

PLANTATION PLAN

For

Development of Urban Extension Road-II (NH-344M) from design chainage Km
0.000 to Km 38.111 in the state of NCT of Delhi

By



NATIONAL HIGHWAYS AUTHORITY OF INDIA, MoRTH, GoI, New Delhi.

PLANTATION PLAN

1. INTRODUCTION

Due to the proposed development, some of the existing trees are to be felled. To offset this impact, compensatory afforestation programme through tree plantation, median plantation, horticulture and landscaping strategy has been prepared, based upon the experiences of successful implementation of several ongoing and completed projects.

2. OBJECTIVE

The main objectives are as follows:

- Reducing the impacts of air pollution
- Natural noise barrier
- Arrest of land erosion
- Prevention of vehicle glare from vehicles coming from opposite direction
- Enhancement of aesthetic view of the corridors
- Climatic amelioration
- Defining of ROW especially at sharp curves during night

3. SPECIES SELECTION

Grasses, shrubs and trees are the main species that are readily available in India. Wherever possible, the use of non-native species should be avoided since they can out compete and displace native plants leading to loss of native biodiversity. To maximise the chances of success of survival of species, selection of species shall be done according to environmental conditions of the project site. Care should also be taken to select species with root systems that match the nature of the soil movement at the project site. Homogenous avenues of trees should be selected for long stretches as it provides aesthetic qualities in the landscaping. One should also consider the economic and other social benefits while selecting the species for plantation. During the selection of species, preference should be given towards rapid growing, pollution tolerant and pest & disease resistant species. Shrub species, which are dwarf and pollution tolerant, are to be planted in the median to prevent the glare of traffic moving in opposite direction. Flowering, ornamentals plants and climbers can also be planted in urban areas to provide beauty. For this purpose, the species may be decided by interaction with local forest authority and local populace. Few species are recommended in the table below.

Table 1: Species Recommended

Scientific name	Common Name	Reason
<i>Ailanthus excelsa</i>	Maharukh / Adu Neem	Pollution Sink, Noise Barrier
<i>Alstonia scholaris</i>	Saptaparni	Pollution Sink, Aesthetic Value, Medicinal Value
<i>Azadirachta indica</i>	Neem	Noise barrier, Pollution sink, Economic & Medicinal Value
<i>Bombax ceiba</i>	Semal	Aesthetic Value, Economic Value
<i>Butea monosperma</i>	Dhak	Aesthetic value, Pollution sink
<i>Calistemon viminalis</i>	Bottle Brush	Aesthetic value, Pollution Sink
<i>Cassia fistula</i>	Amaltas	Landscaping, Flowering plant, Pollution sink, Medicinal Value
<i>Dalbergia sissoo</i>	Sheesham	Economic Value, Pollution Sink
<i>Ficus bengalensis</i>	Bargad	Noise barrier, Pollution sink, Medicinal Value & Religious value
<i>Ficus religiosa</i>	Peepal	Noise barrier, Pollution sink, Religious values
<i>Melia azedarach</i>	Bakain	Noise Barrier, Pollution Sink, Economic and Medicinal Value
<i>Moringa oleifera</i>	Sahajana	Economic Value, Medicinal value
<i>Pongamia pinnata</i>	Karanj	Economic and Medicinal Value
<i>Syzygium cumini</i>	Jamun	Pollution sink, Economic Value
<i>Tamarindus indica</i>	Imli	Noise barrier, Pollution sink, Economic & Medicinal Value
<i>Tecomella undulata</i>	Rohira	Aesthetic Value, Economic and Medicinal Value
<i>Terminalia arjuna</i>	Arjun	Noise barrier, Pollution sink, Medicinal Value

Table 2: No. of Trees to be Planted (Package wise)

S.No.	Package No.	No. of Trees	Median Plantation	Along the edges of RoW on both sides
1	Package 1	13817	4350	9467
2	Package 2	6600	1200	5400
3	Package 3	7108	1775	5333
	Total	27525	7325	20200

Table 3: Area identified for landscaping & tree plantation

S. No.	Type of plantation	Location (Km)	Remarks
1.	Shrubs	In median except structures	Ornamental type plantation shall be provided
2.	Landscaping	All service areas/ interchanges/ O&M centres/toll booths	Ornamental type plantation shall be provided
3.	Plantations	Available open land along RoW	About 27,525 nos. of trees to be planted as per IRC:SP:21-2009 preferably indigenous species like Jamun, Neem, Babul, Peepal, Shisham etc. List provided in table 1.

4. TASKS OF THE CONTRACTOR/CONCESSIONAIRE

As part of this project implementation, the contractor/concessionaire shall plant and maintain flowering, shade, medicinal, ornamental & fruit bearing trees in suitable area for which cost has been budgeted besides planting and maintenance of ornamental, medicinal & flowering plants and shrubs in the median for which cost has also been budgeted. The specific roles and responsibilities of the Contractor/Concessionaire include:

- Identification of the plantation stretches with NHAI and / or Consultant.
- Identification of nursery area and preparation of nurseries
- Planting of saplings in the nurseries during the construction period so that the saplings are a minimum 24 months old.
- Replantation of old saplings to the plantation stretches.
- Maintenance for three years including watering, removal of weed, litter and debris from the vicinity of the plantation.
- Ensure the protection of the tree guards provided to the saplings from trampling and browsing by the cattle.

5. GUIDELINES FOR HORTICULTURE PLANTATION AND LANDSCAPING

5.1. General

5.1.1. Scope

Contractor/Consultant to furnish all materials, labour and related items necessary to complete the work indicated on drawing and specified herein.

5.1.2. Materials

Plant Materials

- Plant Materials shall be well formed and shaped true to type, and free from disease, insects and defects such as knots, sun-scaled, windburn, injuries, abrasion or disfigurement.
- All plant materials shall be healthy, sound, vigorous, free from plant diseases, insects, pests of their eggs, and shall have healthy, well-developed root systems. All plants shall be hardy under climatic conditions like native species of the project area. Plants supplied shall conform to the names listed on the plant list provided above. Besides these plant species, the Contractor/Concessionaire shall supply other species as desired by the landscaping specialist and or the environmental specialist of the consultant. Under no circumstances, non-native species which might have a negative impact on the ecology of the area shall be permitted. No plant material will be accepted if branches are damaged or broken. All material must be protected from the sun and weather until planted.
- Any nursery stock shall have been inspected and approved by the Environmental Specialist of the Consultant.
- All plants shall conform to the requirements specified in the plant list. Except that plants larger than specified may be used if approved but use of such plants shall not increase the contract price. If the use of the larger plant is approved, the spread of roots or ball of earth shall be increased in proportion to the size of plant. Deliver plants with legible identification labels.

Topsoil (Good Earth)

- Topsoil or good earth shall be a friable loam, typical of cultivated topsoil of the locality containing at least 2% of decayed organic matter (humus). It shall be taken from a well-drained arable site. It shall be free of subsoil, stones, earth skids, sticks, roots or any other objectionable extraneous matter or debris. It shall contain no toxic material. No topsoil shall be delivered in a muddy condition. It shall have pH value ranging in between 6 to 8.5.

Fertiliser

- Measurement of sludge shall be in stacks, with 8% reduction for payment. It shall be free from extraneous matter, harmful bacteria, insects or chemicals (Subjected to safety norms).

Root System

- The root system shall be conducive to successful transplantation. While necessary, the root-ball shall be preserved by support with Hessian or other suitable material. On soils where retention of a good ball is not possible, the roots should be suitably protected in such a way that the roots are not damaged.

5.1.3. Condition

Trees and shrubs shall be substantially free from pests, diseases and shall be materially undamaged. Torn or lacerated roots shall be pruned before dispatch. No roots shall be subjected to adverse conditions such as prolonged exposure to drying winds or subjection to water logging between lifting and delivery.

5.1.4. Supply and Substitution

Upon submission of evidence that certain materials excluding the plant Species prescribed are not available at time of contract, the Contractor/Concessionaire shall be permitted to substitute with an equitable adjustment of price. All substitutions shall be of the nearest equivalent species and variety to the original specified and shall be subjected to the approval of the Environmental Specialist of the Consultant.

5.1.5. Packaging

Packaging shall be adequate for the protection of the plants to avoid heating or drying out.

5.1.6. Marking

Each specimen of tree and shrub or each bundle shall be legibly labelled with the following particulars:

- Its name
- The name of the supplier, unless otherwise agreed.
- The date of dispatch from the nursery.

5.2. Plantation Pattern

The type of plantation would be based upon the requirements and the feasibility of the sites along the project corridor. The availability of the space in the RoW is a major guiding factor for landscaping. The plantation pattern to be followed is:

- The first row of plants along the highways will be of small to medium height plants planted at a spacing of 2m c/c and the distance from the second row should be 3m. The second row should be in staggered. The distance from the toe of the embankment should be 1m minimum and the height should be between 2m to 3m.
- Flowering shrubs shall be planted in the median in rows as per width availability. Where the width is less than 1m, grass turfing is to be done. One row of plantation to be done at a spacing of 1 m c/c.

For special landscaping, embankment slopes and ground cover, herbaceous species to be used. Turfing to be done by grass.

5.3. Tree Planting

5.3.1. Plants and Shrubs

Trees should be supplied with adequate protection as approved. After delivery, if planting is not to be carried out immediately, balled plants should be placed back to back and the ball covered with sand to prevent drying out. Bare rooted plants can be heeled in by placing the roots in prepared trench and covering them with earth, which should be watered into, avoid air pockets round the roots and shrubs shall be planted with the approval of Environmental Specialist of Consultant.

5.3.2. Digging of Pits

Tree pits shall be dug a minimum of three weeks prior to backfilling. The pits shall be 120cms in diameter and 120cms deep. While digging the pits, the topsoil up to a depth of 30cms may be kept aside, if found good (depending upon site conditions), and mixed with the rest of the soil.

The side of the pit shall be replaced with the soil mixture as specified further herein. If the soil is normal it shall be mixed with manure; river sand shall be added to the soil if it is heavy. The bottom of the pit shall be forked to break up the subsoil.

5.3.3. Back Filling

The soil for backfilling shall be watered thoroughly and gently pressed down, a day before planting, to make sure that it may not further settle down after planting. The soil shall be pressed down firmly by treading it down, leaving a shallow depression all-round for watering.

5.3.4. Planting

No tree pits shall be dug until final tree position has been pegged out for approval. Care shall be taken that the plant sapling when planted is not buried deeper than in the nursery, or in the pot. Planting should not be carried out in waterlogged soil. Plant trees at the original soil depth; soil marks on the stem is an indication of this and should be maintained on the finished level, allowing for setting of the soil after planting. All plastic and other imperishable containers should be removed before planting. Any broken or damage roots should be cut back for sound growth.

The bottom of the planting pit should be covered with 50mm to 75mm of soil. Bare roots should be spread evenly in the planting pit; and small mound in the centre of the pits on which the roots are placed will aid on even spread. Soil should be placed around the roots, gently shaking the tree to allow the soil particles to shift into the root system to ensure close contact with all roots and prevent air pockets. Back filled soil should be firmed as filling proceeds, layer by layer, care being taken to avoid damaging the roots. The balance earth shall be filled in a mixture of 1:3 (1-part sludge to 3-part earth by volume) and 50gms potash, 50gms of Super Phosphate and 1 Kg. Neem oil cake. Aldrin or equivalent shall be applied every 15 days in a mixture of 5ml in 5 litres of water.

5.3.5. Staking

Newly planted trees must be held firmly although not rigidly by staking to prevent a pocket forming around the stem and newly formed fibrous roots being broken by mechanical pulling as the tree rocks.

The main methods of staking shall be:

- A single vertical stake, 900mm longer than the clear stem of the tree, driven 600mm to 900mm into the soil.
- Two stakes as above driven firmly on either side of the tree with a cross bar to which the stem is attached. It is suitable for bare- rooted or ball material.
- A single stake driven in at an angle at 45 degrees and leaning towards the prevailing wind, the stem just below the lowest branch being attached to the stake. Suitable for small bare- rooted or ball material.
- For plant material 3m to 4.5m high with a single stem, a three- wire adjustable guy system may be used in exposed situations.

The end of stake should be pointed and the lower part up to 1 m to 1.2 m should be coated with a non-injurious wood preservative allowing at least 150mm above ground level.

5.3.6. Tying

Each tree should be firmly secured to the stake to prevent excessive movement. Abrasion must be avoided by using a buffer, rubber or Hessian, between the tree and stake. The tree should be secured at a point just below its lowest branch, and just above ground level: normally two ties should be used for tree. These should be adjusted or replaced to allow for growth.

5.3.7. Watering

The Contractor/Concessionaire through the Landscape Contractor should allow for the adequate watering of all newly planted trees and shrubs immediately after planting and he shall during the growing season, keep the plant material well-watered

5.3.8. Fertilising

Fertilising shall be carried out by application of rotation of the following fertilisers, every 15 days from the beginning of the monsoon till the end of winter:

- Sludge or organic well-rotted dry farmyard manure: 0.05 cum or tussle.
- Urea 25gm.
- Ammonium sulphate 25gm.
- Potassium sulphate 25gm.

All shrubs, which are supplied pot grown, shall be well soaked prior to planting. Watering in and subsequent frequent watering of summer planted container- grown plants is essential.

The activities are listed in table below-

Table 4: Proposed Activities Schedule for Avenue Plantation/Median Plantation

Year	Month	Activities to be done	
1 st Year	January-March	1	Surveying & cleaning of the area
		2	Digging of Pits
		3	Procurement of Angles Iron and barbed wire (or other fencing material), an erecting the fence
	April-June	4	Procurement of Tree guard
	July-Sept.	5	SMC work
	Oct-Dec.	6	Planting of Saplings
		7	Watering

Year	Month	Activities to be done	
2 nd Year	April-June	1	Purchase of Farm yard manure
		2	Brick/iron etc. guard for 1 st row
		3	Plantation along the highway
		4	Filing up of Pits with Farm Yard manure and Soil
	July-August	1	Transportation of Plants
		2	Planting of Saplings
		3	Watering
		4	Weeding and hoeing
	September-November	1	Weeding and hoeing
		2	Watering 4 times a month
	December-February	1	Weeding and hoeing
		2	Maintenance
	March	1	Watering 4 times a month
3 rd Year	April-June	1	Watering 6 times a month
	July-August	1	Casualty Replacement (20% of the total plants)
		2	Weeding
		3	Maintenance by Mali
	September-November	1	Watering 2 times a month
		2	Maintenance by Mali
	Dec.-Feb.	1	Maintenance by Mali
	March	1	Watering 4 times a month
		2	Maintenance by Mali
4 th Year	April-March	1	Watering

Year	Month	Activities to be done	
		2	Casualty Replacement (10% of the total plants)
		3	Maintenance by Mali
5 th Year	April-March	1	Watering
		2	Casualty Replacement (5% of the total plants)
		3	Maintenance by Mali

Proposed arrangement for monitoring is given below.

Table 5: Proposed Monitoring Arrangement

Phase	Monitoring Parameter	Monitoring by	Release of Payment
1 st Year (Advance Soil Work)	No. of Pits	Horticulture Expert of Supervision Consultant, Environmental Officer of Project Proponent	December-40% of the total amount
2 nd Year (Plantation of Saplings)	Survival % of saplings	Horticulture Expert of Supervision Consultant, Environmental Officer of Project Proponent	April-20% of the total amount
3 rd Year (Maintenance of Plantation)	Survival % before & after Casualty Replacement	Horticulture Expert of Supervision Consultant, Environmental Officer of Project Proponent	April-20% of the total amount
4 th Year (Maintenance of Plantation)	Survival % before & after Casualty Replacement	Horticulture Expert of Supervision Consultant, Environmental Officer of Project Proponent	April-10% of the total amount
5 th Year (Maintenance of Plantation)	Survival % before & after Casualty Replacement	Horticulture Expert of Supervision Consultant, Environmental Officer of Project Proponent	April-10% of the total amount

5.4. Shrub Planting in Planter Beds

All areas to be planted with shrubs shall be excavated, trenched to a depth of 750mm, refilling the excavated earth after breaking clods and mixing with sludge in ratio 8:1 (8 parts of stacked volume of earth after reduction by 20%: 1 part of stacked volume of sludge after reduction by 8%). Tall shrubs may need staking, which shall be provided if approved by the Contracting-consulting engineer, depending upon the conditions of individual plant specimen. For planting shrubs and ground cover shrubs in planters, good earth shall be mixed with sludge in the proportion as above and filled in planters. Positions of planters shall be marked out in

accordance with the Design drawings. When shrubs are set out, precautions should be taken to prevent roots drying. Planting holes 40cm diameter and 40cm deep should be excavated for longer shrubs. Polythene and other non-perishable containers should be removed, and any badly damaged roots carefully pruned. The shrubs should then be set in holes so that the soil level after settlement will attain original soil mark on the stem of the shrub. The holes should be back filled to half of its depth and firmed by treading. The remainder of the soil can then be returned and again firmed by treading.

5.5. Grassing

5.5.1. Preparation

During period prior to planting, the ground shall be maintained free from weeds. Grading and preparation of the area shall be completed at least three weeks prior to the actual sowing. Regular watering shall be continued until sowing by dividing the area into portions of approximately 5m squares by constructing small bunds to retain water. These 'bunds' shall be levelled just prior to sowing of grass plants; it shall be ensured that the soil has completely settled.

5.5.2. Soil

The soil itself shall be ensured to the satisfaction of Environmental Specialist Consultant to be a good fibrous loam, rich in humus.

5.5.3. Sowing the grass roots

Grass lines will be used to provide a strong surface cover and will be planted over a well-prepared surface. Slope treatments using grasses will be allowed to establish properly such that the slopes are not subject to undue stress from erosion and mass movement in its initial stages. The sowing of grasses will create a strengthened surface that will reduce the vulnerability to erosion. Median with a width of 1.5 m will have only grasses to strengthen the surface. The Contractor/Concessionaire will ensure that the condition of the site is good enough for the successful establishment of grasses. Grass roots shall be obtained from a grass patch, seen and approved beforehand. The grass roots stock received at site shall be manually cleared of all weeds and water sprayed over the same after keeping the stock in place protected from sun and dry winds. Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date, fresh stock of grass roots shall be ordered and obtained.

5.5.4. Execution

Small roots shall be dibbled about 5cms apart into the prepared grounds. Grass will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed. The Contractor/Concessionaire through the landscape contractor shall supervise all field operations like preparation of surface, sowing of grasses and quality of grasses seeds used.

- Carry out grassing such that a cover of 25 gm of grass seed per sqm of surface is achieved.
- Carry out seed sowing before the onset of monsoon [May & June] to achieve the desired results. The watering of the surface will be by tankers till the onset of the monsoon.

- Ensure that a mulch of prepared and dried out herbs is laid over the whole seeded area after sowing, in a thin layer, so that the grass is not affected by direct sunlight and transpiration loss.
- The grasses and herbs recommended are *Cynodon dactylon*, *Bothriochloa intermedia*, *Cenchrus setigerus*, *Echinochloa colona* etc.

5.5.5. Maintenance

As soon as the grass is approximately a 3cm high, it shall be rolled with a light wooden roller in fine, dry weather and when it has grown to 5 to 8cm, above the ground, weeds must be removed and regular cutting with the scythe and rolling must be begun. A top-dressing of an ounce of guano to the square yard or well decomposed well broken sludge manure shall be applied when the grass is sufficiently secure in the ground to bear the mowing machine, the blades must be raised an inch above the normal level for the first two or three cuttings. That is to say, the grass should be cut so that it is from 4 to 5cms in length, instead of the 3cm necessary for mature grass. In the absence of rain, in the monsoon, the lawn shall be watered every ten days heavily, soaking the soil to a depth of at least 20cm. Damage or dying back of grass due to neglect of watering especially for seeding out in normal season shall be the responsibility of the Landscaping Contractor. Any shrinkage below the specified levels during the contract or defect liability period shall be rectified at the Landscaping Contractor's expense. The Landscaping Contractor is to exercise care in the use of rotary cultivator and moving machines to keep minimum the hazards of flying stones and brickbats. All rotary moving machines are to be fitted with safety guards.

5.5.6. Rolling

A light roller shall be used periodically, taking care that the area is not too wet and sodden.

5.5.7. Edging

These shall be kept neat and must be cut regularly with the edging shears.

5.5.8. Fertilising

The area shall be fed once in a month with liquid manure prepared by dissolving 45gms of ammonium sulphate in 5 litres of water.

5.5.9. Watering

Water shall be applied at least once in three days during dry weather. Watering whenever done should be thorough and should wet the soil at least up to a depth of 20cm.

5.5.10. Weeding

Prior to regular mowing, the Landscaping Contractor shall carefully remove rank and unsightly weeds.

5.6. Maintenance of Plants

5.6.1. Cultivating

The Contractor/Concessionaire through the Landscaping Contractor shall maintain all planted areas within contract boundaries for one year until the area is handed over in whole or in phases. Maintenance shall include replacement of dead plants, watering, weeding, cultivating, control of insects, fungus and other diseases by

means of spraying with an approved insecticide or fungicide, pruning, and other horticulture operations necessary for proper growth of the plants and for keeping the sub-contract area neat in appearance

5.6.2. Pruning and Repairs

Upon completion of planting work of the sub-contract all trees should be pruned, and all injuries repaired wherever necessary. The amount of pruning shall be limited for the necessity to remove dead or injured twigs and branches and to compensate for the loss of roots and the result of the transplanting operations. Pruning shall be done in such a manner not to change the natural habit or special shape of trees.

5.6.3. Tree Guards and Protective Fencing

According to local environment, shrubs shall be protected adequately from vandalism until established. Where the tree guards are necessary, care should be taken to ensure that they do not impede natural movement or restrict growth. The specifications of the tree guard proposed are given below:

- The tree guards shall normally be brick in urban and bamboo guards in rural and semi urban areas. The specifications of the cement guards should be as per the relevant IS specification. In certain cases, if required by the Consultant, Circular Iron Tree Guard with Bars shall be provided. The specifications of such tree guard shall be as per relevant IS specification. The Consultant shall spell out in details about the cases where such exception shall be applicable. In absence of any proper specification, the decision of the Consultant and or NHAI shall be binding.

5.7. Nursery Stack

Planting should be carried out as soon as possible after reaching the site. Where planting must be a necessity and / or be delayed, care should be taken to protect the plants from pilfering or damage from people / animals. Plants with bare-roots should be heeled-in as soon as received or otherwise protected from drying out, and others set closely together and protected from the wind. If planting is to be delayed for more than a week, packaged plants should be unpacked, the bundles should be opened, and each group of plants heeled in separately and clearly labelled. If for any reason the surface of the roots becomes dry, the roots should be thoroughly soaked before planting.

5.8. Completion

On completion, the ground shall be formed over and left tidy.

6. SPECIAL CONDITIONS AND PARTICULAR SPECIFICATIONS.

- Wherever applicable, work shall be done according to specifications in vogue, at the time of invitation of tender.
- The Plantation area should avoid the stretches within the settlement area and the Ecological Sensitive area.

- The stretches identified should be free from encumbrances and should not lead to impact on any private or community asset. No fresh land acquisition shall be made under the project for the purpose of plantation.
- Contractor/Concessionaire through the Landscaping Contractor shall make his own arrangement for water.
- The work included in the schedule of Quantities includes grassing as well as planting of trees and shrubs. The quoted rates shall include execution of these works at different levels and nothing extra shall be paid for any item, for working at these levels
- The Landscaping Contractor shall not be entitled to any compensation for any losses suffered by him and/or revision in the rates originally quoted by him.
 - On account unforeseen delay in commencing the work, irrespective of the cause of such delays.
 - On account of reduction in the scope of work.
 - On account of suspension of work or abandon after award of work.
- The Contractor/Concessionaire shall provide all facilities to Environmental Specialist / Project Engineer and / or his authorized representatives to make frequent inspection of their Nursery and ascertain the process / quality of various categories of trees / plants etc., grown by them.
- The quote rate shall include the cost of transportation of tools and plants to and from the site, including GST. It shall be clearly understood that no claim for any extra payment on account of GST shall be entertained after the opening of the tender.
- The safe custody and up-keep of various categories of plants brought to the site is the sole responsibility of the Contractor/Concessionaire and he shall employ enough supervisory personnel to ensure the safety of these items.
- The site of work may be handed over to the Contractor/Concessionaire in phases, as soon as the same are available and the Contractor/Concessionaire in turn shall work in these areas forthwith. Nothing extra shall be payable for such phased execution of work.
- While excavating / executing the work the Contractor/Concessionaire shall ensure that the existing cables / pipelines / structures / fittings are not damaged and if due to his negligence, these are damaged, the same shall be set right with no extra cost to the clients.
- The Contractor/Concessionaire shall co-ordinate his work with other agencies employed by the Clients and ensure that the works of other agencies are not hampered in any way during the duration of contract.
- The Contractor/Concessionaire shall keep the sites neat and clean during the execution of the work. Any debris found at or near the site of work shall be moved immediately as and when so required by the Environmental Specialist / Project Engineer.

- On completion of the work, the site of work shall be thoroughly cleaned, and all debris shall be removed before the work is handed over satisfactorily.
- The Contractor/Concessionaire shall, without any additional charge to the clients, renew or replace any dead or defective plants/grass for a period of 12 months after the certified date of completion.
- "General condition of contract and standard contract forms shall also be the part of the contract.
- All Tree saplings should be two years (2) years old before they are planted. The numbers of the plants shall be as specified in the schedule of quantities and shall be straight and symmetrical with a crown and having a persistent main stem. The size of crown shall be in good overall proportion to the height of the tree.
- Small trees and shrubs shall be well formed with the crown typical of the species or variety.

General requirements of plants

- Plants shall be typical of their species and variety, well-developed branches, and well foliated with fibrous root system. Plants shall be free from defects and injuries. Plants shall not be pruned before planting.
- Plants shall be free from defects and injuries.
- Plants shall not be freshly dug, and nursery grown.
- Nursery grown plants shall have been at least once transplanted
- Bark shall be free from abrasion.
- All trees, soon after planting, shall be properly supported with bamboo stocks to ensure their safety against winds or any other factor, which may affect it adversely.

Protection of "tree to be preserved"

- The Contractor/Concessionaire through the Landscaping Contractor shall be responsible for the protection of tops, trunks and roots of existing trees on site. Existing trees subject to the construction damage shall be boxed, fenced or otherwise protected before any work is started. Total 2374 Nos. of existing trees will be protected as it is in situ.

General Requirements of Earth Manure and Fertilisers

- EARTH: Good earth shall be agricultural soil of loamy texture, free from kankar, murram, shingles, rocks, stones, building rubbish and any other foreign matter. The earth shall be free from clods or lumps of sizes bigger than 50mm in any direction. It shall have pH ranging in between 6.5 to 7.5.
- MANURE: Manure shall be of well-decayed organic matter obtained in dry state from the Municipal dump or other similar source approved by the Environmental Engineer/ Project Engineer. The manure shall be free from earth, stone or other extraneous matter. Manure shall be supplied at site well screened.
- FERTILISER: If the soil tests indicate pH value not as per the above specification namely in between 6.5 to 7.5, following measures need to be taken.

- If pH exceeds 7.5, aluminium sulphate or equivalent fertilizer should be added at the rate of 1 kg per cubic metre to lower the pH by one full point.
- If pH is below 6.5, add ground limestone or equivalent fertilizer at the rate of 1 kg per cubic metre to raise pH by one full point.

7. TEAM FOR THE ASSIGNMENT

The Contractor/Concessionaire is free to recommend a team commensurate with the requirements of the project.

8. PACKAGEWISE TREE PLANTATION

Tree species will be selected as per guideline and list provided above. The number of tree package wise to be planted under plantation plan is listed below.

Table 7: Chainage Wise Area and No. of trees package wise

LHS		Area	No of trees planted	MEDIAN		Area	No of trees planted	RHS		Area	No of trees planted
From (km)	To (km)			From (km)	To (km)			From (km)	To (km)		
PACKAGE 1											
0.6	1.5	3600	600	0.6	1.7	2750	550	0.6	1.1	2000	333
1.9	3.4	6000	1000	1.8	2.5	1750	350	2.5	2.6	400	67
3.6	4.0	1600	267	4.1	5.1	2500	500	2.7	2.8	400	67
4.1	5.0	3600	600	5.2	7.0	4500	900	4.1	4.6	2000	333
5.4	6.1	2800	467	7.3	7.6	750	150	5.9	6.3	1600	267
6.3	6.9	2400	400	7.8	9.1	3250	650	6.4	6.9	2000	333
7.3	9.1	7200	1200	10.7	11.2	1250	250	7.9	8.6	2800	467
10.5	11.2	2800	467	11.4	13.4	5000	1000	9.3	9.8	2000	333
11.4	12.2	3200	533			21750	4350	12.2	13.8	6400	1067
12.3	12.6	1200	200							19600	3267
12.8	13.1	1200	200								
13.3	13.7	1600	267								
Total		37200	6200								
PACKAGE 2											
15	15.9	3600	600	15.4	15.5	250	50	21.7	22.4	2800	467
16.1	17.3	4800	800	16.5	17.0	1250	250	23.7	25.1	5600	467
17.4	20.6	12800	2133	18.7	19.9	3000	600			8400	933
22.1	22.3	800	133	23.3	23.9	1500	300				
24.7	25.6	3600	600			6000	1200				
26.3	26.6	1200	200								
		26800	4467								

PACKAGE 3											
28.45	29	2200	366	28.45	29.35	2250	450	28.45	29.5	4200	700
29.4	29.8	1600	267	32.3	32.6	750	150	32.6	32.9	1200	200
32.5	34.1	6400	1067	34.1	34.6	1250	250	33.1	33.3	800	133
35.5	36.5	4000	667	35.7	37.05	3375	675	33.6	36.5	11600	1933
		18200	2367	37.5	38	1250	250			17800	2966
						8875	1775				

9. RECOMMENDATIONS

Due care should be taken to ensure that a greenbelt is developed around the plant. All areas devoid of vegetation and having low density should be systematically and scientifically afforested. Greenbelt will be a set of rows of trees planted such a way that they form an effective barrier between the plant and the surroundings. The persistence of plantation plan is to contribute to the following factors:

- To attenuate noise levels generated from the plant;
- To improve the aesthetics of the plant area;
- To trap the vehicular emissions and fugitive dust emissions;
- To maintain ecological homeostasis;
- To prevent soil erosion and to protect the natural vegetation;
- To utilize the treated effluents.

The plantation species should be considered based on the following:

- Adapted to the Geo-climatic conditions of the area;
- Mix of round, spreading, oblong and conical canopies;
- Different heights ranging from 4 m to 20 m.
- 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;
- Providing shade.

For the Calculation of Cost for Plantation Plan, following parameters has been considered.

For Capital Cost

- a) Cost of Sapling (Trees/Shrub/Herbs)
- b) Transportation Charges

- c) Planting cost (including soil & moisture workings, pits etc.)
- d) Fencing Cost/Tree Guard
- e) Labour Charges/Gardner/Others

For Recurring Cost:

- a) Cost of drip irrigation
- b) Annual weeding and soil working
- c) Req. of water for irrigation
- d) Fertilization Cost
- e) Security and Vigilance

The cost of every heads has been provided below for Plantation Plan and its maintenance.

Table 8. Cost of Plantation for different heads including Maintenance

Heads	1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year	Total Cost (Lakhs)
Gardner/Labour	23	17	17	12	9	77
Cost of Saplings	9	7	6	5	3	30
Transportation Charges	13	9	9	7	5	42
SMC work/Plantation cost	19	15	14	9	7	65
Fertilization/Manure	11	9	9	6	5	40
Fencing/Tree Guard	42	31	31	20	14	138
Irrigation	12	9	9	6	5	41
Security & Vigilance	9	7	7	6	5	34
Misc.	8	6	6	4	3	28
Contingency	16	12	12	8	6	55
Total Cost (Lakhs)	163	123	120	83	62	551

Table 9. Year wise Plantation Plan with Cost for 5 Packages of Highway

P.No.	1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year	Total	Cost (Lakhs)
1	4200	3337	2850	2120	1310	13817	280.00
2	2000	1500	1700	700	700	6600	131.00
3	2000	1700	1600	1200	608	7108	140.00
Total	8200	6537	6150	4020	2618	27525	551
	163	123	120	83	62	551	

10. CONCLUSION

The tree species has been recommended as per soil quality and climatic conditions of the area. Year wise plan has been prepared for tree plantation on entire length of highway. Total 27,525 Trees will be planted and for its development, the budget of Rs. 551.00 Lakhs has been provided for the same.