CHAPTER - 4 BASELINE ENVIRONMENTAL PROFILE

This chapter assesses the nature, type and dimensions of the study area and describes the physical, biological, cultural and socioeconomic components along the project roads. The data on the various environmental components relevant to decisions about project location, design and operation have been assembled from the EA/SA reports by the PCC. To address the gaps and deficiencies identified during the independent review, various secondary sources were consulted and primary surveys conducted by the review consultants.

4.1 PHYSICAL ENVIRONMENT

4.1.1 METEOROLOGY

4.1.1.1 Climate

The climate is tropical, with distinct wet and dry seasons. According to the agro ecological classification the state is situated in Zone VIII i.e. hot and semi arid climate. The climate may be broadly classified into four seasons: winter (January-February), summer (March-May), southwest monsoons (June-September) and northeast monsoons (October-December).

The meteorological data of stations near/along the TNRSP Corridors is presented in **Table 4.1**. The detailed meteorological data for the stations located at Chennai, Trichy and Madurai is presented in **Appendix 4.1 to 4.3**.

Table 4.1: Tamil Nadu - Annual Average: Rainfall, Temperature & Relative Humidity

Location of Station	District	Package	Elevation (m) above MSL	Recording period	Rainfall (mm)	Temperature (oC)	Relative Humidity (%)
Cuddalore*	Cuddalore	TNRSP 01 (E) & (S)	5	1978-91	1,266	28.3	74.4
Keelnatchipatti*	Tiruvannamalai	TNRSP 01 (N)	170	1978-91	900	29.6	72.8
Lekkur*	Villupuram	TNRSP 01 (N)	90	1973-91	971	29	62
Vellore	Vellore	TNRSP 01 (N)	213	1978-91	1,057	27.7	64.1
Koradacheri	Thanjavur	TNRSP 02	62	1977-91	1,052	28.9	78.4
Kurunkulam	Thanjavur	TNRSP 01 (S) & TNRSP 02	62	1974-91	924	29.1	75.9
Thanjavur	Thanjavur	TNRSP 02	68	1977-91	927	29.8	75.7
Adiramapattinam	Thanjavur	TNRSP 02	4	1978-91	1,171	28.5	75.3
Nagappattinam	Nagappattinam	TNRSP 02	2	1978-91	1,431	29.0	72.8
Tondi	Ramanathapuram	TNRSP 03	5	1959-80	856	27.9	77.0
Pamban*	Ramanathapuram	TNRSP 03	2	1978-91	791	29.0	73.8
Tuticorin	Tuticorin	TNRSP 04	2	1978-91	623	28.4	73.3
Annual Average for Tamil Nadu					899	28.5	68.4
Note: * Stations are not located directly on the upgradation corridors. Source: WS Atkins, 1993							

4.1.1.2 Temperature

The variation of temperature along the corridors is negligible with the average annual temperature around 29 °C (**Table 4.1**). March-June is the hottest part of the year in the region with the maximum monthly mean temperature varying from 38.7°C in Chennai, 39.8°C in Trichy and 39.0°C in Madurai respectively (**Appendix 4.1 through 4.3**). During winters, the average temperatures do not drop below 19°C.

4.1.1.3 Relative Humidity

The relative humidity is quite high for most part of the year especially from June to December. The maximum humidity recorded is during northeast monsoons. The minimum humidity occurs during the summer months. (Refer **Appendix 4.1 – 4.3**).

4.1.1.4 Winds

Between October and December, when north - east monsoon sets in, winds blow from north and northwest towards the east. In January and February, winds blow steadily from northeast, occasionally from the north and northwest. Between June and September, the winds reverse their direction and blow mostly from southwest. The maximum monthly wind speeds vary from 7 to 19 km/hour (Refer **Appendix 4.1 – 4.3**). The monthly wind rose diagrams in both morning and evening for Trichy and Madurai are shown in **Appendix 4.4(A) & (B) and 4.5(A) & (B).**

4.1.1.5 Rainfall

The State has two wet seasons[1]:

- The northeast monsoon from October to December, in which 47.5 per cent of the average annual rainfall occurs, and
- The southwest monsoon from June to September, in which 32.5 per cent of the average annual rainfall occurs.

Rainfall received at different stations is presented in **Tables 4.1 and 4.2**. The State receives little rainfall during the southwest monsoon because of the rain shadow cast by the Western Ghats. From the tables it is observed that the heaviest rainfall occurs at Nagappattinam (1470 mm mean annual rainfall) while the scantiest rainfall is at Tuticorin (670 mm mean annual rainfall).

Table 4.2: Rainfall along the Corridors, 1998 – 99

Sl No	Station	District	Package	South West Monsoon		North East Monsoon		Winter Season		Hot Weather Season		Total Rainfall	
				Normal Rainfall	Actual Rainfall	Normal Rainfall	Actual Rainfall	Normal Rainfall	Actual Rainfall	Normal Rainfall	Actual Rainfall	Normal Rainfall	Actual Rainfall
1	Vellore*	Vellore	TNRSP 01 (N)	435	509.1	365.8	436.6	23.4	1.5	101.9	65.2	926.1	1012.4
2	Tiruvannamalai	Tiruvannamalai	TNRSP 01 (N)	451	314.4	443.4	574.2	41	0.9	108.4	57.3	1043.8	946.8
3	Villupuram*	Villupuram	TNRSP 01 (N)	418	325.6	517.4	838.7	46.1	0	92.4	30.4	1074.7	1194.7
4	Cuddalore*	Cuddalore	TNRSP 01 (E) &(S)	370	227.3	685.2	973.6	65.8	6.3	97.8	107.2	1219.6	1314.4
5	Perambulur*	Perambulur	TNRSP 01 (S)	456	336.9	475.8	528	48.2	12.3	126.8	76.5	1107.3	953.7
6	Thanjavur*	Thanjavur	TNRSP (S) & 02	316	351.4	518.4	643.7	64.7	22.8	113.4	93.4	1012.7	1111.3
7	Nagapattinam	Nagapattinam	TNRSP 02	265	230.9	908.8	1036	100.4	103.8	106.2	99.5	1380.6	1470.2
8	Thiruvarur	Thiruvarur	TNRSP (S) & 02	287	367.5	683.8	869.9	81.4	62.9	112.8	112.9	1165.7	1413.2
9	Pudukkottai*	Pudukkottai	TNRSP 01 (E)	352	383	399.7	531	50.2	7.4	117.8	119.1	920.2	1040.5
10	Ramanathapuram	Ramanathapuram	TNRSP 03	141	245.5	486	558.9	62.7	97.6	125.8	55.6	815.8	957.6
11	Tuticorin	Tuticorin	TNRSP 04	66	111.9	433.8	488.4	56.5	55.7	114.5	14.4	671.5	670.4

Note: * Stations are not located directly on the upgradation corridors.
Source: Statistical Hand Book of Tamil Nadu, 1999

[1] Natarajan et al, 1991

4.1.1.6 Special Weather Phenomena - Cyclones and Storms

During the northeast monsoon, cyclones originating from the Bay of Bengal strongly influence rainfall. During the past 100 years, 39 cyclones have been recorded to cross the coast from the Bay of Bengal. **Table 4.3** gives an indication of the damage in three coastal districts traversed by the Project roads during 1996 cyclone.

Table 4.3: Damage and Losses during 1996 Cyclone

District	Package	Crops		Huts		Roads Damaged (Km)	Bridges Damaged (Nos.)	Culverts Damaged (Nos.)	Lives lost (Nos.)
		Damaged (Ha.)	Lost (Ha.)	Damaged (No.)	Lost (No.)				
Cuddalore	TNRSP 01 (S) & (E)	9143	27311	46584	119370	NA	NA	NA	60
Thanjavur	TNRSP 01 (S) & TNRSP 02	18066	34673	2935	24231	2598	62	996	1082
Nagappattinam	TNRSP 01 (S) & TNRSP 02	65793	57684	NA	NA	NA	NA	NA	442
Source: EIS for Northern Corridor, March 1999 & EIS for Corridor I, June 1999, Prepared by PCC.									

4.1.1.7 Special Weather Phenomena - Floods

Stretches of project roads are subject to flooding during heavy rains especially along the low-lying stretches. At various locations along the Northern Corridor from Arcot to Elavanasur a flooding depth of 0.3m is common. Along Jayamkondam to Thiruvarur greater flooding depths of up to 1m are common as the stretch falls within the Cauvery delta. The flooding depth along the Eastern Corridor varies from 0.1 to 0.5 m. The stretch of the road between Nagapattinam and Muthupet passes through the Cauvery basin. Data on the damage caused by floods in 1993 and 1994 (Refer **Table 4.4**) give an indication of the potential flood damage along the project roads.

Table 4.4: Damage and Losses during Floods (1993 & 1994)

District	Package	Crops		Huts		Roads Damaged (Km)	Bridges Damaged (Nos.)	Culverts Damaged (Nos.)	Lives lost (Nos.)
		Damaged (Ha.)	Lost (Ha.)	Damaged (No.)	Lost (No.)				
1993 Floods									
Cuddalore	TNRSP 01 (E)	NA	NA	NA	NA	NA	NA	NA	NA
Nagapattinam	TNRSP 02	6295	NA	NA	NA	NA	NA	46	NA
Thanjavur	TNRSP 01 (S) & TNRSP 02	NA	NA	137	27	NA	NA	4	NA
Ramanathapuram	TNRSP 03 & 04	NA	NA	NA	NA	NA	NA	1	NA
Tuticorin	TNRSP 03	NA	NA	NA	NA	NA	NA	NA	NA
1994 Floods									
Cuddalore	TNRSP 01 (E)	NA	NA	2987	1741	NA	NA	NA	NA
Nagapattinam	TNRSP 02	NA	NA	2505	962	NA	NA	NA	8
Thanjavur	TNRSP 01 (S) & TNRSP 02	NA	NA	2933	1871	23	NA	98	26
Ramanathapuram	TNRSP 03 & 04	NA	NA	6781	3714	NA	NA	328	93
Tuticorin	TNRSP 03	1055	NA	567	259	NA	NA	NA	NA
Source: EIS for Northern Corridor, March 1999 & EIS for Corridor I, June 1999, Prepared by PCC. Note: NA. - Not available from GoTN records.									

4.1.2 PHYSIOGRAPHY

Geomorphologically from west to east three major units are recognized in the landmass of Tamil Nadu viz. the Western Ghats, the Central Region and the Coastal Plains. The Western Ghats trending roughly in North South direction is marked geomorphologically by a continuous range of hills, extending from Nagercoil in the south upto Nilgiri-Bilgirirangan hills in the north and further northwards through Karnataka.

The central part of the state is a vast track of dissected pediments and pediplains. Residual hills in this part viz. Shevaroys, Kalrayan, Chitteri, Kollimalai, Pachchimalai and Javadi demarcate the extensions of

the Eastern Ghats, while Karandamalai, Sirumalai and Kodaikanal hills form another set of residual hills further south.

The coastal plains mark the eastern part of Tamil Nadu with associated landforms like vast tidal flats, estuaries and lagoons and a narrow but fairly continuous beach. The coastline of Tamil Nadu comprises a number of cusps, spits, wave-cut platforms and several palaeo-shorelines. Some of the palaeo-shorelines extend from inland suggesting periods of transgression and regression. The ongoing geodynamic process is generally progradation along the coast, which is modified in several places by the erosion and deposition by aeolian and fluvial agents.

4.1.3 TOPOGRAPHY

4.1.3.1 Terrain

The upgradation corridors pass along predominantly plain terrain. The terrain along the corridors is presented in **Table 4.5.**

Table 4.5: Terrain along the Upgradation Corridors

S No	Package	Percentage of Terrain				
		Plain	Rolling	Mountainous	Steep	Total
1	TNRSP 01 (N)	46	54	-	-	100
2	TNRSP 01 (S)	92	8	-	-	100
3	TNRSP 02 to TNRSP 04	93	7	-	-	100
Source: Feasibility Report, August 1998.						

4.1.3.2 Low lying Areas along Upgradation Corridors

A total of 27.2 Km of the 733 Km long upgradation roads passes through low lying area. The lengths of low lying stretches along the upgradation corridors along with the flooding depths is presented in **Table 4.6.** The locations are presented in **Appendix 4.6.**

Table 4.6 Low Lying Stretches along the Upgradation Corridors

Package	Length (m)	Flooding Depth (m)
TNRSP 01(N)	2380	0.3
TNRSP 01(S)	1400	0.3-0.9
TNRSP 02	11575	0.3-0.5
TNRSP 03	9455	0.15-0.3
TNRSP 04	2360	0.1-0.3
TOTAL	27170	
Source: EIS for Northern Corridor, March 1999 & EIS for Corridor I, June 1999, Prepared by PCC.		

4.1.3.3 Low Lying Areas along Maintenance Corridors

Low lying areas along maintenance corridors have been identified and is presented in **Table 4.7.** The maintenance corridors, other than those mentioned in the table, are free from any significant patch of low lying areas where flooding is a common phenomenon.

Table 4.7: Low Lying Areas along Maintenance Corridors

Sl. No	Corridors	Length of Low Lying Areas (m)	Sl. No	Corridors	Length of Low Lying Areas (m)
1	Cuddalore Chittor	200	19	Erode Karur	3600
2	Wallajah Sholingur	1900	20	Manaparai Kulithalai	200
3	Vellimedpettai Mailam	200	21	Karur Vanagal	200
4	Cuddalore Tirukovillur Anaicut	200	22	Paramathy Noyyal Road	200
5	Perambalur Manamadurai	100	23	Rajapalayam Keelarajakularaman	200
6	Vikravandi Kumbakonam	1000	24	Alagapuri Virudhunagar	3000
7	DindigulNatham Karaikudi	600	25	Watrap Maharalpuram Alagapuri	3000
8	Dindigul Karur	900	26	Paruvakudy Vilathikulam Vembar	400
9	Andipatty Varusa Nadu Road	15000	27	Tiruchandur Shencottah	300
10	Arupukkottai Vallnokkam	200	28	Srivaikuntam Pudukkottai	400
11	Musiri Thuraiyur Attur	800	29	Trichy Pudukkottai	835
12	Salem Vaniyambadi	600	30	Tarangambadi Myladuthurai	400
13	Krishnagiri Ranipet	300	31	Myladuthurai Pattavarhti	1100
14	Denkanicottah Kahamangalam	500	32	Thirutturaippundi Vedharanyam	150
15	Dharmapuri Hoggenakkal	400	33	Tirupur Vijaya Mangalam	100
16	Dharmapuri Papparapatti	400	34	Nagapattinam Gudalor Mysore	400
17	Sholagiri Berigai	1000	35	Rajapalayam Keelarajakularaman	200
18	Hosour Denkanicotta	6000	36	Musiri Tpet Murugur	2800
				TOTAL	47785
Source: Inventory of Maintenance Corridors by HD.					

4.1.4 GEOLOGY

Geologically, the entire state can be broadly classified into hard Rock or Crystalline Formation and Sedimentary Formations. Nearly 73 % (95467 sq. Km) of the state is underlain by crystalline rocks of Archaen metamorphic complex comprising of granite, charnockites, gneisses, schists etc. They are further intruded at many places by quartz veins, pegmatites and other ultra basics like dolomites. The sedimentary rocks occur along the coast, flanking the crystalline mass in the west. This sedimentary formation mainly comprises of recent alluvial deposits, tertiary sandstone, lignite, cretaceous limestone, argillaceous sandstone etc. Besides these, sporadic occurrences of upper Gondwana formations consisting of compact sandstone, shale etc. are found as thin and isolated patches. Younger alluvial and deltaic deposits cover the entire coastal belt.

The general geological successions of the state is furnished below:

Quaternary { Recent to Pleistocene}	Alluvial Formation
Tertiary	Sandstones, clay, clay mixes sands, shales, lignites etc.
Cretaceous	Lime stones, argillaceous sand stones
Gondwana	Conglomerates, shales, clay, Sandstone (Compact)

The generic strike direction of the formation is North East – South West and dips towards the South Easterly direction.

Geological formations along the Northern Corridor from Arcot to Elavanasur comprise mainly of Charnockite, Hornblende-Biotite Gneiss, Granite, Garnet and Granolite.

In the southern part of the Northern Corridor i.e. from Vridhachallam to Thiruvarur Mesozoic formation represented by marine Cretaceous rocks are quite common. Some fluvial quaternary formations are also observed, especially between Kumbakonam and Thiruvarur.

Quaternary Formations of late Pleistocene to Recent age comprise the geological formations for a major length of the Eastern Corridor. These include the aeolian deposits of 'Teri' and other types of sand near

the coast. They also include fluvial deposits in river terraces, alluvium along river valleys, delta and black soil with gypsum in some interior basins besides the marine deposits along the coastal beach terraces and associated coastal landforms. The geological formations along the corridors are presented in **Figure 4.1(A) & (B)**. No fault lines cut any of the upgradation corridors.

4.1.5 HYDROGEOLOGY

By and large, the occurrence of ground water depends on the geological set up, climate, rainfall, drainage, topography and extent of surface water bodies. The cretaceous formations consisting of limestones, calcareous shales, clays, argillaceous sandstones etc. occur in parts of Tiruchirapalli districts besides near Vridhachallam in Cuddalore district and west of Thanjavur district and forms moderate source of ground water. The occurrence and movement of ground water in Granites, Charnockites, Gneisses etc. depend upon the intensity, depth of weathering, fractures and fissures present in the rocks.

The gondwana formations comprising of impervious formations like shale, clay etc. are do not contribute much of ground water because of its low transmissivity and compact nature of formation. The Charnockites are generally found to be poor acquifer except in isolated pockets. The tertiary sandstones capped by laterites in most of the places occur all along the East Coast as detached patches and found to occur in Cuddalore, Cauvery delta of Thanjavur district, eastern parts of Pudukkottai, Sivaganga and Ramnathpuram districts. They are highly permeable confined aquifers and occur under artesian/sub artesian conditions. The quaternary sediments occurring in the coastal region are represented by laterites, older alluvium and recent alluvium in Ramnathpuram and Tuticorin districts. In pockets of such formation near the coast, the ground water tends to be brackish due to seawater intrusion.

The aquifer parameters as per the geological formations during Quaternary, Tertiary, Cretaceous and Gondwana period are given in **Table 4.8**.

Table 4.8: Aquifer Parameters

Sl No	Formations	Package	Coeff. of Transmissibi-lity	Coeff. of storage	Specific capacity	Draw-down	Disc-harge	Principal Rock Types	Places of Occurrences
1	Quaternary to Recent	TNRSP 02 TNRSP 03 TNRSP 04	7.64 to 4180 m^2 / day	1.2 x 10^{-3} to 7.75 x 10^{-4}	6.9 to 942 lps/m of dd	2.4 to 23m	1 to 39 lps	Occurring in coastal regions are represented by Laterites, Older Alluvium, Recent Alluvium, and Sands	Ramanathapuram, Tuticorin districts. Besides this almost all major rivers such as Palar, Ponnaiyar, Cauvery, Kusaithalaiyar and Thambaraparani.
2	Tertiary	TNRSP 01 (S) TNRSP 02 TNRSP 03 TNRSP 04	29.74 to 8492 m^2 / day	7.74 x 10^{-6} to 2.575 x 10^{-1}	5.22 to 1892 lps/m of dd	0.26 to 23.45m	3.0 to 689 lps	Sandstones capped by laterites	All along East Coast. Also found in some patches in Cuddalore, Cauvery delta of Thanjavur district, eastern part of Pudukkottai, Sivaganga and Ramnathpuram district.
3	Cretaceous	TNRSP 01 (S) TNRSP 02	295.62 to 544.54 m^2 / day	1.77 x 10^{-3} to 2.4 x 10^{-2}	3.6 to 217.24 lps/m of dd	7.56 to 32.57m	3.34 to 30.8 lps	Limestone, Calrareous shales, Clays and Argillaceous sandstone.	Ariyalur district and near Vridhachallam in Cuddalore district, and west of Thanjavur district.
4	Gondwana (Upper)	TNRSP 01 (S)	1.17 to 871.8 m^2 / day	2.9 x 10^{-4} to 4.5 x 10^{-3}	5.7 to 322 lps/m of dd	0.22 to 67m	1 to 32.78 lps	Shale, Clay etc.	Chengalpattu, Ariyalur and Sivaganga districts.

Source: State Framework Water Resources Plan of Tamil Nadu, Institute for Water Resources, 1999.

FIGURE 4.1A
GEOLOGICAL MAP OF NORTHERN CORIDORS

FIGURE 4.1B
GEOLOGICAL MAP OF EASTERN CORIDORS

4.1.6 SOILS

There are four major soil types in Tamil Nadu. Major extent (61%) is occupied by red soil. The area occupied by other soils is alluvial (24%), black (12%) and laterites (3%). Saline and alkaline soils occur in 6.7 lakh hectares.

4.1.6.1 Soil types and Characteristics

Proposed upgrade of the Northern and Eastern Corridors traverse through four main soil types - Alfisols, Vertisols, Entisols and Inceptisols. **Figure 4.2 (A) & (B)** shows the location of these soil types in each of the districts traversed by the Corridors. The soil types, their distribution, and their erosion potential are described below. Package wise length of the corridor passing through various soil types is presented in **Table 4.9.**

Table 4.9: Soil Types along Upgradation Corridors

Soil Types	Length (Km)				Total
	TN RSP 01	TN RSP 02	TN RSP 03	TN RSP 04	
Red Sandy & Reddish Brown Loam	150	18	32	-	200
Black Cotton Soil	93	99	68	118	378
Recent Sandy Soil	151	-	-	-	151
Immature Soil	4	-	-	-	4
Total	398	117	100	118	733
Source: EIS for Northern Corridor, March 1999 & EIS for Corridor I, June 1999, Prepared by PCC.					

Alfisols (*Red Sandy and Reddish Brown Loams*)

These soils have a large clay accumulation and are prone to gully erosion if the velocity of surface runoff is high. As a consequence of the high clay accumulation (and therefore small particle size), these soils result in turbid runoff that generally remains suspended in water. These soils occur along the Northern Corridor over parts of the route between Arcot and Arani, Polur and Tirukkovilur, Jayamkondam and Ariyalur and Kumbakonam and Thiruvarur. In the Eastern Corridor they are found in several locations on the Cauvery delta, areas around Manora and Kattumavadi, and along the coast south of Devipattinam to Tuticorin

Vertisols (Black Cotton Soil)

These soils are characterised as being cracking clay soils that shrink and swell over the seasons and that have wide deep cracks during periods of moisture deficiency. These soils are generally formed over gentle slopes and their erosion potential is only moderate. These soils are found over parts of the route between Jayamkondam and Thiruvarur along the Northern Corridor, in the lower reaches of the Cauvery delta in extensive inland areas, and south of Mimisal right upto Tuticorin along the Eastern Corridor.

Entisols (Recent Sandy Soil)

These soils are common to the flood plains and are characterised by receiving new deposits of alluvium at frequent intervals. These soils have the potential for high erosion but this seldom occurs due to the low-lying flat terrain and related low flow velocities. These are only found between Arcot and Polur Vridhachallam and Jayamkondam and on the northern side of the Kollidam River.

Inceptisols (*Immature Soil*)

These soils are imperfectly or very poorly developed soils with indistinct soil profiles. These soils have a high potential for erosion. These soils only occur along Tiruvannamalai to Tirukkovilur along the Northern Corridor and near Muthupet and generally to the east of the Eastern Corridor.

4.1.6.2 Soil Quality

To study the soil characteristics along the corridors seven locations were selected for collection and analysis of soil samples[2] (Refer **Figure 4.3 and Table 4.10**). Locations were selected in such a way that representative of samples different types of soils were obtained.

Table 4.10: Soil Quality Monitoring Stations

Code	Package	Section	Location	Chainage, Km
S1	TNRSP 01(N)	Arcot Elavanasur	Junction of Arcot Arani & Arani Cheyiar Road	Km 24.4 on Arcot Arani Road
S2	TNRSP 01(N)	Polur Chengam	Junction of Arani Polur & Polur Chengam Road	Km 2.4 on Polur Chengam Road, Vasur
S3	TNRSP 01(S)	Jayamkondam Ariyalur	Junction of Jayamkondam Ariyalur & Jayamkondam Trichy Road	Km 0 on Jayamkondam Ariyalur Road, Melkudiyiruppu
S4	TNRSP 01(S)	Vridhachallam Thiruvarur	Junction of Jayamkondam Kumbakonam, Kumbakonam Grand Anaicut & Kumbakonam Kotur Road	Km 123.6 on Jayamkondam Kumbakonam Road
S5	TNRSP 02	Nagappattinam Kattumavadi	Near Papagani River (Area with Mangrove Vegetation)	Km 24.1
S6	TNRSP 03	Kattumavadi Ramanathapuram	Tondi Junction	Km 108.6
S7	TNRSP 04	Ramanathapuram Tuticorin	Surangudi 5 Road Junction	Km 41.6
Source: Primary Survey, LASA, May 2002.				

[2] Soil samples at 3 depths viz. 0-30 cm, 30-60 cm and 60-100 cm were collected using sampling augers, spades and field capacity apparatus. For analysis, the air dried sample was passed through 2 mm sieve after taking a note of its gravel content. Soil extraction (10%) was used for analysis of physical, chemical and other parameters.

Table 4. 11: Soil Quality

Sl No	Parameter	S1	S2	S3	S4	S5	S6	S7
A	Type	Loamy Sand	Loamy Sand	Sandy Loam	Loamy Sand	Sandy Clay Loam	Sandy	Sandy Loam
B	Colour	Brown	Brown	Yellow	Brown	Pale Yellow	Grey	Brown
C	Compaction	Low	Low	High	Low	High	Low	Low
1	pH (1:10 solution)	8.17	8.09	8.32	8.33	9.45	8.12	7.94
2	Elecl. Conductivity (mmhos/cm at 20 °C)	1.098	0.729	0.594	0.829	1.775	0.786	0.584
3	Natural Moisture Content (%)	10.6	8.5	11.3	11.8	18.3	9.2	6.5
4	Available Nitrogen (%)	0.010	0.012	0.008	0.010	0.014	0.006	0.010
5	Available Phosphorus (%)	0.008	0.010	0.012	0.010	0.012	0.008	0.004
6	Available Potassium (%)	0.010	0.008	0.014	0.012	0.018	0.010	0.010
7	Organic Matter (%)	2.24	1.48	1.02	1.78	3.60	0.94	1.06
8	Cation Exchange Capacity, meq/100 g	13.5	25.7	16.9	14.8	24.4	11.2	16.7
9	Grain Size Distribution Gravel (%) Sand (%) Silt & Clay (%)	 2.8 88.4 8.8	 5.4 86.8 7.8	 8.8 74.8 16.4	 6.6 84.2 9.2	 4.8 72.8 22.4	 4.6 89.6 5.8	 3.8 84.8 11.4
10	Bulk Density (g/cc)	1.25	1.03	1.29	1.23	1.88	1.28	1.28
11	Infiltration Rate (cm/hr)	3.2	3.5	3.0	3.7	3.0	3.8	3.4
12	Field Capacity (%)	10.9	9.2	13.0	11.6	17.4	9.4	11.2
13	Wilting Co-efficient (%)	0.3	0.2	0.4	0.2	0.6	0.2	0.4
14	Available Water Storage Capacity (%)	10.6	9.0	12.6	11.4	16.8	9.2	10.8
15	Lead (as Pb) (%)	< 0.0001	< 0.0001	0.0004	0.0003	< 0.0001	< 0.0001	< 0.0001
Source: Primary Survey, LASA, May 2002.								

The analysed soil quality data are presented in **Table 4.11**. The colour of the soils varies from brown to yellow with either low or high compaction. Alkaline pH (7.94-9.45) and significant Conductivity values (0.584-1.775 mmhos/cm) were marked by those soil samples. The maximum pH and Conductivity values of 9.45 and 1.775 mmhos/cm were recorded near the Papagani river along the Eastern Corridor indicating the presence of alkaline soils. This is due to the tidal influence in the area, which also supports mangrove vegetation. Predominantly loamy sand and sandy loam soils were observed along the Corridors. NPK contents and Organic Matter were found to be in significant levels. Cation exchange capacity (CEC) values were ranging from 11.2 meq/100 g to 25.7 meq/100 g reveal the fact that the soils have more ability to absorb or release cations. This property of base exchange is significant as other wise the available nutrients would not have been held by soil colloids for being absorbed by plants but would simply have been leached away. The maximum CEC was observed at Vasur village (S2) along Northern Corridor. Bulk density of the soils was monitored to be medium and the infiltration capacity was moderate. No pollutants or leachate are observed at any of the sampling locations.

FIGURE 4.2A
SOIL MAP OF NORTHERN CORRIDORS

FIGURE 4.2B
SOIL MAP OF EASTERN CORRIDORS

FIGURE 4.3
LOCATION OF WATER & SOIL MONITORING STATIONS

4.1.7 WATER RESOURCES

4.1.7.1 Surface Water Resources

The corridors cut across numerous irrigation channels, creeks, minor and major rivers, and estuaries. The project road traverses across the river basins of Palar, Ponnaiyar, Vellar and Kollidam along the Northern Corridor and Cauvery, Agniar, Pambar, Vaigai, Gundar and Vaippar along the Eastern Corridor. Apart from the major rivers canals and creeks constitute a major part of the watercourses[3] traversed (Refer **Table 4.12**).

The drainage basins of the corridors are shown in **Figure 4.4 (A) & (B)**. The Palar, Ponnaiyar and Cauvery catchments have their upper reaches in the Eastern Ghats lying in Kerala and Karnataka which receive rain from the south-west monsoon from June to September, at a time when there may be little rain in the lower parts of these catchments. It is, therefore, possible to have high flows in the lower reaches of these drainage basins at times of little or no local rains.

Table 4. 12: Watercourses Traversed by the Corridors

District	Package	Drainage Basin	Canal / Creek	Minor River	Major River	Total	
						No.	%
Vellore	TNRSP 01 (N)	Palar	46	2	-	48	3.3
Tiruvannamalai	TNRSP 01 (N)	Cheyiar / Ponnaiyar	205	3	3	211	14.5
Villupuram	TNRSP 01 (N)	Ponnaiyar	71	4	1	76	5.2
Cuddalore	TNRSP 01 (E) & (S)	Vellar	32	5	2	39	2.7
Perambalur	TNRSP 01 (S)	Vellar / Kollidam	112	7	-	119	8.2
Thanjavur	TNRSP 01 (S) TNRSP 02	Cauvery	218	12	12	242	16.7
Thiruvarur	TNRSP 01 (S) TNRSP 02	Cauvery	127	28	9	164	11.3
Nagappattinam	TNRSP 01 (S) TNRSP 02	Cauvery	188	7	10	205	14.1
Pudukkottai	TNRSP 03	Agniar/Pambar	70	5	18	93	6.4
Ramanathapuram	TNRSP 03 TNRSP 04	Pambar/Kottakaraiar/ Vaigai/Gundar/Vaippar	185	15	23	223	15.4
Tuticorin	TNRSP 04	Kallar	26	2	3	31	2.1
Total			1280	90	81	1451	100.0
Percentage			88.2	6.2	5.6	100.00	
Source: EIS for Northern Corridor, March 1999 & EIS for Corridor I, June 1999, Prepared by PCC.							

Apart from the water bodies mentioned in the above table, a number of roadside ponds and tanks have been observed along all the packages. The package wise lists of such water bodies are presented in **Appendix 4.7.**

[3] For the purpose of this assessment, canals or creeks have been defined as watercourses that pass under the road by means of a culvert. Minor rivers are defined as those crossed by a bridge that is less than 30 m long, while a major river has a bridge more than 30 m long.

4.1.7.2 Ground Water Resources

With the exception of Vellore and Villupuram districts along the Northern Corridor and Nagappattinam district along the Eastern Corridor, utilisation of groundwater in the districts traversed by the corridors is less than the statewide average of 51.4 per cent (Refer **Table 4.13**). The allocation of groundwater resources within Tamil Nadu allows 85 per cent of resources for irrigation of crops and the remaining 15 per cent for domestic and industrial use. **Figure 4.5 (A) & (B)** shows the pattern of groundwater usage in the districts through which the Corridors pass.

Table 4.13: Groundwater Recharge and Irrigation Use

District	Package	Available GR (Ha.m)	85% of Available GR (Ha.m)	Utilisation of Groundwater (Ha.m)	Utilisation of Groundwater (%)	Balance of GR (Ha.m)
Vellore	TNRSP 01 (N)	150,378	127,822	94,076	62.6	33,746
Tiruvannamalai	TNRSP 01 (N)	200,352	170,300	92,196	46.0	78,104
Cuddalore	TNRSP 01 (E) & (S)	129,929	110,440	55,428	42.7	55,012
Villupuram	TNRSP 01 (N)	291,877	248,095	205,448	70.4	42,647
Thanjavur, Thiruvarur*	TNRSP 01 (S) TNRSP 02	163,162	138,688	58,087	35.6	80,601
Nagappattinam	TNRSP 01 (S) TNRSP 02	59,058	50,199	50,031	84.7	168
Tiruchchirapalli	TNRSP 01 (S)	222,805	189,384	98,461	44.2	90,923
Pudukkottai	TNRSP 02	118,105	100,389	23,506	19.9	76,883
Ramanathapuram	TNRSP 03 & TNRSP 04	22,609	19,217	1,402	6.2	17,815
Tuticorin	TNRSP 04	28,369	24,114	12,600	44.4	11,514
Total Tamil Nadu		2,639,125	2,243,256	1,355,773	51.4	887,483

* Data for these two districts were combined in the PWD Document. GR – Ground Water Recharge

Source: PWD, GoTN, Ground water 1994.

FIGURE 4.4(A)
DRAINAGE BASIN MAP OF NORTHERN CORRIDOR

FIGURE 4.4(B)
DRAINAGE BASIN MAP OF EASTERN CORRIDOR

FIGURE 4.5(A)

GROUND WATER UTILISATION (NORTHERN CORRIDOR)

FIGURE 4.5(B)
GROUND WATER UTILISATION (EASTERN CORRIDOR)

The ground water potential of the districts through which the corridors pass have been assessed in various studies carried out by Ground Water Section, PWD and Institute of Water Studies, Government of Tamil Nadu. The extent of ground water utilisation has been used to demarcate different blocks within a district as over exploited, dark, grey and white. Over exploited blocks and dark are those where ground water extraction is 85 - 100 %. Blocks with extraction between 65 and 85 % have been classified as grey. Blocks with extraction below 65 % have been termed as white. Details are provided in **Table 4.14**.

Table 4.14: Categorization of Blocks with reference to Ground Water Potential

Sl. No	District	Package	Categorization of Blocks		
			Over Exploited & Dark	Grey	White
1	Vellore	TNRSP 01 (N)	Kaniyambadi, K.V.Kuppam, Madunar, Tirupathur, Anaicut, Vellore	Katpadi, Gudiyaham, Natrampalli, Kandili, Timiri, Kaveripakkam, Jolarpet, Alanyagam, Arcot, Nemili.	Walajapettai, Sholingur, Arakonam, Pernampet
2	Tiruvannamalai	TNRSP 01 (N)	Chengam	Anakavoor, Cheyyar, Kilpennathur, Tandarampattu, Thurinjapuram, Vembakkam, Vandavasi, Arani (E).	Peranamallur, Thellar, Arni (W), Tiruvannamalai, Polur, Pudupalayam, Kalasapakka, Chetput, Javadu Hills.
3	Cuddalore	TNRSP 01 (E) & (S)	Nellikuppam, Keerapalayam	Panruti.	Bhuvanagiri, Protonova, Kattumanarkoil, Kumartchi, Cuddalore, Kurinjipadi, Vridhachallam, Kammapuram, Nallur, Mangalore
4	Villupuram	TNRSP 01 (N)	Kolianur, Tiruvennainallur, Kandamangalam, Vickravandi, Ulunderpettai, Tirunavallur Gingee, Vallam	Melmalayanoor, Marakanam,Tindivanam, Mailam	Kallakurichi, Chinnasalem, Tirukkovilur, Mugaiyur, Kanai, Vanur, Thiyagaduram, Sankarapuram, Rishivandiyam, Kalrayan Hills
5	Thanjavur	TNRSP 01 (S) TNRSP 02	Papanasam.Kumbakonam, Thiruvidaimaruthur, Thirupanendal Thiruvaiyar	Nil	Budalur, Thanjavur, Tiruvonam, Orthanadu, Sethubavachattram, Pervaoorani, Pattukottai, Madukur Ammapaettai
6	Nagapattinam	TNRSP 01 (S) TNRSP 02	Mailaduthrai, Kuttalam, Kollidam, Sirkazhi, Sembanarkoil (Nagapattinam, Vedarnyam, Keelaiyur, Thalaignaiyar, Kilvalur, Thirumaruga are saline blocks)	Nil	Nil
7	Thiruvarur	TNRSP 01 (S) TNRSP 02	Needamangalam, Nannilam, Koradachery (Muthupet, Tiruthuraipundi are saline blocks)	Nil	Tiruvarur, Kodavasal, Valangaiman, Mannargudi, Kottur
8	Perambulur	TNRSP 01 (S)	Nil	Veppanthattai, Perambalur, Ariyalur	Tirumanur, Veppur, Alathur, Jayankondam, T. Pudur, Andimadam, Sendurai
9	Pudukkottai	TNRSP 03	Nil	Nil	Annavasal, Kunandarkoil, Ponnamaravathy, Viralimalai, Karamabakudi, Arimalam, Pudukkottai, Tirumayam, Aranthangi, Avudayarkoil, Manalmelkudi, Tiruvarankulam, Gandarvakottai
10	Ramnathpuram	TNRSP 03 & TNRSP 04	Nil	Nil	Ramanathapuram, Tirupulani, Mandapam, Tiruvadanai, R.S. Mangalam, Bogalur, Nainarkoil, Mudukulathur, Kadaladi, Kamudhi, Paramakudi

Sl. No	District	Package	Categorization of Blocks		
			Over Exploited & Dark	Grey	White
11	Tuticorin	TNRSP 04	Vilathikulam,Udangudi, Sathankulam	Srivaikundam, Kovilpatti	Ottapidaram, Kayathar, Pudur, Tuticorin, Karungulam, Alwarthirunagari, Tiruchandur
Source: Ground Water Section, PWD, GoTN.					

The stretches passing through different ground water blocks are shown in **Table 4.15.**

Table 4.15: Ground Water Blocks along Upgradation Corridors

Sl. No	Package	Length Passing Through (km)							
		Saline Blocks	Length (km)	Dark Blocks	Length (km)	Grey Blocks	Length (km)	White Blocks	Length (km)
1	TNRSP 01	Not Present	-	Chengam, Ulunderpettai Kumbakonam, Tiruvidaimaruthur, Thirupanendal Koradachery	Pudupalayam to Chengum Chainage 38-47 (9 km) Narippalayam to Elavanasur Chainage 18-31 (13 km) Viracholapuram to Kumbakonam Chainage 96-122 (26 km) Arasangudito Tiruvarur Chainage 12.0-0.0 (12 km) **(Grand Total 60 km)**	Arcot, Timiri, Turinjapuram, Cheyyar, Arani (E), Ariyalur	Arcot to Arani Chainage 0.0-25.0 (25 km) Tiruvannamalai to Tharaiyur Chainage 90-75.0 (15 km) Senthurai to Ariyalur Chainage 25-1.0 (21 km) **(Grand Total 61 km)**	Arni (W), Tiruvannamalai, Polur, Pudupalayam, Kalasapakka, Chetput, Vridhachallam, Nallur, Tirukoilur, Mugaiyur, Kodavasal, Valangaiman, Jayankondam, Andimadam, Sendurai	Arani to Polur Chainage 2.0-17.0 & 150.0-143.0 (24 km) Polur to Pudupalayam Chainage 2.0-38.0 (36 km), Polur to Tiruvannamalai (Maintenance corridor), Tharaiyur to Tirukkovilur 90.0-105.0 (15 km), Vriddhachalam to Jayamkondam 20.0-0.0 (30.4 km), Jayamkondam to Senthurai 0.0-25.0 (26 km), Jayamkondam to Viracholapuram 86.0-96.0 (11 km), **(Grand Total 276.9 km)**
2	TNRSP 02	Nagapattinam, Kilvellur, Keelaiyur, Tiruthuraippundi, Talanayar, Muthupet and Vedaranniyam	Nagapattinam to Muthupet Chainage 0.0-90.0 (57 km) **(Grand Total 57 km)**	Not Present	-	Not Present	-	Pattukotai and Sethubhavachar am	Muthupet to Kattumavadi Chainage 90.0 - 41.0 (59.6 km) **(Grand Total 59.6 km)**
3	TNRSP 03	Not Present	-	Not Present	-	Not Present	-	Arantangi, Manamelkudi, Avadaiyar kovil, Tiruvadanai, R S Mangalam and Ramnathpuram	Kattumavadi to Ramnathpuram Chainage 41.0 - 0.0/63.0 (99.8 km) **(Grand Total 99.8 km)**
4	TNRSP 04	Not Present	-	Vilathikulam	Vembar to Kulattur Chainage 13.0-1.0 (21 km) **(Grand Total 21 km)**	Not Present	-	Ramnathpuram, Tiruppallanai, Kadaladi and Ottapidaram	Ramnathpuram to Vembar Chainage 0.0 – 13.0 and Kulattur to Tuticorin Chainage 1.0 – 0.0 (96.9 km) **(Grand Total 96.9 km)**
5	**Total Length**	**Through Saline Blocks= 57 Km**		**Through Dark Blocks= 81 Km**		**Through Grey Blocks= 61 Km**		**Through White Blocks= 533.2 Km**	
Source: Ground Water Section, PWD, GoTN.									

The Groundwater Section of the PWD collects biannual water quality measurements from approximately 2,100 observation wells. For assessment of the ground water quality data on groundwater

quality was collected from the PWD for wells within 30 Km from the coast. Since the problem of salt water intrusion is confined to only the Eastern Corridor, it was exclusively taken up for detailed assessment. Contours for Total Dissolved Solids (TDS) and Salinity were plotted based on maximum values recorded by the PWD in the observation wells over a period of 10 years.

Figure 4.6 (A) & (B) maps the TDS and Salinity of groundwater in the districts traversed by the Eastern Corridor. The desirable level of TDS in drinking water as per IS: 10500 is 500 mg/l which in absence of an alternate source is permitted up to 2000 mg/l. Most districts along the Eastern Corridor contain groundwater with TDS levels not recommended for drinking without any treatment (Refer **Figure 4.6**). Maximum TDS values along the Eastern Corridor was observed around Devipattinam (10,000 – 12,000 mg/l). High TDS values were also observed along Ramanathapuram (3000 mg/l), Tuticorin (3000 mg/l), Kattumavadi (6000 mg/l) and Tondi (7000 mg/l).

To further study the effects of seawater intrusion within the 30 km zone salinity along the Eastern Corridors salinity was also mapped. Salinity levels in order of 0.5 ppt (parts per thousand) are desirable while levels upto 1.8 ppt is permissible. Salinity levels in excess of 18.1 ppt indicate salt water intrusion. The maximum salinity levels along the Eastern Corridor (15 ppt) are observed between Tiruppalaikkudi and Uppoor. Other areas with high salinity includes Devipattinam (10 ppt), Kattumavadi (5 ppt), Tondi (5 ppt), Manora (2 ppt), S P Pattinam(2 ppt), Ramanathapuram (2 ppt) and Tuticorin (2 ppt).

4.1.7.3 Utilisation of Water Resources

The predominant use of water in the corridor-of-influence along the Northern Corridor is for agriculture. Crops include paddy, cotton, sugarcane, banana, horse gram, groundnut, mustard and others (see Section 3.4.5). The water comes from canals (fed by rainfall), tanks (fed from rainfall and groundwater) and wells (fed from groundwater). The distribution of these sources for the districts traversed by the Corridors is shown in **Table 4.16**. Canal irrigation is particularly important in the districts of the Cauvery delta: Thanjavur, Nagappattinam and Thiruvarur. In Pudukkottai, Ramanathapuram and Tuticorin districts the major irrigation source are tanks and ponds, which are, rain fed and irrigation through canals is not commonly practiced.

Table 4. 16: Irrigation by Different Sources within each District

District	Package	Canals (%)	Tanks (%)	Wells (%)	Total (%)
Vellore	TNRSP 01 (N)	4	26	70	100
Tiruvannamalai	TNRSP 01 (N)	2	46	52	100
Cuddalore, Villupuram	TNRSP 01 (S) & (E)	23	24	53	100
Perambalur/ Tiruchirapalli	TNRSP 01 (S)	45	15	40	100
Thanjavur	TNRSP 01 (S) & TNRSP 02	90	6	4	100
Nagappattinam	TNRSP 01 (S) & TNRSP 02	98	-	2	100
Thiruvarur	TNRSP 01 (S) & TNRSP 02	98	-	2	100
Pudukkottai	TNRSP 03	8	85	7	100
Ramanathapuram	TNRSP 03 & 04	-	94	6	100
Tuticorin	TNRSP 04	9	63	28	100
Average – Tamil Nadu		29	32	49	100
Source: Directorate of Economics & Statistics. Season Crop Reports, 1993-1994.					

FIGURE 4.6(A)
CONCENTRATION OF TOTAL DISSOLVED SOLIDS ALONG EASTERN CORRIDOR

FIGURE 4.6(B)
SALINITY ALONG EASTERN CORRIDOR

4.1.7.4 Water Quality

(A) MONITORING LOCATIONS

Surface and ground water samples[4] were collected from twelve identified locations (**Table 4.17 & Figure 4.3**) and analysed for selected physical, chemical and bacteriological parameters. Surface water quality was monitored predominantly in the Northern Corridor (TNRSP 01), as they are the main sources of irrigation, bathing, drinking, etc. Importance was given to monitor the ground water quality along the Eastern Corridor (TNRSP 02, 03 & 04) keeping in mind the fact that the ground water Table is less than 10 m with significant threats like sea water intrusion, pollution due to aqua culture, salt pans, etc.

Table 4.17: Water Quality Monitoring Stations

Location Code	Package	Section	Location	Chainage	Category	Present Use
W1	TNRSP 01(N)	Polur Chengam	Bore well, Mullat Nagar	47.5	Ground Water	Drinking
W2	TNRSP 01(N)	Tiruvannamalai Tirukkovilur	Kumlapatti Tank	95.4	Surface Water	Irrigation
W3	TNRSP 01(S)	Jayamkondam Ariyalur	Minambhatti Tank	1.1	Surface Water	Irrigation & Bathing
W4	TNRSP 01(S)	Jayamkondam Kumbakonam	Kollidam River	102.0	Surface Water	Irrigation & Bathing
W5	TNRSP 02	Nagappattinam Kattumavadi	Bore well, Sangandi	81.4	Ground Water	Drinking
W6	TNRSP 02	Nagappattinam Kattumavadi	Dug well, Rajamadam	18.8	Ground Water	Washing & Bathing
W7	TNRSP 02	Nagappattinam Kattumavadi	Papagani River	24.1	Surface Water	Irrigation & Prawn Culture
W8	TNRSP 03	Kattumavadi Ramanathapuram	Dug well, M. Pattangadu	51.4	Ground Water	Drinking
W9	TNRSP 03	Kattumavadi Ramanathapuram	Dug well, Tondi	108.6	Ground Water	Washing & Bathing
W10	TNRSP 04	Ramanathapuram Tuticorin	Pond, Ervadi	4.2	Surface Water	Washing & Bathing
W11	TNRSP 04	Ramanathapuram Tuticorin	Dugwell, Sayalkudi	22.0	Ground Water	Washing & Bathing
W12	TNRSP 04	Ramanathapuram Tuticorin	Bore well, Vaipar	5.2	Ground Water	Drinking

Source: Primary Survey, LASA, May 2002.

(B) RESULTS AND INFERENCE

The results of analyses of water samples are presented in **Table 4.18**.

Ground Water Quality: pH of the ground waters was found to be in the range 7.04-7.87 along the Corridors. TDS content was ranging from 460 mg/l (Tondi) to 4600 mg/l (Sayalgudi). Chloride values were analysed in the range 75 (Tondi) -1750 mg/l (Sayalkudi) and Sulphate values were found to be in the range 28 mg/l (M. Pattangadu near Manamelkudi) - 260 mg/l (Rajamadam). Low BOD (<2-2 mg/l) values reveal the fact that the groundwater sources is free from any industrial pollution. Lead contents were found to be below the detection limit. In general the following inferences can be made:

In the Northern Corridor (TNRSP 01), the ground water can be used for drinking after suitable treatment and disinfection.

In TNRSP 02 (Nagappattinam - Kattumavadi), the ground water is unfit for drinking as TDS content is high. At Sangandi and Rajamadam high Percent Sodium values were monitored.

[4] Parameters like pH, conductivity, temperature, DO, etc., were measured in the field itself while collecting the samples using a microprocessor based potable Water Analysis Kit (Elico Model PE136). Samples for chemical analyses were collected as per procedures outlined in IS: 2488. Sterilised bottles were used for collection of water samples for bacteriological analysis.

Page Break..... Insert Table: 4.18

In TNRSP 03 (Kattumavadi – Ramanathapuram), the ground water quality comply with the drinking water norms (IS: 10500) in the absence of an alternate source (except for Total Coliforms). The ground water quality at the Tondi dugwell fluctuates from potable to unpotable depending on the availability of water at a nearby surface water source (pond) which helps in recharging all ground water sources in that area (as reported by the local people).

In TNRSP 04 (Ramanathapuram – Tuticorin), the ground water has become brackish and is unfit for drinking. At Sayalkudi and Vaipar very high chloride values (1078 – 1750 mg/l) were monitored.

Surface Water Quality: pH of the surface waters was found to be in the range 7.66-8.18 along the Corridors. TDS content was ranging from 560 mg/l (Ervadi) to 17500 mg/l (Papagani River). Chloride values were analysed in the range 103 (Minambhatti Tank) - 8950 mg/l (Papagani River) and Sulphate values were found to be in the range 32 mg/l (Kumlapatti Tank) - 290 mg/l (Papagani River). Low BOD (2-5 mg/l) and COD (48-240 mg/l) values were monitored at these sources. Lead contents were found to be below the detection limit.

In general, surface water quality along the Corridors is good and complies with CPCB Surface Water Quality Norms except for Papagani River. The water quality of Papagani River is influenced by seawater, which intermingles with it during tidal action.

4.1.7.5 Water resources along maintenance corridors

The surface water bodies lying along the maintenance corridors have been identified and the corridors have been categorized according to the number of such water bodies observed along each stretch. **Table 4.19** presents the list of all such corridors. The maximum number of water bodies (20) was noted along the Paruvakudy Vilathikulam Vembar Corridor.

Table 4.19: Water Bodies along Maintenance Corridors

MAINTENANCE CORRIDORS WITH				
Only One Water Body	**Two to Three Water Bodies**	**Three to Five Water Bodies**	**Five to Ten Water Bodies**	**More Than Ten Water Bodies**
Bukkathurai Uthiramerur	Cuddalore Chittor	Cuddalore Vchalam Salem	Wallajah Sholingur	Rajapalayam Tirunelveli
Arcot Tindivanam	Cuddalore Tirukollur Anaicut	Karur Vanagal	Athivuthu Surandai	Srivilliputhur Parthibanur
Trichy Chidambaram Road	Vikravandi Kumbakonam	Nagore Vettar	Tarangambadi Myladuthurai	Alagapuri Virudhunagar
Dharmapuri Morappur	DindigulNatham Karaikudi	Grand Annicut Cauveripattinam	Paruvakudi Ettayapuram	Perambalur Manamadurai
Hosour Denkanicotta	Karur Velliyanai Dindigul	Thiruthurai Poondi Vedharanyam	Myladuthurai Pattavarhti	Paruvakudy Vilathikulam Vembar
Trichy Namakkal	Arupukkottai Vallnokkam	Coonoor Kundah	Salem Vaniyambadi	
Manaparai Kulithalai	Musiri Thuraiyur Attur	Musuri Tpet Murugur		
Parasery Colachel	Denkanicottah Kahamangalam	Rajapalayam Keelarajakularaman		
Thanjavur Vaduvoor Mannagurdy	Tirunelveli Shencottah Quilon	Tiruchandur Shencottah		
Pattukottai Muthupet	Trichy Pudukottai	Rajapalayam Keelarajakularaman		
Peraurani Sethubavachatran	Aranthangi Kattumavadi	Cuddalore Chitt` or		
Arcot Tindivanam	Tarangambadi Myladuthurai	Dindigul Karur		
		Watrap Maharalpuram Alagapuri		
		Srivaikuntam Pudukkottai		
		Thanjavur Sayalkudi		
Source: Inventory of Maintenance Corridors by HD				

4.1.8 AMBIENT AIR QUALITY

To assess the ambient air quality along the project corridors, ambient air quality monitoring was carried out at eleven identified locations (**Figure 4.7 & Table 4.20**). The monitoring locations were selected based on the sensitivity of the receptors to vehicular traffic and to obtain baseline concentrations of the various representative land uses along the corridors.

4.1.8.1 Monitoring locations

24 hourly continuous air quality monitoring was carried out for pollutants such as Respirable Particulate Matter (RPM), Suspended Particulate Matter (SPM), Sulphur dioxide (SO_2), Oxides of Nitrogen (NOx). Carbon monoxide (CO) and Hydrocarbons (HC as CH_4) were monitored 8 hourly. The methodology adopted for the monitoring of the various pollutant parameters is presented in **Appendix 4.8**. Locations of the monitoring stations are presented in **Table 4.20**.

Table 4. 20: Ambient Air Quality Monitoring Stations

Code	Package	Section	Location	Reference	Chainage km	Distance from the C/L, m	Height of Sampling Point ,m	Category
A1	TNRSP 01 (N)	Arcot Elavanasur	Arani Bypass	Near Start Point of Arani Bypass, Hariharan Nagar.	24.4	15	4	Residential, Rural & Other Areas
A2	TNRSP 01 (N)	Polur Chengam	Mundanai Reserve Forest	Kalyanmandapam (Marriage Hall) in Pudur Village	39.7	10	3.5	Sensitive Area
A3	TNRSP 01 (N)	Arcot Elavanasur	Tiruvannamalai Bypass	Near End Point of Tiruvannamalai Bypass, Edapalayam Village	104.8	20	3.5	Residential, Rural & Other Areas
A4	TNRSP 01 (N)	Arcot Elavanasur	Pugaipatti	Opposite to Pugaipatti Primary School	26.8	10	4	Residential, Rural & Other Areas
A5	TNRSP 01 (S)	Vridhachallam Thiruvarur	Vridhachallam Bypass	Mid Point of Vridhachallam Bypass, Savari Kuttam	1.9	15	4.5	Residential, Rural & Other Areas
A6	TNRSP 01 (S)	Vridhachallam Thiruvarur	Jayamkondam	Jayamkondam Market Near Junction Ariyalur - Jayamkondam - Kumbakonam Roads	86	7	7	Residential, Rural & Other Areas
A7	TNRSP 01 (S)	Vridhachallam Thiruvarur	Thiruvarur Bypass	Near Start Point of Thiruvarur Bypass	2.8	10	4	Residential, Rural & Other Areas
A8	TNRSP 02	Nagappattinam Kattumavadi	Muthupet Bypass	Near End Point of Muthupet Bypass	65.7	10.0	4.0	Residential, Rural & Other Areas
A9	TNRSP 03	Kattumavadi Ramanathapuram	Manamelkudi	Manamelkudi Market Area	54.2	12.0	7.0	Residential, Rural & Other Areas
A10	TNRSP 03	Kattumavadi Ramanathapuram	Tondi	Tondi Market Area	108.8	6.0	3.5	Residential, Rural & Other Areas
A11	TNRSP 04	Ramanathapuram Tuticorin	Tuticorin	End Point of TNRSP - 04 Intersection of NH 45 B with ECR	0 (ECR) / 250.8 (NH)	5.0	2.5	Industrial & Mixed Zone

SPM: Suspended Particulate Matter, RPM: Respirable Particulate Matter, SO_2: Sulphur dioxide, NO_X: Oxides of Nitrogen, CO: Carbon monoxide, HC: Hydrocarbons & Pb: Lead. NAAQ Standards: National Ambient Air Quality Standards (24/8 hourly only for CO) stipulated by CPCB for Residential, Rural and Other Areas.

Source: Primary Survey, LASA, May 2002

4.1.8.2 Monitoring results

The results of analyses of air samples are presented in **Table 4.21.**

Table 4. 21: Ambient Air Quality along the Upgradation Corridors

Sl. No	Location	Package	Location Code	Pollutant Concentration (µg/m³)						
				SPM	RPM	SO_2	NO_x	CO	HC	Pb
1	Arani Bypass	TNRSP 01 (N)	A1	89.4	38.6	6.0	9.0	<40	<65	< 0.01
2	Mundanai Reserve Forest	TNRSP 01 (N)	A2	63.2	34.6	6.0	5.3	<40	<65	< 0.01
3	Tiruvannamalai Bypass	TNRSP 01 (N)	A3	89.9	46.8	6.7	9.7	<40	<65	< 0.01
4	Pugaipatti	TNRSP 01 (N)	A4	64.3	28.7	6.0	5.3	<40	<65	< 0.01
5	Vridhachallam Bypass	TNRSP 01 (S)	A5	89.9	38.8	7.3	9.7	<40	<65	< 0.01
6	Jayamkondam	TNRSP 01 (S)	A6	107.2	56.4	15.0	16.7	40	<65	0.075
7	Thiruvarur Bypass	TNRSP 01 (S)	A7	96.8	45.7	10.7	14.0	<40	<65	< 0.01
8	Muthupet Bypass	TNRSP 02	A8	69.4	32.8	6.0	4.3	<40	<65	< 0.01
9	Manmelkudi	TNRSP 03	A9	93.0	42.6	6.3	6.0	<40	<65	< 0.01
10	Tondi	TNRSP 03	A10	90.1	47.1	9.0	8.7	78	<65	< 0.01
11	Tuticorin	TNRSP 04	A11	109.9	47.6	10.3	17.0	<40	<65	< 0.01
NAAQ Standards				200	100	80	80	2000	-	1.0
Source: Primary Survey, LASA, May 2002										

The following observations can be made based on analysis of the AAQ along the corridors.

In **Arcot-Elavanasur Section {TNRSP 01(N)}**, RPM levels were monitored in the range 36 µg/m³ to 52 µg/m³ with an average value of 37.0 µg/m³. SPM values were ranging from 55 µg/m³ to 101 µg/m³ with an average value of 76.7 µg/m³. SO_2 and NOx levels were found to be in low levels (6-8 µg/m³ and 4-12 µg/m³). CO and HC values were found to be below their respective detectable limits (40 µg/m³ and 65 µg/m³). Particulate Lead values was found to be below the detectable limit of 0.01 µg/m³.

In **Vridhachallam-Thiruvarur Section {TNRSP 01(S)}**, RPM levels were monitored in the range 35 - 65 µg/m³ with an average value of 47.0 µg/m³. SPM values were ranging from 86 µg/m³ to 116 µg/m³ with an average value of 98.0 µg/m³. SO_2 and NOx levels were found to be in the range 6-21 µg/m³ and 8-22 µg/m³ respectively. CO content of 40 µg/m³ was monitored at Jayamkondam. Other CO and HC values were found to be below their respective detectable limits (40 µg/m³ and 65 µg/m³). All Particulate Lead values were found to be below the detectable limit of 0.01 µg/m³, except at Jayamkondam.

In **Nagappattinam-Kattumavadi Section (TNRSP 02)** near Muthupet Bypass, RPM values were ranging between 30-35 ug/m³ with a mean value of 32.7 ug/m³ and SPM values were ranging between 65-73 ug/m³ with a mean value of 69.7 ug/m³. SO_2 and NOx levels were found to be in insignificant levels (6 ug/m³). CO, HC and Particulate Lead values were found to be below their respective detectable limits.

In **Kattumavadi-Ramanathapuram Section (TNRSP 03)**, RPM levels were monitored from 38 ug/m³ to 54 ug/m³ with an average value of 44.8 ug/m³. SPM values were ranging from 84 ug/m³ to 97 ug/m³ with an average value of 91.7 ug/m³. SO_2 and NOx levels were found to be in the range 6-12 ug/m³ and 6-11 ug/m³ respectively. CO levels were monitored in the range 40-78 ug/m³ at Tondi. Other CO and HC values were found to be below their respective detectable limits. All Particulate Lead values were found to be below the detectable limit of 0.01 ug/m³.

In **Ramanathapuram-Tuticorin Section (TNRSP 04)** at Tuticorin, RPM values were monitored to be in the range 47-55 ug/m³ with an average value of 47.5 ug/m³. SPM levels were ranging from 103 ug/m³ to 118 ug/m³ with an average value of 109.5 ug/m³. SO_2 and NOx levels were found to be in the range 9-12 ug/m³ and 11-22 ug/m³ respectively. CO, HC and Particulate lead values were found to be below their respective detectable limit.

4.1.8.3 Inferences

In general for all monitoring stations the RPM values were monitored in the range 26-65 ug/m³ with an average value of 41.7 ug/m³. While comparing with the National Ambient Air Quality (NAAQ) Standard of 100 ug/m³ (24-hourly) for Residential, Rural and other Areas prescribed by Central Pollution Control Board (CPCB), all the monitored RPM values were found to be very well within the stipulated value. SPM values were ranging from 55-118 ug/m³ with an average value of 87.6 ug/m³. While comparing with the NAAQ Standard of 200 ug/m³ for Residential, Rural and other Areas, all the monitored SPM values were found to be well within the limit.

The maximum SO_2 and NOx levels monitored were 21 ug/m³ and 22 ug/m³ respectively. While comparing with the NAAQ Standard of 80 ug/m³, the mean SO_2 (8.1 ug/m³) and NOx (9.6 ug/m³) levels were found to be well within the limits. The maximum CO concentration monitored was 78 ug/m³ and most of the CO levels were monitored below the detectable limit of 40 ug/m³. While comparing the NAAQ Standard of 2000 ug/m³, the monitored CO levels were found to be well within the limit. All HC values were found to be below the detectable limit of 65 ug/m³.

All Particulate Lead values (except at Jayamkondam Intersection) were found to be below the detectable limit of 0.01 ug/m³ and within the NAAQ Standard of 1.0 ug/m³ (24-hourly).

Hence from the above discussion the following inferences can be drawn:

- All monitored RPM, SPM, SO2, NOx, CO, HC & Particulate Pb. concentrations were found to be very well within the 24-hourly NAAQ Standard for Residential, Rural and other areas.
- Buffer levels of 58.3%, 56.2%, 89.9% and 88.0% exists for RPM, SPM, SO_2 and NOx respectively with respect to the NAAQ Standards.
- Low standard deviation values reveal that no significant variations in pollutants' levels are occurring and a stable atmosphere is prevailing in the vicinity of all corridors.
- While comparing with other corridors, the ambient air pollutants' levels in Vridhachallam Thiruvarur corridor is higher which can be attributed to the heavier volume of traffic, bad road conditions and congestion.

4.1.9 NOISE LEVELS

4.1.9.1 Selection of monitoring stations

Monitoring of noise levels was carried out at eleven selected locations to establish the baseline noise levels along the project corridors (Refer **Table 4.22 and Figure 4.7**). The monitoring stations were selected based on a reconnaissance survey carried out along the project roads. The stations were selected to represent various landuses.

Table 4. 22: Noise Monitoring Stations

Location Code	Package	Section	Location	Chain-age	Reference	Distance from the C/L, m	Category
N1	TNRSP 01 (N)	Arcot Elavanasur	Arani Bypass	24.5	Arcot-Arani-Cheyyar Roads Junction, Hariharan Nagar	5.0	Residential Area
N2	TNRSP 01 (N)	Polur Chengam	Mundanai Reserve Forest	40.0	Reserve Forest Area, Pudur	7.0	Silence Zone
N3	TNRSP 01 (N)	Arcot Elavanasur	Tiruvannamala i Bypass	105.0	Near End Point of Tiruvannamalai Bypass, Edapalayam village.	10.0	Residential Area
N4	TNRSP 01 (N)	Arcot Elavanasur	Pugaipatti	26.6	Road Junction near Pugaipatti Primary School	5.0	Silence Zone
N5	TNRSP 01 (S)	Vridhachallam Thiruvarur	Vridhachallam Bypass	1.7	Mid Point of Vridhachallam Bypass, Savarikuttam Village	5.0	Residential Area
N6	TNRSP 01 (S)	Vridhachallam Thiruvarur	Jayamkondam	86.0	Jayamkondam Market Near Intersection of Ariyalur - Jayamkondam -Kumbakonam Roads.	5.0	Commercia l Area
N7	TNRSP 01 (S)	Vridhachallam Thiruvarur	Thiruvarur Bypass	3.0	Opposite to Police Station, Pavithramanickam	5.0	Residential Area
N8	TNRSP 02	Nagappattinam Kattumavadi	Muthupet Bypass	65.5	Brilliant Matriculation School Near Start Point of Muthupet Bypass	4.0	Silence Zone
N9	TNRSP 03	Kattumavadi Ramanathapuram	Manmelkudi	54.5	Manmelkudi Primary Health Care Centre	5.0	Silence Zone
N10	TNRSP 03	Kattumavadi Ramanathapuram	Tondi	108.9	Road Junction Near Overhead Tank, Tondi Market Area	4.0	Commercia l Area
N11	TNRSP 04	Ramanathapuram Tuticorin	Tuticorin	0(ECR) / 250.8 (NH)	End Point of TNRSP 04 Intersection of NH 45B with ECR	4.0	Industrial Area
Source: Primary Survey, LASA, May 2002.							

FIGURE 4.7:
LOCATION OF AIR & NOISE MONITORING STATIONS

4.1.9.2 Monitoring methods and results

Continuous 24 hours noise levels were monitored using a totally potable measurement system[5] (B&K type Lutron SL 4001 with an internal calibrator and windscreen). About 40 to 50 instantaneous levels were noted every hour. Noise measurements were made at 1.5 m above the ground and a suitable distance[6] from the corridor. The basic unit of measurement was A-weighted sound level. Measurements were taken in the fast mode and were analysed to yield statistical information such as L_{eq} (equivalent noise level), L_{10} and L_{90}, those exceeded for 10 and 90 percent of the time respectively. Traffic flows at the time of measurements were also recorded. Equivalent noise levels worked out based on the analysis of the noise levels monitored are presented in the **Table 4.23.**

Table 4. 23: Noise Levels along the Corridors

Sl. No.	Location	Package	Code	Noise Levels, dB(A)													
				Day Time (06:00-22:00 hrs.)							Night Time (23:00-06:00 hrs.)						
				L min	L max	L10	L50	L90	Leq (Day)	MoEF Norms Leq (Day)	Lmin.	Lmax	L10	L50	L90	Leq(Night)	MoEF Norms Leq (Night)
1	Arani Bypass	TNRSP 01 (N)	N1	35.4	73.5	63.1	55.5	50.2	60.1	55	33.0	66.3	56.1	46.4	38.2	51.9	45
2	Mundanai RF	TNRSP 01 (N)	N2	29.8	61.5	50.2	41.8	35.6	47.1	50	23.6	50.4	38.2	33.0	28.6	35.7	40
3	Tiruvannamalai Bypass	TNRSP 01 (N)	N3	35.2	63.3	51.5	44.5	40.4	48.8	55	30.1	57.7	44.7	39.2	34.2	42.9	45
4	Pugaipatti	TNRSP 01 (N)	N4	27.1	60.2	50.3	43.2	38.6	47.4	50	24.5	56.2	40.3	34.3	29.3	39.7	40
5	Vridhachallam Bypass	TNRSP 01 (S)	N5	35.3	68.5	55.4	47.3	41.1	52.3	55	29.6	57.2	45.8	40.0	35.2	43.3	45
6	Jayamkondam	TNRSP 01 (S)	N6	40.3	84.3	68.4	56.8	49.6	66.8	65	34.8	69.5	52.3	44.3	38.6	50.6	55
7	Thiruvarur Bypass	TNRSP 01 (S)	N7	37.0	68.5	56.4	48.7	42.9	53.6	55	31.2	59.8	47.0	39.7	36.3	43.6	45
8	Muthupet Bypass	TNRSP 02	N8	35.5	61.6	54.4	45.7	39.8	50.2	50	28.5	52.8	42.8	37.1	33.3	40.5	40
9	Manamelkudi	TNRSP 03	N9	34.7	68.6	55.3	47.8	40.2	51.9	50	28.6	50.6	41.3	37.8	33.8	39.2	40
10	Tondi	TNRSP 03	N10	35.3	63.8	55.6	47.6	40.8	51.6	65	28.7	57.3	43.0	37.6	33.5	40.7	55
11	Tuticorin (NH45B-ECR Junction)	TNRSP 04	N11	42.8	80.2	65.6	55.0	50.2	63.0	75	40.8	77.9	64.1	54.3	48.6	61.9	70

Source: Primary Survey, LASA, May 2002.

[5] The sound level meters used were in accordance with IS: 9779 and IEC 651 standards for noise survey. The built-in internal oscillation system 1 kHz sine wave generator (Bruel & Kjaer multi-function acoustic calibrator-Model 4226) was used for on the spot calibration at 94.0 dB(A) at 1000 Hz.

[6] In the case of rural areas the distance was 10 metres but in the urban sections it had to be reduced to only 4 -7 metres representing the location of receptors.

4.1.9.3 Observations and Inference

The monitored noise levels were ranging from 27.1 dB(A) (Pugaipatti) to 80.2 dB(A) (Tuticorin) with Leq values ranging from 47.1 dB(A) (Mundanai Reserve Forest) to 63.0 dB(A) (Tuticorin) during day time. During night times, noise levels were ranging from 23.6 dB(A) (Mundanai Reserve Forest) to 77.9 dB(A) (Tuticorin) with Leq values ranging from 35.7 dB(A) (Mundanai Reserve Forest) to 61.9 dB(A) (Tuticorin).

While comparing the MoEF Ambient Noise Norms for different categories, Leq noise levels at Arani Bypass [60.1 dB(A) during day time & 51.9 dB(A) during night time], Jayamkondam Intersection [66.8 dB(A) during day time], Muthupet Bypass [50.2 dB(A) during day time and 40.5 dB(A) during night time] and Manamelkudi [51.9 dB(A) during day time] were found to be exceeding their respective limits.

It may be noted that as the noise survey was carried out at sensitive receptors i.e. School Zone and Hospital Zone at Muthupet and Manamelkudi respectively, noise standards for sensitive zones have been compared with. However, those monitored values were well within the MoEF Standard for Residential Areas. Arani Bypass is close to a significant road junction (Arcot-Arani-Cheyyar Road Junction) with considerably high traffic flow especially of two wheelers. Jayamkondam Intersection is a congested market place where anthropogenic activities also contribute significantly to the noise levels apart from traffic. Analysis of traffic flow data indicates that the high noise levels monitored at Arani bypass and Tuticorin NH45B-ECR junction can be attributed predominantly to the vehicular traffic.

4.2 BIOLOGICAL ENVIRONMENT

The areas of ecological significance such as Reserve Forest, Biosphere Reserve, Wild life Sanctuary, Social Forestry along or in close proximity to the corridors have been studied with respect to the impact of the road upgrade on the existing flora and fauna.

4.2.1 RESERVE FORESTS

The Reserve Forest locations along or in close proximity to the corridors are described below [Refer **Figure 4.8 (A) & (B)**]

FIGURE 4.8(A)
RESERVE FOREST (NORTHERN CORRIDOR)

FIGURE 4.8(B)

RESERVE FOREST AND WILDLIFE SANCTUARY (EASTERN CORRIDOR)

4.2.1.1 Reserved forests along Northern Corridor

(I) KASAMBADI (KELUR) RESERVE FOREST - ARANI POLUR ROAD LINK

The Project Road passes through this Reserve Forest for a length of about 2 Km between Km 17.6 – 18.0 (148.6) – 148.3 and Km 147.0-146.4(**Figure 4.9**). The forest extends several kilometers west from the road. The forest is patchy because of human settlements (villages) inside the forest at several places.

Flora: In this Reserve Forest, a total of 98 plant species were recorded. Of these, none of the species are threatened or endangered. The common plants are *Zizipus mauritiana, Acacia farnesiana, Wrightia tinctoria, Randia malabarica, Randia brandisii, Tamarindus indica, Hemidesmus indicus* and *Cassia auriculata*. Most of them are thorny shrubs. The Forest Department has planted the area with a mixture of tree species such as *Acacia leucocephala, Acacia arabica, Eucalyptus* sp., *Tamarindus indica, Madhuca indica, Azadirachta indica* and *Santalum album*.

Fauna: A total of 111 animal species occur in this forest (20 species of reptiles, 76 species of birds and 15 species of mammals). There are 200 deer, scattered widely in the forests, which extends up to Javvathu hills. The protected spotted deer are also reported in this forest.

(II) PARVATHAMALAI RESERVE FOREST – POLUR CHENGAM ROAD LINK

The Parvathamalai Forest (**Figure 4.10**) is an undisturbed portion of the Eastern Ghats, all of which was once densely forested. The protected land and forest run parallel to the road (on the northern side) between Km 21.0 - 24.0 at a distance of about 750 m from the road. Near the road, the protected land is recently planted with Acacia. There are many small temples in the forest area between the Parvathamalai hill and Munnurmangdam village. On the southern side of the road paddy and sugarcane are cultivated

Flora: There are 152 species of plants in the Parvathamalai Reserve Forest. None of these plants are enlisted as threatened or endangered species. However, these plant species are characteristic of this area only.

Fauna: There are 128 species of animals (22 species of reptiles, 89 species of birds and 17 species of mammals) in this area. Of these, the Star Tortoise, the Orange Breasted Green Pigeon and Slender Loris are rare and the Bareheaded Goose, Black Buck and Civet Cat are threatened and endangered.

FIGURE 4.9

KELUR RESERVE FOREST

FIGURE 4.10

PARVATHAMALAI RESERVE FOREST

(III) MUNNARMANGALAM AND MUDANAI RESERVE FOREST – POLUR CHENGAM ROAD LINK

The forests are a part of the continuous vegetation of the Western Ghats. The existing road runs parallel to the forest adjoining the ROW, from Km 38.0 – Km 40.0(**Figure 4.11**). The interior of the forest has healthy trees whereas the periphery nearer to the road, has only thorny bushes and climbers with a few scattered trees

Flora: There are 166 plant species in these forests. The vegetation is similar to that of Parvathamalai, as this is a continuation of Parvathamalai hill. The plant species found along the road are common thorny shrubs and small trees, not threatened or endangered.

Fauna: In the forest area there are about 115 animal species belonging to 20 species of reptiles, 80 species of aves and 15 species of mammals. The forest is home to wild bores, deer, antelope, civet cats and a large bird population. Of the animal species present, the Star Tortoise, Orange Breasted Green Pigeon and Slender Loris are rare and the Bar Headed Goose and Civet Cat are threatened and endangered.

(IV) ATTIPAKKAM RESERVE FOREST - TIRUVANNAMALAI TIRUKKOVILUR ROAD LINK

The link road passes through the core of Attipakkam Reserve Forest from Km 85.6 – 83.8 (**Figure 4.12**).

Flora: A total of 106 species were recorded within this Reserve Forest. Of these the common are *Eucalyptus sp., Zizyphus mauritiana, Acacia farnesiana, Wrightia tinctoria, Randia malabarica, Randia brandisii, Tamarindus indica, Hemidesmus indicus* and *Cassia auriculata. On either side of the road there are thorny shrubs.* In the middle of the road stretch that passes through the forest, the entrance to St. Xaviers Church is located on the northern side of the road. It has tree species such as Tamarind and Neem.

Fauna: There are 16 species of reptiles, 71 species of birds and 11 species of mammals. Among mammals, the spotted deer (a threatened species) occur in few numbers in this forest. However it was revealed during the consultations with the forest officials and the local communities, that the deer reside far away from the road upgrade and are unlikely to be affected.

(V) THIPPAKKADU RESERVE FOREST - TIRUVANNAMALAI TIRUKKOVILUR ROAD LINK

The road link passes through the western end of the Thippakkadu Reserve Forest for a distance of about 1km between Km 102.0-103.0 (**Figure 4.13**).

Flora: A total of 112 plant species are reported. The species found are *Randia malabarica, Randia dumetorum, Azadirachta indica, Opuntia stricta, Acacia arabica, Prosopis julifora, Cassia auriculata, Acacia leucophloea* and *Euphorbia antiquorum*. None of the species are rare or threatened.

Fauna: There are 109 species of animals belonging to reptiles (15 species), birds (80 species) and mammals (14 species). The Tamil Nadu Forest Department has introduced a few spotted deer to the forest, which is the only rare and threatened animal species.

FIGURE 4.11
MUNDANAI RESERVE FOREST

FIGURE 4.12
ATTIPAKKAM RESERVE FOREST

FIGURE 4.13
THIPPAKKADU RESERVE FOREST

(VI) NATTAMUR RESERVE FOREST – TIRUKKOVILUR ELAVANASUR ROAD LINK

The road passes through one end (western side) of the forest (**Figure 4.14**). The roadside areas have already been cleared by the Forest Department for Eucalyptus plantation.

Flora: There are 68 floral species in the Reserve Forest. The dominant species are *Dodonaea angustifolia, Acacia farnesiana, Carissa carandas, Acacia leucophloea, Randia malabarica, Randia dumetorum* and *Eucalyptus sp.* The vegetation within the forest along the roadside comprise of mainly small trees and thorny bushes. None of the plant species are threatened or endangered.

Fauna: There are 17 species of reptiles, 68 species of birds and 13 species of mammals in this Reserve Forest. A large number of birds inhabit the thorny bushes and shrubs. There are 20 -30 of the threatened spotted deer in the middle and eastern border of the forest.

(VII) SILUVAICHERI RESERVE FOREST - VRIDHACHALLAM JAYAMKONDAM ROAD LINK

The road traverses 0.6 km of the forest in a north-south direction from Km 17.0-16.4 (**Figure 4.15**). Eucalyptus and Cashew plantations are seen on both sides of the road.

Flora: 59 floral species are recorded from this Reserve Forest. The most common plant species are *Zizyphus oenoplia, Morinda tinctoria, Tectona grandis, Syzigium cumini, Randia malabarica, Randia dumetorum* and *Anacardium occidentale.* None of species are threatened or endangered.

Fauna: A total of 94 animal species represented by 14 species of reptiles, 67species of birds and 13 species of mammals are reported from the forests. None of the species are threatened or endangered.

(VIII) PERIAVALAYAM RESERVE FOREST - JAYAMKONDAM KUMBAKONAM ROAD LINK

Periyavalayam Reserve Forest, 2 km to the east of Jayamkondam, is traversed for 1.5 km by the road between Km 95.0-96.5 (**Figure 4.16**).

Flora: Periavalayam is a Reserve Forest where the Tamil Nadu forest department has cleared the natural vegetation and raised *Eucalyptus* plantation. The thorny shrubs are growing along with the planted *Eucalyptus.* 62 plant species are reported from the area. None of the species is threatened or endangered.

Fauna: Faunal species associated with Periavalam include 18 species of reptiles, 56 species of aves and 10 species of mammals. They are commonly found species and none of them are rare or endangered.

FIGURE 4.14
NATTAMUR RESERVE FOREST

FIGURE 4.15
SILUVACHERI RESERVE FOREST

FIGURE 4.16
PERIVALAYAM RESERVE FOREST

4.2.1.2 Reserved Forests along Eastern Corridor

(I) MUTHUPET RESERVE FOREST - NAGAPPATTINAM KATTUMAVADI ROAD LINK

The Muthupet Reserve Forest, essentially a mangrove forest, lies at a distance of about 5 km from the proposed road upgrade between Km 91.0 – 92.0.

Flora: The Muthupet mangroves are characterised by the presence of only 4 exclusive mangrove species namely *Avicennia marina, Excoecaria agallocha, Aegiceros corniculatum* and *Acanthus ilicifolius* (Kannan, 1994). Studies on the impact of past management practices and the present status of the mangrove ecosystem in Muthupet reveal that the species composition is very poor when compared to the number of exclusive mangrove species present in Pitchavaram, which is, located just 140 km north of Muthupet. Uncontrolled and unregulated exploitation, cattle grazing, and some environmental factors like poor inundation and damage due to cyclonic storm seem to be the reason for the low species diversity of the Muthupet mangrove forest. Restoration and conservation of these mangroves is being carried out with funding from India Canada Environment Facility (ICEF) by the MS Swaminathan Research Foundation.

(II) MARAVAKKADU RESERVE FOREST - NAGAPPATTINAM KATTUMAVADI ROAD LINK

On the southern side of the proposed road upgrade dense mangrove vegetation occurs at a distance of about 3 Km between Km 7.0 – 8.0. This forest area comes under the Muthupet Reserve Forest Range.

Flora: Apart from the mangrove species the major tree species include *Cocos nucifera, Delonix elata, Thespesia populnea, Azadirachta indica, Borassus flabellifer* and *Lannea coromandelica*. Majority of trees are found on the bunds of the paddy fields and not along the roadside.

The Maravakkadu village has dense mangrove vegetation along its coast. *Suaeda maritima, S. monica, Sesuvium portulacastrum, Excoecaria agallocha* and *Avicennia marina* are the major mangrove species present in the area.

Fauna: The faunal diversity comprises of 16 reptilian species, 59 avian species and 10 mammalian species. Reptiles such as *Varanus sp., Chamelion sp.* and *Naja naja* are commonly seen. Some mammalian species such as *Antelope cervicapra, Axis axis, Lacaca radiata, Felia chaus* and *Pteropus medium* are said to occur here rarely.

(III) KODIAKKADU RESERVE FOREST – KATTUMAVADI RAMANATHAPURAM ROAD LINK

Kodiakkadu is a scrub jungle forest extending over about 100 Ha. on the eastern side of Manmelkudi in Pudukkottai district. It is located 3 km away from the road between Km 54.0 – 55.0.

Flora: The Forest Department has cleared the vegetation in several places for coconut and casuarina plantation and only about 20 Ha. of forest remains intact. The dominant forest trees are *Memecylon edule, Mimusops hexandra, Streblus asper, Calophyllum inophyllum* and *Hiptage madablota*.

Fauna: Kodiakkadu reported of 20 reptilian, 45 avian and 14 mammalian species. The prominent avian species included *Dendrocitta vagabunda, Pycnonutus cafer, Erithacus brunneus, Coracias benghalensis, Treron bicinda, Pavo cristatus* and *Mirafra assamica*. Reptilian species include *Calotes versicolor, Chamaleon vulgaris, Varanus sp., Python molurus, Zamenis musucus* and *Dryophis myterizans*. Further a large number of mammals such as *Herpestes edwardsi, Herpestes auropunctatus, Lepus nigricollis, Canis aureus, Vulpus sp.* and *Dugong dugong* are also said to be occurring in this area.

4.2.1.3 Reserve Forests along Maintenance Corridors

One of the maintenance corridors, the Salem Vaniyambadi Road, in Dharmapuri district passes through Reserve Forest. About 2 Km of the corridor from Km 73.8 to 75.8 crosses the RF. Deer crossings along this stretch are also reported.

4.2.2 WILD LIFE SANCTUARY / BIOSPHERE RESERVE

The Udayamarthandapuram Birds Sanctuary and Gulf of Mannar Biosphere Reserve occur within 10 km of the Eastern Corridor [**Figure 4.8 (B)**]. A third sanctuary, Point Calimere Sanctuary, lies at a distance of 25km from the Eastern Corridor. There are no Wild life Sanctuaries or National Parks along or in close proximity to the Northern Corridor.

4.2.2.1 Wildlife Sanctuary / Reserves along Eastern Corridor

(I) UDAYAMARTHANDAPURAM BIRDS SANCTUARY

The Sanctuary covers an area of 45 ha and comprises a buffer storage irrigation tank drawing water from the Mettur canal system (*Tamil Nadu Forest Department Management Plan; n.d*). The entire Sanctuary is enclosed within a bund wall and the wetland habitat provides suitable feeding areas for approximately 25 to 30,000 resident and migratory birds, comprising at least 55 species (*Tamil Nadu Forest Department Management Plan*). On the Sanctuary's bund walls, thickets dominated by *Acacia nilotica* provide nesting and roosting habitat for the birds. The habitat within the Sanctuary is not unique to the area, and during periods of flooding, birds also forage and nest in the extensive agricultural areas that surround the Sanctuary. Water in the Sanctuary is available from August to mid-March, but is severely restricted outside this time by insufficient release from the Mettur Dam (Tamil Nadu Forest Department Management Plan). The bund walls of the Sanctuary are approximately 400 m from the nearest section of road upgrade. The avifauna observed in the Sanctuary in March 2002 is presented in **Table 4.24.**

Table 4.24: Avifauna Observed in Udayamarthandapuram Bird Sanctuary

Species	Number Observed on 22.3.2002	Species	Number Observed on 22.3.2002
Open Billed Stork	10000	Common Sandpiper	175
Cattle Egret	1000	Little Tern	100
Purple Moorhen	100	Black winged Stilt	25
Peasant Tailed Jacana	20	Indian Moorhen	-
Pond Heron	500	Little Cormorant	25
Coot	6	White Ibis	50
Red Wattled Lapwing	6	Small Egret	1500
Purple Heron	-	Common Snipe	10
White Heron	250		
Source: Daily Records of the Sanctuary.			

(II) GULF OF MANNAR BIOSPHERE RESERVE

The Gulf of Mannar Biosphere Reserve is a marine reserve off the districts of Ramanathapuram and Tuticorin. The Reserve comprises 21 islands and, with a land area of 623 ha and seas shallower than 3.5 fathoms on the landward side of the islands. The nearest among the 21 islands, Kariyashuli, lies at a distance of about 7 km from the road upgrade The Gulf of Mannar is the first Marine Biosphere Reserve not only in India, but in South and South-east Asia. Biophysical uniqueness, economic, social, cultural and scientific importance, national and global significance, and management compatibility at the local and national level, were used as the basis for selecting the reserve as a priority site (*Gulf of Mannar Management Plan, Draft*). The Gulf of Mannar Biosphere Reserve comprises 21 islands, mostly of coral origin. The marine resources supported by the Bio Reserve are described below:

Coral Reefs

The islands are built of a calcareous framework of dead corals and coral reefs. There are approximately 120 species of coral belonging to 33 genera associated with these reefs (*Neelakantan, 1993*). The coral reefs support a wide variety of marine animals, vegetation and a great diversity of algae, sponges, and fish.

Coastal Wetlands

There are a wide variety of natural wetlands along the coast, including estuaries, salt marshes, tidal flats and coastal lagoons. Most of the wetlands offer valuable habitat for birdlife. Of particular importance are the wetlands with mangroves and the coastal lagoons with extensive vegetation. The economically viable species of *Hypnea, Gelidiella, Gracelaria, Stiechospermum, Hydrodathums, Clathratus, Padina,* and *Caulerpa* are well distributed in the Gulf of Mannar.

Sea grasses

Seagrass are marine plants belonging to two monocotyledonous families, *Hydrocharitaceae* and *Potamogetonaceae*. There are extensive seagrass beds along the coast). The seagrass beds are feeding grounds for the dugong (*Dugong dugong*). They are responsible for making Park Bay and the Gulf of Mannar the most important areas in the region for the Dugong. The seagrass beds also provide feeding areas for five species of marine turtles.

These are the Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Olive Ridley (*Lepidochelys olivacea*), Hawksbill (*Eremochelys imbricata*) and Leatherback (*Dermochelys coracea*).

Many species of crustaceans, molluscs, gastropods and fish are also known to inhabit the seagrass beds off the coast. The seagrass communities are also valuable habitat for commercial species, particularly the green tiger prawn, *Penaeus semisulcatus*, which is extensively harvested for the export market.

Chankbeds

The sacred chank, *Acnus pyram*, is found on fine or soft sandy areas under the waters of the Gulf of Mannar (*Neelakantan, 1993*). The chank beds are very productive. The sinistral forms are used for worship in Hindu temples. The Tuticorin jadi variety of chanks is in demand in West Bengal for manufacturing ornaments.

Oyster banks

There are 10 oyster banks in the Gulf of Mannar (*Neelakantan, 1993*). The depth of the banks varies from 10 to 20 m. The main concentrations are off Tuticorin and to a lesser extent between Nalla Thanni Tivu and Vinokkam. Species of oyster include:

- *Pinctada fucata*, the preferred pearl oyster;
- *Perna viridis*, an edible species;
- *Meretrix sp, Katalaysia sp, Anadara sp, Donax sp*, all edible bivalves;
- *Ponna bicolor*, a fan shell.

Sea Cucumber

Holothurian (sea-cucumber), an endemic echinoderm found in abundance along the coasts of the Gulf of Mannar and Palk Bay, is extensively harvested for export to Japan and other South-East Asian countries as a highly prized food item. However, some species have become rare as a consequence of over-fishing. *Holothuria scabra, Holutheria spinifera* and *Holuthuria atra* could become endangered in the absence of appropriate conservation measures.

(III) POINT CALIMERE SANCTUARY

At Point Calimere, which separates the Bay of Bengal from the Palk Straits, a Wildlife and Bird Sanctuary extends over 1726 Ha. Most of it is tropical dry evergreen forest. The Sanctuary is 25 km from the Eastern Corridor [**Figure 4.8(B)**].

The Forest Department has proposed to extend the sanctuary to the west, vast saline marshes that stretch from the Sanctuary to Muthupet. Along with the rich terrestrial flora (300 plant species) of the adjoining dry evergreen forests at Point Calimere and Kodiakkadu, these marshes support more than 260 species of resident and migratory birds belonging to 50 families. With the onset of the northeast monsoon in October, many passerine and aquatic species arrive from Russia, Iran, Australia, Europe, North India and other places. Important species include flamingos, pelicans, white ibis, caspian term, storks, gulls, wild ducks, stints, sandpipers and plovers. Most of the birds leave by the end of January when salt extraction commences.

Point Calimere has the second largest congregation of flamingoes in India after the Rann of Kutch. The birds come mostly for feeding and evidence of breeding is not available. During the 1980s roughly 50,000 flamingos were recorded, but the numbers have dropped to below 10,000 because of biotic interference, fishing activities, and the effects of salinity.

4.2.2.2 Wildlife Sanctuary along Maintenance Corridors

Only one of the corridors, the Ambasamudram Papanasam Road, in Tirunelveli District is in close proximity to the Mundanthurai Wild life Sanctuary. The other maintenance corridors do not pass through or close to any Sanctuary or National Park.

4.2.3 AVENUE TREES

4.2.3.1 Avenue Trees along Upgradation Corridors

The avenue trees along the corridors as well as the bypasses within 15 m of the centre line of the road are presented in **Table 4.25**. The Table also presents the tree density along each road. A total of 13049 trees were observed along the Northern Corridor and 8234 trees were observed along the Eastern Corridor. The predominant species included Tamarind (Tamarindus indica), Palmyrah Palm (Borassus flabellifer), Coconut (Cocos nucifera), Neem (Azadirachta indica) etc.

57 % of the trees belong to a single species i.e. Tamarind. In most cases single row of avenue trees are observed. The maximum tree density along TNRSP 01(N) is observed in Tiruvannamalai Tirukkovilur link (66.3) followed by Polur Chengam link (61.1). The overall tree density along TNRSP 01(N) is 51.6. Along TNRSP 01 (S) the tree density is much lower (19.9). The maximum tree density along TNRSP 01(S) is observed in Kumbakonam Thiruvarur link (28.5). Some green tunnels are also observed along the Northern Corridor along Polur Chengam link (Km 15.0-16.0 & Km 18.0-19.0) and Vridhachallam Jayamkondam link (Km 3.0-2.0). Among the bypasses along Northern Corridor the maximum tree density is observed along Thiruvarur Bypass (32).

Along the Eastern Corridor the maximum number of trees (3413) are along TNRSP 04 i.e. Ramanathapuram to Tuticorin. Palmyrah Palm is the most common species along the Eastern Corridor accounting for 57 % of the total trees. The maximum tree density is also observed along Ramanathapuram to Tuticorin (33.4). The total number of trees along TNRSP 03 and 04 is 1642 and 3413 respectively. The tree density varies from 16.5 along TNRSP 03 to 33.4 along TNRSP 04.Some green tunnels are also observed along the Eastern Corridor between Tiruthuraipundi Muthupet (Km 72.0-73.0, Km 83.0-84.0, Km 88.0-89.0 and Km 90.0-91.0).

4.2.3.2 Avenue Trees along Maintenance Corridors

The tree density (number/Km) along the maintenance corridors has been calculated and the corridors have been categorized accordingly. **Table 4.26** presents the list of corridors with significant tree density. As the major maintenance of corridors does not include any land uptake, no adverse impact on the roadside plantation is expected. The maximum tree density is noticed along the Aranthangi Kattumavadi Corridor in Pudukkottai District.

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Table 4.26: Tree Density along Maintenance Corridors

TREE DENSITY (Within RoW)		
50 - 75 Trees / Km	**75 - 100 Trees / Km**	**> 100 Trees / Km**
Pallikonda Palamaneri	Dharmapuri Hoggenakkal	Erode Perundurai
Trichy Chidambaram Road	Musuri Tpet Murugur	Thlttai Melatoor
Trichendur Shencottah	Thuraiyur Perambulur	Thiruvanthipuam Arni
Chittor Thiruthani	Arcot Tindivanam	Musiri Piulivilam
Perambalur Manamadurai	Palani Dharmapuram(E)	Vikravandi Kumbakonam
Dindigul Karur	Musiri Thuraiyur Attur	Mailam Pondy Road
Kannamangalam Arni	Paruvakudy Vilathikulam Vembar	Vellimedpettai Mailam
Srivilliputhur Parthibanur	Erode Karur	Aranthangi Kattumvadi
Cuddalore Chittor	Trichy Namakkal	
Manaparai Kulithalai	Vaiyampatti Mylampatti	
	Ooty M Palayam Erode	
	Krishnagiri Royacotta	
Source: Inventory of Maintenance Corridors by HD		

4.2.4 SOCIAL FORESTRY

The Tamil Nadu State Forest Department has come up with forestry schemes in the state. The upgradation routes along the Northern Corridor pass through 5 of these social forestry areas. The plantations are mainly of Acacia, Prosopis and Eucalyptus. A list of such areas (observed mostly along the Northern Corridor) is presented in **Table 4.27.**

Table 4.27: Social Forestry along the Corridors

Sl No	Package	Name	Link	Nearest Chainage	Faunal Species	Flora
1	TNRSP 01 (N)	Nambiyendal	Polur Chengam	-	-	Low species diversity due to overgrazing by cattle. Introduced Prosopis is only striking feature of the area
2	TNRSP 01 (S)	Peria odai	Vridhachallam Jayamkondam	5.0	Monkeys	Acacia Plantation
3	TNRSP 01 (S)	Sendurai (Social Forestry with two large Reservoirs)	Jayamkondam Ariyalur	23.5	Terrestrial and Aquatic Birds	Acacia arabica and Prosopis
4	TNRSP 01 (S)	Kuranguthope (Dense patch of vegetation)	Kumbakonam Thiruvarur	-	Mostly Birds	Diversified tree population and also medicinal herbs such as Adathoda
5	TNRSP 01 (S)	Nachiyar Koil	Kumbakonam Thiruvarur	31.0	94 species (15 reptiles, 67 birds & 12 mammalian species).	Trees such as Coconut and Palm and also medicinal herbs
Source: EIS for Northern Corridor, March 1999 & EIS for Corridor I, June 1999, Prepared by PCC & Ecological Survey Reports, 1998.						

4.2.5 OTHER SENSITIVE AREAS

4.2.5.1 Along Northern Corridor

(I) ANAIKARAI

The river Cauvery originates from Karnataka (Western Ghats) and flows to the Bay of Bengal. Its branch, the river Kollidam, divides into two and forms an island called "Nadu Thittu" at Anaikari. On both sides of the river, dense healthy vegetation occurs supported by the water supply from the river.

This site falls in Jayamkondacholapuram – Kumbakonam stretch in between chainage 100-101. In this ecologically sensitive area of high floral diversity and large trees which act as home for many local birds. There are 153 species of plants, none threatened or endangered. In Anaikarai (lower anaicut), there are good freshwater fishery resources and fishing (mainly freshwater prawn, catfish and snake head

murrels) is carried out. Of the 115 animal species present, the reptilian Crocodilus porosus is a threatened species and is well acclimatized to this environment. They stay next to the Anaikari regulator without moving down stream.

Along the river, in many places, the Tamil Nadu Forest Department is planting teak trees. The Public Works Department (PWD) has built an anicut (dam) for irrigation purposes. So, necessary water supply and the care taken by the PWD have helped to maintain a healthy tree population. On the northern bank of the southern branch of the river, away from the existing road (500 meters) and next to the PWD Guest House, a sacred grove is located.

(II) ARIYALUR

The Ariyalur district, resting on fossil beds 65 million years old, contains macrofossils ranging from coelenterates, molluscs, echinoderms and chordates including plesosaurs and other reptiles. The fossil eggs of dinosaurs, found in the Ariyalur and Senthurai areas, reveal that these areas could have served as the breeding sites for these animals. Marine fossils further reveal that this area was under sea at some stage. There are fossils of both lower and higher plant forms to a depth of 1 meter. These fossil resources are being mined for cement production. The fossil bed lies at a distance of more than 4 km from end of the corridor.

4.2.6 COASTAL AND MARINE RESOURCES

Tamil Nadu has a coast of 1,000 km and a continental shelf area of 41,412 sq. km with a high diversity of coastal species. There are numerous fishing villages, old trading ports and also a high diversity of coastal resources including fisheries, aquaculture farms, mangroves, salt pans, coral reefs, seagrass beds, marine algae, chank beds, oyster banks and sea-cucumbers.

4.2.6.1 Fisheries

The coast is important to the economy of Tamil Nadu. The State's fish catch of 439,000 tons in 1994-95 and 449,000 tons in 1995-96 produced an annual return in excess of Rs 400,000,000. Along the coast there are 442 marine fishing villages supporting a total population of 537,000 (*Evaluation and Applied Research Department, 1997*). Major fisheries centers exist at Chennai, Tuticorin and Chinna Muttam, while medium sized centers operate at Palayar, Valinokkam, Cuddalore and Nagappattinam. The three districts of Nagappattinam, Pudukkottai and Ramanathapuram together account for nearly 60% of the fisheries catch. A list of fishing villages along the upgradation corridors is given in **Table 4.28**.

Table 4.28: Fishing Villages along Upgradation Corridors

Sl. No.	Package	Fishing Village	District
1	TNRSP 02	Velankanni	Nagapattinam
2	TNRSP 02	Alaganvayal	Pudukkottai
3	TNRSP 02	Sethubavachatram	Thanjavur
4	TNRSP 02	Enathi	Pudukkottai
5	TNRSP 02	Melasthanam	Pudukkottai
6	TNRSP 02	Mumpalai	Pudukkottai
7	TNRSP 03	Mimisal	Pudukkottai
8	TNRSP 03	Devipattinam	Ramnathpuram
9	TNRSP 02	M.R. Pattinam	Ramnathpuram
10	TNRSP 03	Tondi	Ramnathpuram

Sl. No.	Package	Fishing Village	District
11	TNRSP 03	Nambuthulai	Ramnathpuram
12	TNRSP 03	Eripurakkarai	Thanjavur
13	TNRSP 03	Kollukadu	Thanjavur
14	TNRSP 03	Pudupattinam	Thanjavur
15	TNRSP 03	Adaikkathevan	Thanjavur
16	TNRSP 03	Senthalaivayal	Thanjavur
17	TNRSP 03	Uppur	Thiruvarur
18	TNRSP 03	Alankadu	Thiruvarur
19	TNRSP 03	Duraikadu	Tuticorin
20	TNRSP 04	Vembar	Tuticorin
21	TNRSP 04	Pattanamardur	Tuticorin
22	TNRSP 04	Tharvaikulam	Tuticorin
Source: Directorate of Fisheries, GoTN.			

4.2.6.2 Marine Algae

Marine algae are primitive plants lacking roots, stems and leaves. They grow in the intertidal and subtidal areas of the sea. Luxuriant growth of several species of marine algae occurs along the coast of Tamil Nadu from Sethubachatram (Thanjavur district) to Kanyakumari (*Kalimuthu and Kalaiperumal, 1996*). Marine algae are the only source for production of phytochemicals such as agar, carrageenan and algin which are widely used as gelling, sterilizing and thickening agents. Commercial harvesting off the coast of Tamil Nadu has taken place since 1966. People also collect seaweed and sea grasses for local use as manure for coconut trees. Experiments have shown that commercial scale cultivation of marine algae in Tamil Nadu is possible (*Kalimuthu and Kaliaperumal, 1996*).

4.2.6.3 Aquaculture

Aquaculture ponds are observed along the Eastern Corridor along Package TNRSP 02 and TNRSP 03. Brackish waters shrimp farming is carried out, mostly of the black tiger shrimp (*Penaeus monodon*), to a lesser extent the white shrimp (*P. indicus*) and giant Malaysian prawn (*Macrobrachium rosenbergii*) (Refer **Table 4.29**).

Table 4.29: Aquaculture along Upgradation Corridors

S. No	Package	Link	Chainage	Side
1	TNRSP 02	Nagapattinam Tiruppundi	4.000-5.000	Both
2	TNRSP 02	Nagapattinam Tiruppundi	9.000-10.000	Right
3	TNRSP 02	Muthupet Kattumavadi	23.000-24.000	Right
4	TNRSP 02	Muthupet Kattumavadi	28.000-29.000	Both
5	TNRSP 02	Muthupet Kattumavadi	29.000-30.000	Left
6	TNRSP 02	Muthupet Kattumavadi	33.8	Right
7	TNRSP 02	Muthupet Kattumavadi	38.000-39.000	Both
8	TNRSP 03	Kattumavadi SP Pattinam	70.000-71.000	Left
9	TNRSP 03	Kattumavadi SP Pattinam	77.000-78.000	Left
10	TNRSP 03	Tondi Devipattinam	12.000-13.000	Right
11	TNRSP 03	Tondi Devipattinam	17.000-18.000	Left
Source: Primary Survey by LASA.				

4.2.6.4 Saltpans

As early as the eleventh century, there was a series of salt manufacturing centres along the coast of Cuddalore and Nagappattinam districts (*Champakalakshmi, 1996*). Tamil Nadu is the second largest salt producing State after Gujarat. Large areas of former coastal wetlands are now saltpans, and the industry is still expanding. Although saltpans provide temporary feeding habitat for wader bird species, they are generally low in diversity. Salt pans along the upgradation corridors are presented in **Table 4.30.**

Table 4.30: Salt Pans along Upgradation Corridors

Sl. No.	Package	Road	Chainage
1	TNRSP 03	Kattumavadi SP Pattinam	58.0-59.0 & 73.0-75.0
2	TNRSP 03	Tondi Devipattinam	25.0-26.0
3	TNRSP 04	Ramanathapuram Kilakarai	11.0-12.0
4	TNRSP 04	Kulattur Tuticorin	7.0-20.0
Source: Field Survey by LASA.			

4.2.6.5 Mangroves

Tamil Nadu has about 10,000 ha of mangroves[7], about 3 per cent of India's total (Jagtap et al, 1993). There are significant areas of mangroves within 10 km of Project roads near Chidambaram (Pichchavaram, 110 km²), Muttupet (68 km²), along the Palk Bay coast and in the majority of the twenty-one Gulf of Mannar islands. **Table 4.31** presents the areas with prominent mangrove vegetation along the corridors.

Table 4. 31: Mangrove Vegetation along the Upgradation Corridors

Sl. No.	Package	District	Location	Distance (Km)*	Aerial Extent / Significance
1	TNRSP 01(E)	Cuddalore	Pichchavaram	6.0	Area of 1007 Ha.
2	TNRSP 02	Thiruvarur	Muthupet	2.5	Area of 6803 Ha.
3	TNRSP 02	Thiruvarur	Turaikkadu	0.5	Area of 2636 Ha.
4	TNRSP 02	Thanjavur	Vadakkadu	1.5	Area of 372 Ha.
5	TNRSP 02	Thanjavur	Maravakkadu	1.2	Area of 1490 Ha.
6	TNRSP 02	Thanjavur	Atiramapattinam	1.0	Area of 306 Ha.
7	TNRSP02	Nagapattinam	Papagani River	0.1	Sparse Growth
8	TNRSP 02	Pudukkottai	Kattumavadi	1.0	Area of 1007 Ha.
9	TNRSP 03	Pudukkottai	Vaddakku Ammanpattinam	2.0	Area of 8 Ha.
10	TNRSP 03	Ramanathapuram	Gulf of Mannar islands	7.0	Biosphere Reserve
11	TNRSP 03	Ramanathapuram	Tiruppalaikudi Uppar	1.0	Area of 48 Ha.
12	TNRSP 03	Ramanathapuram	Kottakkarai River	0.3	Sparse Growth
13	TNRSP 04	Tuticorin	Mallatar River	0.5	Sparse Growth
Note: * Distance form of existing road / proposed bypass. Source: Ecological Reports by PCC for Northern Corridor, October 1998 & for Corridor I, August 1998, and Field Survey by LASA.					

4.3 CULTURAL RESOURCES

4.3.1 RELIGIOUS CENTRES

4.3.1.1 Upgradation corridors

For centuries, pilgrims have traveled the roads of Tamil Nadu to visit famous shrines of saints. This tradition applies to all the religions in the state - Saivism, Vaisnavism, Christianity, Islam, and Jainism. The towns along the project roads include many of the popular shrines. **Figure 4.17 (A) & (B) and Table 4.32** shows the major religious sites in the vicinity of the Upgradation Corridors.

[7] Mangroves are the predominant component of salt tolerant forest ecosystems found in tidal areas. The low tide exposes the roots of mangroves and the high tide submerges them. Mangroves provide habitat to many animals and birds and serve as important habitat for spawning, nursery and feeding. They are vital to the preservation of biological diversity for many species of plants and animals. Mangrove forests protect the coast from erosion by tidal action and they filter and purify water. Species of mangroves common in Tamil Nadu include *Avicennia alba, Sopperatia apetala, Excoecaria, Argiceras, Avicennia officinalis and Acanthus ilicifolius* (Forest Department, 1990). In areas of degraded vegetation cover, mangroves become almost exclusively *Avicennia alba* and *Acanthus ilicifolius*.

Table 4.32: Religious Centers along Upgradation Corridors

Sl No	Package	Name of the Religious Center	Nearest Chainage	Nearest Settlement	District
1	TNRSP 01 (N)	Vellore Mosque	0.500	Arcot	Vellore
2	TNRSP 01 (N)	Velappakkam Mosque	6.000	Arcot	Vellore
3	TNRSP 01 (N)	Murgan Temple	5.000	Arani	Tiruvannamalai
4	TNRSP 01 (N)	Polur Mosque	1.000	Polur	Tiruvannamalai
5	TNRSP 01 (N)	Polur Church	1.000	Polur	Tiruvannamalai
6	TNRSP 01 (N)	Chengam Mosque	47.000	Chengam	Tiruvannamalai
7	TNRSP 01 (N)	Chengam Church	47.000	Chengam	Tiruvannamalai
8	TNRSP 01 (N)	Durga Temple	143.000	Polur	Tiruvannamalai
9	TNRSP 01 (N)	Subramanyam Temple	143.000	Polur	Tiruvannamalai
10	TNRSP 01 (S)	Virugariswami Temple	5.000	Vridhachallam	Cuddalore
11	TNRSP 01 (S)	Senneeswarar Aalayam Temple	0.500	Jayamkondam	Ariyalur
12	TNRSP 01 (S)	Arunajadeeswarar koil	106.700	Jayamkondam	Thanjavur
13	TNRSP 01 (S)	Sivan koil	116.600	Jayamkondam	Thanjavur
14	TNRSP 01 (S)	Kumbheshvara Temple	121.000	Kumbakonam	Thanjavur
15	TNRSP 01 (S)	Punitha Soosayappar Aalayam Church	20.000	Thiruvarur	Thiruvarur
16	TNRSP 01 (S)	Padikki Arasi Amman Koil	17.000	Thiruvarur	Thiruvarur
17	TNRSP 01 (S)	Tyagaraja Temple	0.000	Thiruvarur	Thiruvarur
18	TNRSP 01 (E)	Nataraja Temple	-	Chidambaram	Cuddalore
19	TNRSP 02	Nagor Mosque	2.000	Nagapattinam	Nagapattinam
20	TNRSP 03	kayarohana Temple	8.000	Nagapattinam	Nagapattinam
21	TNRSP 03	Navagraha Temple	63.000	Devipattinam	Ramnathpuram
22	TNRSP 03	Valividumurga Temple	70.000	Ramnathpuram	Ramnathpuram
23	TNRSP 04	Vishnu Temple	75.000	Ramnathpuram	Ramnathpuram
24	TNRSP 04	Punitha Anthoniar Thiruthalam Church	9.000	Tuticorin	Tuticorin
Source: EIS for Northern Corridor, March 1999 & EIS for Corridor I, June 1999, Prepared by PCC.					

4.3.1.2 Maintenance corridors

Religious sites along the maintenance corridors have been documented and the corridors categorized according to the number of such locations observed along each stretch. **Table 4.33** presents the list of all such corridors. The maximum number of religious sites exists along the Trichendur Shencottah Corridor in Tuticorin District.

Table 4.33: Religious Sites along Maintenance Corridors

MAINTENANCE CORRIDORS WITH			
One Religious Site	**Two to Three Religious Sites**	**Four to Ten Religious Sites**	**More than Ten Religious Sites**
Cuddalore Chittor	Bukkathurai Uthiramerur	Denkanicottah Kahamangalam	Salem Vaniyambadi
Municipal Bypass	Trichy Namakkal	Chittor Thiruthani	Erode Karur
Arcot Tindivanam	Manaparai Kulithalai	Tirunelveli Shencottah Quilon	Srivaikuntam Pudukottai
Mailam Pondy Road	Watrap Maharalpuram Alagapuri	Paruvakudi Ettayapuram	Wallajah Sholingur
DindigulNatham Karaikudi	Kottar Dharmapuram	Cuddalore Tirukollur Anaicut	Tarangambadi Myladuthurai
Palani Dharmapuram(E)	Trichy Pudukottai	Krishnagiri Ranipet	Rajapalayam Tirunelveli
Karur Velliyanai Dindigul	Thanjavur Vaduvoor Mannagurdy	Karur Vanagal	Dindigul Karur
Ramanathpuram Melur	Chennai Trichy Dindigul	Thanjavur Sayalkudi	Tiruchandur Shencottah
Musiri Thuraiyur Attur	Peraurani Sethubavachatran	Tarangambadi Myladuthurai	
Musiri Thuraiyur Attur	Musuri Tpet Murugur	Cuddalore Chittor	
Dharmapuri Morappur	Karur Velliyanai Dindigul	Tirunelveli Shencottah Quilon	
Sholagiri Berigai	Srivilliputhur Parthibanur	Kannamangalam Arni	
Cauveripattanam Kakkangaral	Arupukkottai Vallnokkam	Thiruvanthipuam Arni	
Manaparai Kulithalai	Dharmapuri Hoggenakkal	Paruvakudy Vilathikulam Vembar	
Aralvaimuzhi Rajakkamangalam Colachel	Krishnagiri Royacotta	Grand Annicut Cauveripattinam	
Parasery Colachel	Alagapuri Virudhunagar		

MAINTENANCE CORRIDORS WITH			
One Religious Site	**Two to Three Religious Sites**	**Four to Ten Religious Sites**	**More than Ten Religious Sites**
Marathandom Pechiparai	Pavoorchatram Vellakal Surundai		
Thuraiyur Perambulur	Nagore Vettar		
Thlttai Melatoor			
Myladuthurai Pattavarhti			
Arcot Tindivanam			
Dharmapuri Morappur			
Aravoimozhi Rajakkamangalam Colachel			
Source: Inventory of Maintenance Corridors by HD.			

4.3.2 CULTURAL HERITAGE SITES

4.3.2.1 Upgradation Corridors

Tamil Nadu has a rich cultural heritage and the corridor passes near many sites and structures of religious, historical, and/or cultural significance. The location of these heritage sites along both Northern and Eastern Corridors is shown in **Figure 4.18 (A) & (B).** A list of the some of the notable cultural sites is given in **Table 4.34.**

Table 4.34: Cultural Heritage Sites along Upgradation Corridors

Sl No	Package	Name of the Religious Center	Nearest Chainage	Nearest Settlement	District
1	TNRSP 01 (N)	Palace of the Nawabs	1.000	Arcot	Vellore
2	TNRSP 01 (N)	Tomb of Saadatullah Khan	3.000	Arcot	Vellore
3	TNRSP 01 (S)	Ekattaikkol Kilaiyur,	1.000	Ariyalur	Ariyalur
4	TNRSP 01 (S)	Gangaikondacholapuram	9500	Jayamkondam	Ariyalur
5	TNRSP 01 (S)	Kurugai kavalappar koil	92.500	Jayamkondam	Ariyalur
6	TNRSP 01 (S)	Arunajadeeswarar koil	106.700	Jayamkondam	Thanjavur
7	TNRSP 02	Velakanni Church	11.000	Nagapattinam	Nagapattinam
8	TNRSP 02	Light House	0.200	Nagapattinam	Nagapattinam
9	TNRSP 02	Dutch Tombs	0.250	Nagapattinam	Nagapattinam
10	TNRSP 02	Manora	26.000	Nagapattinam	Pattukkottai
11	TNRSP 03	Sethupathy Palace	65.000	Ramanathapuram	Ramanathapuram
12	TNRSP 04	Old Dutch Cemetery	0.000	Tuticorin	Tuticorin
Source: EIS for Northern Corridor, March 1999 & EIS for Corridor I, June 1999, Prepared by PCC.					

4.3.2.2 Maintenance Corridors

Some cultural heritage sites have been observed along a few (7) maintenance corridors. Details are provided in **Table 4.35**. The maximum number of such sites is observed in Krishnagiri Ranipet Corridor in Dharmapuri District.

Table 4.35: Cultural Heritage Sites along Maintenance Corridors

Sl. No.	Corridors	Cultural Heritage Sites
1	Chittor Thiruthani	1
2	Vellimedpettai Mailam	1
3	Perambalur Manamadurai	1
4	Dindigul Karur	1
5	Krishnagiri Ranipet	5
6	Denkanicottah Kahamangalam	1
7	Krishnagiri Royacotta	1
Source: Inventory of Maintenance Corridors by HD.		

4.3.3 ARCHAEOLOGICAL MONUMENTS

Gangaikondacholapuram is a place of archaeological importance along the Northern Corridor [TNRSP 01(S)]. The temple structure is located at Km 94.5 between Jayamkonadam to Kumbakonam at a

distance of 70 m from the centreline of the existing road. It was the capital of the Cholas established by Rajendra Chola I (1012 - 1044 AD). A temple erected at the site bespeaks the imperial dignity of Chola art and victorious mood of the royal patron, after his successful campaigns in the Deccan up to the Ganga Valley, earning for him his title "Gangai Kondan". The temple, similar in style to the Thanjavur Temple, has a tower of 180 feet over the sanctum sanctorum. The flora and fauna of the area is of no special significance, except for the Blue Rock Pigeon and the Rose Ringed Parakeet that live in the temple tower.

Along the Eastern Corridor between Muthupet and Kattumavadi (Km 26.0 –27.0) the Manora Commemoration Tower is located at a distance of about 1 Km from the road. It was built by King Saroji II in 1814. The monument is protected by the Tamil Nadu State Department of Archaeology.

4.3.4 SACRED GROVES

4.3.4.1 Upgradation Corridors

In every village in Tamil Nadu there is a pond or tank with a shrine on its banks (*Krishna and Prabhakaran, 1997*). Nearby is a grove of trees, or perhaps a single ancient tree. In many villages along the Corridor, sacred groves[8] are observed. In most cases a temple/shrine is the central feature surrounded by number of trees. The trees at some places are very old and also considered sacred by the local people. In other cases ponds/tanks are found in close vicinity of the grove. Some faunal species local to the area and in a few cases some migratory avian species have been observed near some of the groves. The list of sacred groves along upgradation corridors is presented in **Table 4.36**.

Table 4.36: Sacred Groves along Upgradation Corridors

Sl. No	Name	Package	Link Chainage	Distance from Road (m)	Direction	Faunal Species	Flora
NORTHERN CORIDORS							
1	Timiri near Kumaran Koil Hill Temple	TNRSP 01(N)	Arcot Arani (7 – 8)	750	West	67 faunal species (12 species of reptiles, 46 species of birds and 9 species of mammals)	Species diversity is less as most of the land is occupied by cultivable land and the vegetation on the hill is artificial
2	Rajagiri Devalayam (Lord Murugan Temple)	TNRSP 01(N)	Arcot Arani (19 – 20)	700	West	50 faunal species	36 plant species
3	Irrigation Tank with social forestry	TNRSP 01(N)	Arcot Arani (19 – 20)	2700	West	Birds such as herons, cranes, ducks and water hens	Mainly Acacia
4	Irrigation Tank with social forestry	TNRSP 01(N)	Arcot Arani (19 – 20)	800	East	-	Mainly Acacia
5	Poondi Arukur Temple	TNRSP 01(N)	Arcot Arani (22 – 24)	1000	East	88 animal species	52 plant species
6	Poondi Eri Water Tank	TNRSP 01(N)	Arcot Arani (22 – 24)	-	West	Herons, Water Ducks & Water Hens	Social Forestry of Acacia
7	Natchathira Koil (Hill Temple of Lord Murugan)	TNRSP 01(N)	Polur Chengam (11 – 12)	200	North	65 animal species	46 floral species. Predominant are Madhuca indica, Tamarindus indica, Ficus religiosa, F. benghalensis & Mimusops elongi
8	Irrigation Tank with social	TNRSP 01(N)	Polur Chengam (11 – 12)	200	South	-	Mainly Acacia

[8] Sacred groves are pockets of natural vegetation which local people protect out of religious sentiment

Sl. No	Name	Package	Link Chainage	Distance from Road (m)	Direction	Faunal Species	Flora
	forestry						
9	Sadakatti Sacred Grove	TNRSP 01(N)	Tiruvannamalai Tirukovillur (82 – 83)		East	Peafowls (2 Nos.) are reportedly seen during the night	
10	Nattamur Sri Ayyanar Temple	TNRSP 01(N)	Tirukovillur Elavanasur (17 – 18)	500	West	Sizable population of monkeys (200 Nos.) and Common Birds. The Indian Pitta observed during July to Oct.	Albizia amara, Randia dumetorum, Strychorus nuxvomica, Strychorus potatorum, Randia malabarica and Wrightia tinctoria
11	Koothanur Sri Periandavar Temple	TNRSP 01(N)	Tirukovillur Elavanasur (19 – 20)	500	West	Monkeys and Common Birds	Albizia amara (dominant species), Murraya paniculata, Albiziz lebbeck, Ziziphus mauritiana, Ficus bengalensis, Cassia auriculata, Azadirachta indica, Tamarindus indica etc.
12	Pugaipatti Sri Ayyanar Temple	TNRSP 01(N)	Tirukovillur Elavanasur (26 – 27)	200	West	-	Azardiracta indica, Albizia amara, Szygium cumini, Borassus flabelliber, Mafhuca indica, Phoenix sylvestrix & Ixora nigricans
13	Vedappar Temple	TNRSP 01(S)	Vridhachallam Jayamkondam (1 – 2)	250	East	-	Species diversity is low as the natural vegetation has been removed for agriculture and human habitation
14	Maruvathur (Sri Muneeswarar Temple)	TNRSP 01(S)	Jayamkondam Ariyalur (20 – 21)		West / South		About 20 trees
15	Sri Vinayakar Temple, Jayamkondam Cross Roads	TNRSP 01(S)	Jayamkondam Kumbakonam (86 – 87)	200	South	-	Sacred Ficus religiosa and Azardirachata indica trees (15 – 20 years old) on the edge of the road
16	Sri Throupathiamma n Temple, Chinnavalayam	TNRSP 01(S)	Jayamkondam Kumbakonam (87 – 88)		West	-	A Sacred Neem tree
17	Cholagangam (Ancient Lake)	TNRSP 01(S)	Jayamkondam Kumbakonam		Both	500 Water birds	No vegetation except for Acacia on the inner margin of the lake
18	Sri Nagakanniamman Temple, Thirupanadal	TNRSP 01(S)	Jayamkondam Kumbakonam (106 – 107)		East	-	75 year old sacred Ficus religiosa tree
19	Manambadi (Sri Ayyanar, Sri Sivan and Sri Amman Temples)	TNRSP 01(S)	Jayamkondam Kumbakonam (111 – 112)		East (2) West (1)	-	Coconut, Tamarind and Bamboo trees
20	Sri Maduraiveeran Temple, Jayamcholapuram	TNRSP 01(S)	Jayamkondam Kumbakonam (112 – 113)		South	-	Sacred Odina and Pongamia trees
21	Koranattukarupp ur (Elevated patch of rich vegetation)	TNRSP 01(S)	Jayamkondam Kumbakonam (120 – 121)			Diverse flora and fauna	
22	Sri Vinayakar Temple, Kumbakonam	TNRSP 01(S)	Jayamkondam Kumbakonam (121)	1	North	-	50 year old sacred Ficus religiosa tree

Sl. No	Name	Package	Link Chainage	Distance from Road (m)	Direction	Faunal Species	Flora
23	Sri Padavetti Mariamman Temple, Sakkattai	TNRSP 01(S)	Kumbakonam Thiruvarur (37 – 36)	3	South	-	-
24	Sri Veeranar koil, A.. Semmangudi	TNRSP 01(S)	Kumbakonam Thiruvarur (28 – 27)	150	West	-	Sacred trees of Mangifera indica
25	Sri Sivan Temple, Manjakuli	TNRSP 01(S)	Kumbakonam Thiruvarur (19 – 18)	1.5	North	-	A Sacred Aegle Tree inside the compound wall. 25 year old Ficus religiosa at a distance of 3 m from the edge of the
26	Sri Sidhivinayakar Temple, Theepanampettai	TNRSP 01(S)	Kumbakonam Thiruvarur		South	-	25 year old sacred Ficus religiosa tree
27	Sri Ivan Temple, Maniacal	TNRSP 01(S)	Kumbakonam Thiruvarur (9 – 10)		South	-	Sacred Aegle tree at 7 m from the edge of the road A Ficus religiosa tree with a statue of Sri Vinayakar at 1 m from the road
EASTERN CORIDORS							
28	Sri Sadayappan Temple Ammanichatram	TNRSP 02	Manora Kattumavadi (35 – 36)	5	East	-	A sacred tree of Basssia latifolia
29	Sundaresa Gothandasamy	TNRSP 02		45	West	-	A 100 year old Tamarind tree
30	Palakkudi(Pudukkottai District) Kaliamman Temple	TNRSP 03	Kattumavadi S P Pattinam		East	-	7 Sacred Ficus bengalensis trees
31	Sacred Grove with fresh water pond at Idampadal	TNRSP 04	Eravadi Sayalkudi (18 – 19)	1000		A number of local birds along with a few species of migratory birds	Acacia planifrons, Acacia arabica, Palmyrah, Cassia auriculata and Prosopis julifora are dominant species
Source: Ecological Survey Reports by PCC, for Northern Corridor, October 1998 & for Corridor I, August 1998.							

4.3.4.2 Maintenance Corridors

Sacred groves along the maintenance corridors have been documented and the corridors categorized according to the number of such locations observed along each stretch. **Table 4.37** presents the list of all such corridors.

Table 4.37: Sacred Groves along Maintenance Corridor

Sl No	Corridor	Number of Sacred Groves
1	Cuddalore Vridhachallam Salem	5
2	Perambalur Manamadurai	5
3	Vikravandi Kumbakonam Thanjavur	3
4	Karur Vanagal	1
5	Rajapalayam Keelarajakularaman	8
6	Alagapuri Virudhunagar	2
7	Watrap Maharalpuram Alagapuri	1
8	Tirunelveli Shencottah Quilon	2
9	Athivuthu Surandai	2
10	Tarangambadi Myladuthurai	1
11	Parasery Colachel	1
Source: EIS for Northern Corridor, March 1999 & EIS for Corridor I, June 1999, Prepared by PCC.		

FIGURE 4.17 (A)
RELIGIOUS SITES ALONG NORTHERN CORIDOR

FIGURE 4.17 (B)

RELIGIOUS SITES ALONG EASTERN CORIDOR

FIGURE 4.18(A)

HERITAGE SITES ALONG NORTHERN CORIDOR

FIGURE 4.18(B)

HERITAGE SITES ALONG EASTERN CORRIDOR

4.4 SOCIO ECONOMIC ENVIRONMENT

As per 1991 census, Tamil Nadu consisted of 29 districts with a total population of 55.8 million (**Table 4.38**). The State is the fifth most densely populated state in the country. 34% of this population is urban. From 1961 to 1991, the percentage urban population percentage has increased by 8%. The literacy rate in the state is 63%. The state has a vast natural resource base. It has a 1000 km long coastline offering a vast potential in coastal resource development. Besides, the state also has a strong manufacturing base.

Table 4.38: Decennial Population Growth - Tamil Nadu

Census Year	Population (Million)	Decennial Change (%)	Urban Population (%)
1961	33.6	11.8	26
1971	41.1	22.3	30
1981	48.4	17.5	33
1991	55.8	15.4	34
Source: Department of Statistics, GoTN.			

As part of TNRSP, the upgradation works are to be taken up in 11 districts of the state. Description of the demographic and the socio-economic profile has been done specifically with respect to these districts.

4.4.1 DEMOGRAPHIC PROFILE

The districts along the Northern corridor roads have annual rate of population growth almost equal to that of the state average (1.4) while the district along the Eastern corridors have a comparatively lower growth rate. The population growth rate has seen a decline between 1981-1991 especially due to the backwardness of the districts. Amongst the 11 districts, Tuticorin is the most urbanised district followed by Vellore, Tiruchhirappali and Tanjavur. The least urbanised districts are those of Tiruvannamalai, Cuddalore and Pudukkotai. **Table 4.39** shows the demographic profile of the districts.

Table 4.39: District Populations 1981, 1991 and 1997

District	Package	Census Population (Million)		Estimated Population (Million), 1997	Annual Percentage Increase		Percentage of Urban Population (1991)
		1981	1991		1981-1991	1991-1997	
Northern Corridors							
Vellore	TNRSP 01 (N)	2.629	3.026	3.18	1.42	0.83	32
Tiruvannamalai	TNRSP 01 (N)	1.786	2.043	2.14	1.35	0.78	12
Cuddalore	TNRSP 01 (S) & (E)	1.828	2.123	2.24	1.51	0.9	12
Villupuram	TNRSP 01 (N)	2.374	2.755	2.91	1.5	0.92	20
Tiruchchirapalli (Perambalur + Ariyalur + Tiruchchirapalli)	TNRSP 01 (S)	3.612	4.138	4.34	1.37	0.8	26
Total Northern Corridors		12.229	14.085	14.81	1.41	0.83	
Eastern corridor							
Thanjavur (Thiruvarur + Thanjavur)	TNRSP 02	1.917	2.141	2.21	1.11	0.53	23
Nagappattinam	TNRSP 02	2.146	2.39	2.47	1.08	0.55	23
Pudukkottai	TNRSP 02 /03	1.157	1.327	1.39	1.38	0.78	14
Ramanathapuram	TNRSP 03	1.022	1.144	1.18	1.13	0.52	22
Tuticorin	TNRSP 04	1.35	1.456	1.47	0.76	0.16	41
Total Eastern Corridors		7.592	8.458	8.72	1.09	0.508	

District	Package	Census Population (Million)		Estimated Population (Million), 1997	Annual Percentage Increase		Percentage of Urban Population (1991)
		1981	1991		1981-1991	1991-1997	
Subtotal (Northern + Eastern Corridors)		19.821	22.543	23.53	1.25	0.67	23
Total Tamil Nadu		48.407	55.859	58.82	1.44	0.86	34
Source: Department of Statistics, GoTN.							

4.4.2 SETTLEMENT PATTERN

The largest town along the Northern Corridor is Kumbakonam with a population of 139,483 followed by Tiruvannamalai with a population of 109,196. Along the Eastern Corridor Tuticorin is the largest town with a population of 199,854 followed by Nagappattinam with a population of 99,700. The major towns traversed or bypassed by the proposed Corridors are presented in **Table 4.40.**

Table 4.40: Major Settlements along the Upgradation Corridors

Settlements	District	Package	Administrative Status	Local Body	Population (1991)	Bypass
Northern Corridor						
Arcot	Vellore	TNRSP 01 (N)	Taluka	Municipality	45,205	–
Arani	Tiruvannamalai	TNRSP 01 (N)	Taluka	Municipality	54,898	Yes
Polur	Tiruvannamalai	TNRSP 01 (N)	Taluka	Town Panchayat	23,046	Yes
Chengam	Tiruvannamalai	TNRSP 01 (N)	Taluka	Town Panchayat	17,629	-
Tiruvannamalai	Tiruvannamalai	TNRSP 01 (N)	District	Municipality	109,196	Yes
Tirukkovilur	Villupuram	TNRSP 01 (N)	Taluka	Town Panchayat	23,636	Yes
Vridhachallam	Cuddalore	TNRSP 01 (E)	Taluka	Panchayat	52,898	Yes
Chidambaram	Cuddalore	TNRSP 01 (E)	Taluka	Municipality	67,900	Yes
Jayamkondam	Ariyalur	TNRSP 01 (S)	Taluka	Panchayat	28,227	-
Ariyalur	Ariyalur	TNRSP 01 (S)	Taluka	Town Panchayat	24,141	Yes
Kumbakonam	Thanjavur	TNRSP 01 (S)	Taluka	Municipality	139,483	Yes
Thiruvarur	Thiruvarur	TNRSP 01 (S)	District	Municipality	24,768	Yes
Sirkazhi	Nagappattinam	TNRSP 01 (E)	Taluka	Municipality	28,980	Yes
Total for Northern Corridor					**640,007**	
Eastern Corridor						
Nagappattinam	Nagappattinam	TNRSP 02	District	Municipality	99,700	Yes
Thirutturaippundi	Thiruvarur	TNRSP 02	Taluka	Municipality	23,328	Yes
Muthupet	Thiruvarur	TNRSP 02	-	Town Panchayat	18,826	Yes
Atiramapattinam	Thanjavur	TNRSP 02	–	Town Panchayat	26,645	-
Tondi	Pudukkottai	TNRSP 03	–	Town Panchayat	12,332	-
Ramanathapuram	Ramanathapuram	TNRSP 03	District	Municipality	52,879	-
Kilakarai	Ramanathapuram	TNRSP 04	–	Town Panchayat	29,928	-
Sayalkudi	Ramanathapuram	TNRSP 04	–	Town Panchayat	10,182	-
Tuticorin	Tuticorin	TNRSP 04	District	Municipality	199,854	-
Total for Eastern Corridor					**473,674**	
Note: (1) – Municipalities and Town Panchayats with populations over 10,000 (1991 Census) Source: 1991 Census.						

4.4.3 LAND USE PATTERN

4.4.3.1 Land use pattern in the districts

In terms of land utilisation (**Table 4.41**), the districts through which the Northern and Eastern Corridors pass comprise 43 per cent of the total land area of the state. Land usage in both the Corridor districts follows the same pattern as the State. Tiruvannamalai and Vellore districts have the highest area under forest cover while the lowest area under forest cover can be seen in Thanjavur and Ramanathapuram. Thanjavur and Ramanathapuram districts on the other hand have the highest

Cropped Area. 23.6% of the total forest cover of the state and 47.4 % of the total Cropped Area of the state lie in the TNRSP corridors.

Table 4.41: Land Utilization, 1993-94 (000 ha)

District	Package	Forest Area	Barren	Non-Agricultural	Grazing	Cropped Area	Other	Total Area
Vellore	TNRSP 01 (N)	161	26	82	4.0	234	85	592
Tiruvannamalai	TNRSP 01 (N)	153	21	90	4.0	272	91	631
Villupuram/ Cuddalore	TNRSP 01 (N) / TNRSP 01 (E)	73	90	150	5.0	609	163	1090
Perambalur/Ariyalur/ Tiruchchirapalli	TNRSP 01 (S)	68	30	163	18.0	567	253	1099
Thanjavur/Thiruvarur	TNRSP 01 (S) & TNRSP 02	5	2	78	2.0	220	53	360
Nagappattinam	TNRSP 01 (S) & TNRSP 02	7	34	79	2	287	52	461
Pudukkottai	TNRSP 03	24	10	126	5	184	117	466
Ramanathapuram	TNRSP 03 & 04	5	5	86	1	218	108	423
Tuticorin	TNRSP 04	11	20	70	5	209	144	459
Total of Northern & Eastern Corridors (% of Total Corridor District)		507 (9.1)	238 (4.3)	924 (16.6)	46 (0.8)	2800 (50.2)	1066 (19.1)	5581 (100.0)
Tamil Nadu (% of Total State)		2,144 (16.5)	515 (4.0)	1,884 (14.5)	122 (0.9)	5,901 (45.3)	2455 (18.9)	13,021 (100.0)
TNRSP Corridor Districts as % of Total Tamil Nadu		23.6	46.2	49.0	37.7	47.4	43.4	42.9
Source: Tamil Nadu – An Economic Profile, 1994-95.								

4.4.3.2 Land Use Pattern along the Eastern Corridor

The land use pattern along the Eastern Corridor presents a diverse mix of uses. The categories of land uses along with their spread along the east coast is given in the Table below. The issue of landuse planning along the Eastern Corridor 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**).

Table 4.42: Land Use Pattern along the Eastern Corridor

Land Use Category	Packages (Length Km)			
	TNRSP 02	TNRSP 03	TNRSP 04	Total
Settlement	28.7	30	27	85.7
Agricultural	64.9	38.8	38	142
Salt pans	-	2	14	16
Shrimp Farming	23	7	6	36
Scrub Lands	0	22	33	55
Total	117	99	118	334
Source : Primary Survey, LASA, May 2002.				

As evident from **Table 4.42**, the maximum percentage of land along the corridor is that of agricultural land uses (42%) following by settlements that are present along 25% of the length of the corridor. The other uses are salt pans and shrimp farming. The maximum length covered by salt pans is in TNRSP 04 (Ramanathapuram-Tuticorin). Shrimp farming is found maximum between Nagapattinam to Kattumavadi. The description of the land use characteristics of each of the project packages is presented in the following sections:

TNRSP 02 (Nagapattinam-Kattumavadi): This section starts at Nagapattinam, which is the third biggest port in Tamil Nadu. The bypass proposed for the Nagapattinam town is towards the western side (away from the coast). The alignment has been routed through agricultural lands for a major length. Major developments apart from the port development include a refinery unit of GoI, which are all towards the western side of the town, i.e., closer to the bypass. South of Nagapattinam, is the pilgrimage town of Velankanni, 1km east of the corridor.

Between Nagapattinam to Tiruppundi, the predominant land use is agriculture. Along this stretch, there exist several small villages, which are largely dependent on agriculture apart from the coastal villages, which are predominantly fishing villages. From Tiruppundi to Tiruthuraipundi, though there is no intense ribbon development along the road, there is a continuous habitation with small settlements occurring almost every km of the corridor. These communities are largely agriculture dependent.

Along the Tiruthuraipundi – Rajamadam section, there exist villages, which are larger in size with a higher density as compared to the earlier stretch. This can be attributed to the highly fertile land in this stretch and these settlements serving as agricultural market centers for the hinterland. Brackish water shrimp farms are present along some stretches. Udayamarthandapuram bird sanctuary is situated at a distance of 800 m from the corridor. From Rajamadam to Kattumavadi the corridor runs parallel to the coast and at some places within 500 m. In the absence of any agricultural activities, fishing is the only economic activity and most of the settlements along the road are fishing villages or small market centers for fishing produces.

Apart from Nagapattinam, three major settlements viz., Tiruppundi, Tiruthuraipundi and Muthupet are being bypassed in this section. These bypass alignments are routed through agriculture lands.

TNRSP 03 (Kattumavadi - Ramanathapuram): The Kattumavadi - Tondi section of the corridor for a major length runs within a km from the coast. Along the roadside most of the lands are vacant/scrub lands. These lands are not utilized for agriculture due to the lack of water. As the soil is sandy, the land is not suited for either salt mining or shrimp farming. At stretches where the soil is not sandy, especially along Pudupattinam to Mandiripattinam (10km) shrimp farms are present for a continuous stretch. In the absence of any other agricultural produces, the only species that survives on this tract is palm, due to which extensive palm plantations are present along a significant length of the corridor.

The urban centers along this stretch can be broadly categorized as follows: Tondi - commercial center, Manamelkudi – a newly declared Taluka head quarter and Mimisal, Devipattinam – other major settlements.

TNRSP 04 (Ramanathapuram - Tuticorin): The entire stretch between Ramanathapuram and Tuticorin is sandy and does not support any agricultural activities. Consequently, scrub lands and dry vacant lands are the predominant land use along this stretch. On either side of the corridor, *Prosopis juliflora* is grown in large areas for fuel wood for commercial purposes in this water scarce region. In this area, palm plantations are present in small pockets. At locations where water is available, as along certain pockets around Kilakarai, coconut plantations are present. The urban settlements along this

stretch include Sayalkudi, Kulattur – major commercial centers; Kilakarai – educational and commercial center and Vembar – a major settlement in the area.

Apart from these urban centers, the other settlements are predominantly fishing villages. The absence of any prospective economic opportunities in this region has triggered large-scale migration of skilled and unskilled workers to outside the country mostly to the Middle East and southeast Asian countries. The increased spending power due to the inflow of these monies can be attributed to the higher degree of urbanization along this stretch.

Ramanathapuram is the only major town between Nagapattinam and Tuticorin. The town is very old and important trade center for this region for many centuries. Nearer to Ramanathapuram, Gas Authority of India limited (GAIL) has developed exploration units. The Gulf of Mannar Biosphere Reserve though not directly falling on the corridor has the potential to attract tourists and the GoTN has recently initiated several measures in the Gulf of Mannar region to develop tourism and capitalize the marine resources without environmental degradation.

At the bridge locations mangroves are seen in small patches. The settlements in this stretch are small in size with low density. From Vembar to Tuticorin, the corridor runs through saltpans for a length of 8 km. Tuticorin, apart from being a major port, is a major industrial center for the southern part of Tamil Nadu. The significant development around Tuticorin includes the proposal of the GoTN for a Special Economic Zone (SEZ) at Nanguneri. Private entrepreneurs have plotted the southern stretch of the corridor for industrial development.

4.4.4 ECONOMIC BASE

The economic base in the coastal districts is largely comprised of agriculture and fishing. 71.4% of the employment is in agricultural sector followed by 9% in the Manufacturing sector. Agriculture is therefore the major economic activity. Vellore has the largest persons employed in the industrial sector. Trade and other services are other important occupations. The Work Participation Rate (WPR) varies between 37% to 43%.

4.4.4.1 Agriculture

The percentage of workforce in agricultural sector is higher in the project corridor districts as compared to the entire Tamil Nadu (61.5%). The Corridor districts account for approximately 42 % of the area in Tamil Nadu under crops. The main crops are cereals (mainly rice), pulses, sugarcane, cotton and groundnuts. These districts are major contributors to the State's production of food grains (mainly rice) as well as other food crops such as fruit.

4.4.4.2 Animal Husbandry

Cattle are the major types of livestock kept with a particular concentration in Cuddalore. Overall, these districts account for 41 per cent of the livestock kept in Tamil Nadu. This is reflected in the volume of milk production from these districts, which accounted for approximately a quarter of the state's total milk production.

4.4.4.3 Fisheries

This sector is existent predominantly along the Eastern Corridor consists of both marine and inland fish production (fish farming). The total length of the coastline in the State is approximately 1,000 km with a continental shelf area of 41,412 km². The total fish production in the State increased from 439,000

tonnes in 1994-95 to 449,000 tonnes in 1995-96, mainly due to an increase in marine fish catches. Of the fishing ports in Tamil Nadu, one major port, Tuticorin and one medium-sized port Nagappattinam is served by the Eastern Corridor. In 1994-95, the districts traversed by the Eastern Corridor roads accounted for 267,448 tonnes of marine fisheries or 80 per cent of the state total.

4.4.4.4 Mining

Mining is not a major occupation in these districts with only 0.6% of the total population engaged in the occupation. However, recently oil has been found in the Cauvery Basin in the districts of Thanjavur, Nagappattinam and Cuddalore, which are traversed by the Corridor. This might accelerate the employment opportunities in this sector.

4.4.4.5 Manufacturing

Growth of industries as is seen from the **Table 4.43**, has been more pronounced in the districts of Villupuram, Cuddalore, Pudukkottai, and Tuticorin. Along the Northern Corridor the towns of Arani and Ariyalur both have industrial areas on their outskirts. In the case of Arani, there are rice mills; and in the case of Ariyalur there are cement factories. Along the Eastern Corridor Tuticorin is a prominent industrial centre. It is the largest industrial centre among all districts traversed by the Corridors. The level of industrialization in the Corridor districts has generally been fairly steady from the early 1980s to the mid 1990s with these districts continuing to account for approximately 21 per cent of the total factories throughout the State.

Table 4.43: Industrial Growth

Districts	Package	Number	Growth 1981 to 1994 %
Northern Corridor			
Vellore	TNRSP 01 (N)	256	38
Tiruvannamalai	TNRSP 01 (N)	NA	NA
Cuddalore/Villupuram	TNRSP 01 (N)	212	163
Perambalur/Ariyalur/ Tiruchchirappali	TNRSP 01 (S)	203	45
Eastern Corridor			
Thanjavur/Thiruvarur	TNRSP 02/ TNRSP 01 (S)	94	27
Nagappattinam	TNRSP 01 (S) & TNRSP 02	152	101
Pudukkottai	TNRSP 02	112	153
Ramanathapuram	TNRSP 03 & 04	23	58
Tuticorin	TNRSP 04	342	78
Total of Northern & Eastern Corridors		1394	61
Tamil Nadu-Total		7,917	78
Corridor Districts as % of Total Tamil Nadu		17.6	-
Source: EIS for Northern Corridor, March 1999 & EIS for Corridor I, June 1999, Prepared by PCC.			

4.4.4.6 Tertiary Sector

Tourism and religious pilgrimage is the most significant activity in the tertiary sector in the Northern Corridor districts. Tiruvannamalai, built at the foot of the sacred Mount Arunachala, has a large temple, a famous ashram, Ramanashram, and over 50 shrines. It is a prominent centre of monthly pilgrimage (particularly during full moon) for Indian and foreign visitors. Thanjavur, Chidambaram and Kumbakonam have a host of temples visited by numerous devotees. The Brihadeeshwarar temple of Thanjavur is a frequently visited place by foreign tourists. The local art and culture in the form of dances and crafts also attract tourists to this place. In case of the Eastern Corridor too pilgrimage centres contribute to the tourism industry in a significant manner. Major tourist centers are Rameshwaram, Velankanni and Nagore.

4.5 ROAD SAFETY ASPECTS

4.5.1 UPGRADATION CORRIDORS

The number of accidents recorded in the State has increased from 18,583 in 1981 to 44,203 in 1997. Over the same period the number of fatalities has increased at a higher rate, from 3,156 to 8,755. This could indicate that not only are accident numbers increasing rapidly, but also that the severity of accidents is increasing. The National Road Safety Policy aims to reduce road accident fatalities nation-wide to 10 to 12 per 10,000 registered vehicles; in Tamil Nadu the rate was 21.5 in 1997-98, about two times the target; in the TNRSP Upgradation Corridor districts it was about four times the target.

About two-thirds of all accidents and fatalities occur on State Roads, and one-third on National Highways. MDRs and ODRs amount to 93 per cent of all Government roads, but account for only 27 percent of reported accidents and fatalities in Tamil Nadu. These statistics partly reflect the higher vehicle-kilometres travelled on National and State Highways. For 1997, accident rates by district are available and these are shown in **Table 4.44**.

Table 4.44: Road Accidents in Tamil Nadu by District - 1997

District	Package	Total Accidents	Number of Persons Injured	Number of Persons Killed	Registered Motor Vehicles	Accidents per 10,000 Vehicles	Fatalities per 10,000 Vehicles
Cuddalore	TNRSP 01 (E)	1,856	2005	400	107,992	171.9	37.0
Villupuram	TNRSP 01 (N)	2,084	2030	450	54,552	382.0	82.5
Vellore	TNRSP 01 (N)	2,074	1787	500	133,437	155.4	37.5
Tiruvannamalai	TNRSP 01 (N)	853	773	171	69,208	123.3	24.7
Pudukkottai	TNRSP 02/03	877	854	143	43,520	201.5	32.9
Nagapattinam	TNRSP 01 (S) & TNRSP 02	841	792	204	45,148	186.3	45.2
Thanjavur	TNRSP 01 (S) & TNRSP 02	1,867	1361	262	74,115	251.9	35.4
Ramanathapuram	TNRSP 03 & 04	463	502	110	31,165	148.6	35.3
Tuticorin	TNRSP 04	914	1011	206	75,761	120.6	27.2
Total for TNRSP		11,829	11,115	2,446	634,898	186.3	38.5
Total Tamil Nadu		44203	40577	8755	4,070,734	108.6	21.5
Note: Districts Reported are Police Districts Source: Statistical Hand Book of Tamil Nadu, 1999.							

Once the upgrading work is complete, the public health benefits will include both adverse and beneficial impacts. The improved road standard will increase accessibility to local and regional health centers and other community support facilities. However, there will be the potential for adverse impacts on public health related to increases in noise, especially as traffic volumes increase. There will also be the potential for increased collisions between vehicular traffic travelling at higher speeds than previously and lower speed vehicles and pedestrians also using the roads.

4.5.2 MAINTENANCE CORRIDORS

The accident-prone locations along the maintenance corridors have been identified and the corridors have been categorized according to the number of such black spots observed along each stretch. **Table 4.45** presents the list of all such corridors. The maximum number of black spots is existing along the Calicut Vythiri Gudalor Corridor in Uthagai District.

Table 4.45: Accident Prone Areas along Maintenance Corridors

MAINTENANCE CORRIDORS WITH ACCIDENT PRONE AREAS			
One Locations	**Two to Four Locations**	**Five to Ten Locations**	**More than Ten Locations**
Chittor Thiruthani	Cuddalore Chittor	Wallajah Sholingur	Dindigul Karur
Karur Velliyanai Dindigul	Ambur Sathgur	Palani Dharmapuram(E)	Calicut Vythiri Gudalor
Andipatty Varusa Nadu Road	Cuddalore Tirukollur Anaicut	Tarangambadi Myladuthurai	
Ramanathpuram Melur	Thiruvanthipuam Arni	Musuri Tpet Murugur	
Denkanicottah Kahamangalam	Rajapalayam Keelarajakularaman	Vikravandi Kumbakonam	
Cauveripattanam Kakkangaral	Watrap Maharalpuram Alagapuri	Salem Vaniyambadi	
Hosour Denkanicotta	Paruvakudy Vilathikulam Vembar	Nagapattinam Gudalor Mysore	
Erode Karur	Thanjavur Vaduvoor Mannagurdy	Kannamangalam Arni	
Manaparai Kulithalai	Coonoor Kattabettu	Srivaikuntam Pudukottai	
Aravakurichi Pungampadi	Rajapalayam Keelarajakularaman	Tarangambadi Myladuthurai	
Alagapuri Virudhunagar	Tiruchandur Shencottah	Coonoor Kundah	
Tirunelveli Shencottah Quilon	Peraurani Sethubavachatran		
Rajapalayam Tirunelveli	Perambalur Manamadurai		
Parasery Colachel	Arupukkottai Vallnokkam		
Pattukottai Muthupet	Musiri Thuraiyur Attur		
Grand Annicut Cauveripattinam			
Myladuthurai Pattavarhti			
Thiruthurai Poondi Vedharanyam			
Ambur Sathgur			
Parasery Colachel			
Source: Inventory of Maintenance Corridors by HD.			

4.6 BASELINE PROFILE OF HEALTH ISSUES ALONG PROJECT ROADS

Transportation networks, especially the roads have been for long considered as conduits for the spread of various diseases, as they provide a string interface between the local and the mobile communities. Human activity plays a critical role in the spread of communicable diseases. Changes in the size, density and distribution of human populations, due to large-scale development activities, both during and after construction, contribute significantly to the transmission of infections. Population mobility has always contributed spread of communicable diseases either to reaching unaffected areas and population groups or enhancing existing scenario of low level epidemic.

All transport projects, by the description would increase the mobility of people and consequently, the risk of communicable diseases. However, compared to the rail and other surface transport modes, roads permit highest level of transience and mixing of population groups. Therefore, roads possess higher potential for risk multiplication for communicable diseases. Thus, communicable diseases in question, i.e., sexually transmitted diseases (STD) along with Acquired Immuno-Deficiency Syndrome (AIDS) as a consequence of infection caused by Human Immunodeficiency Virus (HIV). This spread of STD / HIV / AIDS is found to cause due to the pattern of high-risk behaviour of the mobile people, very often followed by truckers and their partners in the physical acts located at different halt points on their way, the commercial sex workers (CSW). The details of district wise medical infrastructure data are presented in **Table 4.46**.

Table 4.46: Data on Health Issues

Project Districts	Population (1991) in Lakhs	Population Served				Number of AIDS Cases*		
		Total Beds	Population/ Bed	No. of Doctors	Population/ Doctor	Total	Male	Female
1. Vellore	30.26	1637	1849	148	20446	134	107	27
2. Tiruvannamalai	20.42	651	3137	70	29171	111	94	17
3. Villupuram	N.A.	N.A.	N.A.	N.A.	N.A.	133	112	21
4. Cuddalore	21.22	962	2206	113	18729	116	97	19
5. Ariyalur / Perambalur	N.A.	N.A.	N.A.	N.A.	N.A.	53	45	8
6. Thanjavur	N.A.	N.A.	N.A.	N.A.	N.A.	54	37	17
7. Thiruvarur	N.A.	613	N.A.	N.A.	N.A.	3	3	0
8. Nagapattinam	23.90	947	1532	145	16483	27	23	4
9. Pudukkottai	13.27	991	1339	93	14269	21	20	1
10. Ramanathapuram	11.44	814	1405	85	13456	7	5	2
11. Tuticorin	14.55	495	2939	88	16354	15	13	2
Source: Statistical Hand Book of Tamil Nadu, 1999.								

* *Note: Number of samples screened up to May 1999 = 746323*
Number of AIDS Positive cases = 13846
Positivity Rate per thousand = 18.60
District-wise Cumulative Data (Reported up to May 1999)