CHAPTER - 8 ENVIRONMENTAL MANAGEMENT MEASURES

The chapter details out the measures incorporated during the project preparation stage to avoid and mitigate adverse impacts on the various environmental components. Apart from mitigation measures, enhancement designs have been worked out with an objective of improving the quality of environment along the upgradation corridor and thereby increase the acceptance of the communities to the project. The management measures have been discussed in the same order as the impacts identified in Chapter 7, where impacts have been assessed for each of the environmental components.

With regards to the maintenance component no significant impacts are envisaged. How ever in event of any unforeseen adverse impacts, they will be adequately mitigated through measures suggested as a part of the Environmental and Resettlement Management Plan prepared for the maintenance roads. The generic mitigation measures formulated for the maintenance routes are covered in the relevant sections of this Chapter.

A brief description of the environmental monitoring plan and the institutional strengthening measures required by the implementing agency has also been presented. The final section presents the budget for environmental management in the project.

8.1 APPROACH TO MITIGATION MEASURES

The development of mitigation and avoidance measures for adverse impacts of the proposed road development has been an iterative process, and has been a result of continued interaction between the design and environmental teams. This has resulted in incorporation of the environmental and social concerns into the project design. Though conscious efforts have been made to minimize the impacts of environmental and social components, certain impacts have been inevitable. The avoidance and mitigation measures involve reduction in magnitude of these impacts during various stages of the project through:

- Alterations during design, site clearance, construction and operation stages of the project to avoid adverse impacts
- Additional mitigation measures for unavoidable negative impacts on the environmental components.

These measures were incorporated into various stages of the project. Based on their applicability, both general and case specific measures were incorporated as follows:

Standard: The 'Standard designs' of various road sections, were arrived at after detailed deliberations between the design and the environment teams.

General: To avoid or mitigate impacts on environmental components, general mitigation measures were identified based on their characteristic features.

Generic: For various typologies, enhancement designs were prepared at a generic level so that they could be applied to locations selected by the Engineer in consultation with the PIU for implementation.

Specific: At various sensitive locations, site-specific measures and enhancement designs have been formulated as mitigation / compensatory measures for addressing the negative impacts as well to

improve the quality of the project corridors and generate goodwill among local communities regarding the project.

The following sub sections detail the mitigation measures adopted in TNRSP to minimize adverse impacts envisaged due to the project. In-depth investigations on the site have been carried out to ensure that encroachments onto the environmental resources are effectively avoided / minimized, and the alignment selected is environmentally acceptable.

8.2 AVOIDANCE AND MITIGATION MEASURES

8.2.1 METEOROLOGY

Avoidance measures, such as minimising of the number of trees to be cut etc, have been worked out as part of the design finalization. Only trees within 1.5 m from the edge of the proposed shoulder will be felled. By this modification of the CoI, the trees to be felled have been significantly reduced. However, a total of 5696 trees will be felled. Due to this felling, though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged, the microclimate is likely to be temporarily modified by vegetation removal, loss of roadside plantations and the addition of increased pavement surface.

Compensatory plantation and landscaping proposed shall help in restoring the green cover along the corridor. The forest wing within the environmental unit of the Project Implementation Unit will carry out the compensatory afforestation along the project roads.

8.2.2 TOPOGRAPHY

Raising the embankment height in habitations that are flood prone might further aggravate the situation. This has been overcome in the design by focusing more on improving existing cross drainage structures and/or constructing new cross drainage structures, than raising the embankment. At locations, where raising the embankment has been unavoidable, the road will be raised no more than the depth of the structural overlay to permit the water flow without appreciably raising the road level. The design of the cross drainage structures will follow IRC Guidelines (IRC, 1995). The cross drainage structures proposed under TNRSP are presented in **Table 8.1.**

Table 8.1: Summary of Culverts

Sl No.	Package	Description	Number of Culverts[1]
1	TNRSP 01	Arcot Thiruvarur	958
2	TNRSP 02	Nagapattinam Kattumavadi	325
3	TNRSP 03	Kattumavadi Ramanathapuram	190
4	TNRSP 04	Ramanathapuram Tuticorin	158
		Total	**1631**
Note: 1-Numbers includes improvement of existing culverts as well as provision of new culverts			

8.2.3 SOIL

8.2.3.1 Erosion control

(A) Along Upgradation Corridors

To address the problem of soil erosion along bridge-end fills, over steep banks and embankment slopes, the maximum batter slopes has been fixed for each cross section type. **Table 8.2** presents for each of the cross sections, the steepest allowable batter slope. Flatter slopes have been worked out to ensure

stability and reduce possibilities of slope failures. The appropriate type of treatments of slopes will reduce the potential for erosion of high embankments and bridge fills.

Table 8.2: Maximum Batter Slopes

Section	Steepest Allowable Batter Slope
2LSS	1:2
2LGS	1:3
2LMR	1:2
Source: Typical Cross sections.	

The contractor will be required to initiate measures to prevent runoff from road works, construction sites and stockpiles. Provisions under erosion control are included in BoQ. The budgetary provisions made are included in engineering costs. The measures will include:

- Accurate grading of drains and correct batter slopes to reduce erosion
- Arrangements for training and supervision of contractor personnel
- Mulching, netting and seeding of batters & drains immediately on completion of earthwork
- Ensuring runoff control structures are in place before earthworks are started
- Designs to cope with higher levels of runoff at times of high rainfall
- Construction of paths on embankments at strategic locations to minimize erosion from uncontrolled pathway use.

To check soil erosion on critical stretches some special measures needs to be employed. They include turfing on critical road embankment slopes with grass sods, in accordance with the recommended practice for treatment of embankment slopes for erosion control, IRC: 56-1974. The work shall be taken up as soon as possible provided the season is favourable for the establishment of sods. Other measures of slope stabilization will include mulching, netting and seeding of batters and drains immediately on completion of earthworks. Dry stone pitching for apron and revetment will be provided for bridges and cross drainage structures. **Table 8.3** presents the various erosion control measures proposed along the different packages. Adequate provisions have been made in the Engineering budget for implementation of such measures. Locations where such measures are to be implemented will be identified during project implementation.

Table 8.3: Erosion Control Measures

Type	Unit	BoQ Item No	TNRSP 01	TNRSP 02	TNRSP 03	TNRSP 04
Turfing on Slopes	m^2	Clause 307	706327	168867	162498	202963
Seeding and Mulching	m^2	Clause 308	6356932	675222	649992	304444
Stone Pitching	m^3	Clause 2500	30789	13064	3797	3542
Source: Bill of Quantities.						

Apart from provision of the mitigation measures, their effectiveness and further improvement in designs to reduce the concentration of pollutants in the watercourses with increase in traffic shall be monitored. The monitoring plan shall be functional in construction as well as in operation stages. Details regarding the monitoring plan have been described in the section on monitoring measures.

(B) Along Maintenance Corridors

On road embankment slopes where slippage is possibility, bio engineering techniques will be adopted to control soil erosion and also prevent any occurrence of landslides. On sections with high filling and deep cutting the side slopes will be graded and covered with bushes and grass, etc., adopting suitable bioengineering techniques. Maintenance Corridors where such measures might be felt necessary have been listed out in the ERMP (**Table 2**). The Engineer will decide the specific locations and the suitability of the measures to be adopted at site.

8.2.3.2 Soil Contamination

Soil contamination is likely due to the possible leakage of fuel/lubricants and dumping of construction wastes during construction stage and surface runoff and accident spills during the operation stage. These impacts will be largely localized.

(i) Construction Stage

The contractor will be required to initiate measures to reduce/prevent waste generation from all activities. Landfill sites will be identified and prepared by the contractor on approval of Construction Supervision Consultant and PIU. The measures will include:

- Arrangements for training and supervision of contractor personnel
- Measures for minimisation of waste and recycling of surplus materials for use by local communities
- Methods of collection and disposal of domestic waste
- Procedures for storage of hazardous goods and chemicals
- Plans for clean up of any accidental spillage
- Method of treatment of liquid waste
- Checks for ensuring erosion control structures are in place before earthworks are started

All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary will be considered incidental to the work and should be planned and implemented by the contractor as approved and directed by the Engineer. Disposal of all waste materials is responsibility of the contractor and provisions to this effect are provided in the engineering budget.

At various construction sites, the vehicles and equipment will be maintained and refueled in such a fashion that oil/diesel spillage does not contaminate the soil. It will be ensured that the fuel storage and refueling sites are kept away from drainage channels and important water bodies. At the wash down and refueling areas, "oil interceptors" shall be provided. All spills and petroleum products shall be disposed off in accordance to the SPCB Guidelines. Fuel storage and fuelling areas will be located at least 300m from all cross drainage structures and significant water bodies. In all fuel storage and refueling areas located on agricultural lands or productive lands, the topsoil preservation shall be carried out.

To minimize the dumping of construction wastes from the project, the debris generated due to the dismantling of the existing pavement structure shall be suitably reused in the proposed construction, subject to the suitability of the material and the approval of the Engineer, as follows:

- The embankment fill materials shall be reused for the proposed embankment.
- The sub grade of the existing pavement shall be used as embankment fill material
- The existing base and sub-base shall be recycled as sub-base of the new road
- The existing bitumen surface can be utilized for the paving of cross roads, access roads, and paving works in construction sites and camps, temporary traffic diversions, haulage routes etc.

Unusable debris material shall be suitably disposed off by the contractor at pre-designated dump locations, subject to the approval of the Engineer. The bituminous wastes shall be dumped in secure landfill sites only. At such locations dumping will be carried out over a 60 mm thick layer of rammed clay so as to eliminate any chances of leaching. The identification of such landfill sites shall be carried out by the Contractor (before start of construction activity) and duly approved by the CSC and PIU.

The effectiveness of the measures provided and any further improvement in designs to reduce the contamination with increase in traffic shall be studied by regular monitoring of the soil quality, both during the construction as well as the operation stages. A monitoring plan has been prepared for all the contract packages and is presented in the Section on monitoring measures. In the construction stage, soil quality shall be assessed at productive agricultural lands abutting major traffic intersections, near traffic detours and traffic diversions.

(ii) *Operation Stage*

During the operation stage, the probability of contamination of soil is only from the road runoff. The design of the road has been worked out such that the runoff is directed into nearest water bodies through well-designed drains. Impacts are anticipated only in case of accidents involving large spill over of hazardous materials or petroleum products. Monitoring shall be done at the locations where these have occurred and further course of action to reduce the pollution shall be worked out. Therefore, no contamination of the soil during operation stage except in case of accidents is anticipated.

8.2.3.3 Loss of productive top soil

As part of the finalization of the design for the project, efforts have been made to minimize the intake of productive lands. Road design has minimized the loss of productive lands by reducing the CoI and modifying the cross sections. The borrow areas; construction camp locations; traffic detours and other construction sites shall be selected carefully in consultation with the Engineer to minimize the agricultural land acquisition. To conserve the productive topsoil of all areas affected due to project, the following measures have been proposed:

- The topsoil from all areas to be permanently covered shall be stripped to a specified depth of 150mm and stored in stockpiles. At least 10% of the temporarily acquired area shall be earmarked for storing topsoil.
- The stockpile shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile will be restricted to 2m.

- Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum and shall be covered with gunny bags or tarpaulin.
- It shall be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles.
- To prevent any compaction of soil in the adjoining productive lands, the movement of construction vehicles, machinery and equipment will be restricted to CoI

The stored topsoil will be utilized for:

- Covering all disturbed areas including for the redevelopment of borrow areas.
- Top dressing of the road embankments and fill slopes.
- Filling up of tree pits, proposed as part of compensatory plantation.

The contractor shall be responsible for working out haul roads with the minimal loss of productive soils, in consultation with the Engineer.

8.2.3.4 Management of Borrow Areas

Specific locations of borrow areas to be used in TNRSP will be identified by contractor. The selection and recommendations for borrow areas for use in TNRSP, will be based on environmental as well as civil engineering considerations. Location of source of supply of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoEF, MoRTH and as specified in IRC: 10-1961.

Certain precautions have to be taken to restrict unauthorized borrowing by the contractor. No borrow area shall be opened without permission of the Engineer. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Engineer that there is no suitable uncultivable land in the vicinity for borrowing or private landowners are willing to allow borrowing on their fields. To avoid any embankment slippage, the borrow areas will not be dug continuously, and the size and shape of borrow pits will be decided by the Engineer. Redevelopment of the borrow areas to mitigate the impacts will be the responsibility of the contractor. The contractor shall evolve site-specific redevelopment plans for each borrow area location, which shall be implemented after the approval of the Engineer.

Precautionary measures as the covering of vehicles will be taken to avoid spillage during transport of borrow materials. The unpaved surfaces used for the haulage of borrow materials will be maintained properly. The haul roads and borrow areas will be managed and maintained by the contractor. Since dust raising is the only impact along the haul roads sprinkling of water will be carried out twice a day along such roads during their period of use. Necessary BoQs are incorporated in the project.

Borrowing of earth shall be carried out at locations recommended as follows:

Non-Cultivable Lands: Borrowing of earth will be carried out upto a depth of 2.0 m from the existing ground level. Borrowing of earth shall not be done continuously. Ridges of not less than 8m width shall be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges, if necessary, to facilitate drainage. Borrow pits shall have slopes not steeper than 1 vertical in 4 horizontal.

Productive Lands: Borrowing of earth shall be avoided on productive lands. However, in the event of borrowing from productive lands, under circumstances as described above, topsoil shall be preserved in stockpiles. The conservation of top soil shall be carried out as described in section 6.2.3.3 of this chapter. At such locations, the depth of borrow pits shall not exceed 45 cm and it may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside.

Elevated Lands: At locations where private owners desire their fields to be levelled, the borrowing shall be done to a depth of not more than 2 m or up to the level of surrounding fields.

Borrow pits along Roadside: Borrow pits shall be located 5m away from the toe of the embankment. Depth of the pit should be such that the bottom of the pit shall not fall within an imaginary line of slope 1 vertical to 4 horizontal projected from the edge of the final section of the bank. Borrow pits should not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300 m. Small drains should be cut through the ridges to facilitate drainage.

Borrow pits on the riverside: The borrow pit should be located not less than 15m from the toe of the bank, distance depending on the magnitude and duration of flood to be withstood.

Community / Private Ponds: Borrowing can be carried out at locations, where the private owners (or in some cases, the community) desire to develop lands (mostly low-lying areas) for pisciculture purposes and for use as fishponds.

Borrow Areas near Settlements: Borrow pit location shall be located at least 0.8 km from villages and settlements. If unavoidable, they should not be dug for more than 30 cm and should be drained.

8.2.3.5 Environmental measures in Quarries

As part of the project preparation process, all existing quarries along the corridor have been assessed of the suitability of the quarry material and their legal status. The details of such licensed quarries, with the suitable materials and already in operation are presented in **Figure 7.1(A) & (B)** and in **Appendix 7.1**. It has been envisaged that no new quarries will be proposed.

The quarries that have been identified as suitable have been established under "The Tamil Nadu Mines and Mineral Concession Rules, 1959 (corrected upto 31.3.2001)". The act lays down guidelines for establishing quarries and obtaining quarry lease. It also specifies the conditions to be maintained for operating the quarry or for obtaining renewal of quarry lease. In respect of quarrying in environmentally sensitive areas certain restrictions have been imposed to avoid any detrimental impact due to irresponsible quarrying. The rules lay down various precautionary measures during blasting, safety of workers, management measures within quarries, approval of the village heads prior to material leaving the village, precautionary measures to avoid spillage during transport of quarry materials. Excerpts from the TN mines and mineral concession rules are presented in **Appendix 8.1**.

The contractor is free to choose the quarries from amongst this list of quarries or any other existing quarry, which is already operational with the relevant clearances and compliance to environmental requirements. In case the whole quarry is taken up by the contractor then the contractor will be responsible for environmental management.

8.2.4 WATER

8.2.4.1 Impact on Surface water bodies

The impacts on ponds and other surface water bodies have been avoided by suitable design modifications. At locations where the encroachment onto the ponds and surface water bodies was necessitated due to other engineering and social concerns, loss due to the project has been compensated for. Typical enhancement designs have been contemplated for various pond locations that offer scope for mitigation as well as enhancement.

For *water bodies that are entirely lost due to the project*, construction of replacement ponds at the closest possible location with respect to the original water body will be taken up. The PIU will carry out the construction of these ponds with the participation of the project affected communities.

For *water bodies that are partly filled*, the area of the water bodies will be increased to compensate the loss. The loss shall be compensated for by the excavation of an equal volume of earth from elsewhere of the water body. If sufficient area is not available (as incase of confined ponds) the increase in depth will be contemplated. When the excavation is undertaken in the wet area of the water body, the banks will be protected, such that the slopes are not steeper that 1 vertical to 2 horizontal.

For ponds whose storage capacity is not being impacted but the embankment is being cut across, reconstruction of earthen embankment with turfing/pitching or strengthening bunds will be considered.

- Other measures for improvements for the water bodies include:
- Desilting of tank bed
- Clearing and shaping inlet and outlet channels
- Reconditioning sluice or weir
- Renovating steps or bathing ghat

The contractor shall carry out enhancement of the various surface water bodies in accordance to the drawings specified in the individual EMPs. Enhancement details of selected ponds are explained in the individual EMP's.

Future development that may involve the filling up of water bodies, or adversely impacting the water quality of these resources shall be discouraged. As part of the monitoring plan, water quality monitoring of various surface water bodies has been proposed at several locations along the corridors.

8.2.4.2 Prevention of degradation of water quality

All wastes arising from the project will be disposed off, as per SPCB norms, so as not to block the flow of water in the channels. The wastes will be collected, stored and transported to the approved disposal sites. To avoid contamination of the various surface water bodies and drainage channels in the vicinity of the construction site, construction work close to the streams or other water bodies will be avoided, especially during monsoon period. It will be ensured that any liquid construction waste discharged into the existing waterways is treated to the required standard. Construction of temporary or permanent devices to prevent water pollution due to increased siltation and turbidity shall be ensured. It will be ensured that no sanitary wastes from the labour camps are discharged into the nearby watercourses. Adequate sanitary measures in labour camps are essential in this regard.

Various measures that have been proposed for the protection of water quality along the corridor have been detailed in the following sections.

(I) Silt Fencing: Silt fencing will be provided to prevent sediments from the construction site entering into the nearby watercourses. The silt fencing consists of geotextile (MIRAFI 140N or equal) with extremely small openings supported by a wire-mesh mounted on a panel made up of angle frame (Refer **Figure 8.1**). Modules of 625 mm each are designed to allow ease of handling and construction. It is expected a single person will be able to drive the angles 300 mm into the ground by pressing from the top. The frame will be installed around stockpiles close to water bodies. The wire-mesh will provide structural stability and the 25x25x3 mm angle section will act as posts for the silt fencing. Number of silt fencing to be used has been worked out keeping in mind the tentative number of construction sites in each package and the number of roadside water bodies that have chances of being impacted. Number of silt fencing required for each package is presented in **Table 8.4**. The probable locations where such structures need to be installed along each package have been appended with the individual EMP's.

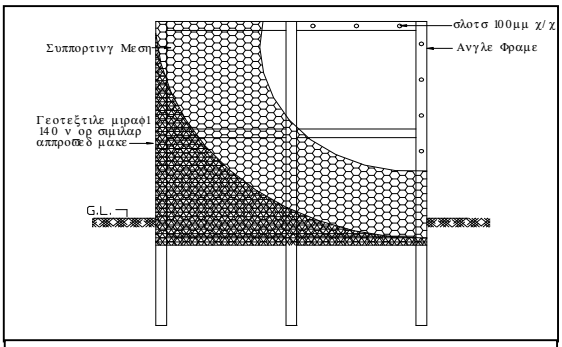

FIGURE 8.1: SILT FENCING

Table 8.4: Number of Silt fencing proposed for Upgradation Corridors

Sl. No.	Package	Construction Sites	Proposed Number of Silt Fencing
1	TNRSP 01	50	100
2	TNRSP 02	15	30
3	TNRSP 03	15	30
4	TNRSP 04	15	30
	TOTAL	95	190

Oil Interceptor: Oil and Grease from road run-off is another major concern. During construction, discharge of Oil and Grease is most likely from vehicle parking areas of the contractors' camps. The source is well defined and restricted. The technique for the separation of oil and water is gravity separation. Enough detention time is provided to allow oil to float on to the surface.

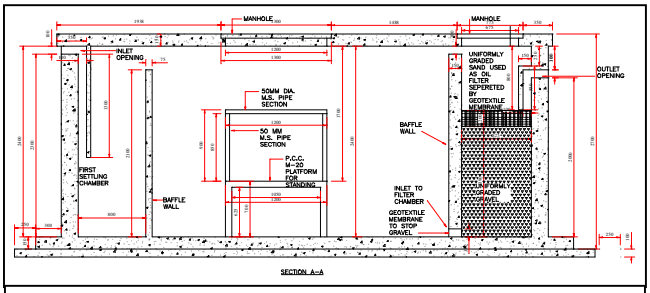

FIGURE 8.2: OIL AND GREASE INTERCEPTOR

The construction vehicle parking area, vehicle repair area and the workshops will be provided with oil interceptor. Slope of the prepared and paved site (1:40) ensures that all the wastewater flows into the interceptor before discharge. Periodic cleaning (once in a week) will be done from the outside by skimming off film of oil over the surface. **Figure 8.2** provides the details of the arrangement for the oil interceptor for the removal of oil and grease from 'point' sources.

The location of all fuel storage and vehicle cleaning area will be at least 300 m from the nearest drain/ water body. In addition, the maintenance and repairs of vehicles will be carried out in a manner such that contamination of water bodies and drainage channels can be avoided. The slopes of embankments leading to water bodies will be modified and rechannelised to prevent entry of contaminants into the water body.

The number of oil interceptors to be used has been worked out considering the tentative number of construction camps in each package since the vehicle parking areas will be located near such camps. The number of oil interceptors required for each package is presented in **Table 8.5.**

Table 8.5: Number of Oil Interceptors Proposed for Upgradation Corridors

Sl. No.	Package	Proposed Number of Oil Interceptors
1	TNRSP 01	6
2	TNRSP 02	2
3	TNRSP 03	2
4	TNRSP 04	2
	TOTAL	**12**

8.2.4.3 Disruption to other water users during construction

The contractor will arrange for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected. The total requirement of water has been worked out as 1280 m^3/day for Northern Corridor and 910 m^3/day for Eastern Corridor (Refer **Table 7.10** of Chapter 7). Maximum requirement of water at a particular place works out to approximately 20 to 25 m^3/day at a particular location.

There are several surface water sources as ponds, tanks etc in almost every village the corridors pass through. In the absence of potable water supply, these ponds traditionally have been the source of drinking water and irrigation to the communities. Along both the upgradation roads, most of the settlements have access to potable water through pipelines. This has reduced the dependence on the surface water bodies, especially along the settlements. Interactions with the communities especially along the Muthupet – Tondi - Ramanathapuram stretch revealed that the surface water, though not brackish, was not preferred due to the availability of a better source. However, these water bodies are used for irrigation and for other domestic uses by the community. At locations where the surface water sources are not available, especially along Ramanathapuram to Tuticorin stretch, water from desalinization plant is transported through pipelines to the neighboring villages, each of which has a pumping station for internal distribution. One such desalinization plant exists along the corridor at Naripaiyur (Km 6.0-7.0).

The Northern corridor has far lesser ponds (1 pond for every 8.3 Km) as compared to the eastern corridor. (1 ponds for every 3.8 km) [Refer **Appendix 4.7**]. However, there are major rivers along the stretch, which can be used for the project

No major threat to other water users is expected due to extraction of water from the surface water bodies as:

- Along the northern corridor, the flow in the rivers such as Palar, Kollidam and Cauvery is almost perennial. Only at locations where surface water sources are not available, the contractor can contemplate extraction of ground water. Consent from the Engineer that no surface water resource

is available in the immediate area for the project is a pre-requisite prior to extraction of ground water. The contractor shall need to comply with the requirements of the state ground water department and seek their approval for doing so.

- To avoid disruption/disturbance to other water users, the contractor will extract water from fixed locations
- Ground Water Board, PWD, GoTN has categorized blocks based on ground water extraction as over exploited and dark (85-100 %) and grey (65-85%). The contractor will not be allowed to extract any ground water from such over exploited and dark blocks and grey blocks.
- Along the eastern corridor, the surface water bodies get replenished from the aquifers. Any extraction of ground water, beyond the natural recharge might lead to degradation of water quality of these surface water bodies. Therefore, extraction of ground water is to be restricted along the eastern corridor.
- The TDS concentrations in the ground water were found exceeding 2000 mg/l for distances upto 20km from the coast, with the exception of the surface water bodies, which get recharged from the aquifers. The ground water will not be extracted by the contractor from over exploited, dark blocks and grey blocks. In the white blocks, the contractor is permitted to extract ground water at locations where the TDS is less than 1500 ppm. Through out the period of extraction the contractor will periodically monitor the TDS content (every season) to ensure that the TDS does not exceed 2000 ppm levels.
- Along TNRSP 04, two road stretches have been identified between Vembar and Kulattur and Kulattur and Tuticorin that are bereft of any roadside surface water bodies (Refer **Appendix 4.7**). Hence for these stretches alternate sources have been identified. They include:
    - For the stretch between Vembar and Kulattur, water for construction will be purchases from Naripaiyur Desalination Plant' s spare capacity. The plant is functional at present.
    - For the stretch between Kulattur and Tuticorin the required water will be sourced from the Manjaneer Kayal water treatment plant at Tuticorin. The plant treats 45000 KL/day with 1800 KL/day of filter backwash water being drained. The water requirement for this stretch is about 75 KL/day, which can be met from the filter backwash water, which will be separately treated and transported by trucks to this stretch.
- Wastage of water during the construction will be minimized. While working across or close to perennial water bodies, the Contractor will not impede or block any flow of water. If for any bridgework, containment of flow is required, the Contractor will seek approval of the Engineer. The Engineer will have the right to ask the Contractor to serve notice on all downstream users in advance of any closure.
- Construction over and close to any non-perennial streams shall be carried out in the dry season. Construction over irrigation canals will be undertaken with permission with the Department of Irrigation. Care should be taken to minimise any disruption to the flows and to ensure that a high quality of water is maintained.
- The Contractor may use the natural sources of water subject to the provision that any claim arising out of conflicts with other users of the said natural sources will be his responsibility.

8.2.4.4 Relocation of other water supply sources

Conservation / Avoidance of water supply sources as tube wells, water taps, wells etc. have been worked out in the design of the alignment. Wherever unavoidable, relocation of these water supply

sources, both private and community sources, shall be completed prior to the commencement of the construction by the contractor. To prevent any stress on the local water sources due to the relocation, the process of dismantling shall commence only after the community agrees upon the provision of the water supply source at the relocation site.

8.2.4.5 Drainage related issues

(i) Construction Stage

Detailed drainage surveys and hydrological investigations have been undertaken and suitable design of bridges and culverts have been proposed to ensure that the project road does not obstruct the existing course of the surface water flow and alter the hydrological setting. Existing cross-drainage structures will be upgraded and additional cross-drainage structures will be provided at locations where the flow is obstructed at present. In many places, a wider waterway has been proposed. Adequately sized roadside drains will ensure that the ponding on the roadside after a storm event is reduced to a minimum. The cross drainage works have been designed to handle discharge from a 50-year peak flood event.

The contractor will remove obstructions that may cause temporary flooding of local drainage channels, during construction. In sections along water courses, and close to cross-drainage channels, earth, stone or any other construction materials must be properly disposed off so as not to block the flow of water. All necessary measures will be taken to prevent earthwork, stonework and other debris from impeding cross-drainage at rivers, streams, water canals and existing irrigation and drainage systems. Covered drains will be provided in urban areas, which can also be utilized, for vehicle parking resulting in unobstructed vehicle movement on the main carriageway. For village areas both open as well as sub soil drains with perforated AC pipes at base of GSB layer including cross connectors for discharging to the open drain at 100m intervals will be provided. **Table 8.6** gives the length of drains to be provided as part of the project. Provision of cost for cross drainage structures and road side structures are included as part of engineering cost. Recharging pits for road side drains in urban areas will be provided.

Table 8.6: Provision for New Drains in TNRSP

Type	Area	Length (Kilometres)			
		TNRSP 01	TNRSP 02	TNRSP 03	TNRSP 04
Covered Drains	Urban Areas	25.753	4.7	2.78	1.0
Open Drains	Village Areas	104.49	53.027	19.853	37.264
Sub Soil Drains	Village Areas	104.49	53.027	19.853	37.264
Source: Bill of Quantities.					

Recharging Pit for Roadside Drain in Urban Areas: In urban areas, the run-off in roadside ditches needs to be disposed off. Provision has been made for urban recharging pits along stretches where the road passes through urban areas. These vertical drains serve two purposes: they dispose off unwanted run-off and encourage recharging of underground water resources. The drains have gravel columns and geo-synthetic filter fabric at about 2 m depth from the top of the bores and to prevent the transportation of contaminants into the aquifer. The drains will be provided for each kilometre of the road through settlements and near the outfall to a natural drain if the road crosses one inside a

settlement. **Figure 8.3** shows the details of one such recharge pit. The recharging pit designed requires a periodic maintenance and cleaning to operate at their design capacity. A total of 74 recharge pits have been proposed. **Table 8.7** provides the number of such pits proposed along each package.

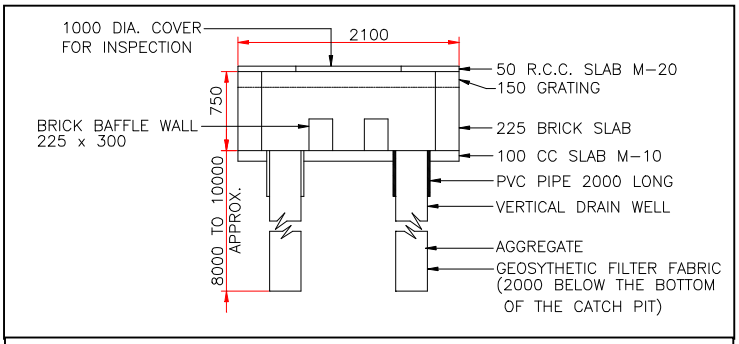

FIGURE 8.3: RECHARGING PIT FOR URBAN DRAINS

Table 8.7: Recharge Pits proposed along Upgradation Corridors

Sl. No.	Package	Proposed Number of Recharge pits
1	TNRSP 01	40
2	TNRSP 02	12
3	TNRSP 03	10
4	TNRSP 04	12
	TOTAL	**74**

(ii) Operation Stage

The roadside ditches will be cleaned regularly, especially before the monsoon season during the operation stage of the project to maintain the efficient functioning of the road drainage system.

8.2.5 AIR QUALITY

(i) Design Stage

At critical sections especially along the congested stretches of the existing road, removal of bottlenecks and congestion in built-up stretches were incorporated by improving road geometry and by widening the road to smoothen traffic flow. Bypassing settlements and consequent elimination of the slow moving local traffic, will ensure smooth flow of traffic and reduce emission of pollutants which is maximum when there is frequent changing of gears or travel speeds. **Table 8.8** presents a list of the critical locations from the air pollution point of view and the avoidance / mitigation measure in each case.

Table 8.8: Avoidance / Mitigation Measures for Air Pollution at Critical Locations

Sl No	Link / Chainage	Location	Description	Suggested Avoidance / Mitigation Measures
Package TN RSP 01(N)				
1	Arcot Elavanasur Km 2.000-3.000	Arani	Considerable Congestion due to narrow ROW, vending activities and encroachments. Rice mills in and around the town generate a lot of truck traffic following rice harvest.	The town is bypassed
2	Arcot Elavanasur Km 146.000-145.000	Kelur Reserve Forest	Alignment passes through the Reserve Forest at two locations. Forest is patchy due to human settlements at several places inside the forest	Pollutant levels monitored at Arani (20 Km up the road) have indicated levels in compliance with standards for sensitive areas.
3	Polur Chengam Km 0.000-1.000	Polur	High proportion of through traffic along with a busy rail crossing on the Vellore Villupuram line. Buses parked on the roadside due to lack of parking space for passing route services also add to the congestion.	The urban area is bypassed
4	Polur Chengam Km 5.000-6.000	Kamayansur School	School is located at a distance of 20 m from the C/L of the road on the left side. The School is in close proximity to a number of stone quarries and crushers	Fugitive emissions of particulate matter to be regulated through enforcement of prevalent norms
5	Polur Chengam Km 38.000-40.000	Mudanai Reserve Forest	The alignment runs through the Reserve Forest in close proximity to a small settlement (Pudur)	Present Pollutant Concentrations monitored within the Mudanai Reserve Forest are well within the Standards for Sensitive Areas
6	Arcot Elavanasur Km 103.00-104.00	Tiruvannamalai	The town is known for its famous Arunchaleshvara temple. Year by year the number of people and vehicles using the road has been increasing thereby compounding pollution levels	The town is bypassed
7	Arcot Elavanasur Km 100.000-99.000	Thippakkadu Reserve Forest	The road passes through the Reserve Forest for about 1 Km with shrubs and thorny bushes along both sides of the road	Pollutant levels monitored at Tiruvannamalai (3 Km up the road) have indicated levels in compliance with standards for sensitive areas.
8	Arcot Elavanasur Km 85.000-83.000	Attipakkam Reserve Forest	The road passes through a monoculture of Eucalyptus created by the Forest Department.	Pollutant levels monitored at Tiruvannamalai (20 Km up the road) have indicated levels in compliance with standards for sensitive areas.
9	Arcot Elavanasur Km 76.000-75.000	Tirukkovilur	A pilgrimage centre with two important temples attracting many pilgrims. Congestion due to through traffic is significant.	The town is bypassed
10	Arcot Elavanasur Km 17.000-18.000	Nattamur Reserve Forest	The road passes through the Reserve Forest with Eucalyptus plantations on the eastern side and Nattamur Sri Ayyanar temple and sacred grove on the western side. The Naripalayam Settlement is in close proximity	Present level of congestion is low. Monitoring carried out at Pugaipatti, 10 Km down the road have revealed Pollutant Concentration within the standards for sensitive areas
11	Arcot Elavanasur Km 26.800	Pugaipatti	Congested Settlement and Market. A School is also located on the right side at a distance of 10 m from C/L	Monitoring carried out near the School have revealed Pollutant Concentrations within the standards for sensitive areas. The proposed widening will further enable smooth movement of traffic thus solving the problem of congestion.
Package TN RSP 01(S)				
12	Vridhachallam Thiruvarur Km 2.000	Vridhachallam	Congestion levels are high due many trucks plying on the Cuddalore Salem MDR carrying coal from Neyveli to Steel plant at Salem	The town is bypassed

Sl No	Link / Chainage	Location	Description	Suggested Avoidance / Mitigation Measures
13	Vridhachallam Thiruvarur Km 18.000-16.500	Siluvaicheri Reserve Forest	The road passes through Eucalyptus & Cashew Plantations for about 1.5 Km. At Km 16.6 a School is located at a distance of 40 m from the C/L of the road.	Present Congestion levels is low. Monitoring carried out at Vridhachallam (15 Km up front) have indicated levels satisfying standards for sensitive areas Widening of the road will ensure a smoother flow of traffic and thereby bring down pollution levels
14	Vridhachallam Thiruvarur Km 1.000-0.000	Jayamkondam Junction	A highly congested urban intersection with a narrow RoW and commercial activity on either side of the road. Increase in traffic will further increase the pollutant concentrations adjacent to the road where maximum numbers of receptors are present	Monitoring carried out near the intersection have revealed pollutant levels within standards for rural and residential areas but with a propensity to increase due to further deterioration of congestion levels. Proposed widening will relieve the congestion significantly and also help in proper dispersal of air pollutants
15	Jayamkondam Ariyalur Km 23.000-24.000	Sendurai	Congested urban area. Sensitivity of the area is increased due to the presence of an artificial forest ecosystem established by the forest department	Proposed widening will relieve the congestion significantly
16	Jayamkondam Ariyalur Km 1.000-2.000	Ariyalur	Heavy laden cement trucks and other multi axled vehicles from the numerous cement factories near Ariyalur have to pass through the narrow roads within the town to reach the highway (NH 45). Sensitivity is compounded by the presence of number of higher secondary schools.	The town is bypassed
17	Vridhachallam Thiruvarur Km 88.000-90.000	Periavalayam Reserve Forest	The road passes through Eucalyptus & Cashew Plantations for about 1.5 Km. At Km 87.6 a School is located close to the road. The Uduchawdi Settlement lies between Km 89.0 & 90.0. The paddy and sugarcane fields bordering most of the link between Vridhachallam and Jayamkondam generate a lot of slow moving traffic (tractors, trailers) following crop harvest	Monitoring carried out at Jayamkondam (2 Km up front) have indicated levels satisfying standards for sensitive areas. However the particulate concentration was found to be above the standards. Widening of the road is expected to ensure faster movement of traffic and thereby bring down pollution levels
18	Vridhachallam Thiruvarur Km 121.800	Kumbakonam	Congested urban area with considerable through traffic along Chennai Kumbakonam MDR	The town is bypassed
19	Vridhachallam Thiruvarur Km 1.000-0.000	Thiruvarur	The town is heavily congested due mixing of pilgrimage traffic with local traffic, narrow ROW, vending and parking activities. Need for decongesting the traffic is felt to reduce present pollutant levels.	The town is bypassed
Package TN RSP 01(E)				
20	Chidambaram Bypass	Chidambaram	An important pilgrimage centre with high levels of congestion due to several narrow sections and four right angle turns. Problem is compounded due to presence of Annamalai University on the eastern side.	The town is bypassed
21	Sirkazhi Bypass	Sirkazhi	Important tourist and pilgrimage centre with narrow roads and four right angled turns	The town is bypassed
Package TN RSP 02				
22	Nagapattinam Kattumavadi Km 2.200	Nagapattinam	Narrow stretches of the existing road connect the heavily built up areas of Nagore and Nagapattinam.	The town is bypassed

Sl No	Link / Chainage	Location	Description	Suggested Avoidance / Mitigation Measures
23	Nagapattinam Kattumavadi Km 16.000 -17.000	Tiruppundi	Existing alignment passes through congested stretch of the village	Realignment of the congested stretch will help to abate further pollution
24	Nagapattinam Kattumavadi Km 38.000-39.000	Tiruthuraipundi	Although present traffic levels are low, route through the town is narrow, tortuous and congested. Increase in future pollutant concentration is likely with increased traffic volumes.	The town is bypassed
25	Nagapattinam Kattumavadi Km 91.000-92.000	Muthupet	Urban area with constricted ROW	The town is bypassed
Package TNRSP 03				
26	Kattumavadi Ramanathapuram Km 54.000-55.000	Manmelkudi	A congested urban area with commercial activity on either side of the road causing hindrance to the through traffic.	Proposed widening will relieve the congestion significantly
27	Kattumavadi Ramanathapuram Km 1.000-0.000	Tondi	A congested urban area with commercial activity on either side of the road causing hindrance to the through traffic.	Proposed widening will relieve the congestion significantly
28	Kattumavadi Ramanathapuram Km 16.000-17.000	Uppoor	Existing alignment passes through congested stretch of the village	Realignment of the congested stretch will help to avoid further increase in pollution levels
29	Kattumavadi Ramanathapuram Km 74.000-75.000	Ramanathapuram	Major urban centre with congestion resulting from lack of parking and roadside encroachments	The town is proposed to be bypassed
Package TNRSP 04				
30	Ramanathapuram Tuticorin Km 0.000	Sayalkudi	Constricted T intersection with commercial activities on both sides of the road	Junction Improvement is likely to relieve the present congestion levels
31	Ramanathapuram Tuticorin Km 0.000	Kulattur	Major T junction with the road passing through a congested stretch for 500 m with buildings and commercial establishments on both sides of the road	Improvement of the T Junction will help to alleviate pollution levels
Source : Field Surveys by LASA.				

(ii) Construction Stage

The asphalt plants, crushers and the batching plants will be sited at least 1 km in the downwind direction from the nearest human settlement.

All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants and other transportation of materials will be taken up including

- Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on existing roads
- Water will be sprayed on earthworks, temporary haulage and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation.

- The hot mix plant will be fitted with dust extraction units.
- It shall be ensured that the dust emissions from the crusher and vibrating screen from the stone quarries do not exceed the standards.

To ensure the control of exhaust gas emissions from various construction activities, the contractor shall take up the following mitigation measures:

- An adequate cyclone/scrubber to control emissions from the stack of hot mix plants will be provided in the event of the emissions exceeding the SPCB norms.
- To ensure the efficacy of the mitigation measures suggested, air quality monitoring shall be carried out at least once every season during the period for which the plant is in operation.
- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB norms. A vehicle management schedule prepared by the contractor and approved by the Engineer shall be adhered to.

(iii) Operation Stage

Planting of pollution resistant species: Pollution resistant species, which can grow in high pollutant concentrations or even absorb pollutants, can be planted in the first row. Broad-leaved tree species can help settle particulates with their higher surface areas along with thick foliage, which can reduce the distance for which particulates are carried from the road itself.

Following species are recommended for plantation in the first row along the most polluted stretches of the road: *Terminalia arjuna* (Arjun), *Cassia fistula* (Amaltas), *Tamarindus indica* (Tamarind), and *Azadirachta indica* (Neem).

Other measures: Other measures such as the reduction of vehicular emissions, ensuring vehicular maintenance and up-keep, educating drivers about driving behaviour / methods that will reduce emissions are beyond the scope of the TNRSP but will be far more effective in reducing the pollutant levels. TNRSP could assist implementation of these programmes only by putting up signboards and drawing attention to air pollution problems.

Apart from provision of the mitigation measures, their effectiveness and further improvement in designs to reduce the pollutant levels with increase in traffic shall be monitored. A monitoring plan (see Section 8.4) to this affect has been prepared for all the contract packages for the construction as well as the operation stages and is presented in the individual EMPs.

8.2.6 NOISE LEVELS

(i) Construction Stage

Noise and vibration during construction is a significant impact especially around settlements and inhabited areas. The following mitigation measures need to be worked out by the contractor for the noise impacts associated with the various construction activities:

- Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less that 90dB(A). If required, machinery producing high noise, as concrete mixers, generators etc, must be provided with noise shields and their usage timings can be regulated.

- Machinery and vehicles will be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum. Workers in the vicinity of high noise levels must wear earplugs, helmets and be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8-hour shift.
- Construction camps shall not be located 1000 m from settlement areas. No hot mix, batching and aggregate crushing plants shall be located within 1000 m of sensitive land uses as schools, hospitals etc.
- Blasting when required shall be restricted to daytime hours. All the statutory laws, regulations, rules etc, pertaining to acquisition, transport, storage, handling and use of explosives will be strictly followed. Blasting will be carried out during fixed hours as permitted by the Engineer.

(ii) Operation Stage

Noise levels were monitored at various locations along the corridors covering different land uses (Refer Section 4.1.9 of Chapter 4). Existing noise levels in some of the congested areas were found to be in excess of the relevant standards. So based on the field monitoring and other reconnaissance surveys a list of critical locations have been prepared which are likely to be adversely affected as a result of the implementation of the project (Refer **Table 7.12** of Chapter 7). Primary Health Centres and other medical facilities that do not have bedding facilities have been excluded as the impact at these locations is of intermittent nature.

At such locations the necessity of providing certain mitigation measures for the attenuation of noise levels is called for. Mitigation of the noise effects during the operation of the project can be effected by the following options: (i) Modifications of the characteristics of the sources of noise generation or (ii) Introduction of an obstruction between source and receptor.

As the modification of the characteristics of the vehicles / vehicle components etc, does not fall under the purview of this project, the second option of the introduction of an obstruction in the form of a noise barrier between the source of noise and the receptor along the road will be adopted. The different types of noise barriers as well as their applicability has been described in this section.

Noise barriers: The impacts due to high noise levels will be critical at the various urban locations, due to the larger number of receptors and their continuous exposure to high noise levels from the traffic. The shielding of the noise from the roads shall call in for the provision of barriers for the attenuation for the entire length of the settlements. Either the sound waves can be controlled near the source or the receptor can be shielded. Since safety of vehicles using the road is of paramount importance, a specific clear distance needs to be maintained from the pavement. Hence, the only viable option is to provide a shield around the receptor. The noise attenuation can be worked out by the adoption of the following types of noise barriers[1]:

[1] An evaluation of each of these barrier types was carried out to realistically work out the feasible measures that can be implemented for the project.

- Physical barriers in the form of walls, screens etc.
- Structural modifications at receptor locations, in form of provision of double-glazing etc.
- Rearrangement of the sensitive locations, through changes in internal planning
- Earthern berms between the road and the receptor and
- Vegetative barriers in the form of thick screen of vegetation etc.

Selection of an appropriate barrier for a location is based on the various factors as:

- Length and height of barrier for obtaining the required attenuation at the receptor location.
- Availability of land for location of barrier without obstruction to cross roads.
- Alternative causing minimum disturbance to ventilation for the adjacent structures.
- Structural stability and cost of construction of the proposed barrier.

Provisions have been made in the environmental budget for double-glazing of windows of all the sensitive receptors identified along the corridors. **Table 8.9** presents the details of the provisions incorporated in the budget. The actual decision on the type, specification and installation of barriers/ structural modifications to be carried out at appropriate locations will be taken by the Supervision Consultants in consultation with the Environmental Specialist of the PIU.

Table 8.9: Double Glazing of Sensitive Receptors

Sl. No.	Package	Number of Sensitive Receptors	Area to be Glazed (sq. m)
1	TNRSP 01	19	309
2	TNRSP 02	5	105
3	TNRSP 03	5	105
4	TNRSP 04	6	126
	TOTAL	35	735

Physical Barriers: Provision of a physical barrier shall attenuate noise levels upto a maximum of 20dB(A). As they do not require any large spaces, they can be easily constructed. Material of construction of these walls can be bricks, plain cement concrete or foam concrete. Unlike the first two materials, foam concrete is a custom-designed mix, much lighter than concrete and available in modular components. These can be erected on site as per the shielding length required. However the provision of such barriers for the entire length of the settlement is not practicable due to the high cost involved in the construction of such barriers. Such barrier severs the community on either side of the road, preventing crossroad access and causes a visual blight. The barrier also facilitates opportunistic encroachment for urban squatters. The availability of a free wall on a public land encourages the squatters to erect structures within the RoW.

Earthern Berms: Earthen berms, though they require a larger area, can effectively reduce the noise levels upto 23 dB(A). Earthen berms require a much larger base area since the angle of repose of the material used for the berm governs the height it can be raised to. Such a large area is not available along urban settlements or congested stretches of road.

Vegetative Barriers: The provision of vegetative barriers for attenuation of noise levels can reduce the sound levels by 10dB(A). The vegetative barriers, similar to earthern berms, require a considerable area, and for the attenuation of 10dB(A), require a barrier of depth 40m. Such land acquisition will result in considerable social disruption and loss of livelihood of the various communities.

Other measures: This shall involve the introduction of the barrier to absorb the incoming sound waves completely and not allow any diffracted or reflected waves to reach the receptor. Other measures for noise levels reduction at the sensitive receptors as the structural modifications or change in the internal layout of these locations will call in for a consultation with the community and incorporation of their perceptions on the proposed actions.

Apart from provision of the mitigation measures, their effectiveness and further improvement in designs to reduce the noise levels with increase in traffic shall be monitored. A monitoring plan to this affect has been prepared for all the contract packages and is presented in the individual EMPs. A generic monitoring plan is presented in **Section 6.4**. The monitoring shall be functional in both construction as well as operation stages.

8.2.7 ECOLOGY

8.2.7.1 Along Upgradation Corridors

The mitigation /enhancement measures proposed for the various ecological attributes along the upgradation corridors is presented in the following sub sections. A "Natural Habitat Management Plan" that specifies the natural habitats relevant to all the project roads and refers to all mitigation/enhancement measures pertaining to them has been appended as **Appendix 8.2**.

(A) RESERVE FORESTS

Constricted cross-sections have been designed within the Reserve Forest stretches to minimize the acquisition of forestlands. However, the acquisition of 3.2 hectares of forestland has been unavoidable. It includes 2.9 Ha. in Kelur Forest Range (Arani Polur road link) and 0.3 Ha. in Mudanai Forest Range (Polur Chengam road link). The acquisition of these forestlands for the project is being taken up in accordance with the Forest (Conservation) Act, 1980. The PIU is in the process of identifying double the area of land acquired, for transfer to the forest department towards compensatory afforestation.

Precautionary / preventive measures during construction

For stretches of the corridor passing through the Reserve Forest areas, the contractor shall ensure that the construction activities shall be limited to the proposed RoW, so as to avoid any impacts on the vegetation within the forest areas. The following conditions need to be adhered to, to safe guard the forest areas

(i) Location of Construction Camps: No Construction Camps, StockYards, Concrete Batching or Hot mix Plants shall be located within 500 m of the forest area.

(ii) No use of material from Quarry /Crusher/Borrow Area within the forest Area: Procurement of any kind of construction material from within the forest area and upto 200 m on either side is strictly prohibited

(iii) Use of Water Resources in the Forest Area: No water resources within the forest area shall be tapped for road construction.

(iv) Control of Noise: The road passing through the forest area shall be declared as a silence zone. Signages curbing the speed of vehicles and horns shall be placed at the start and end location and every subsequent km along the forest length.

(v) Disposal of wastes: Care to be taken to prevent any disposal of construction wastes/ debris and other types of sanitary / construction effluents within 1 Km of such areas

Mitigation / Enhancement Measures within the Reserve Forests

The upgradation roads traverse about 13 km along Reserve Forests. Along certain sections as presented in **Table 8.10**, crossing of wildlife is an impact that needs to be addressed. The animals cross the road for drinking water. (Refer Section 7.2.1.1 of Chapter 7). The increase in traffic and higher speeds along the upgraded corridors might adversely affect such animals. Hence mitigation measures are necessary to abate the impacts.

Wildlife vehicle collision: The specific mitigation measures have been formulated for the animal crossings. The details are provided in **Table 8.10.**

Table 8.10: Animal Crossings

Sl. No	Link	Package	Forest	Animal Crossing	Chainage	Mitigation Measures
1	Polur Chengam	TNRSP 01(N)	Parvathamalai Reserve Forest	Monkeys & Spotted Deer Crossing	Between Km 22.0 & 23.0	Provision of perennial water source Plantation of fruit bearing trees
2	Polur Chengam	TNRSP 01(N)	Mudanai Reserve Forest	Spotted Deer Crossing	Between Km 40.0 & 41.0	Provision of perennial water source
3	Tirukkovilur Elavanasur	TNRSP 01(N)	Nattamur Reserve Forest	Spotted Deer Crossing	Between Km 17.0 & 19.0	Provision of perennial water source
4	Vridhachallam Jayamkondam	TNRSP 01(S)	Peria Odai Social Forestry	Monkeys Crossing	Between Km 4.2 & 5.0	Plantation of fruit bearing trees

Extensive consultations were held at each of the Reserve Forest locations with the forest department officials and the local communities [Refer **Appendix 6.2 (i) & (iv)**]. The frequency of animal crossings, particular crossing routes and the reasons for crossing etc were discussed. It was found in most of the cases that the deer cross the roads in search of drinking water and monkeys go out of the forests in search of food, usually from agricultural fields or habitations nearby. This issue is more pronounced during the summers. This has been largely due to the non-availability of a drinking source within the forests. It was felt prudent that provision of a drinking source within the forests would be a more lasting solution than providing safe passages for animal crossings. Also, the effectiveness and utility of such crossings in minimizing collision with vehicles is not very encouraging.

To minimize the movement of the monkeys along the corridor, planting fruit species that provide fruits at different seasons of the year as well as tender shoots are suggested at locations specified in **Table 8.10**. The selection of the species to be planted is to be finalized during the implementation in consultation with the local forest officials.

Prevention of access / control of grazing within forests: To prevent the animals in the forest coming onto the roads and to protect the forest from grazing cattle, a thick vegetative barrier of *Parkinsonia aculata* and *Acacia lactronomis* is planned. To discourage cattle from grazing the roadside vegetation, species suggested for avenue plantations within the Reserve Forests stretches shall be non-palatable.

Provision of water sources within the forests: The existing source of water in some forest areas such as Mudanai forests is the percolation ponds dug by the forest department. These are rain fed and do not serve the purpose during summers when it is most needed. Therefore, instead of percolation ponds it is suggested to have small ponds of size 1m x 10m x 0.3m with cement concrete sealing (to prevent percolation losses). The shallow tanks will not submerge the animal in case it falls into the tank. Such tanks of 115 ft^3 were constructed in the Mudanai forest to prevent animals from crossing the raod. It is reported by one of the officers regarding reduction of the number of animals crossing the road after construction of the tanks. Requirement of such tanks for prevention of animal crossing is brought to the notice of the PIU by the concerned forest ranger. The letter is attached in the **Appendix 8.6**.

Deep tube wells will be dug within such forest areas. Water will be pumped from these tube wells with a motor powered by photo voltaic cell. The water will drain into ponds of size 1m x 10m x 0.3m with cement concrete sealing. For animal consumption water sources will be provided at locations as specified in **Table 8.10**.

(B) WILD LIFE SANCTUARY

Udayamarthandapuram Bird Sanctuary is located at a distance of about 500 m from the project road. The sanctuary attracts about 30,000 birds between October and January. The impact anticipated due to the project is the increased noise levels during construction. The construction work should be scheduled for periods outside October to January time frame at this stretch to minimize the impacts on migratory species.

(i) Construction stage

During the construction period, all preventive and precautionary measures that have been suggested for construction within the Reserve Forest stretches [**Section 8.2.7.1(A)**] will be taken up. Besides those, the contractor shall ensure that the movement of construction equipments and machinery, including the movement of construction crew should be restricted to at least a distance of 300m from the wetland portion of the sanctuary to avoid any impacts to the avifauna.

(ii) Operation stage

During the operation of the road, no impacts are expected because most of the species of migratory birds are high flying and are not vulnerable to collision. Signboards informing the road-users about the sanctuary shall be provided along the road on either side. This informative signage will also depict latest available data on the population and diversity of the avifauna species of interest and other information on the sanctuary. The improved road can also encourage an additional influx of visitors in the Sanctuary. One km stretch on either side of the sanctuary area shall be declared as a silent zone. Signages curbing the speed of vehicles and horns shall be placed at the start and end location.

(C) MANGROVES

Implementation of the project will not cause any removal or degradation of mangrove species. Amongst the 3 water crossings along the eastern corridor where mangroves exist (Refer **Table 4.31**), a new minor bridge is proposed at one location along Malattar river (Km. 7.800). At this location, adequate care must be taken during the construction period to avoid any adverse impact due to the road construction activity. The preventive / precautionary measures proposed include:

- No construction sites camps to be located within 500 m of mangrove areas

- No borrow areas to be located within 200 m of such areas
- Care to be taken to prevent any disposal of construction wastes/ debris and other types of sanitary / construction effluents within 1 Km of such areas.
- Adequate training of the workers, and availability of their fuel requirements to be ensured by contractual obligations to prevent any illegal felling.

(D) LANDSCAPING STRATEGY FOR PROJECT CORRIDOR

To minimize the felling of trees, the designs have been worked out such that only trees within 1.5 m of the carriageway in urban sections and trees within 1.5 m from the edge of the shoulder will be felled for the project. During the construction stage, the contractor shall ensure that no trees outside the CoI or those not marked are felled due to the project. To compensate for the cut trees, for every tree cut as part of the project, four trees shall be planted. Also additional tree planting along all bypasses has also been proposed. Details are provided in **Table 8.11.**

Table 8.11: Replantation along the Project Packages

Sl. No	Package	No of Trees to be Planted	
		Along Upgradation Corridors[1]	Additional Tree Planting Along Bypasses[2]
1	TNRSP 01	17904	22108
2	TNRSP 02	7733	5177
3	TNRSP 03	1733	-
4	TNRSP 04	2789	-
TOTAL		**30,159**	**27,285**

Source: 1: Bill of Quantities, July 2002, Prepared by PCC Consultants.
2: Additional Tree Planting along proposed during the IER along the 13 bypasses.

The following improvements to roadside landscape are suggested as part of the project.

i) Avenue plantations

ii) Buffer plantations along forest stretches

iii) Tree plantations within the forest areas

iv) Plantations at enhancement sites.

v) Landscaping at junctions and intersections

i) Avenue plantations

The roadside landscaping suggested aims at not only providing shade but also improving the aesthetic quality of the road. Avenue plantations are suggested all along the rural stretches of the upgradation roads. A concept has been evolved so as to maintain visual characteristics and uniformity in terms of landscape along the stretch. The various aspects of tree plantation including the plantation scheme, selection of species, implementation arrangements and the plantation schedule have been detailed out in

a separate Appendix titled "Tree Plantation Strategy" (**Appendix 8.3**). The crucial aspects of the Plantation Strategy have been discussed in the following subsections.

a) Planting Scheme

One row of trees is suggested on either side of the proposed carriageway. Subsequent rows of trees shall be planted wherever space is available. The first row is proposed to be a shade-giving tree with a broader crown of 7 to 10m. These will be planted at a distance of 5m from the edge of the proposed shoulder. The subsequent row of trees, if planted (2.5 m away from the first row) will be interspersed at 7m c/c with respect to the first row. Tree species with a smaller crown, either fruit giving or ornamental are suggested for the inner row. To avoid monotony the species is to be varied after every 250m. A spacing of 10m will be maintained for the broader crown species while a minimum of 7 m will be maintained for moderate crown trees, to avoid any shoot competition and enable healthy survival of the trees planted. Tree planting details are provided in individual EMPs as Appendix 3-12, Landscape strategy.

b) Selection of Species

A study on the local flora and vegetative cover native to these sections has been carried out as part of the field surveys to enable a choice of the suitable species for that particular section. The criteria for selection of species for choice as avenue plantation are that the species is

- Indigenous and suited to the soil and rainfall of the area, and
- Hardy and needs no attention after the maintenance period.

Thespesia populnea is highly recommended species for avenue plantation. Other trees recommended for avenue plantation are Rain Tree (*Samania Saman*), Neem (*Azadirata indica*) and *Pongamia glabra*. *Thespesia populnea* is easily propagated by cuttings. It is suitable for both coastal areas as well as inland areas. Neem (*Azadirata indica*) is a valuable tree and provides a good shade. *Pongamia glabra* also provides a good shade and has a pleasing appearance.

The incidental spaces created as a result of road realignment may be developed as landscaped green areas. Ornamental and exotic species are recommended for such spaces. These include *Cassia marginata* - a flowering tree, *Acacia auriauriformis* - a graceful tree for gardens, *Cassia fistula* - a yellow flowering tree.

The typical planting designs that are suggested for the Northern Corridor are presented in **Figure 8.4 (A). Figure 8.4(BI)** and **8.4(BII)** presents the typical designs for the Eastern Corridor.

(i) NORTHERN CORRIDOR

The suitable species for planting on the front row identified based on these criteria is presented in the **Table 8.12.** To avoid monotony the species is to be varied after every 500m.

Table 8.12: Species for the Front Row

Broader Crown	Moderate Crown
Thespesia populnea	*Acacia auriculiformis*

Samania saman	*Acacia mangium*
Terminalia arjuna	*Terminalia katapa*
Azadiracta indica	*Cassia marginata*
Tamarindus indica	*Peltophorum ferrugineum*
Holoptelia integrifolia	
Tabebuia roses	

The ornamental, fruit yielding as well as other tree species (with small crown) suggested for the inner row are presented in **Table 8.13.**

Table 8.13: Species for the Inner Row

Fruit Yielding species	**Ornamental plants**	**Other species (Small crown)**
Eugenia cupinoides	*Peltophorum pterocarpum*	*Morinda tintria*
Bassia longifolia	*Butea sp.*	*Polialthia longifolia*
Pongamia glabra	*Cassia fistula*	*Caesopinea cassia*
	Milligtonia	
	Bauhinia variegata	

The following grass species have been suggested for planting along the embankment slopes *Cenchrus glaucus (*Blou buffel*)* and *Cenchrus ciliaris (*White Kolukatti*)*. Shrubs as *Ipomea pescaprae (*Goats food*), Stylosanthus lemotta* and *Calotropis gigantea (*Madar*)* are suggested at locations where space is available beyond the inner row of trees.

(ii) EASTERN CORRIDOR

The Eastern corridor runs parallel to the coast within 2km from the sea for a major length. Given the sandy soil and the saline ground water conditions existing, limited species can grow in such areas. Based on a study of the local flora and interactions with botanical experts, the following species were found suitable for avenue plantations: *Thespesia populnea, Acacia auriculoformis, Acacia mangium and Peltophorum ferrugineum.*

In coastal areas the trees are faced with strong winds and stand a risk of getting uprooted. Thespesia populnea, though can sustain in highly saline conditions is not a very sturdy tree. Therefore, Thespesia is not suggested along stretches directly exposed to the sea. Along stretches directly facing the sea, the spacing of the inner row of trees will be reduced to 3m on the seaward side so that it will serve as a windbreak. The species suitable for planting on the inner row of trees include *Polyalthia longifolia* and *Casuarina equisetifolia.*

c) Implementation Mechanisms

The highways department will establish 6 nurseries for the project. The raising of the saplings will start 15months prior to the completion of construction activities along a particular section of the corridors. Saplings that are over one year old and have reached a height of 2.5m will be planted. To implement the avenue plantation scheme, an Assistant Conservator of Forests (ACF) has been inducted full time within the PIU [Refer **Appendix 6.2 (iv)**]. In performing his duties, he will be assisted by two rangers one each for the northern and eastern corridors. To manage the operations of the nursery and to carry

out the implementation at the field level, the rangers will be assisted by 6 foresters, who will be entrusted the responsibility of managing and maintaining each nursery.

d) Work Schedule

The schedule of working for the tree planting programme has been prepared in tandem with the engineering programme for widening of roads in TNRSP. The engineering programme will be carried out in a single contract package (comprising of three sections) along the Northern Corridor and in three contract packages along the Eastern Corridor. They are described in **Table 8.14**.

Table 8.14: Sections for Tree Plantation

Corridor	Contract Package	Sections	Location
Northern Corridor	TNRSP 01	S I	Arani – Polur; Tirukkovilur – Ulundurpettai; Jayankondam – Kumbakonam;
		S II	Polur – Tiruvannamalai Polur bypass; Tiruvannamalai – Tirukkovilur Tirukkovilur bypass; Kumbakonam Bypass Sirkazhi Bypass
		S III	Tiruvannamalai bypass Arcot – Arani Arani bypass; Vriddhachalam – Jayankondam Vriddhachalam bypass; Kumbakonam – Tiruvarur Tiruvarur Bypass
		S IV	Chengam – Polur Chidambaram bypass Ariyalur – Jayankondam Ariyalur bypass;

The actual tree plantation programme will start a year after the commencement of construction in a particular stretch. Nursery stock planted during the second year will be maintained in the third year and handed over to the Highways Department at the beginning of the fourth year. Nursery stock for second year planting will be raised in the first year. The details of the schedule of working for the engineering and planting programmes for both Northern and Eastern Corridors for individual packages is presented in **Appendix 8.3**.

e) Additional Tree Plantation along Bypasses

Additional tree plantation apart from the compensatory tree plantation has been proposed along the 10 bypasses in TNRSP 01. Two rows of trees at 7 m spacing on both sides of the road for the entire length along the bypasses are to be planted. To accommodate for the number of trees proposed for locations where space is not available (i.e. within habitations and near intersections), multiple rows of planting will be done in locations wherever space is available – either on bypass or along the upgradation corridor. With due importance to aesthetics and comfort along a new road, 25 % of the species selected should be flowering species and 25 % should be shade providing species. The selection of species for plantation along any particular bypass will same as that of the connecting TNRSP road link in a corridor [Refer Section 8.2.7.4-i (e)]. The same implementation mechanism, as that of the compensatory afforestation, will be responsible for implementing this programme of additional planting along the bypasses.

ii) Buffer plantations along forest stretches

The Northern corridor passes through reserved forest areas at 8 locations (Refer **Table 8.15**). At these locations, to prevent cattle from encroaching onto forestland a vegetative barrier has been proposed. The planting will be done within the RoW. The species that are thorny, non-palatable and not of timber value have been suggested. These include *Parkinsonia aculata* (xerophytic adaptation) and *Acacia lactronomis*. 3 staggered rows will be provided at a distance of 1 m.

Table 8.15: Buffer Plantation along Reserve Forests

Sl. No	Link	Package	Forest	Chainage
1	Arani Polur	TNRSP 01(N)	Kelur RF	Km 17.6–18.0(148.6)–148.3 & Km 147.0-146.
2	Polur Chengam	TNRSP 01(N)	Parvathamalai RF	Km 21.0 & 24.0
3	Polur Chengam	TNRSP 01(N)	Mudanai RF	Km 38.0 & 40.0
4	Tiruvannamalai Tirukkovilur	TNRSP 01(N)	Attipakkam RF	Km 85.6 – 83.8
5	Tiruvannamalai Tirukkovilur	TNRSP 01(N)	Thippakkadu RF	Km 102.0-103.0
6	Tirukkovilur Elavanasur	TNRSP 01(N)	Nattamur RF	Km 17.0 & 19.0
7	Vridhachallam Jayamkondam	TNRSP 01(S)	Siluvaicheri RF	Km 17.0-16.4
8	Jayamkondam Kumbakonam	TNRSP 01(S)	Periavalayam RF	Km 95.0-96.5

iii) Tree plantations within forest areas

Though not directly impacted due to the project, there are two locations where monkeys within the forests cross the project corridor in search of water and food (Refer **Table 8.10**). As part of the project, enhancement measures as the provision of water sources within the forests and fruit bearing trees and tender shoots are suggested. The choice of the species will be done to ensure that there is an availability of fruits all round the year. The forest department will do the selection of the suitable species for planting.

iv) Plantations at enhancement sites

The plantation of flowering trees near cultural properties especially enhancement sites will further enhance the site and contribute to vista. Trees like *Cassia marginata*, *Cassia fistula* and *Delonex regia* may be planted in such places. Tall growing varieties with straight stem such *Arjuna myrobalam* may be planted at selected spots to serve as effective landmarks. Landscape designs have been worked out for each of the enhancement sites identified in the project.

v) Plantations at junctions/ intersections

No trees are planted up to 50m before the intersections so as to achieve clear sight distances For intersections, shrubs will be planted at 1.5m c/c as per the design shown in the **Figure 8.5**. Beyond this point only dwarf shrubs are planted. The height of these shrubs should be such that they do not obstruct the view of traffic coming from the intersecting road. The plants recommended for intersections are *Celodendron inerme*, *Antirhinnum*, *Browallia*. The intersections where landscaping is

proposed is presented in the individual EMPs. The supervision consultant shall ascertain availability of space in the junctions mentioned below and plantation shall be done in the available space.

(f) Nursery Plan

Saplings for landscaping and other plantations shall be raised in 3 nurseries. Number of saplings to be raised is planned such that the saplings are 1.5 to 2 years old at the time of plantation. A replacement casualty of 10% is considered for estimating the number of saplings to be raised. The nurseries shall be maintained by forest wing of PIU headed by the ACF. The number of shrubs to be raised for planting at intersections shall be worked out at the time of implementation and provisions shall be made accordingly. Nursery stock is worked out for the project and presented in the **Table 8.16** below.

Table 8.16 Nursery Plan

POLUR NURSERY, TIRUKKOVILUR RANGE, TNRSP01 - SECTION I							
S.No	**DETAILS**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**
1	(I) Raising nursery stock for avenue plantation in the roads to be widened in current year	4604	2374	3688	1900	-	-
	(ii) 10% for casuality replacement in current year	460	237	369	190	-	-
2	Nursery for 20% casuality replacement during First Year maintenance	-	920	474	738	380	-
3	Nursery for 10% casuality replacement during second Year maintenance	-	-	460	237	369	190
4	Raising shrubs for Junction planting at "T" and "X" Junctions, Size 16 x 30	Will be decided after seeing the number required based on area availbility					
5	Raising throny species for buffer planting, Size 16 x 30	-	1200	-	6000	-	-
	TOTAL size 30 x 45	5064	3531	4991	3065	749	190
	size 16 x 30	-	12000	-	6000	-	-
TIRUKKOVILUR NURSERY, TIRUKKOVILUR RANGE TNRSP01 - SECTION II							
1	(I) Raising nursery stock for avenue planting in the roads to be widened in current year	1450	2314	7290	6084	-	-
	(ii) 10% for casuality replacement in current year	145	231	729	608	-	-
2	Nursery for 20% casuality replacement during First Year maintenance	-	290	462	1458	1216	-
3	Nursery for 10% casuality replacement during second Year maintenance	-	-	145	234	729	608
4	Raising shrubs for Junction planting at "T" and "X" Junctions, Size 16 x 30	Will be decided after seeing the number required based on area availbility					
5	Raising throny species for buffer planting, Size 16 x 30	"	3000	10800	3600	"	"
	TOTAL size 30 x 45	1595	2835	8626	8381	1945	608
	size 16 x 30	-	3000	10800	3600	"	"
JAYAMKONDAM NURSERY, TIRUKKOVILUR RANGE TNRSP01 SECTION III							
1	(I) Raising nursery stock for avenue planting in the roads to be widened in current year	1560	4618	733	3176	-	-
	(ii) 10% for casuality replacement in current year	156	462	73	318	-	-

POLUR NURSERY, TIRUKKOVILUR RANGE, TNRSP01 - SECTION I								
S.No	DETAILS		2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
2	Nursery for 20% casuality replacement during First Year maintenance		-	312	924	146	636	-
3	Nursery for 10% casuality replacement during second Year maintenance		-	-	156	462	73	318
4	Raising shrubs for Junction planting at "T" and "X" Junctions, Size 16 x 30		Will be decided after seeing the number required based on area availbility					
5	Raising throny species for buffer planting, Size 16 x 30		4500	-	-	-	-	-
	TOTAL	size 30 x 45	1595	2835	8626	8381	1945	608
		size 16 x 30	4500	-	-	-	-	-
TIRUTTURAIPOONDI NURSERY, SIRKAZI RANGE, TNRSP02								
S.No	DETAILS		2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
1	(I) Raising nursery stock for avenue planting in the roads to be widened in current year		1910	3894	7292	-	-	-
	(ii) 10% for casuality replacement in current year		191	389	729	-	-	-
2	Nursery for 20% casuality replacement during First Year maintance		-	382	778	1458	-	-
3	Nursery for 10% casuality replacement during second Year maintance		-	-	191	389	729	-
4	Raising shrubs for Junction planting at "T" and "X" Junctions, Size 16 x 30		Number will be decided based on area availability					
5	Raising throny species for buffer planting, Size 16 x 30		-	-	-	-	-	-
	TOTAL	size 30 x 45	2101	4665	8990	1847	729	-
		size 16 x 30	-	-	-	-	-	-
TONDI NURSERY, SIRKAZI RANGE, TNRSP03								
1	(I) Raising nursery stock for avenue planting in the roads to be widened in current year		275	442	1030	-	-	-
	(ii) 10% for casuality replacement in current year		28	44	103	-	-	-
2	Nursery for 20% casuality replacement during First Year maintance		-	56	88	206	-	-
3	Nursery for 10% casuality replacement during second Year maintance		-	-	28	44	103	-
4	Raising shrubs for Junction planting at "T" and "X" Junctions, Size 16 x 30		Number will be decided based on area availability					
5	Raising throny species for buffer planting, Size 16 x 30		-	-	-	-	-	-
	TOTAL	size 30 x 45	303	542	1249	250	103	-
		size 16 x 30	-	-	-	-	-	-
SAYALKUDI NURSERY, SIRKAZI RANGE, TNRSP04								
1	(I) Raising nursery stock for avenue planting in the roads to be widened in current year		860	950	1000	-	-	-
	(ii) 10% for casuality replacement in current year		86	95	100	-	-	-
2	Nursery for 20% casuality replacement during First Year maintance		-	172	190	200	-	-

POLUR NURSERY, TIRUKKOVILUR RANGE, TNRSP01 - SECTION I								
S.No	DETAILS		2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
3	Nursery for 10% casuality replacement during second Year maintance		-	-	86	95	100	-
4	Raising shrubs for Junction planting at "T" and "X" Junctions, Size 16 x 30		Number will be decided based on area availability					
	TOTAL	size 30 x 45	946	1217	1376	295	100	-
		size 16 x 30	-	-	-	-	-	-

8.2.7.2 Along Maintenance Corridors

(A) Tree Plantation

Trees will generally not be removed from the Corridor of Impact unless they are a safety hazard. Removal of trees shall be done with prior written permission from the forest department. Disposal of cut trees is to be done immediately to ensure that the traffic movement is not disrupted. Trees felled will be replaced as per the compensatory afforestation criteria in accordance with the Forest (Conservation) Act, 1980. Four trees will be planted for every tree lost along the project corridors

(B) Conservation of Bio Diversity

Bamboo fencing shall be erected to delineate the area rich in floral diversity as identified by the Engineer during field visits. Drains will be provided in the area to prevent exposure to contaminated run-off during the construction phase. The protection works will be completed before earthworks start in such stretches. During construction, at any point of time, if a rare/ threatened/endangered floral/faunal species is found, it shall be conserved in a suitable manner. The Engineer, on specific advice from the HD shall approve detailed conservation processes, plans and designs as well as associated modification in the project design.

Maintenance Corridors where such measures might be felt necessary have been listed out in the ERMP (**Table 2**). The Engineer prior to start of construction will identify the specific locations where such measures are to be carried out.

(C) Mitigation/Enhancement Measures within Reserve Forests

Provisions have been made in the environmental budget for adequate mitigation/enhancement measures within the Reserve Forests stretches along the maintenance corridors in event of any detection of animal crossings. The measures will include provision of water sources within forest areas and plantation of fruit bearing trees for providing food to the animals.

Maintenance Corridors where such measures might be felt necessary have been listed out in the ERMP (**Table 2**). The Engineer prior to start of construction will identify the specific locations where such measures are to be carried out.

Figure 8.4 (A)

Landscaping Details along Northern Corridor

Figure 8.4 (B) - I

Landscaping Details along Eastern Corridor

Figure 8.4 (B) - II

Landscaping Details along Eastern Corridor

Figure 8.5

Landscaping Details along Junctions

8.2.8 SOCIAL ENVIRONMENT

To prevent any disruption to the community, all community resources likely to be impacted due to the project shall be relocated and compensated for before the commencement of the construction. Detailed designs have been worked out to address the relocation, mitigation of impacts on such common property resources such as tube wells, hand pumps etc.

8.2.8.1 Loss of Access

The contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. The construction activities that affect the side roads and existing access to individual properties shall not be undertaken without providing adequate provisions.

The construction works will not interfere with the convenience of the public or the access to use and occupation of public or private roads, railways and any other access footpaths to or of properties, whether public or private.

8.2.8.2 Resettlement Impacts

Road improvement and widening will inevitably lead to social impacts that require adequate mitigation / compensation measures. The Consolidated Resettlement Action Plan (RAP) includes specific mitigation measures for resettlement and rehabilitation of project affected communities, in accordance to the R&R policy that has been framed for the project.

Institutional mechanisms for the effective implementation and monitoring of the same have been detailed in the RAP document for the project.

8.2.9 SAFETY ASPECTS

8.2.9.1 Traffic control during construction

Traffic Control Plans containing details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of each day's work will be prepared by the contractor prior to initiation of construction. Temporary diversion (including scheme of temporary land acquisition) will be constructed with the approval of the Engineer. Special consideration will be given to the safety of pedestrians and workers at night in the preparation of the traffic control plans.

The Contractor will ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. The temporary traffic detours will be kept free of dust by frequent application of water.

The Contractor will take all necessary measures for safety of traffic during construction. He shall provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing

through the section of the road under improvement. Provisions are included in BoQ as part of good engineering practice.

8.2.9.2 Additional Measures during Operation Stage

Additionally the appropriate measures that will be adopted are listed below:

- Provide sidewalks in towns and crosswalks where appropriate
- Incorporate Speed Breakers in the road surface with corresponding signage whenever the standard of design alignment is about 65 km/hr at the entry to a village/urban area with street lighting. Speed Breakers should be designed as per the IRC Guidelines: 99-1998
- Specify Speed Limit and De-restriction Signs (RS12 & RS13) at the entry and exit to each urban or village area, which has street lighting. The speed limits will normally be 50 km/hr but may be 80 km/hr where there is no space constriction in the road land. These signs will be shown on the road plans and will be subject to local agreement or modification prior to erection.
- Provide cattle crossings as shown in **Figure 8.6** where there are new embankments and a need for a cattle crossing as determined in consultation with the local community

8.2.9.3 Safety measures for construction workers

Risk from operations: The Contractor is required to comply with all the precautions as required for the safety of the workmen as per the International Labour Organisation (ILO) Convention No. 62 as far as applicable to the contract. The contractor will supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workmen. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.

Risk from electrical equipment: Adequate precautions will be taken to prevent danger from electrical equipment. No material at any of the sites will be so stacked or placed so as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, be free from patent defect, in good working order and will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.

Risk at hazardous activity: All workers employed on mixing asphaltic material, cement, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Workers engaged in stone breaking activities, will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals.

The use of any herbicide or other toxic chemical will be strictly in accordance with the manufacturer's instructions. The Engineer will be given at least 6 working days notice of the proposed use of any herbicide or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the site will be kept and maintained up to date by the Contractor. The register will include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.

Figure 8.6

Cattle Crossings

Risk of lead pollution: No man below the age of 18 years and no woman will be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. Face masks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint is dry rubbed and scrapped.

Risk caused by force de majure: All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.

Risk from explosives: Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor will not use explosives. Where the use of explosives is so provided or ordered or authorized, the Contractor will take every possible precaution. He will comply with appropriate laws and regulations relating to the import, handling, transportation, storage and use

of explosives and will, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer.

The Contractor will at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties who so ever concerned or affected or likely to be concerned or affected by blasting operations.

Malarial risk: The Contractor will, at his own expense, conform to all anti-malarial instructions given to him by the Engineer, including filling up any borrow pits which may have been dug by him. Gravid, blood-laden mosquitoes cannot fly very far, so they generally bite within a kilometre or so of their breeding place. Thus borrow pits and any other water bodies created during the construction process should be situated 1 to 2 km away from the human settlements. Pits dug up closer than these will be adequately drained to prevent water logging.

Similarly compensatory measures for filling up part of the water bodies situated adjacent to the project corridors will be directed towards deepening of the water bodies concerned. This way the capacity of the water body remains the same, while water surface available for breeding of mosquitoes is reduced. This will have an additional advantage of decreased evaporation losses.

First aid: At every workplace, a readily available first aid unit including an adequate supply of sterilized dressing material and appliances will be provided as per the Factory Rules of Tamil Nadu. Workplaces remote and far away from regular hospitals will have indoor heath units with one bed for every 250 workers. Suitable transport will be provided to take injured or ill person(s) to the nearest hospital. At every workplace an ambulance room containing the prescribed equipment and nursing staff will be provided.

Potable water: In every workplace, at suitable and easily accessible places, a sufficient supply of cold potable water (as per IS) will be provided and maintained. If the drinking water is obtained from an intermittent public water supply then, storage tanks will be provided. All water supply storage will be at a distance of not less than 15m from any latrine, drain or other source of pollution.

Where water has to be drawn from an existing well, which is within such proximity of any latrine, drain or any other source of pollution, the well will be properly chlorinated before water is drawn from it for drinking water. All such wells will be entirely closed in and be provided with a trap door, which will be

dust proof and waterproof. A reliable pump will be fitted to each covered well. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once a month.

Sanitation Facilities: There will be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996. Except in workplaces provided with water-flushed latrines connected with a water borne sewage system, all latrines will be provided with dry-earth system (receptacles) which will be cleaned at least four times daily and at least twice during working hours and kept in a strict sanitary condition. Receptacles will be tarred inside and outside at least once a year. If women are employed, separate latrines and urinals, screened from those for men and marked in the vernacular language will provided. There will be adequate supply of water, close to latrines and urinals.

Unless otherwise arranged for by the local sanitary authority, arrangement for disposal of excreta will be made through anaerobic decomposition. Excreta will be disposed off by putting a layer of night soils at the bottom of a permanent tank prepared for the purpose and covering it with 15 cm layer of waste or refuse and then covering it with a layer of earth for a fortnight (by then it will turn into manure).

8.2.10 CONSTRUCTION WORKERS CAMP

8.2.10.1 Layout of Construction Camp

The contractor based on the following guidelines shall identify the location of the construction site. The construction site shall be located

- A minimum of 1 km away from any major settlement or village.
- A minimum of 300m of any major surface water course or body
- A minimum of 500m away from any Reserve Forest/Wild life Sanctuary/Ecologically sensitive areas
- On non agricultural lands, as far as possible

A conceptual layout of a typical construction site has been presented in **Figure 8.7**

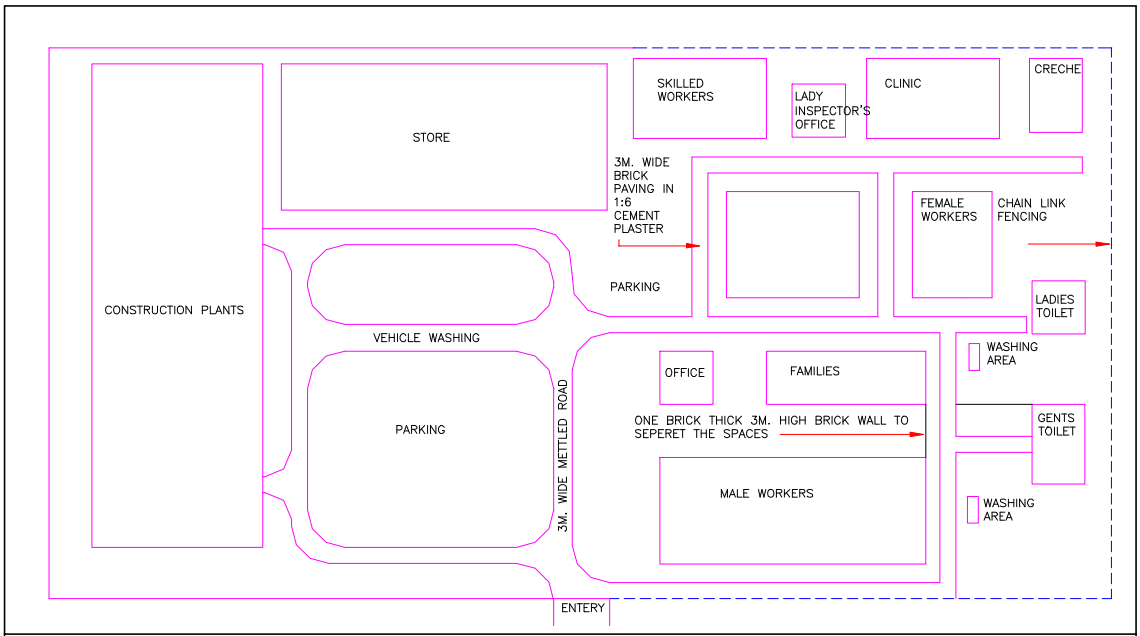

FIGURE 8.7: TYPICAL LAYOUT OF CONSTRUCTION CAMP

8.2.10.2 Facilities at Workers Camps

The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the engineer. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Safe drinking water should be provided to the dwellers of the construction camps. Adequate washing and bathing places shall be provided, and kept in clean and drained condition. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force.

Sanitation Facilities: Construction camps shall be provided sanitary latrines and urinals. Sewerage should be provided for the flow of used water outside the camp. Drains and ditches should be treated with bleaching powder on a regular basis. The sewage system for the camp must be designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a hygienic manner

Shelter at Workplace: At every workplace, there shall be provided free of cost, four suitable shelters, two for meals and two others for rest, separately for use of men and women labourers. The height of shelter shall not be less than 3m from floor level to lowest part of the roof. Sheds shall be kept clean and the space provided shall be on the basis of at least 0.5m² per head.

Canteen Facilities: A cooked food canteen on a moderate scale shall be provided for the benefit of workers wherever it is considered necessary. The contractor shall conform generally to sanitary requirements of local medical, health and municipal authorities and at all times adopt such precautions as may be necessary to prevent soil pollution of the site.

Health Care Facilities: Health problems of the workers should be taken care of by providing basic health care facilities through health centres temporarily set up for the construction camp. The health centre should have at least a doctor, nurses, duty staff, medicines and minimum medical facilities to tackle first-aid requirements or minor accidental cases, linkage with nearest higher order hospital to refer patients of major illnesses or critical cases.

The health centre should have MCW (Mother and Child Welfare) units for treating mothers and children in the camp. Apart from this, the health centre should provide with regular vaccinations required for children.

Day Crèche Facilities: At every construction site, provision of a day crèche shall be worked out so as to enable women to leave behind their children. At construction sites where 20 or more women are ordinarily employed, there shall be provided at least a hut for use of children under the age of 6 years belonging to such women. Huts shall not be constructed to a standard lower than that of thatched roof, mud walls and floor with wooden planks spread over mud floor and covered with matting. Huts shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean. There shall be two maidservants (or aayas) in the satisfaction of local medical, health, municipal or cantonment authorities. Where the number of women workers is more than 25 but less than 50, the contractor shall provide with at least one hut and one maidservant to look after the children of women workers. Size of crèches shall vary according to the number of women workers employed.

8.2.11 LAND USE MANAGEMENT ALONG THE EASTERN CORRIDOR

The issue of Induced Development along the Eastern Corridor has already been discussed in the relevant sections in Chapter 4 (Section 4.4.3.2) and Chapter 7 (Section 7.6). The comprehensive coverage of the topic covering policy, institutional setting, impacts, analyses of possible mitigation and monitoring measures and implementation arrangements have been presented in a separate Appendix titled "Land use Management along the Eastern Corridor" (**Appendix 4.9**). The measures proposed for management of land use have been presented in this Section.

8.2.11.1 Institutional Mechanisms and Implementation Arrangements

The findings of the suitability exercise and the induced development issues related to the land use changes were presented to the various governmental agencies[2]. The land use workshop provided a forum for assessing the situation and arrive at an implementation mechanism that would address the core issue of induced development by planning and for regulating land uses. There was an overall consensus amongst the workshop participants that there was no necessity for modifying the existing legislations, as they had in them in-built all necessary safeguards for regulating and planning land uses. Though these legislations have been amended periodically by the respective Government agencies to suit the growing requirements, the change in the existing process for this project was not discussed at length, as it was found not necessary.

The various institutional mechanisms that were discussed include:

- Notification of the coastal stretch as a planning area,
- Establishment of a separate planning authority for monitoring land uses along the coast
- Monitoring by the State and District Level Committees for TNRSP
- Formation of a high level committee comprising heads of departments of line agencies for according land use approvals, supported at the district levels
- Incorporation of the TNRSP development controls within the guidelines for clearance of the village and town Panchayats and educating the officials of the local bodies on the clearance procedures.

The evaluation of each of these institutional mechanisms, as discussed during the workshop and the subsequent discussions with the stakeholders is presented in the following sub-sections.

(A) Notification of the Entire Coastal Stretch as a Planning Area

The Tamil Nadu T&CP Act, 1971, (Provision 10.1) states "the Government may by notification in TN Govt. Gazette, from time to time, declare their intention to specify any area in the state to be a planning area". Once notified as a planning area, a land use plan for the area notified can be prepared and the development controls implemented in accordance with the plan provisions.

The notification is generally done for a definite geographical or administrative boundary. The delineation of a strip of land along the road will cut across different administrative boundaries. Also, delineating such a planning area would involve depriving the local authorities of their existing powers.

[2] A land use workshop was conducted by the Highways Department on the 25th of September 2002 to work out mechanisms for managing land uses along the corridor.

As a result, the operationalization of this option was not considered practical. Also, the time taken for notification and preparation of the development plans is enormous.

Therefore, this option is not taken up for subsequent consideration.

(B) Establishment of a Separate Authority for Monitoring Land Uses along the Coast

All the existing departments, local authorities and regulatory authorities do have their own rules, regulations, laws, by-laws etc and are sufficient to take care of controlling and monitoring the development activities. Therefore no changes are required. Further, no guarantee is there to the effect that such revised statutes will meet the requirements in full and without legal problems.

To address the weak link of effective enforcement mechanisms, an option can be to bring into being an institutional mechanism, which will oversee the deliveries of the local bodies and statutory authorities pertaining to this project. The secretariat of such an institution shall be a full time office headed by an senior revenue officer delegated with powers to take decisions on all land use permission related issues along the corridor. He will be supported in his activities by the Heads of such Local Bodies, the Heads of concerned Government departments, the District collectors and other district level officials of the departments. This District level committee will monitor the functioning of the agencies under this project and remedy the situations wherever called for. Besides, there shall arise a single point monitoring of the project to ensure course-corrections as needed and completion on time.

The authority at present lies with several heads of department as the Department of Town and Country Planning, Department of Town Panchayats, Department of Environment etc. Setting up such an authority for the project was not found acceptable to the participants. Therefore this option is not further elaborated.

(C) Monitoring by the State and District Level Committees for TNRSP

As part of the project implementation mechanisms, state and district level committees have been constituted. The state level committees comprise apart from the Project Director, the heads of departments of other agencies as the Finance, Revenue, Highways etc. At the districts, District Level Committees have been formed with the District Collector as the Chairperson and the district heads of the various Government Departments including the Regional Deputy Director of T&CP. These committees have been constituted to address the grievance redressal of the PAPs and the various resettlement and rehabilitation issues in the project. The grievances are referred to the apex committee at the state level, only if the grievances are not resolved at the level of the District Collector.

On similar lines, it is suggested that committees are set up along the coastal districts for regulating and planning the land uses along the corridor. Based on the suitability of the land stretches, permissions can be accorded. The committee at the district level shall be chaired by the District Collector, with the district heads of the departments of town and country planning, town panchayats, environment, ground water board etc advising him on the technical aspects.

The difficulty associated with this mechanism is that these committees are purely temporary and are set only to address the issues raised during the project implementation. To address this, it has been recommended that the committee continue throughout the project implementation period till one year after the completion of the project. After this period, the Government will review the need for extending the tenure of this committee.

(D) Capacity building of the local bodies

Incorporation of the TNRSP development controls within the guidelines for clearance of the village and town panchayats. As part of TNRSP, training programs will be conducted for educating the officials of the local bodies on the clearance procedures.

Suggested set-up

The formation of district level committees for approval of land uses chaired by the District Collector and represented by the various government agencies has been suggested. Only in cases where the issue is not resolved at the district level, the issue will be referred to the State level committed where all heads of departments will be members. To educate the members of the local municipal bodies, it is proposed that training on the controls and regulations will be provided as part of the project.

Further Deliberations on the issue of Landuse Management

The issue of landuse management along the Eastern Corridor was further discussed with various levels of stakeholders[3] to ascertain their views. A separate session in the workshop was set aside to exclusively discuss the issues related to landuse management. After adequate deliberations on the issue it was decided by all participants to institute a study on the Chennai Cuddalore section of the East Coast Road. The study would focus on the implementation process, the mistakes committed therein, the lessons learnt and the present day situation. It would provide critical inputs to formulate measures to control induced development along the project road.

It was decided that an external agency would be responsible for formulating the Terms of Reference (ToR) of the study, which would be sent to the HD for incorporating their suggestions. The HD is now under the process of finalizing the TOR for the study. Adequate cost provisions has been incorporated in the Environmental Budget to initiate the study.

Training Modules

Detailed training modules for landuse management along the Eastern Corridor would be developed based on the results of study on induced development to be carried out subsequently. However, a tentative training schedule has been prepared and budgetary provisions are made for the same. The training is envisaged to be carried out at state and district levels. Two state level training sessions and three district level training sessions (for each of the districts selected) are proposed. Each training session will be of 3 days. The agency selected for carrying out the study on the Chennai Cuddalore section of the East Coast Road will also be responsible for organizing the training sessions.

[3] A State level Stakeholders workshop was conducted by the Highways Department on the 24th of October 2002 at Chennai to address the concerns of the various Stakeholders.

At the state level the training sessions will be organised for the senior officials from the following departments:

- Highways Department
- Public Works Department, Ground water
- Directorate of Town and Country Planning
- Department of Fisheries
- Department of Tourism
- Town Panchayat

Eight districts have been selected for the district level training programmes. The districts selected are Nagapattinam, Thiruvarur, Thanjavur, Pudukkottai, Ramanathapuram, Tuticorin, Cuddalore and Sivaganga. The Eastern Corridor runs across the first six districts. Cuddalore has been selected as the Chidambaram bypass (a new road of 16.9 Km) is proposed in it while the Sivaganga has been selected because of its proximity to the Eastern Corridor. The field level officials of the following departments will attend the district level programmes:

- Highways Department
- Public Works Department, Ground water
- Town Panchayats
- Village Panchayats

The first session of the state level training programme can commence immediately after the completion of the proposed study. After an interval of three months the district level programmes can start at the concerned districts. The next training session at the central level can ideally occur at the start of the implementation stage. This session will analyze the feedbacks received from the field level officials. The second and third sessions at the district level can soon follow suit with an interval of about three months.

8.3 ENHANCEMENT MEASURES

Environmental Enhancements specifically refers to the **positive actions** to be taken up during the implementation of the project for the benefit of the road users and the communities living along the TNRSP Corridors. These positive actions are in addition to several other enhancements that occur inherently because of the very nature of the project such as improved drainage, pedestrian facilities, prevention of existing erosion, overtopping and flooding etc. as these improvements are in-built in the design, as part of good engineering practices. The enhancements have been carried out with the following objectives:

- To enhance the appeal and environmental quality of the project corridor to its users,
- To enhance visual quality along the highway, and

- To generate goodwill amongst the local community towards the project, by the enhancement of common property resources.

The enhancement measures have been suggested for the following environmental components:

- Enhancement of surface water bodies
- Enhancement of Cultural properties
- Enhancement of incidental spaces

8.3.1 SURFACE WATER BODIES

8.3.1.1 Criteria for Selection

The criteria for selection of a surface water body (pond/tank) as an enhancement candidate is:

- The sites directly impacted by the project and are in active use of the community. These should essentially be a community property, and not under private ownership.
- The sites not directly impacted (upto 100m and directly opens onto the highway), being a part of a religious structure or any other property, but still can be of visual as well as social importance

Proper edge protections, walkways, plantation of shade and ornamental trees are integral part of the enhancement.

All the enhancement concept aims at improving the present status of water body, which can be of more use to the local community. The enhancement includes general landscaping, proper access to the water edge and other measures as per the site requirements.

8.3.1.2 Design concepts - Overview

The concept for enhancements is based on the data collected from the local people through community consultation. The information collected includes name, distance of nearest settlement, the age of the structure, local importance, religious or historical significance, type and frequency of use e.g. drinking/washing/etc. The site observation also provided vital inputs in concept formulation.

The water body lying just at the edge of the carriageway will have an impact on the water quality as well as quantity. For such community ponds proper edge protection should be given in the form of brick pitching or stone pitching. The design concept includes provision of physical access only to the existing steps but maintaining visual accessibility throughout the length as well as the surrounding area.

Other parameters taken into consideration are whether water pollution is being caused by activities of the settlement, existing erosion/slope condition, catchment area details by visual inspection, presence of Aquatic life, details of seasonal fair/festival/congregation held, if any. Washing platforms are provided at the edge of the pond on the side where the community uses

the water body for washing or bathing purposes. Canopy is provided wherever need is felt for a covered or a shaded sitting area due to the lack of existing trees.

8.3.2 CULTURAL PROPERTIES

The sites identified as suitable for enhancements along the TNRSP corridors can be classified into three broad categories on the basis of values attached with them. These include the cultural sites having only religious value, those having both the religious as well as historical value and those having only historical values. Of the above-mentioned three categories the second one has been given prime importance in the enhancement proposals.

8.3.2.1 Criteria for Selection

The criterion for the selection of sites suitable for enhancement was based on four factors. Firstly their importance for the local people secondly the religious significance, thirdly, the historical importance and fourthly the scope for enhancements. The importance of the site for the local people as well as the historical significance was identified through extensive discussions with the local community and general observations of the sites and structures. The scope for enhancement included the possibility of any further improvement, availability of space for enhancements and the likely benefits for the local community as well as the road users. Poor condition of some historical structures was a constraint in selecting sites for enhancement. Such sites tough having high historical values exist in a very bad physical condition. At such places enhancement measures have no meaning without restoring the main structure, which is beyond the scope of the enhancement works.

8.3.2.2 Design Concepts - Overview

The concept for enhancements is based on the suggestions given by the people. Extensive community consultations were carried out on each of the enhancement sites. The information gathered included the age of the structure, importance for the local people, religious significance, historical importance, the size of the population using it, suggestions for enhancements, willingness of people to participate, etc. The site observation also provided vital inputs in concept formulation. It provided the general information about the condition of the main structure and the surrounding, visibility of the enhancement site from the project road, the scenic beauty of the site as well as the surrounding area etc.

In case religious places, enhancements are suggested on the basis of the usage. For example paving is suggested around the temple in most of the cases as people move around the temple. This ritual known as *prabkshina* is a common practice in most of the temples in Tamil Nadu. Similarly in mosques paving is proposed in front side where people pray on Fridays.

The type of paving proposed varies at different places within a site according to the use of spaces and their relative importance. For example the paving proposed in front of temple is different than that for approach pavement, which is again different from the paving for *prabkshina*. Such diversity in the paving pattern is maintained in all the enhancement proposals.

In the religious places like temples mosque, dargah and church where large number of people gathers weekly or annually, measures are taken for the safety of the people, as they tend to spill over on road. Compound wall and fencing is suggested as safety measures at such places.

In many cases the local people were concerned about the safety of the property. Compound wall with gate and fencing are proposed for such sites.

There are many important religious and historical centers that are accessible from the project road. Approach enhancement is proposed at the place where the approach meets the project road. The enhancement measures are suggested to emphasize the presence of such religious or historical place. The measures include provision of arch or columns with decorative and visible signage. These measures are conceived in such a way so as to reflect the architectural characteristics and the religious or historic significance of the place.

There are sites along the project corridor, which have high historical significance, but are neglected. The lack of awareness among the people and negligence on the part of authorities is evident form the very state of these structures. Enhancement measures for these sites are proposed in such a way as to increase public awareness, which may in turn lead to conservation of these structures, by the concerned authorities.

The sites having good scenic beauty and ample space for parking and sitting are conceived as potential stopovers. Shading and pleasant views are considered important in such places. The presence of pond near stopover is considered preferable as it not only gives a pleasant view but also provides refreshing cool breeze. The incidental spaces resulting by the realignment of the road is proposed to be developed as landscaped green areas to improve the visual quality of the road. Tree plantations are suggested only at those places where the local people are willing to take care of the trees, as maintenance of trees is a major issue.

8.3.3 COMMUNITY SPACE

Any other type of space identified along the project corridor rendered important for the local communities are enhanced on similar guidelines. These are possibilities of a combination of different type of cultural properties, for e.g. a temple with incidental space in front of it, any site forms an interesting combination owing to the road realignment at the spot.

8.3.3.1 Criteria for selection

The aim of enhancement on the incidental space would be to create a spot of usual relaxation for the onlookers in the locality and the traveling motorists. Consultation with public at some of the locations revealed that they are willing to participate in the enhancement programme though they may not be able to contribute monetarily. The example of this type of space includes the space in front of a temple or any realignment section of road that creates open space in between.

8.3.3.2 Design concepts- Overview

The enhancement especially at these places includes provision of a planter for planting flowering shrubs. The open space has the potential to be a very interesting stop over. Also some of the site has a historic,

sacred & emotional value. In case of religious places attached to this enhancements are suggested on the basis of the usage that would be harmonically integrate the two sites. For example paving is suggested around the shrine and sitting arrangements are made with shade giving trees. It improves the quality of space before the temple and also forms a relief along the roadside. Green fencing is done to define the boundary. Garden spaces are provided for giving fresh views and to bring in an air of freshness. Area for parking is demarcated.

8.3.4 ENHANCEMENTS CONSIDERED UNDER TNRSP

The list of enhancement sites selected along the upgradation corridors is presented in **Table 8.16**. A total of 44 sites were selected for which specific enhancements designs have been prepared. 23 of these sites lie along the Northern Corridor while the remaining 21 sites are along the Eastern corridor. Apart from these 9 generic designs were also prepared. The Table also shows the importance of each site which is either social (including religious importance) or historic or both. The willingness and contribution from the local community as expressed by them during the consultations is also presented. A cultural properties plan are prepared and included as **Appendix 8.4**. The individual concepts and intervention proposed are presented in the **Appendix 8.5**.

Insert Enhancement Table

Insert Enhancement Table

Insert Enhancement Table

8.4 MONITORING MEASURES

The monitoring programme is devised to ensure that the envisaged purpose of the project is achieved and results in the desired benefit to the target population. To ensure the effective implementation of the EMP, it is essential that an effective monitoring programme be designed and carried out. Broad objectives of the monitoring programme are:

- To evaluate the performance of mitigation measures proposed in the EMP
- To suggest improvements in the management plans, if required
- To satisfy the statutory and community obligations
- To provide feedback on adequacy of Environmental Impact Assessment

The monitoring programme contains monitoring plan for all performance indicators, reporting formats and necessary budgetary provisions. Monitoring plan for performance indicators and reporting system is presented in the following sections. Budgetary provisions for the envisaged programme is presented in **Table 8.20.**

8.4.1 PERFORMANCE INDICATORS

8.4.1.1 For Upgradation Corridors

Physical, biological and environmental management components identified as of particular significance in affecting the environment at critical locations have been suggested as Performance Indicators (PIs). The Performance Indicators shall be evaluated under three heads as:

- Environmental condition indicators to determine efficacy of environmental management measures in control of air, noise, water and soil pollution;
- Environmental management indicators to determine compliance with the suggested environmental management measures
- Operational performance indicators have also been devised to determine efficacy and utility of the mitigation/enhancement designs proposed.

The Performance Indicators and monitoring plans prepared for TNRSP are presented in **Table 8.17.**

Table 8.17: Performance Indicators Proposed for TNRSP

Sl. No	Indicator	Details	Stage	Responsibility
A	Environmental Condition Indicators and Monitoring Plan			
1	Air Quality	The parameters to be monitored, frequency and duration of monitoring as well as the locations to be monitored will be as per the Monitoring Plan prepared (Refer Table 8.20)	Construction	Contractor through approved monitoring agency
2	Noise Levels		Construction	Contractor through approved monitoring agency
			Operation	HD through approved monitoring agency
3	Water Quality		Construction	Contractor through approved monitoring agency
4	Soil Quality		Construction	Contractor through approved monitoring agency
B	Environmental Management Indicators and Monitoring Plan			
1	Dumping Locations	Locations for dumping have to be identified and parameters	Pre-Construction	Contractor

Sl. No	Indicator	Details	Stage	Responsibility
		indicative of environment in the area has to be reported	Stage	
2	Construction Camps	Location of construction camps have to be identified and parameters indicative of environment in the area has to be reported	Pre-construction	Contractor
3	Borrow Areas	Location of borrow areas have to be identified and parameters indicative of environment in the area has to be reported	Pre-construction	Contractor
4	Tree Cutting	Progress of tree removal marked for cutting is to be reported	Pre-construction	Foresters to PIU
5	Protection Measures at RF locations	Progress of measures suggested as construction of water sources is to be reported	Pre-construction /construction	Contractor
6	Enhancements	Progress of enhancement measures suggested for cultural properties, water bodies and incidental spaces is to be reported	Construction	Contractor
7	Tree Plantation and Landscaping	Progress of measures suggested as part of the Landscaping Strategy is to be reported	Construction	Foresters to PIU
8	Top soil	Implementation of the measures suggested for top soil preservation shall be reported by Contractor to CSC	Construction	Contractor
C	Management & Operational Performance Indicators			
1	Survival Rate of Trees	The number of trees surviving during each visit will be compared with the number of saplings planted	Operation	The CSC will be responsible for monitoring upto the Defect Liability Period in any particular stretch. After this period the Forest wing of the PIU will be responsible for monitoring over a period of 5 years.
2	Utility of Enhancement Provisions	The PIU will visit each of the enhancement locations (for cultural properties, water bodies and incidental spaces) to determine the efficacy of the enhancements carried out and the community utilisation of such areas.	Operation	The CSC will be responsible for monitoring upto the Defect Liability Period in any particular stretch. After this period the Environmental Cell of the PIU will be responsible for monitoring over a period of 5 years (Provisions have been included in the budget for five such visits by a two member team of the PIU for inspecting the enhancements carried out along all packages)
3	Status Regarding Rehabilitation of Borrow Areas	The PIU will undertake site visits to determine how many borrow areas have been rehabilitated in line with the landowners request and to their full satisfaction.	Operation	The CSC will be responsible for monitoring upto the Defect Liability Period in any particular stretch. After this period the Environmental Cell of the PIU will be responsible for monitoring over a period of 5 years (Provisions have been included in the budget for five such visits by a two member team of the PIU for inspecting the borrow areas utilized by the project along all packages)
4	Utility of enhancement measures within Forest Areas	The PIU will visit the locations where plantations have been carried out and water sources have been provided within forest areas. They will check for the availability of water and fodder especially during peak summer months to determine the fruitfulness of such measures.	Operation	The CSC will be responsible for monitoring upto the Defect Liability Period in any particular stretch. After this period the Environmental Cell of the PIU will be responsible for monitoring over a period of 5 years (Provisions have been included in the budget for five such visits by a two member team of the PIU for inspecting the enhancements carried out within the forest areas along TNRSP 01)
5	Utility of Double Glazing of Sensitive Receptors	The PIU will visit such sensitive locations along with the environmental monitoring agency (responsible for monitoring of	Operation	The CSC will be responsible for monitoring upto the Defect Liability Period in any particular stretch. After this period the Environmental Cell of the PIU will be responsible for monitoring over a period of 5 years

Sl. No	Indicator	Details	Stage	Responsibility
		noise levels during operation stage) to check for the efficacy of the double-glazing carried out.		(Provisions have been included in the budget for five such visits by a two member team of the PIU for inspecting the noise sensitive receptors along all packages)

8.4.1.2 For Maintenance Corridors

Certain performance indicators have also been devised for the maintenance routes of TNRSP. The environmental condition indicators comprise of Air Quality, Water Quality and Noise levels. The parameters to be monitored and the frequency and duration of monitoring will be as per the Monitored Plan prepared for the maintenance corridors (Refer **Table 8.19**). The management and operational performance indicators comprise of the following: Erosion Indices (Turbidity in Storm water & Silt load in watercourses), Management of Construction Camps (Monitoring of storage areas, drainage arrangements and sanitation facilities), Monitoring of Bio diversity (Species diversity through quadrate method) and Efficacy of Bio engineering measures carried out.

8.4.2 MONITORING PLANS

8.4.2.1 For Upgradation Corridors

The monitoring plans during construction and operation stages have been described in detail in the respective EMP documents for each of the project routes. For each of the environmental components, the monitoring plan specifies the parameters to be monitored; location of monitoring sites; frequency and duration of monitoring. The monitoring plan also specifies the applicable standards, implementation and supervising responsibilities. The monitoring plan for the various performance indicators of the project in the construction and operation phases is summarized in **Table 8.18.**

8.4.2.2 For Maintenance Corridors

The monitoring plan for the various performance indicators of the project for the maintenance corridors is summarized in the **Table 8.19.**

Table 8.18: Monitoring Plan (Upgradation Corridors)

Table 8.18: Monitoring Plan (CONTD..)

Table 8.19: Monitoring Plan for Maintenance Corridors

8.4.3 REPORTING SYSTEM

8.4.3.1 For Upgradation Corridors

Reporting system for the suggested monitoring program operates at two levels as:

- Reporting for environmental condition indicators and environmental management indicators (except tree cutting indicator)
- Reporting for operational performance indicators at the PIU level.

Contractor and construction supervision consultants operate the reporting system for environmental condition and environmental management indicators (except tree cutting). The Environmental Cell of PIU will operate the reporting system for environmental management tree cutting indicator and operation performance indicators. The PIU will set the targets for each activity envisaged in the EMP beforehand and all reports will be against these targets.

Contractor will report to the Engineer of construction supervision consultant, on the progress of the implementation of environmental conditions and management measures as per the monitoring plans. The Engineer will in turn report to the PIU on a quarterly basis which will be reviewed and forwarded by the PIU to the World Bank. Along with these reports, forestry wing of the PIU(EC) shall report progress of tree cutting, compensatory plantation, landscaping and survival rate as per the monitoring plan. The quarterly reports of the EMP will form an integral part of the Quarterly Progress Reports that are to be regularly submitted to the Bank. The PIU will also send compliance report to the MoEF every six months as per the conditions of clearance granted for the project after receiving the report from the contractor and duly verified by the Engineer. The reports submitted to the MoEF will also be forwarded to the Bank along with the Quarterly Progress Reports. Reporting formats have been prepared, which will form the basis of monitoring, by the CSC and/or the Environmental Cell as required.

In addition to these formats, to ensure that the environmental provisions are included at every activity of the implementation by the contractor, it is suggested that the approval of the environmental personnel of the engineer is required in the Request for application to proceed or other similar reporting formats used by the contractor. These will not only ensure that the environmental provisions are addressed but also link the satisfactory compliance to environmental procedures prior to approval of the Interim Payment Certificate (IPC) by the Engineer. The activities by the contractor that can impact the environment will be identified based on discussions between the Environmental Specialist of the PIU, team leader of the Engineer and the Environmental personnel of the Engineer. The decisions will be communicated to the contractor prior to the start of the construction activities.

8.4.3.2 For Maintenance Corridors

Reporting system provides the necessary feedback for project management to ensure quality of the works and that the program is on schedule. The rationale for a reporting system is based on accountability to ensure that the measures proposed as part of the Environmental & Resettlement Management Plan get implemented in the project.

The reporting system will operate linearly with the contractor reporting to the Divisional Officer, who in turn shall report to HD. All reporting by the contractor and Divisional Officer shall be on a quarterly basis. The HD shall be responsible for preparing targets for each of the identified ERMP activities. All subsequent reporting by the contractor shall be monitored as per these targets set by the HD before the contractors move on to the site. The reporting by the Contractor will be a monthly report like report of progress on construction and will form the basis for monitoring by the HD, either by its own Environmental Engineer/s or the Environmental Specialist hired by them.

8.5 IMPLEMENTATION ARRANGEMENTS

8.5.1 FOR UPGRADATION CORRIDORS

The HD is responsible for the implementation of the provisions made within the EMP through the PIU. To monitor the construction activities to assist the department in implementation, the services of an Engineer are procured for each corridor. In addition to the monitoring of the implementation of the environmental provisions by the Environmental personnel of the engineer, the Environmental Cell (EC) created within the PIU (including officials deputed from the Forests Department officials in addition to engineers from the HD) will oversee the effective implementation of the measures suggested. An externally sourced environmental expert will be procured to provide key inputs to the Environmental Cell, especially during the initial stages of project implementation. The Environmental Cell will also include the Superintending Engineer (SE), Assistant Divisional Engineer (ADE, one for both corridors), eight Assistant Engineers (AE, four for each corridor) and the members of the Forest wing. Three AEs along each corridor will be deputed at the field level. As the implementation of the avenue plantations suggested in the project is to be carried out in-house by the highways department, an elaborate setup of the Forest wing of the EC headed by an Assistant Conservator of Forests and assisted by two rangers and six foresters at the field levels has been suggested. Together, this unit shall be entrusted the responsibility of managing the nurseries for the project, and the planting and maintenance of the same. The EMP implementation arrangements for TNRSP are summarized in **Figure 8.8**

The Environmental Specialist, ACF and SE have been duly appointed/deputed and are already functioning as a part of the Environmental Cell of the PIU. The HD is under the process of appointing /deputing the remaining members of the Environmental Cell, so that the EC is in place before the start of construction activity.

Figure 8.8

Organogram

8.5.2 FOR MAINTENENCE CORRIDORS

The Chief Engineer (General) of the HD shall co-ordinate implementation of the maintenance component. Divisional Engineers of respective districts will be implementing authorities at the district level. Environmental specialist of the PIU shall co-ordinate with the environmental officer of the contractor for implementation of the ERMP. Reporting shall be undertaken by the contractor's environmental officer under the supervision of the Environmental Specialist of the PIU and shall be reported to be PIU as well as the World Bank.

8.5.3 TRAINING OF THE MEMBERS OF THE ENVIRONMENTAL CELL

Members of the Environmental Cell will be trained in environmental protection both in theoretical and practical aspects. While theoretical aspects will form the bedrock of the training programme, it will be the practical site visits and /or hands-on training at project site itself, which will be of direct use to the project.

Basic training required for environmental awareness shall be provided initially and then experts in specific aspects of road-related works who will train the officials regarding the detailed procedures will be identified. Specific modules customized for the available skill set shall be devised after assessing the capabilities of the members of the Environmental Cell and the requirements of the project. The entire training would cover basic principles of environmental assessment and management; mitigation plans and programmes, implementation techniques, monitoring methods and tools. The training modules designed will be suitable for both upgradation and maintenance components. Specific issues for upgradation and maintenance shall be taken up in separate sessions.

Typical modules that would be present for the training session would be as follows:

- Introduction to Environment and statutory regulations
- Environmental Considerations in road project and major issues
- Environmental Assessment methodology and methodology for conduct of field surveys
- Impact assessment adopted for specific components
- Specific issues along maintenance corridors as hill roads maintenance and biodiversity
- Mitigation measures devised, application on field for both upgradation and maintenance components
- Environmental enhancements and landscaping
- Institutional setup and responsibilities
- Monitoring of measures suggested and required reporting

Number of sessions required and duration would be based on the skill set available with the Environmental Cell of PIU and Construction Supervision Consultants. Apart from the modules specified above, it is recommended to include short term training courses abroad for environmental officers of the PIU. The training would be in:

- Understanding the operation of EMPs of advanced countries and the issues involved
- Having insight into prediction of highway pollution and management

The proposed orientation program along with the frequency of sessions is presented in the **Table 8.20.** A specific module for orientation of maintenance contractors is provided in Session III, Module IX. Based on the severity of issues, necessary items provided in the description shall be elaborated. Provision is made for 4 more sessions for training under maintenance corridors including site visits. These sessions shall be exclusively for AE's, ADE's of respective districts where issues have risen and the maintenance contractor.

Table 8.20: Training Program for TN RSP

Module No.	Description	Participants	Form of Training	Duration/Location
Pre-construction Stage				
Session I				
Module I	Introduction to Environment: • Basic Concept of environmental pollution and control • Environmental Regulations and Statutory requirements as per Government of India and World Bank	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts	Lecture	1 working day for lecture / workshop / interactive session 1 working day site visit
Module II	Environmental Considerations in road projects: • Environmental components affected by the road development in construction and operation stages • Activities causing pollution during construction • Activities causing pollution during operation	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts	Workshop	
Module III	Methodology: • Environmental Assessment methodology • Methodology of assessment for Pollution monitoring • Methodology for site selection of borrow areas, construction camps, debris dumping • Methodology for selection of enhancement sites	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts	Interactive session and Field visit to enhancement site	
Session II				
Module IV	Baseline data generation: • Identification of environmental components • Impact Assessment:: • Assessment methodology for individual components as – air, noise, water, soil etc	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts	Lecture	½ working day

Module No.	Description	Participants	Form of Training	Duration/Location
Module V	Mitigation measures: • Mitigation Measures devised for the project – General concepts • Component wise measures to be implemented	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts	Lecture and field visit	½ working day lecture
Module VI	Environmental Enhancements: • Types of Measures • Concepts for enhancements • Design of enhancements • Landscaping • Implementation of EMP	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts	Lecture and Field visit	1 working day lecture (initial stages of construction) 7 days (including days of travel) field visit to locations where EMP is implemented
Construction Stage				
Session III				
Module VII	Institutional Setup • Roles and Responsibilities of officials/contractors/consultants towards protection of environment • Monitoring mechanisms • Reporting requirements with targets	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts and Maintenance contractor	Lecture	1 working day in the initial stages of construction
Module VIII	Monitoring and reporting system	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts and Maintenance contractor	Workshop	1/2 working day subsequent to Module VII
Module IX	Hill roads and Bio-diversity along Maintenance roads • Roads selected and treatments proposed • Environmental issues along hill roads • Ecological conditions & biodiversity • Road maintenance and impacts on conservation efforts • Slope stability – issues of providing adequate formation width. • Mitigation strategy and measures for protection and enhancement • Unanticipated impacts and mitigations required before commencement of works	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts and Maintenance contractor	Workshop	1/2 working day subsequent to Module VII
Session IV				
Module X	Feedback from participants on problems encountered in the implementation of EMP	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts and Maintenance contractor, EA Experts, CSC, CE(General), Project Director	Workshop	½ Working day in the Second year of construction
Module XI	Solutions to unresolved issues raised in Module X	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts and Maintenance contractor, EA	Workshop	1 Working day in the Second year of construction

Module No.	Description	Participants	Form of Training	Duration/Location
		Experts, CSC, CE(General), Project Director		
Module XII	Additional training needs and institutionalizing the solutions arrived at in Module XI	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts and Maintenance contractor, EA Experts, CSC, CE(General), Project Director	Workshop	½ Working day in the Second year of construction
Session V				
Module XIII	Additional training as per Module XII	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts and Maintenance contractor.	Lecture/workshop	1 working day in the second year construction
Session VI				
Module XIV	As per requirements of PIU staff	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts and Maintenance contractor.	Lecture/workshop	1 working day in the final year of construction
Session VII				
Module XV	Feedback lectures on environmental management from Environmental officers	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts and Maintenance contractor.	Workshop	1 Working day in final year of construction
Session VIII				
Module XVI	Environmental management in Operation period • Environmental issues in Operation stage • Monitoring and reporting • Environmental management of issues subsequent to operation stage	Assistant Divisional Engineers (ADE) & Assistant Engineers (AE) of PIU and AEs, ADEs & DEs of HD from all districts and Maintenance contractor.	Lecture/workshop	1 working day in the final year construction

8.5.4 ADITIONAL TRAINING PROGRAMME FOR LANDUSE MANAGEMENT

In addition to the above training modules for environmental management, workshops and training sessions would be conducted for control of induced development. Detailed training modules would be developed based on the results of study on induced development to be carried out subsequently. However, a tentative training schedule has been prepared and budgetary provisions are made for the same. The training is envisaged to be carried out at state and district levels. It would be spread over construction and operation stage of the project. . Details about the proposed training programme are presented in Section 8.2.11.4.

8.6 BUDGET FOR ENVIRONMENTAL MANAGEMENT

Budgetary estimates for environmental management of upgradation corridors in TNRSP includes all items envisaged as part of the Environmental Management Plans. These costs have been worked out based on the detailed BoQs and specifications (provided in the respective EMP documents) for the enhancement and mitigation measures. A substantial portion of the works and therefore costs will form

a part of contractors' costs. The environment budget includes provisions for the various environmental management measures (other than measures considered under good engineering practices). It also includes the environmental monitoring and training costs. The budgetary provisions for TNRSP is presented in **Table 8.21.** The cost estimates for each item along with basis of costing is appended in Volume – Cost estimates for environmental management.

The budgetary estimates for environmental management along the maintenance routes in TNRSP includes costs of all activities envisaged as part of the Environmental and Resettlement Management Plan. The budgetary figures are based on provisional estimates and not exact numbers. The budgetary provisions in TNRSP for the maintenance routes is presented in Table 8.22.

Table 8.21 Budgetary Provisions for Upgradation Corridors

S. No.	Item	Unit	Quantity				Spec No.	Drg. No. / Appendix No.
			TNRSP01	TNRSP02	TNRSP03	TNRSP04		
A	**GENERAL ITEMS**							
1.0	Vehicles	Number	2.0	1	1	1.0		
2.0	Administration (Departmental Staff)	Years/Corridor	5.0	1.7	1.7	1.7		
3.0	Out Sourced Environmental Specialist	Years/Corridor	5.0	1.7	1.7	1.7		
4.0	Firm for implementation of EMP	Included in overall cost for procuring SC						
5.0	Compensatory Afforestation over land transferred to forest dept.	Ha	6.4					
6.0	Training of members of Environmental cell(preconstruction stage)	Amount/Session	0.5	0.5	0.5	0.5		Appendix 6.1
7.0	Study on the Chennai Cuddalore section of ECR	Lump sum	-					
B	**CONSTRUCTION PHASE**							
1.0	***Mitigation Measures other than Good Engineering practices***							
1.1	Oil Interceptors	Number	6.0	2	2	2	MoRTH 304, 1700	Dwg.No. 2002/73121/Env /01/56
1.2	Recharge pits for urban drains	Number	40.0	12	10	12	MoRTH 304, 1700	Dwg.No. 2002/73121/Env /01/58
1.3	Water Source to prevent animal crossings	Number	3.0	0	0	0	EMP 1.0	Appendix 3.5
1.4	AIDS awareness hoardings	Number	5.0	2	2	2	EMP 2.0	
1.5	Deepening of Ponds	Number	41.0	29	2	12	EMP 8.0	
2.0	***Tree Plantation and Protection***							
2.1	*Along Upgradation Corridors*							
2.1.1	Nursery Trees	Number	17904	7733	1733	2789	EMP 3.1	Appendix 3.12
2.1.2	Maintenance for 2 years	Number	17904	7733	1733	2789	EMP 3.1	Appendix 3.12
2.1.3	Tree Guards							
2.1.3.1	Brush wood Fence (Fast Growing Species)	Number	16114	6959.7	1559.7	2510.1		
2.1.3.2	Iron Tree Guards (Slow Growing Species)	Number	1790	773.3	173.3	278.9	EMP 3.2	Fig. In EMP 3.2
2.2	*Along Bypasses*							
2.2.1	Nursery Trees	Number	22108	5177	0	0	EMP 3.1	Appendix 3.12
2.2.2	Maintenance for 2 years	Number	22108	5177	0	0	EMP 3.1	Appendix 3.12
2.2.3	Tree Guards							

S. No.	Item	Unit	Quantity				Spec No.	Drg. No. / Appendix No.
			TNRSP01	TNRSP02	TNRSP03	TNRSP04		
2.2.3.1	Brush wood Fence (Fast Growing Species)	Number	19897	4659	0	0		
2.2.3.2	Iron Tree Guards (Slow Growing Species)	Number	2211	518	0	0	EMP 3.2	Fig. In EMP 3.2
2.3	*Buffer Plantation along Reserve Forest Stretches*							
2.3.1	Reserve Forest on one side of the road	Number	13500				EMP 3.1	Appendix 3.12
2.3.1	Reserve Forest on both sides of the road	Number	26400				EMP 3.1	Appendix 3.12
2.4	*Plantation within Forests*	Locations	2.0	0	0	0	EMP 3.1	Appendix 3.12
3.0	***Landscaping***							
3.1	Along T Junctions	No. of Shrubs	184450	28560	70210	33320	EMP 3.1	Appendix 3.12
3.2	Along X Junctions	No. of Shrubs	28560	2380	0	4760	EMP 3.1	Appendix 3.12
4.0	***Monitoring of Environmental Attributes during Construction Activity***							
4.1	*Air Quality*							
4.1.1	Monitoring of Air Quality near Hot mix plants	No. of Samples	52.5	18.0	18.0	18.0	EMP 4.0	EMP Table 5.2
4.1.2	Monitoring of Air Quality at Critical Locations	No. of Samples	126.0	27.0	27.0	27.0	EMP 4.0	EMP Table 5.2
4.2	*Noise Levels*							
4.2.1	Monitoring of Noise Level at Equipment Yards	No. of Samples	53.0	18.0	18.0	18.0	EMP 4.0	EMP Table 5.2
4.2.2	Monitoring of Noise Levels at Critical Locations	No. of Samples	126.0	27.0	27.0	27.0	EMP 4.0	EMP Table 5.2
4.3	*Water Quality*							
4.3.1	Monitoring of Water Quality	No. of Samples	105.0	60.0	60.0	60.0	EMP 4.0	EMP Table 5.2
4.4	*Soil Quality*							
4.4.1	Monitoring of Soil Quality	No. of Samples	70.0	30.0	30.0	30.0	EMP 4.0	EMP Table 5.2
4.4.2	Additional Soil Monitoring during Spills	No. of Samples	36.0	18.0	18.0	18.0	EMP 4.0	EMP Table 5.2
5.0	***Orientation of Implementing agency staff***	Cost /Session	7.0	2.0	2.0	2.0		
6.0	***Enhancement Measures***	Number						
6.1.1	Specific Enhancements	Number	28.0	5.0	4.0	16.0	EMP 5.0	Drawing Nos. in EMP Table 4.1
6.1.2	Generic Enhancements	Number						
6.1.2.1	For Cultural Properties	Number	100.0	30.0	20.0	20.0	EMP 5.0	Drawing Nos. in EMP Table 4.1
6.1.2.2	For Incidental spaces	Number	60.0	20.0	20.0	20.0	EMP 5.0	Drawing Nos. in EMP Table 4.1
7.0	***Additional Training for Landuse Mnagement***							
7.1	*At State Level*	Sessions/Package		0.3	0.3	0.3		
7.2	*At District Level*	Sessions/Package		2.7	2.7	2.7		
C	**GOOD ENGINEERING PRACTICES**							
1.0	Dust Suppression		**Covered under Engineering Costs**				TS 111.15.4	
2.0	Erosion Control Measures (Turfing / Pitching / Seeding & Mulching)						TS 306, 307.01, 308.7	
3.0	Provision of Cross drainage & side drainage structures						-	
4.0	General Borrow area management and maintenance of haul roads related to borrow areas						TS 111.2	

S. No.	Item	Unit	Quantity				Spec No.	Drg. No. / Appendix No.
			TN RSP01	TN RSP02	TN RSP03	TN RSP04		
5.0	Air/noise pollution control measures in construction equipments						TS 111.5	
6.0	Management and disposal of scarified waste bituminous material						TS 305.9.6	
7.0	Provision of Informatory Signs						TS 111.15.6, 112.4	
8.0	Busbays						TS 815.2	
9.0	Construction of Speed Humps						TS 812.4	
10.0	Cattle Crossings						TS 816.2	
11.0	Relocation of Public Utilities and services						-	
12.0	Management of quarries		**Will form a part of the Contractors cost only if the entire quarry is taken up for the project**				TS 111.3	
13.0	Redevelopment of Borrow Areas		**Will form a part of the Contractor's Cost. 10,98,078 sq m along TN RSP 01, 3,52,191 sq m along TN RSP 02, 14,793 sq m along TN RSP 03 and 12,018 sq m along TN RSP 04.**				TS 111.2	Appendix 3.13
14.0	Construction Camp Mangement Costs		**Will form a part of the Contractor's cost**					
15.0	Silt Fencing	Number	**Covered under Engineering Costs**				TS 111.15.2	
16.0	Safety measures for workers	Persons/ Annum					EMP 6.0, TS 111.15.6	
D	**ITEMS COVERED UNDER THE RAP BUDGET**							
1.0	Relocation of Cultural Properties		**Covered under RAP Budget**				R&R Budget	
2.0	Relocation of Water points (wells,tanks,water taps and hand pumps)						R&R Budget	
3.0	Relocation of graveyards, statues, motor sheds						R&R Budget	
4.0	Relocation of Other Community Assets						R&R Budget	
E	**OPERATION PHASE**							
1.0	***Monitoring of Noise during Operation Phase***							
1.1	*Monitoring of Noise Levels at Critical Locations*	No. of Samples	180	45	45	45	EMP 4.0	EMP Table 5.2
1.2	*Monitoring at additional locations*	No. of Samples	90	30	30	30	EMP 4.0	EMP Table 5.2
1.3	*Noise mitigation measures in form of double glazing of sensitive receptors**	Sq. m	420.0	126	126	126	MoRTH 501, Annex ' A Section 4, EMP 7.0	
2.0	***Monitoring of Management & Operational Performance Indicators***						EMP 4.0	EMP Table 5.2
2.1	*Utility of enhancement provisions*							
2.1.1	For Northern Corridor	No. of trips	5				EMP 4.0	EMP Table 5.2
2.1.2	For Eastern Corridor	No. of trips		5	5	5	EMP 4.0	EMP Table 5.2
2.2	*Status of Redevelopment of Borrow Areas*							
2.2.1	For Northern Corridor	No. of trips	5				EMP 4.0	EMP Table 5.2
2.2.2	For Eastern Corridor	No. of trips		5	5	5	EMP 4.0	EMP Table 5.2

S. No.	Item	Unit	Quantity				Spec No.	Drg. No. / Appendix No.
			TNRSP01	TNRSP02	TNRSP03	TNRSP04		
2.3	*Utility of noise mitigation measures @ Sensitive Receptors*							
2.3.1	For Northern Corridor	No. of trips	5				EMP 4.0	EMP Table 5.2
2.3.4	For Eastern Corridor	No. of trips		5	5	5	EMP 4.0	EMP Table 5.2
2.4	*Utility of Plantations & Water sources within RF*							
2.4.1	For Northern Corridor	No. of trips	5				EMP 4.0	EMP Table 5.2
3.0	***Information Dissemination***	Sessions/ Location	13	4	4	4		
4.0	***Co-ordination with other departments and administrative costs during operation stage***	Years/Corridor	3	1	1	1		
5.0	***Additional Training for Landuse Mnagement***							
5.1	*At State Level*	Sessions/Package		0.3	0.3	0.3		
5.2	*At District Level*	Sessions/Package		5.3	5.3	5.3		

Note: TS - Technical Specifications of TNRSP, EMP – Specifications of EMP given under Appendix 4.2, Section 4.2.2

Table 8.22 Budget Provisions for Maintenance Corridors

COMPONENT	STAGE	ITEM	Unit	QUANTITY
(A) Mitigation / Enhancement				
Air	Construction	Dust Management with sprinkling of water, covers for vehicles transporting construction material	Km	Covered in Engineering Costs
Soil	Construction	Turfing/Pitching	sq. m.	Covered in Engineering costs
	Operation	Redevelopment of Borrow areas	sq. m.	Covered in Engineering costs
Enhancement Within Forests	Construction	Water Source within the forest area by creating pond of size 1m x 10m x 0.3m with Cement concrete sealing	No.	8 forest areas
	Construction	Plantation of fruit bearing trees	L.S.	8 forest areas
(B) Monitoring				
Air	Construction	Monitoring near all hot mix plant locations approved by the Engineer	No. of Samples	15 locations x 3 seasons x 1 year
		Monitoring at construction sites in tandem with construction	No. of Samples	149 corridors x 3 seasons x 1year
Water Quality	Construction	At locations specified in the monitoring plan	No. of Samples	149 corridors x 2 seasons x 1year
Noise	Construction	At equipment yards as directed by the Engineer	No. of Samples	149 corridors x 3 seasons x 1year
Bio Engineering Measures	Construction	Monitoring survival	L.S.	Covered in Engineering Costs
	Operation	Monitoring effectiveness	L.S.	
(C)Training & Mobilisation				
Training	Construction and Operation	As per modules developed for TNRSP and issues arising during construction	No. of Sessions	4 Sessions

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Subject:
Author: Administrator
Keywords:
Comments:
Creation Date: 09-Mar-03 6:18 PM
Change Number: 12
Last Saved On: 10-Mar-03 1:28 PM
Last Saved By: Environment 8
Total Editing Time: 158 Minutes
Last Printed On: 08-May-03 1:22 PM
As of Last Complete Printing
Number of Pages: 68
Number of Words: 23,530 (approx.)
Number of Characters: 134,124 (approx.)