M; deciduous, good along road sides and in garden
41	*Lannea coramandelica* *(Anacardiaceae)* *Height: 3-5m*	Jhingan	L; deciduous, good on well drained green belts and around flares
42	*Lawsonia alba (Lythraceae)* *Height: 3-5m*	Mehndi	S; glabrous much branched shrub, good along canal sides
43	*Madhuca indica* *(Sapotaceae)* *Height: 5-8m*	Mahua	M; deciduous, good in green belts
44	*Mallotus philippensis* *(Euphorbiaceae)* *Height: 5-8m*	Sindur	S; small evergreen tree, good along canals
45	*Melia azedarach* *(Meliaceae)* *Height: 5-8m*	Bakain	M; deciduous good along small roads and canals
46	*Millingtonia hortensis* *(Bignoniaceae)* *Height: 3-5m*	Akas Nim	L; semi evergreen flowers fragrant, good along road sides
47	*Mimusops elengi* *(Sapotaceae)* *Height: 10m*	Maulsari	M; evergreen, good for avenues
48	*Moringa oleifera* *(Moringaceae)* *Height: 10m*	Sainjna	M; deciduous, with fragrant flowers
49	*Murava koenigii (Rutaceae)* *Height: 3-5m*	Mitha Neem	S; semi evergreen good in green belts suitable site and along small channels
50	*Oreodoxia regea (Palmae)* *Height: 5-m*	Royal palm	L; semi- evergreen good along medium and small road sides as an ornamental plant
51	*Peltophorum inerma* *(Leguminosae, Caaesalpiniaceae)* *Height: 3-5m*		M; Semi evergreen, suitable on road sides, in gardens & outside office buildings
52	*Pliumeria acuuminata* *(Apocynaceae)* *Height: 3-4m*	Golainchi	M; semi evergreen, fragrant white flowers, good in green belts
53	*Plumeria alba* *(Apocynaceae)* *Height: 3-4m*		S; semi evergreen good for gardens
54	*Plumeria rubra*	Golaonchi	S; semi evergreen good for gardens

Sr. No.	Botanical Name of the Plant with Height	Hindi Name	Size of Plant Type and Suitable site
	Height: 3-4m		
55	*Pterocarpus marsupium (Leguminosae, Papilionaceae) Height: 3-5m*	Bija	M; deciduous, good on open areas with adequate light
56	*Pogamia pinnata (Leguminosae, Papilionaceae) Height: 3-5m*	Karanj	M; deciduous, good along roads and canals
57	*Samalia malabarica (Bombaceae) Height: 3-5m*	Semul	M; deciduous, good for avenues
58	*Samanea saman (Leguminosae) Height: 20m*		L; deciduous, a good tree along road sides for shade
59	*Saraca indica (Leguminosae, Caesalpinaceae) Height: 5m*	Asok	M; evergreen tree good on road sides within campus
60	*Spathodia campanulata (Bignoniaceae) Height: 12m*	Ruugtoora	L; iin gardens and avenues and in green belts, it is deciduous
61	*Syzygium cuminii (Myyrtaceae) Height: 20m*	Jaman	L; evergreen tree good in green belts, and with in campus road sides
62	*Tabernamontana coronaria (Apocynaceae) Height: 2-3m*	Chandni	S; an evergreen shrub, good in gardens and along cannels
63	*Tamarindus indica (Leguminosae, caesalpiniaceae) Height: 20m*	Imli	L; evergreen tree good along state national highways suitable site
64	*Xylia xyicarpa (Leguminosae;Minosaceae) Height: 2m*	Jambu	Good in gardens and along cannels and streams and on waste lands

Note: S: Small, M: Medium, L: Large