FINAL REPORT

VOLUME 5 – INITIAL ENVIRONMENTAL EXAMINATION

PART – 2

INITIAL ENVIRONMENTAL EXAMINATION

SECTION B - KOLLAM

# FINAL REPORT

## VOLUME 5 – INITIAL ENVIRONMENTAL EXAMINATION

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# List of Abbreviations and Acronyms

| | |
|---|---|
| ADB | Asian Development Bank |
| ADS | Area Development Society |
| BIS | Bureau of Indian Standards |
| BOD | Bio-chemical Oxygen Demand |
| BOT | Build Operate Transfer |
| BOO | Build Own Operate |
| BOOT | Build Own Operate and Transfer |
| CBO | Community Based Organization |
| CDS | Community Development Society |
| COD | Chemical Oxygen Demand |
| CPHEEO | Central Public Health and Environmental Engineering Organization |
| DFID | Department for International Development |
| DPC | District Planning Committee |
| DSC | Design and Supervision Consultancy |
| DWCUA | Development of Women and Children in Urban Areas |
| EIA | Environmental Impact Assessment |
| EDII | Entrepreneurship Development Institute of India |
| FAB | Fluidized Aerobic Bed |
| GDP | Gross Domestic Product |
| GIS | Geographical Information System |
| GoI | Government of India |
| GWA | Ground Water Authority |
| HRD | Human Resources Development |
| HUDCO | Housing and Urban Development Corporation |
| IEE | Initial Environmental Examination |
| IKM | Information Kerala Mission |
| IMA | Indian Medical Association |
| IMR | Infant Mortality Rate |
| IT | Information Technology |
| JBIC | Japan Bank for International Cooperation |
| KocMC | Kochi Municipal Corporation |
| KolMC | Kollam Municipal Corporation |
| KozMC | Kozhikode Municipal Corporation |
| KSEB | Kerala State Electricity Board |
| KSPCB | Kerala State Pollution Control Board |
| KSRTC | Kerala State Road Transport Corporation |
| KSUDP | Kerala Sustainable Urban Development Project |
| KUDFC | Kerala Urban Development Finance Corporation |
| KUDP | Kerala Urban Development Project |
| KWA | Kerala Water Authority |
| LFS | Land Fill Site |
| Lpcd | Litre Per Capita Per Day |
| LSGD | Local Self Government Department |
| MFI | Micro Finance Institutions |
| MGP | Modernizing Government Programme |
| MIS | Management Information System |

| | |
|---|---|
| MLD | Million Liters Per day |
| MNES | Ministry of Non-Conventional Energy Sources |
| MSL | Mean Sea Level |
| MSW | Municipal Solid Waste |
| NABARD | National Agricultural Bank for Rural Development |
| NATPAC | National Transportation Planning and Research Centre |
| NGO | Non Government Organization |
| NH | National Highways |
| NHG | Neighborhood Group |
| NRY | Nehru Rojgar Yojna |
| NRCD | National River Conservation Directorate |
| NRCP | National River Conservation Plan |
| NSDP | National Slum Development Program |
| O&M | Operation and Maintenance |
| PIU | Project Implementation Unit |
| PMO | Project Management Office |
| PPP | Public Private Partnership |
| PPTA | Project Preparation Technical Assistance |
| PSP | Private Sector Participation |
| PWD | Public Works Department |
| RIS | Repayment Information System |
| SC/ST | Schedule Caste and Schedule Tribe |
| SHG | Self Help Groups |
| SJSRY | Swarna Jayanti Shahari Rozgar Yojna |
| STP | Sewage Treatment Plant |
| SWM | Solid Waste Management |
| TCPO | Town and Country Planning Organization |
| ThMC | Thiruvananthapuram Municipal Corporation |
| TMC | Thrissur Municipal Corporation |
| TPPFL | Twin Pit Pour Flush Latrine |
| TRIDA | Thiruvananthapuram Development Authority |
| TSS | Total Suspended Solids |
| TUDP | Trivandrum Urban Development Project |
| UFW | Unaccounted Water |
| ULB | Urban Local Body |
| UASB | Upflow Anaerobic Sludge Blanket |
| USEP | Urban Self Employment Program |
| UBSP | Urban Services for the Poor |
| VAMBAY | Valmiki Ambedkar Awaz Yojna |
| WTP | Willingness to Pay |

# PART –II INITIAL ENVIRONMENTAL EXAMINATION

## Section B. KOLLAM

### B-1 Introduction

This IEE addresses the potential environmental impacts of the infrastructure components proposed for implementation in the Kollam Corporation area. The infrastructure components are drawn from the following sectors:

- Water Supply Rehabilitation;
- Sewage Treatment Plant and Sewerage Upgrade;
- City Drainage Refurbishment;
- Solid Waste Management and Disposal; and
- Road Upgrades.

The components were identified during stakeholder workshops. One of the purposes of the stakeholder workshops was to establish the current and emerging needs of the city, and to identify the issues/problems pertaining to urban infrastructure and also to suggest the sectors that would best contribute towards sustainability of the ongoing development process in the 5 project cities. Following the workshops, field visits and discussion were held in Kollam with local agencies to further focus on the priorities and identify the specific components for urban infrastructure development.

### B-2 Need for the Infrastructure Components

#### B.2.1 Water Supply Rehabilitation

The population of Kollam Corporation in 2001 was 361,440 people and it is projected to be slightly over 400,000 by 2031. The current water supply demand is estimated at 56 MLD, and is estimated to rise to 62 MLD by 2031 at an average consumption level 135 MLD.

Raw water is extracted from the Sasthamkotta, a fresh water lake, and treated in two water treatment plants (WTP) deploying rapid sand filters with total capacity of 57.50 MLD. Currently only one WTP of 37.50 MLD capacity is being operated. The other 22.00 MLD WTP failed in 2000 due to poor maintenance, but is presently undergoing rehabilitation by the Kerala Water Authority. Both WTPs are due to be fully operational by June 2005. The overall effective utilization of extracted water is only 14 MLD. The low water utility level is due to failure of a 700mm diameter concrete transmission main to the city and the treated water being directly tapped from the second 750mm diameter CI transmission main, no control or proper metering and heavy water losses through leakage from the whole system (approximately 60%).

The piped distribution network covers the majority of streets within the city, feeding 23,109 domestic, 2,590 public standposts, 1,977 non-domestic and 27 industrial units. The network suffers from heavy leakages due to aged piping. Also a number of un-authorized connections and inadequate carrying capacity of the network itself to satisfy the needs of development put strain on the system. The present per capita availability of water to Kollam is about 40 lpcd.

Therefore, the priority of this component is first to study the leakage problem, reduce the losses and rehabilitate and optimization the distribution network to increase efficiency and equity in water supply. Further, improvements in the process monitoring of the existing water treatment plants and replacement of the failed transmission main will ensure a secure supply of water to the city and minimize the excessive water loss in the whole distribution network.

**Table B-1: Satisfaction - Present Water Supply System**

| Satisfaction Level (%) | MV | JV | UP | LIG | MIG | HIG | Total |
|---|---|---|---|---|---|---|---|
| Highly satisfied | 2 | 2 | 1 | 13 | 6 | 3 | 27 |
| | 2.5 | 2.4 | 1.3 | 4.6 | 2.5 | 7.1 | 3.3 |
| Satisfied | 35 | 36 | 47 | 174 | 199 | 21 | 512 |
| | 43.2 | 43.9 | 58.8 | 61.5 | 81.6 | 50.0 | 63.1 |
| Moderately Satisfied | 17 | 17 | 16 | 26 | 9 | 4 | 89 |
| | 21.0 | 20.7 | 20.0 | 9.2 | 3.7 | 9.5 | 11.0 |
| Dissatisfied | 24 | 25 | 13 | 61 | 28 | 14 | 165 |
| | 29.6 | 30.5 | 16.3 | 21.6 | 11.5 | 33.3 | 20.3 |
| Highly Dissatisfied | 3 | 2 | 3 | 9 | 2 | 0 | 19 |
| | 3.7 | 2.4 | 3.8 | 3.2 | 0.8 | 0.0 | 2.3 |

MV-Most Vulnerable; JV-Just Vulnerable; UP-Upper Poor; LIG-Low Income Group; MIG-Middle Income Group; HIG-High Income Group.

Source: Loyola College of Social Sciences, Thiruvananthapuram (2004). KSUDP - Socio-Economic Study 2004.

### B.2.2 Sewage Treatment Plant and Sewerage Upgrade

The sewerage system in Kollam is not operational at this stage, though KWA had prepared one such plan as early as in 1975 envisaging then to cover the old Municipal area of 18.48 sq.kms. 38 kms of sewer lines and 3.35 kms of pumping mains were laid in Zone III, IV, V and VI under that plan but without any provision of adequate pumping stations or any sewage treatment facility. So, effectively, the current sanitation mechanism in Kollam is mainly based on household on-site sewage treatment units. Septic tanks have been adopted by middle and high-income residences and shallow pit latrines are being used by lower income groups. Sullage from houses is often discharged into roadside drains, which discharge into the TS canal, which traverses the central city from north to south, or directly to Ashtamudi Lake. The household social surveys carried out under the KSUDP identified 56.2%of households are still without any sanitary latrines and among such house include 25 slums, which do not have any facility at all (**Table B-2**). Any augmentation of the water supply will add to the waste water volume. The situation needs to be addressed with augmentation of the existing unused sewerage and linkage to a sewage treatment plant as well as plans to sewer new areas in future.

**Table B-2: Percentage of Population Using Different Mode of Sewage Disposal**

| Nature of Sewage Disposal | MV | JV | UP | LIG | MIG | HIG | Total |
|---|---|---|---|---|---|---|---|
| UGD | 0 | 0 | 0 | 1.8 | 4.1 | 7.1 | 2.2 |
| Soak pit | 16 | 13.4 | 23.8 | 18.7 | 32.0 | 28.6 | 22.9 |
| None | 45.7 | 42.7 | 52.0 | 68.2 | 54.5 | 42.9 | 56.2 |
| Road side drains | 38.3 | 43.9 | 26.3 | 11.3 | 9.4 | 18.7 | 18.7 |

MV-Most Vulnerable; JV-Just Vulnerable; UP-Upper Poor; LIG-Low Income Group; MIG-Middle Income Group; HIG-High Income Group.

Source: Loyola College of Social Sciences, Thiruvananthapuram (2004). KSUDP - Socio-Economic Study 2004.

### B.2.3 City Drainage Refurbishment

The general topography of the city is flat, with a moderate slope from east to west. The ground level variation is about 10m. Average annual rainfall of Kollam is 2,779mm, with heavy rainfall occurring in the months of May to July due to the southwest monsoon and in October due to the northeast monsoon. The moderate sloping terrain of the city, except for small pockets of low-lying areas, facilitates natural drainage. A number of natural canals (Thodu) exist in the city and act as primary drains for receipt of the city storm runoff. These natural drains outfall to either the sea, to the T.S. Canal or to the Ashtamudi Lake. However the drainage network needs augmentation, including repairs of drains, construction of missing links, and construction of new drains in water logged areas.

**Table B-3: Flooding and its Impact**

| | MV | JV | UP | LIG | MIG | HIG | Total |
|---|---|---|---|---|---|---|---|
| No. of Households | 34 | 39 | 26 | 41 | 19 | 1 | 160 |
| Intensity *(Average no. of days)* | 9.41 | 8.64 | 10.88 | 11.20 | 8.68 | 2.00 | 9.79 |
| Frequency (*Average no. of times*) | 3.73 | 3.19 | 3.38 | 3.29 | 5.11 | 1.00 | 3.58 |
| Average depth (fts.) | 1.84 | 1.93 | 1.59 | 1.71 | 1.53 | 0.50 | 1.73 |
| Average Cost of damage in each time (Rs.) | 150.03 | 129.27 | 107.50 | 194.35 | 2.87 | 0.00 | 107.21 |

Source: Loyola College of Social Sciences, Thiruvananthapuram (2004). KSUDP - Socio-Economic Study 2004.

Water logging (localized flooding) occurs in numerous parts of Mundakkal, Pattatanam and Manayil Kulangari in the heart of the city and in the low-lying areas of Chatinamkulam. Normally, water logging occurs during the period of rainfall of high intensity and/or for extended duration. Water becomes stagnated for up to 2-3 days in these areas.

**Table B-4: Level of Public Dissatisfaction with Current Drainage Infrastructure**

| Satisfaction level | | MV | JV | UP | LIG | MIG | HIG | Total |
|---|---|---|---|---|---|---|---|---|
| Highly satisfied | No | 0 | 2 | 0 | 2 | 1 | 1 | 6 |
| | % | 0 | 2.4 | 0 | 0.7 | 0.4 | 2.4 | 0.7 |
| Satisfied | No | 15 | 17 | 22 | 109 | 113 | 18 | 294 |
| | % | 18.5 | 20.7 | 27.5 | 38.5 | 46.3 | 42.9 | 36.2 |
| Moderately Satisfied | No | 10 | 12 | 5 | 27 | 15 | 9 | 78 |
| | % | 12.3 | 14.6 | 6.3 | 9.5 | 6.1 | 21.4 | 9.6 |
| Dissatisfied | No | 41 | 40 | 36 | 111 | 83 | 9 | 320 |
| | % | 50.6 | 48.8 | 45.0 | 39.2 | 34.0 | 21.4 | 39.4 |
| Highly Dissatisfied | No | 7 | 5 | 4 | 11 | 14 | 2 | 43 |
| | % | 8.6 | 6.1 | 5.0 | 3.9 | 5.7 | 4.8 | 5.3 |
| NA | No | 8 | 6 | 13 | 23 | 18 | 3 | 71 |
| | % | 9.9 | 7.3 | 16.3 | 8.1 | 7.4 | 7.1% | 8.7 |
| Total | No | 81 | 82 | 80 | 283 | 244 | 42 | 812 |
| | % | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

MV-Most Vulnerable; JV-Just Vulnerable; UP-Upper Poor; LIG-Low Income Group; MIG-Middle Income Group; HIG-High Income Group.

Source: Loyola College of Social Sciences, Thiruvananthapuram (2004). KSUDP - Socio-Economic Study 2004.

The socio-economic survey carried out under KSUDP reported that the drainage is perceived as one of the major environmental problems in the urban area, with the vulnerable/poor population the most impacted group.

### B.2.4 Solid Waste Management and Disposal

Kollam city's population was 361,440 people in 2001 and is projected to increase to 400,000 by 2031. Total Municipal Solid Waste (MSW) generated in 2001 was 108 MT/day and is expected to grow to 120 MT/day by 2031. Out of the total generated waste only 60-70% is currently being transported to the dumping grounds under the management of the city municipality. Thus, the remaining 30% is accumulated along roadsides, or is disposed of in rivers/canals, thereby posing serious health hazards to the local people as well as cause drainage problem.

The sweepers of the Kollam Municipal Corporation are still equipped with the traditional tools/equipments like brooms made of coconut leaves, baskets, wheelbarrows/push carts and shovel for the street cleansing operation and hence are exposed to occupational hazards. The current disposal system is primarily unorganized. Solid waste is currently being heaped on road sides as temporary dumping places till it is removed by handcarts/tanks or transport trucks to a open dumping ground. This dumping site is surrounded by residential blocks on three sides and back water in the front. Similarly, market wastes are also dumped in front of respective markets before transport to be dumping ground. This practice is hazardous and unhygienic. As there is no secured landfill site the solid waste disposal site has posed health and hygienic problem to near by residents and scavengers.

The response of the community on the satisfaction level for the prevailing solid waste management practices and willingness to pay for better services is set out below.

**Table B-5: Level of Public Dis-satisfaction with Current Infrastructure**

| Satisfaction level | | MV | JV | UP | LIG | MIG | HIG | Total |
|---|---|---|---|---|---|---|---|---|
| Highly satisfied | No | 0 | 1 | 0 | 1 | 4 | 2 | 8 |
| | % | 0 | 1.2 | 0 | 0.4 | 1.6 | 4.8 | 1.0 |
| Satisfied | No | 31 | 32 | 43 | 162 | 178 | 31 | 477 |
| | % | 38.3 | 39.0 | 53.8 | 57.2 | 73.0 | 73.8 | 58.7 |
| Moderately Satisfied | No | 17 | 19 | 16 | 49 | 28 | 1 | 130 |
| | % | 21.0 | 23.2 | 20.0 | 17.3 | 11.5 | 2.4 | 16.0 |
| Dissatisfied | No | 31 | 27 | 18 | 68 | 31 | 8 | 183 |
| | % | 38.3 | 32.9 | 22.5 | 24.0 | 12.7 | 19.0 | 22.5 |
| Highly Dissatisfied | No | 2 | 3 | 3 | 3 | 3 | 0 | 14 |
| | % | 2.5 | 3.7 | 3.8 | 1.1 | 1.2 | 0 | 1.7 |
| Total | No | 81 | 82 | 80 | 283 | 244 | 42 | 812 |
| | % | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

MV-Most Vulnerable; JV- Just Vulnerable; UP-Upper Poor, LIG-Low Income Group; MIG-Middle Income Group; HIG-High Income Group.

Source: Loyola College of Social Sciences, Thiruvananthapuram (2004). KSUDP - Socio-Economic Study 2004.

### B.2.5 Road Upgrades

Kollam City Corporation has an estimated 347 kms of road network, with a road density of 6 per sq.km. Kollam city is a major intercity junction for road, rail and water transport networks from Thiruvananthapuram, Ernakulam and Shencotta. The central part of the city, known as the Chinnakada area, is the junction for all these transport networks.

The area occupying roads and other transport infrastructure is less than 7% of the total urban development area. The majority of the roads are very constrictive for right of way and have no footpaths.

The social survey carried out to establishing public opinion, reflected that 65% of the respondents are not satisfied with the road infrastructure (see **Table B-6**).

**Table B-6: Level of Public Satisfaction of Road Conditions**

| Level of satisfaction | MV | JV | UP | LIG | MIG | HIG |
|---|---|---|---|---|---|---|
| High | 3.7 | 3.7 | 0.0 | 1.4 | 0.8 | 0.0 |
| Medium | 65.4 | 73.2 | 70 | 66.8 | 72.1 | 52.4 |
| Low | 30.9 | 23.2 | 30.1 | 31.8 | 38.1 | 59.6 |

MV-Most Vulnerable; JV-Just Vulnerable; UP-Upper Poor; LIG-Low Income Group; MIG-Middle Income Group; HIG-High Income Group.

Source: Loyola College of Social Sciences, Thiruvananthapuram (2004). KSUDP - Socio-Economic Study 2004.

## B-3 Level of Environmental Assessment

Asian Development Bank projects are assigned one of four categories (A, B, C, or F1) for environmental assessment depending on the significance of the associated environmental impacts of the various Project components. The category is assigned based on the project's potential for environmental impact.

The proposed components have been selected using the environmental selection criteria defined in Chapter 8, Volume 1 of the Final Report. They are thus “pre-screened” to avoid significant environmental impacts. Generally, the components are small in area coverage and operational throughput. The STP will use fluidized aerobic bed technology, which produces a treated water with 85-90% removal of biological oxygen demand (BOD) and total suspended solids (TSS). The solid waste disposal will employ scientific landfill technology (replacing land dumping). The drainage works will be confined to rehabilitation of existing infrastructure and road upgrade components have been selected to avoid “green field” sites and large-scale construction. In all components the need to relocate residences or commercial premises has been either avoided or kept to a strict minimum.

All components proposed for the Corporations were classified as Category B, as defined in ADB’s *Environmental Assessment Guidelines (2003)* on the basis of their beneficial effects, magnitude, locations, and level of environmental impact.

“A project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas, (e.g., wetlands, forests, grasslands, and other natural habitats) are less adverse than those of Category A projects. These impacts are site-specific, and few

are irreversible. In most cases, mitigation measures can be designed more readily than for Category A projects" (ADB, 2003).

An IEE is an initial examination of potential environmental impacts of the proposed activities of a project. The IEE identifies any potential environmental impacts under different stages of the component implementation and includes environmental management and monitoring plans for the various components. It also describes the appropriate institutional framework to ensure proper implementation of the environmental safeguards.

## B-4 Current Regulatory Provisions

### B.4.1 Environmental Impact Assessment

EIA practice in India is relatively well established, though its application is not universal. The central government in India has created a foundation for environmental protection over the past three decades, beginning in 1974 with the enactment of the Water (Prevention and Control of Pollution) Act. A similar act addressing air pollution, the Air (Prevention and Control of Pollution) Act, was passed in 1981. These laws established baseline thresholds for water and air quality.

In 1986, a more comprehensive Environmental Protection Act was promulgated which established a framework for environmental clearance, requiring that EIAs be conducted for new development projects with a cost of Rs.100 crore (approximately US $.25 million) or more and for capacity expansion/modification with a cost of Rs.50 crores (approximately US $.12.5 million). To rectify ambiguity regarding exactly what type of projects were subject to the Act, specific project types were enumerated in a 1994 EIA Notification issued by the Ministry of Environment and Forests which were updated in subsequent amendments. The earlier Notification identified 32 categories of projects for which proponents must conduct EIAs and receive a clearance from the central government. These include a range of manufacturing facilities, power plants, highways, ports, airports, dams and tourist development in coastal areas.

The Notification does not require EIAs for urban environmental infrastructure projects (UEIP) because these are assumed to result in positive environmental impacts.

In addition to central government requirements, some states, regional development authorities and municipal corporations have established their own EIA requirements for projects under their jurisdiction. These requirements vary widely from one jurisdiction to another. Environmental clearance generally falls under the jurisdiction of the State Pollution Control Boards in each state. Some states require EIAs for certain types of UEIPs, others do not. Those that do require environmental clearance for UEIPs, generally specify sewage treatment and solid waste disposal. The situation is similarly mixed at the regional and municipal levels.

In Kerala there is no specific recommendation on EIA requirement for UEIPs. However, every project requires a "Consent to establish" from the state Pollution Control Board under the Water (Prevention and Control of Pollution) Act and the Air (Prevention and Control of Pollution) Act and authorization under the Municipal Solid Waste (Management and Handling) Rules, 2000.

The key distinction between Indian central government and development agency decision making regarding EIAs lies in the threshold mechanism. For the Indian government, it is the project type and funding level (Rs.100 crores); for development agencies like ADB, it is the project type and the finding of the initial environmental examination.

### B.4.2 Water Quality

The most important regulatory concerns for the projects under the KSUDP concern the impact on the receiving water quality of Ashtamudi Lake under the Water (Prevention and Control of Pollution) Act, 1974. The prescribed standards for the different receiving water quality depending on the designated use of the receiving water are summarized in **Annex A**.

### B.4.3 Municipal Solid Waste Management

The management of municipal solid wastes is covered by the Municipal Solid Wastes (Management and Handing) Rules, 2000 under the Environment (Protection) Act, 1986, which was brought out by the Ministry of Environment and Forests (MOEF). These Rules are applicable to all urban local bodies and are to be implemented by Corporations and LSGs. They prescribe a policy for waste management, which covers:

- Collection and waste storage;
- Segregation of waste;
- Littering;
- Transportation; and
- Waste processing (compost plants, energy recover etc.).

The details of the rules which local authorities are obliged to follow in setting up and operating waste management facilities under this statute are summarized in **Annex B**.

### B.4.4 Bio Medical and Hazardous Waste

Beside MSW management rules, there are separate rules on handling and management of bio-medical waste as well as hazardous waste. As per requirements, all small hospitals, nursing homes, laboratories, dispensaries and pathology laboratories, regardless of size, should attempt to follow the directions contained in the Rules and the instructions given by the Central Pollution Control Board and State Pollution Control Boards. The State Government and the Municipal Authorities should take the lead in setting up proper facilities for their own medical establishments. It should be ensured by the medical institutions that their bio-medical waste does not get mixed with municipal solid waste. Bio-medical waste management is currently being regulated under the Bio-Medical Waste (Management and Handling) Rules, 1998 and its provisions, relevant to the project, are summarized in **Annex C**.

### B.4.5 Ambient Noise and Air Quality Requirements

The Noise Pollution (Regulation and Control) Rules 2000 were promulgated under the authority of the Environment (Protection) Act 1986. In essence they require that:

1) The ambient air quality standards in respect of noise for different areas/zones shall be such as specified in the Schedule annexed to these rules (presented at **Annex D**).
2) The State Government [shall categorize] the area into industrial, commercial, residential or silence areas/zones for the purpose of implementation of noise standards for different areas.
3) The State Government shall take measures for abatement of noise including noise emanating from Vehicular movements and ensure that the existing noise levels do not exceed the ambient air quality standards specified under these rules.
4) All development authorities, local bodies and other concerned authorities while planning developmental activity or carrying out functions relating to town and country planning shall take into consideration all aspects of noise pollution as a parameter of quality of life to avoid noise menace and to achieve the objective of maintaining the ambient air quality standards in respect of noise.
5) An area comprising not less than 100 meters around hospitals, educational institutions and Courts may be declared as silence area/zone for the purpose of these rules.
6) The implementing authority shall be responsible for the enforcement of noise pollution control measures and the due compliance of the standards in respect of noise.

National Ambient Air Quality Standards have been instituted by G.S.R.176 (E), dated 2nd April, 1996. These standards are also listed in **Annex D**. These standards nominate levels of air quality necessary within adequate margin of safety, to protect the public health, vegetation and property.

"Whenever and wherever two consecutive values exceed the limit specified above for the respective category, it shall be considered adequate reason to institute regular/continuous monitoring and further investigations."

### B.4.6 Coastal Management

Restrictions were imposed on developmental activities on coastal areas by introducting the Coastal Regualtion Zone Notification in 1991 under the authority of the Environment (Protection) Act 1986. Coastal stretches of sea between the Low Tide Lines and High Tide Lines and upto 500 meters on the landward side from High Tide line and upto 50 meters from the bank or width of the creek, river or backwater which ever is less will come under the regulated zone. For imposing restriction, the coastal area is classified into four zones viz:

1) CRZ I – Areas that are ecologicaly sensitive and in the area between High Tide Line and Low Tide Line;
2) CRZ II – Areas that have already been developed upto or close to the shoreline;
3) CRZ III – Areas that are relatively undisturbed which does not fall under CRZ I or CRZ II; and
4) CRZ IV – Coastal stretches in the Andaman & Nicorbar, Lakshedweep and small islands.

According to the notification, Coastal Zone Management Plan for Kerala was prepared demarcating the Coastal Regualtion Zone in the state, which was approved in 1996. Under the approved Coastal Zone Management Plan coastal stretches of all the Corporations of the state fall under CRZ II. The notification permits development on the landward side of the existing road or existing building /

structures in CRZ II. However, developments in CRZs require the approval of the Central / State Coastal Zone Management Authority.

## B-5 Component Descriptions

### B.5.1 Water Supply Rehabilitation

The ultimate objective of the component is to optimize the present water supply system by providing a more cost effective production and equitable delivery of water. In order to improve the service to customers through the reduction of leaks and wastage with the ultimate aim of providing a 24 hour water supply system. The aims of the component attributes are:

- Improved efficiency and process monitoring of two water treatment plants at Sasthamkotta Lake and replacement of a failed transmission main to the city (26 km);
- Water Supply System Optimization based on leak detection and rectification, installation of zonal bulk water meters in delivery and feeder mains etc.; and
- Strengthening of city distribution network by incorporating RCC overhead service reservoirs, replacing leaking distribution network (60 km) and installing of 10,000 domestic water meters.

After completion of the proposed work plans, which are expected to be completed within a period of 3 years, the corporation will have a secure 57.5 MLD supply of water. The old town, where sewerage is envisaged (ultimate population 2.4 lakh), will be supplied with water to satisfy an average demand of 135 lpcd. Other areas of the corporation, where on-site sanitation is to be continued (ultimate population of 1.6 lakhs), will be provided with water to meet the minimum satisfactory requirements of 70 lpcd. These improvements will ensure consumers are assured of an equitable and safe water supply until 2031.

**Table B-7: Proposed Sub-Project Components**

| Sl. No. | Project Proposal |
|---|---|
| **1.** | **Rehabilitation of Water Treatment and Transmission** |
| 1a. | Improved process monitoring instrumentation and flow measurement for the two twater treatment plants at Sasthamkotta Lake. |
| 1b. | Replacement of 700mm dia concrete pipe (26 km) with 750mm dia DI pipe. |
| **2.** | **Water Supply System Optimization** |
| 2a. | Distribution Network mapping and hydraulic analysis |
| 2b. | Training on improving leak detection, waste control and metering program |
| 2c | Water and power audit of production, treatment and distribution |
| **3.** | **City Water Distribution Network Strengthening** |
| 3a. | Construction of (RCC) overhead service reservoirs (Total 3ML) |
| 3b. | Distribution network – (80-500 mm dia. MDPE / DI pipes) - 60 km. |
| 3c. | Installation of 10,000 domestic water meters to house connections and stand posts. |

### B.5.2 Sewage Treatment Plant and Sewerage Upgrade

Based on the needs analysis of the existing sewerage and sanitation facilities in Kollam corporation area, the following subcomponents have been identified under KSUDP and are detailed and

prioritized in the following sections. The municipal corporation area of 57.31 sq. km, has been divided into three major zones as follows:

**Zone A.** This consists of old municipal area of 18.48 sq. km for which KWA planned a sewerage system and already laid 38 Km of under ground sewers. The works stopped due to fund paucity. This zone has been further divided into two major sub zones Zone A1 and Zone A2. The first priority of Zone A shall be to undertake conditional survey and if possible, commissioning of 38 km of sewer lines and five pumping stations falling under Zone A1 along with the construction of sewage treatment plant. This zone covers an area of approx. 6.5 sq. km (population coverage of 50,000 according to Census 2001). At a planned water supply rate of 135 lpcd, the sewage generation will be approximately 6 MLD, which will be pumped to the proposed STP at Kureepuzha. The areas covered under the above zones are Andamukkam, Cantonment south, Kottakkakom, Thevally, Cutchery, Kaikulangara, Jonakapuram, Thangassery, Punnathala etc.

After the above, next target could be the laying of sewers and construction of pumping stations falling under Zone A2 covering an area of 12 sq. km. in the remaining part of old Municipal area catering to population of 85,000 according to Census 2001. At a water supply rate of 135 lpcd, the sewage generation will be 10 MLD, which will also be pumped to the proposed STP at Kureepuzha. The areas covered under this zone are Uliyacovil, Asramam, Kureepuzha, Manayil, Kulangara, Mulamkadakom, Mudakkal etc.

**Zone B.** This zone covers North Western side of the Municipal Corporation (8 sq. km.) which can be covered by sewerage system in a later phase. The population served in this zone will be approx. 50,000. The sewage generation will be approximately 8 MLD, which could be taken to the STP at Kureepuzha, if additional land was acquired for expanding the STP in future.

**Zone C.** This zone covers the Eastern area of the Municipal Corporation (27.83 sq. km.), which can be covered by sewerage system in future. Vadakkevila, Mulluvilla, Pallmukku, Eravipuram, Polayathode, Kilikollur are some of the major areas included in this zone. The population served in this zone will be around 140,000. The sewage generation will be approximately 20 MLD, which could be taken to a separate STP at a suitable place at Mullivila. The total land area requirements for this STP shall be around 2 Ha. This can be taken up along with development of Zone C sewerage system.

The priorities under focus for implementing the sewerage component can be summarized under the following three broad objectives:

- Giving priority to Sanitation improvements in general and specifically in slums;
- Conducting conditional survey and commissioning of the acceptable existing sewers lines (38 km) and along with construction of sewage pumping stations; and
- Construction of STP required size for old municipal area and extension of the sewerage system in other parts of the Municipal Corporation.

Based on the system analysis of the existing sewerage and sanitation facilities in Kollam corporation area and also the need analysis, the following augmentation and developmental subcomponents under this sub-sector are proposed:

**Table B-8: Proposed subcomponent attributes**

| Sl. No. | Sewage Disposal and Treatment Proposals |
|---|---|
| 1 | Condition survey and rehabilitation of existing 38 km sewer lines and construction of 20 km missing sewer lengths (200-500mm dia.) (Zone A1 – Popn. ~ 50,000);<br>Construction of 5 Nos. sewage pumping stations; installation of pumps (260 HP); laying of pressure mains; (200-300 mm dia. 6 Km); Installation of DG sets (85 KVA).<br>Provision of 2 No. Diesel driven truck mounted sewer jetting cum suction cleaning machines. |
| 2 | Construction of new sewer lines (250-500 mm dia. 70 Km) (Zone A2 - Popn. ~ 85,000)<br>Construction of 6 nos. sewage pumping stations; installation of pumps (120 HP); laying of pressure mains (250 mm dia. 2 Km); Installation of DG sets (40 KVA). |
| 3 | Construction of 16 Mld FAB sewage treatment plant to cater for Zones A1 & A2 utilizing 1.6 Ha. land already under acquisition notification. This STP is proposed to treat the leachate produced from the adjacent integrated sanitary landfill site. |
| 4 | Provision of 3 No. Diesel driven truck mounted vacuum septic tank cleaning machines, which will benefit a population of 166,500. The sludge would be digested and dried in the proposed 16 MLD STP at Kureepuzha.<br>Provision of 1,500 household twin pit pour-flush latrines and 15 community sanitation blocks (included under poverty alleviation component) |

### B.5.3 City Drainage Refurbishment

At present the existing drains are inadequate to drain excess rainwater from the low-lying areas quickly, during rains of average intensity. The canals and drains are heavily silted and also suffer blockage from localized dumping of solid waste. It is vital that the hydraulic flow condition of the drains is improved such that the effective disposal of storm water can occur. Culverts with inadequate vent ways are to be rehabilitated, and extensive de-silting programs will be undertaken.

The prevailing deficiencies in the existing drainage systems warranting augmentation/improvements are as follows:

- Decreased carrying capacity of the existing canals/drains due to heavy silt deposition, discharge of solid wastes in the canals/drains and growth of vegetation in the canals/drains;
- Unplanned and haphazard development of low land/water bodies without giving due consideration to the drainage system;
- Inadequate or no drainage facilities in certain areas;
- Irregular and inadequate maintenances of the existing canals and storm water drains;
- The existing city drainage system lacks proper maintenance because of multiplicity of agencies. The Kollam Municipal Corporation (KMC), State Irrigation Department and Public Works Department are jointly responsible for operation and maintenance of the existing drainage system of the city;
- Lack of public awareness is also a factor for poor functioning of the existing drains/canals e.g.- indiscriminate disposal of the wastes in to waterways creating drainage problems, and also resulting in stagnant water and subsequent health and hygiene issues; and
- Extensive developments activities near the backwater and filling wetlands areas have blocked natural drainage and leading to flooding of these areas during heavy monsoon periods.

Additionally, no detail study has been undertaken covering the drainage system of the entire city. This results in a lack of adequate information to deal with the city's drainage problem. Low areas, which otherwise were the recipients of storm water runoff, have been filled up due to haphazard and unplanned growth without giving due consideration to the drainage. A comprehensive study of the entire city drainage system along with preparation of a Drainage Master Plan is therefore essential.

**Table B-9: Proposed Drainage Component**

| Sl. No. | Drainage Rehabilitation Proposals |
|---|---|
| 1 | Detail study of city drainage system and preparation of Drainage Master Plan |
| 2. | Improvement of the existing storm water drains-citywide (Approx 22Km). |
| 3. | Construction of new secondary drains (Approximate length 8 Km) |

### B.5.4 Solid Waste Management and Disposal

A deficiency analysis in the existing MSWM system was undertaken by comparing the prevailing situation with that of excepted norms promulgated under regulatory provisions or other accepted guidelines developed on the subject i.e. Municipal Solid Waste disposal (Management and Handling) Rules and CPHEO guidelines. The major identified deficiencies requiring augmentations are set out under:

- There is no waste segregation practice at source. Residents currently leave waste at the nearest open storage point for ultimate collection. In the same way, markets and commercial establishments heap their waste in front of the respective markets or commercial location before its collection and transportation. The waste clearance is often attended whenever complaints are made. The burning of such waste is also quite common.
- The Corporation Health Department lacks the infrastructural support required to effectively manage solid waste. It has a small fleet of collection vehicles, with many currently being tried to assist and at all stages manual handling is used. There is no regular scheduling of waste collection and collection is often to very late. The sweepers are also ill equipped.
- Presently no processing of waste is being done at the open dumping ground (of 4.5 acres) at Kureepuzha. The dumping ground is approximately 4 km from the city centre. It is a source of foul odors and ground water pollution from leachate, which are creating a public health problem for the surrounding area.
- There are 44 private clinics, hospitals and nursing homes within Kollam Municipal Corporation but only two have incinerators. The entire clinical waste generated in the city is disposed of currently using unacceptable practices. For example bio-medical waste is simply dumped in pits and leachates generated may be polluting the surroundings.

Based on identified deficiencies, the following augmentation components were evolved for the 30 years of city growth scenario.

- Augmentation for efficient and safer road sweeping mechanism, efficient collection from commercial and market places and reduction in roadside waste burning;

- Further augmentation of the existing segregation and storage system;
- Intervention needed for reduction, collection and waste handling/transportation;
- Better equipment provision for local storage and transport e.g.; containerized system for collection and storage, dumper placer vehicles etc.;
- Need for scientific disposal site for depositing rejects of composing plants for safe disposal; and
- Augmentation on adequate sized collection and storage bins and better scheduling of transportation curving cleared with 24 hours.

**Table B-10: Proposed Sub-project Attributes**

| Sl. No. | Solid Waste management Component Proposal |
|---|---|
| 1. | Supply of log handle brooms, metal tray, shovels, etc. for street sweeping teams. |
| 2. | Provisions of 66 small (0.5 m3), 44 medium (1.0 m3) and 47 dumper placer (3.0 m3) containers with 24 auto pickups for improved waste storage facilities and segregation. |
| 3. | Provisions of 8 dumper placer trucks and 1 refuse collectors to improve waste collection and scheduling. |
| 4. | Civil works and mechanical equipment for development of composting plant and sanitary landfill disposal site. |

### B.5.5 Road Upgrades

NATPAC (2001) conducted an urban transport study for Kollam for preparing a Traffic Operation Plan for the city. This indicated that the average daily traffic on some of the main roads in the city centre is in the range of about 30,000 to 45,000 PCU, while a range of 10,000 to 20,000 PCU per day on roads in the peripheral areas of the city.

Kollam district has about 189,300 registered motor vehicles, which on average, suggests there are 73 motor vehicles/1,000 persons. The growth rate of population in the city region is approximately 0.7%/year, whereas the growth of motor vehicles is 11.2% p.a. In addition, it is estimated that the traffic growth on roads within the city is 4 to 6% p.a.

The traffic surveys and system analysis identified the following deficiencies in the existing road network:

- Narrow width of roads in central part of the city;
- Heavy traffic congestion at the central area due to absence of bypasses;
- Unorganized on-street parking;
- Three rail level crossings causing flow obstructions;
- Gross encroachments of the right of way; and
- Absence of planned bus bays and ill-designed intersections.

The criteria adopted for identification and prioritizing sub-project components from the long list of candidates are as follows:

- Need Analysis considering demand-supply gap, urban development strategy and existing development plans;
- Environmental and social impact;
- Financial viability and project sustainability;
- Compatibility with the on going committed projects under different schemes;
- Project implementation; and
- Exclusion of projects either ongoing/under plans (committed).

Considering the above mentioned deficiencies and road improvement needs, the following schemes have been identified for the Roads Upgrade component (see **Table B-11**).

**Table B-11: Proposed Transport Improvement Schemes for Kollam Corporation**

| Sl. No. | Road Name |
|---|---|
| **A.** | **Upgradation of Priority Roads** |
| 1. | Inner Ring Road (6 km) |
| | i) Kappalandimukku – Muneshwaran Temple |
| | ii) Ananthavalli Temple – Wadi Jn |
| | iii) Bazar Jn – Kappalandimukku Jn |
| 2. | Mundalamoodu Jn - Thirumullavaram Road (intermediated lane for a length of 1.90 km) |
| 3. | NH 47-Lakshminada Junction to Vellatiyambalam Junction |
| | i) First 250m from Lakshminada junction ( 2 lane for a length of 0.25 km) |
| | ii) Remaining portion of the section (2 lane for a length of 3.05 km) |
| **B.** | **New Infrastructure** |
| 1. | Street Lighting on major and minor road sections |
| 2. | Underpass to existing ROB at Chinnakada |
| **C.** | **Improvements to critical Road Junctions (8)** |

### B.5.6 Component Sites

The proposed component sites are shown in **Figures B-1** to **B-6**.

### B.5.7 Integration of Components

The Sewage Treatment Plant and the Landfill sites will be adjoining. In this configuration, considerable environmental benefits can ensue.

Sludge from the STP can be used in the adjoining composting plant as an enricher (in lieu of cow manure). Surplus leachate from the landfill site (that which is not redirected into the landfill cells) can be directed to the STP to be treated along with the sewage.


KERALA SUSTAINABLE URBAN DEVELOPMENT PROJECT
(ADB TA - 4106-IND)
KOLLAM
WATER TRANSMISSION MAP
BASE LEGEND
Corporation/Project Boundary
National Highway
Railway
Municipal Roads
Other Roads
Ward Boundary
Water Course
OVERLAY LEGEND
750 mm CI Pipe
700 mm Concrete Pipe
Existing OHSR & Pump Houses
(a) Sakthikulangara
(b) Catchery
(c) Opp. Parvathi Mill
(d) Water Authority Campus
(e) Vadakkevila
(f) Asramam
(g) Killikolloor
Laksharweep Sea
Ashtamudi Lake
Sakthikulangara North
Kureepuzha North
Kureepuzha South
Kannimel East
Kannimel West
Thirumullavaram
Thangadsery
Kadappakada
Asyamom South
Asyamom North
Ulyacovil West
Ulyacovil East
Mangadu
Arunnoottimangalam
Chattainam Kadavu
College Division
Kollam
Kokkal
Amman Nada
Pallikkalam
Killikolloor
Ayathil
Vadakkevila
Pattathanam
Thamara Kulam
Pallimukku
Mana Kattu
Kollor Vila
Kayyalakkal
Mundakkal East
Mundakkal West
Thekkevila
Eravipuram
Vaithungal
Thekkumbhagom
To Alappey
To Ernakulam
To Thiruvananthapuram
To Kunnathoor
To Kannanalloor
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and MDP Consultants Pvt Ltd
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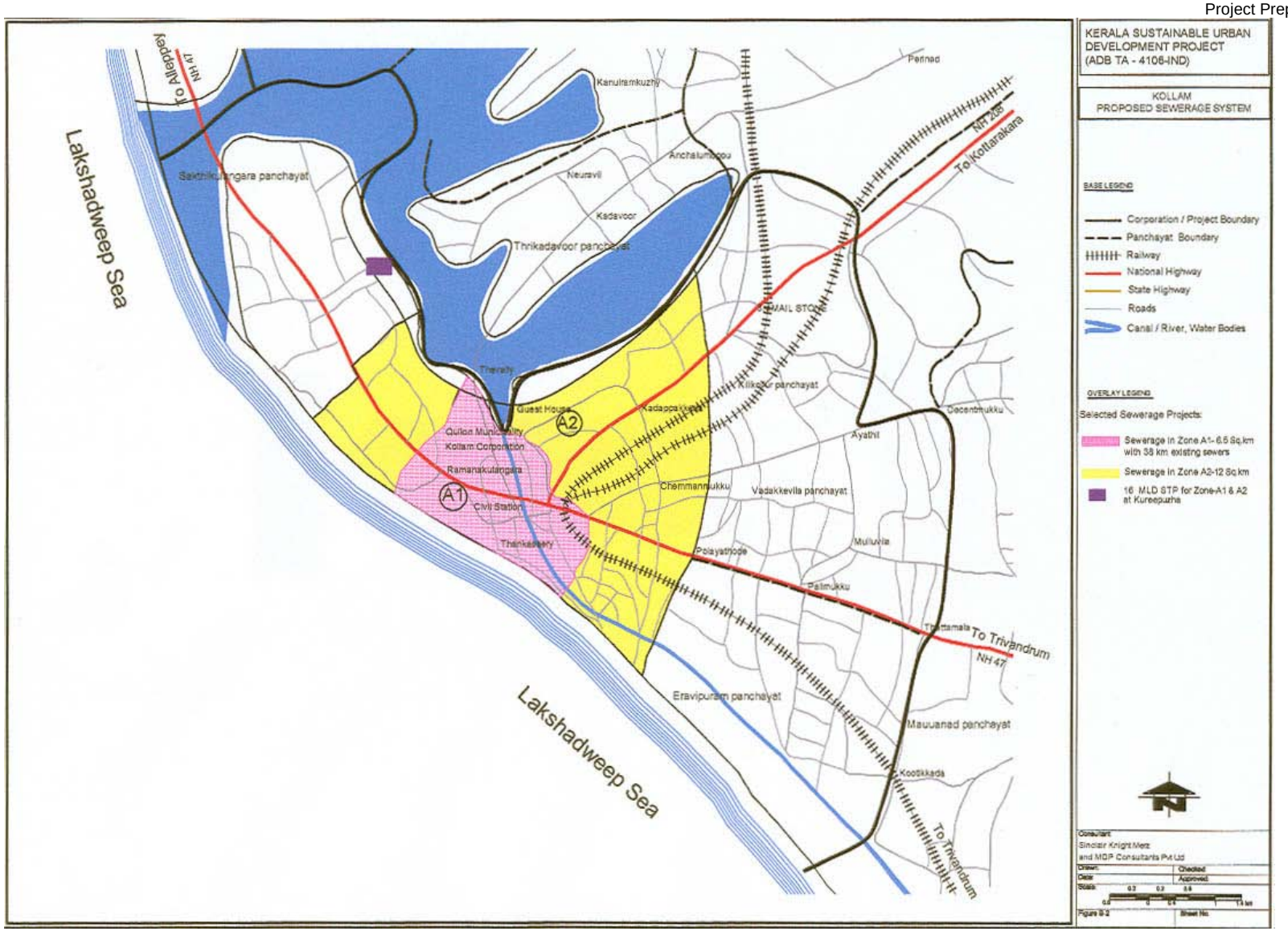
KERALA SUSTAINABLE URBAN DEVELOPMENT PROJECT
(ADB TA - 4106-IND)
KOLLAM
PROPOSED SEWERAGE SYSTEM
BASE LEGEND
Corporation / Project Boundary
Panchayat Boundary
Railway
National Highway
State Highway
Roads
Canal / River, Water Bodies
OVERLAY LEGEND
Selected Sewerage Projects:
Sewerage in Zone A1- 6.5 Sq.km with 38 km existing sewers
Sewerage in Zone A2-12 Sq.km
16 MLD STP for Zone-A1 & A2 at Kureepuzha
Lakshadweep Sea
Lakshadweep Sea
To Alleppey
NH 47
Sakthikulangara panchayat
Kanuttamkuzhy
Perinad
NH 208
To Kottarakara
Anchalumoodu
Neeravil
Kadavoor
Thrikadavoor panchayat
MAIL STOP
Therally
Guest House
A2
Kollam Municipality
Kollam Corporation
Ramanakulangara
A1
Civil Station
Thankassery
Kadapacka
Kilikollur panchayat
Decentmukku
Ayathil
Chemmanmukku
Vadakkevila panchayat
Mulluvila
Polayathode
Palmukku
To Trivandrum
NH 47
Eravipuram panchayat
Mauuanad panchayat
Kootikkada
To Trivandrum
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Figure 8-2
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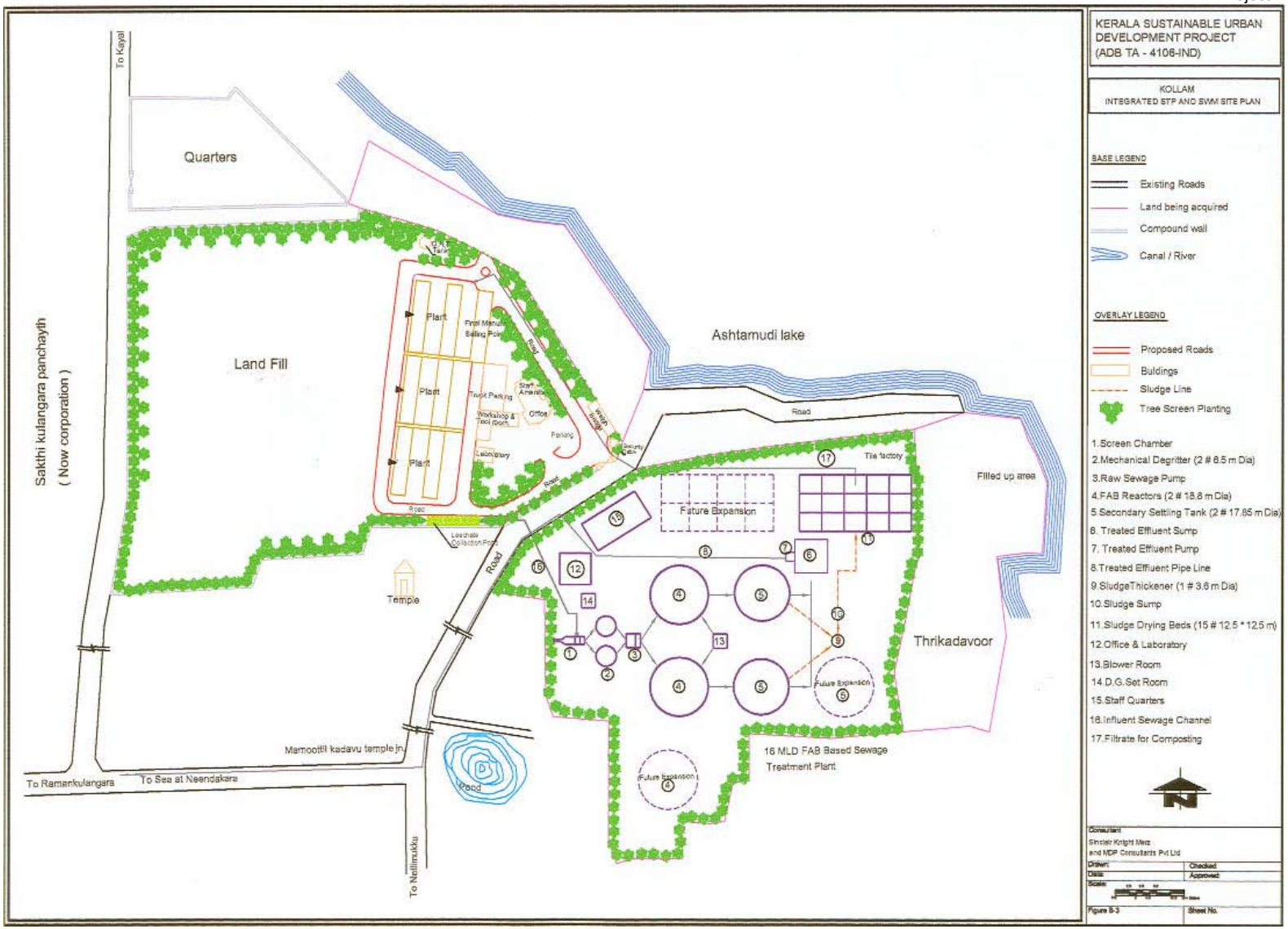
KERALA SUSTAINABLE URBAN DEVELOPMENT PROJECT
(ADB TA - 4106-IND)
KOLLAM
INTEGRATED STP AND SWM SITE PLAN
BASE LEGEND
Existing Roads
Land being acquired
Compound wall
Canal / River
OVERLAY LEGEND
Proposed Roads
Buildings
Sludge Line
Tree Screen Planting
1.Screen Chamber
2.Mechanical Degritter (2 # 6.5 m Dia)
3.Raw Sewage Pump
4.FAB Reactors (2 # 18.8 m Dia)
5.Secondary Settling Tank (2 # 17.85 m Dia)
6. Treated Effluent Sump
7. Treated Effluent Pump
8.Treated Effluent Pipe Line
9.SludgeThickener (1 # 3.6 m Dia)
10.Sludge Sump
11.Sludge Drying Beds (15 # 12.5 * 12.5 m)
12.Office & Laboratory
13.Blower Room
14.D.G.Set Room
15.Staff Quarters
16.Influent Sewage Channel
17.Filtrate for Composting
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Figure 5-3
Sheet No.
Quarters
Land Fill
Ashtamudi lake
Sakthi kulangara panchayth
( Now corporation )
To Kayal
Plant
Plant
Plant
Road
Office
Laboratory
Parking
Temple
Future Expansion
Tile factory
Filled up area
Thrikadavoor
16 MLD FAB Based Sewage
Treatment Plant
Future Expansion
Mamoottil kadavu temple jn
To Ramankulangara
To Sea at Neendakara
To Nellimukku


KERALA SUSTAINABLE URBAN DEVELOPMENT PROJECT
(ADB TA - 4106-IND)
KOLLAM
URBAN DRAINAGE PROPOSALS
BASE LEGEND
Corporation/Project Boundary
National Highway
Ward Boundary
Municipal Roads
Railway
Other Roads
Water Course
OVERLAY LEGEND
Existing Drains (Renovation)
Drains for New Construction
Water logged Area
Lakshadweep Sea
Lakshadweep Sea
Neendakara Panchayat
Sakthikulangara north
Sakthikulangara
Sakthikulangara middle
Kavanadu
Kureepuzha north
Kureepuzha south
Kannimel east
Kannimel west
Thirumullavaram
Mulangadavom
Thevally
Thangassery
Kaikulangara
Cutchery
Beach
Asramam Maidan
Asramam South
Ullyacovil West
Kadappakada
College Division
Kottankara panchayat
Amman Nada
Pattathanam
Thamarakulam
Pallichotam
Vadakevila
Pallimukku
Mulavana
Polathara
Thirikkovilvattam Panchayat
Mundakal west
Mundakal east
Bharanikavu
Koiloor Vila
Theikkevila
Kayyalakkal
Velazhungal
Mayyanadu Panchayat
Ennvisuram
Thekkumbhagom
Akkoli
To Kureeppally
To Karunagappally
To Thiruvananthapuram
To Thiruvananthapuram
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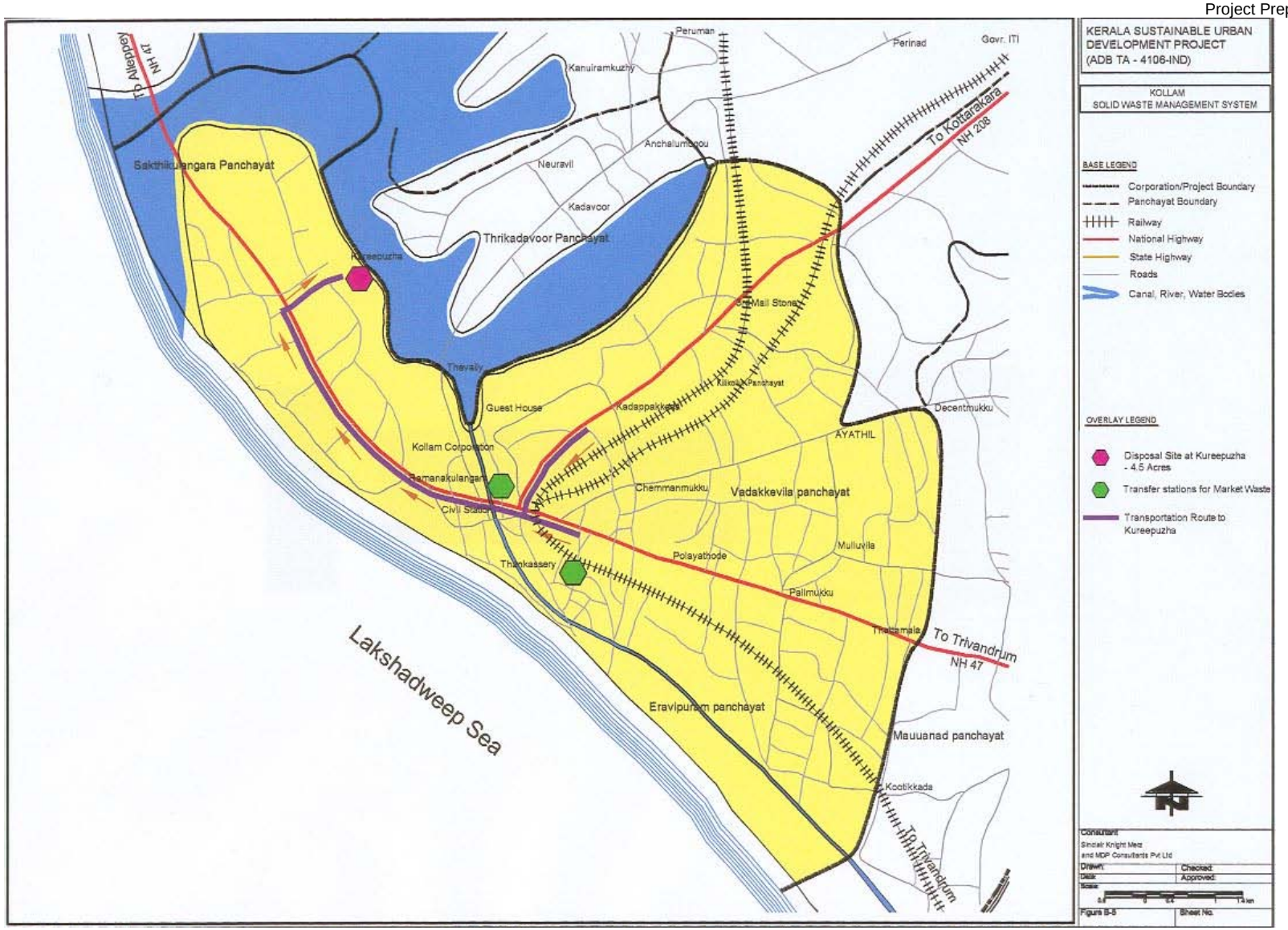
KERALA SUSTAINABLE URBAN DEVELOPMENT PROJECT
(ADB TA - 4106-IND)
KOLLAM
SOLID WASTE MANAGEMENT SYSTEM
BASE LEGEND
Corporation/Project Boundary
Panchayat Boundary
Railway
National Highway
State Highway
Roads
Canal, River, Water Bodies
OVERLAY LEGEND
Disposal Site at Kureepuzha - 4.5 Acres
Transfer stations for Market Waste
Transportation Route to Kureepuzha
To Alleppey NH 47
Sakthikulangara Panchayat
Kanuiramkuzhy
Peruman
Perinad
Govr. ITI
To Kottarakara NH 208
Anchalumoodu
Neuravil
Kadavoor
Thrikadavoor Panchayat
Kureepuzha
Mail Stone
Thevally
Guest House
Kadappakkada
Kilikol Panchayat
Decentmukku
AYATHIL
Kollam Corporation
Ramanakulangara
Civil Station
Chemmanmukku
Vadakkevila panchayat
Mulluvila
Polayathode
Thankassery
Pallimukku
Thalamala
To Trivandrum NH 47
Lakshadweep Sea
Eravipuram panchayat
Mauuanad panchayat
Kootikkada
To Trivandrum
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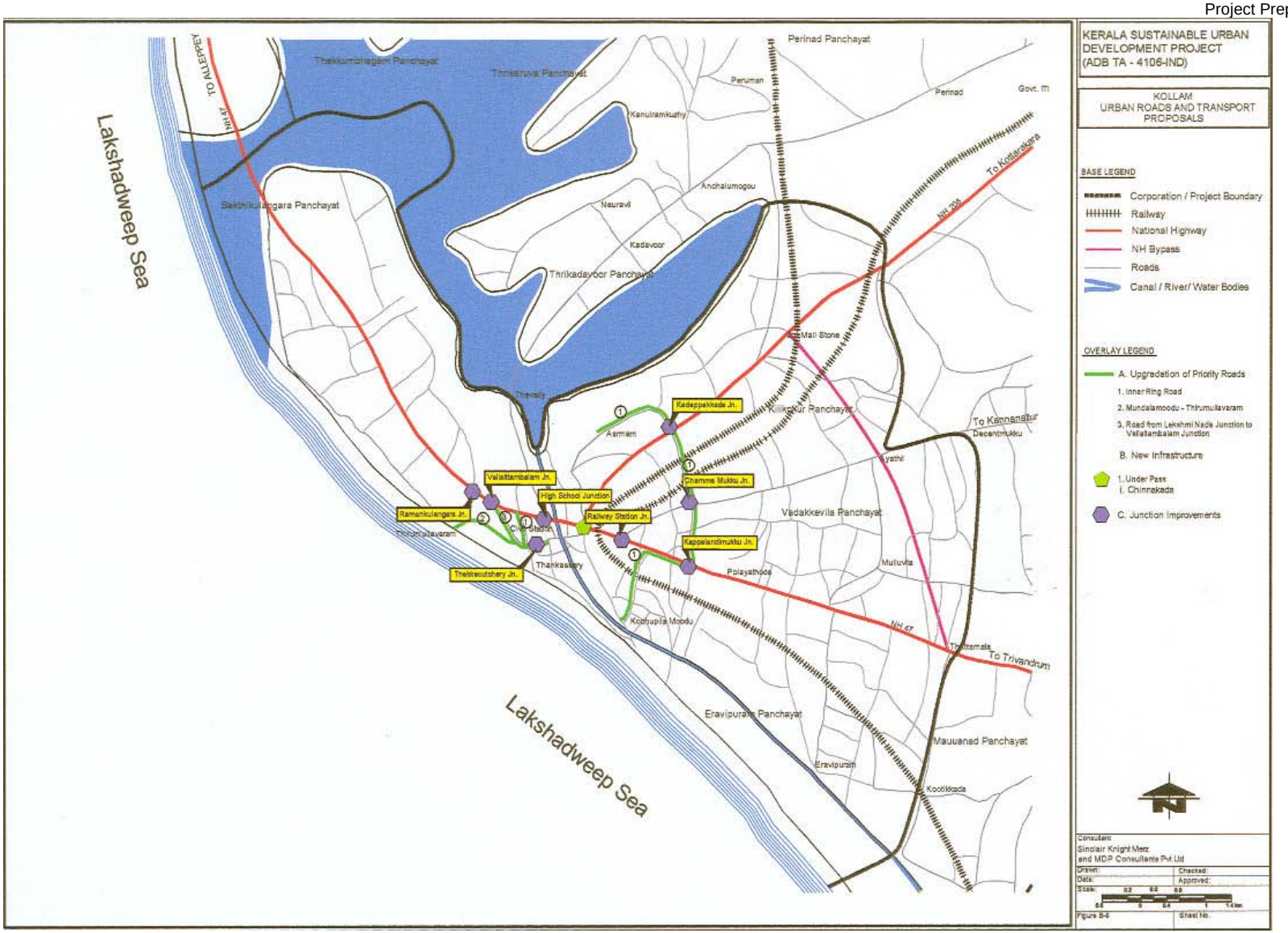
KERALA SUSTAINABLE URBAN DEVELOPMENT PROJECT
(ADB TA - 4106-IND)
KOLLAM
URBAN ROADS AND TRANSPORT PROPOSALS
BASE LEGEND
Corporation / Project Boundary
Railway
National Highway
NH Bypass
Roads
Canal / River/ Water Bodies
OVERLAY LEGEND
A. Upgradation of Priority Roads
1. Inner Ring Road
2. Mundalamoodu - Thirumullavaram
3. Road from Lekshmi Nada Junction to Vellattambalam Junction
B. New Infrastructure
1. Under Pass
i. Chinnakada
C. Junction Improvements
Lakshadweep Sea
Lakshadweep Sea
Thekkumbhagam Panchayat
Thirukaruva Panchayat
Perinad Panchayat
Sakthikulangara Panchayat
Thrikadavoor Panchayat
Kilikollur Panchayat
Vadakkevila Panchayat
Eravipuram Panchayat
Mauuanad Panchayat
Vellattambalam Jn.
High School Junction
Railway Station Jn.
Kadeppakkada Jn.
Chemmn Mukku Jn.
Kappalandimukku Jn.
Thekkeouthery Jn.
Ramankulangara Jn.
Mali Stone
To Kottarakara
To Kannanallur
To Trivandrum
NH 47
NH 208
Perinad
Govt. ITI
Kanuiramkuzhy
Anchalumoogu
Neuravil
Kadavoor
Thevally
Asramam
Decentmukku
Eyathil
Muluvila
Polayathode
Kochupila Moodu
Thankassery
Thirumala
Eravipuram
Kootikkada
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# B-6 Environmental Setting

## B.6.1 Regional Environmental Setting

### B.6.1.1 Biophysical Environment

All project cities are located in the lowland geophysical division of Kerala. This is the coastal plain below the 7.5m contour and supports 26% of the population.

The zone is characterized by marine landforms of beach ridges, beaches, swamps and lagoons. The coastal wetland areas support rain-fed and irrigated rice. Coastal dry-lands support coconut/tapioca/cashew plantations. Reclaimed backwater areas are used for coconut plantations.

#### *Climate*

The lowland areas have 4 typical seasons; the dry weather from December to February, hot weather from March to May, South-West and North-East monsoon prevailing from June to November. The area has a moderate climate with the average annual temperature of $27^0$C where as annual temperature range is 27.8 to $33^0$C as a maximum and a range of 22.3-26.$1^0$C as a minimum. The South-West monsoon provides heavy and reliable rainfall with the average annual rainfall about 3100 mm, within an average of 115 rainy days.

The monthly mean value of relative humidity varies from 75-96% in the morning (08:30 hrs) to 65-91% in the afternoon (17:30 hrs). Excessive rain during June to August causes frequent floods in the rivers and canals in the area, submerging low-lying areas.

#### *Water Resources*

Rainfall in Kerala concentrates on the high ranges of the Western Ghats. Because the coastal plain is narrower in the north of the state, with the highlands in closer proximity to the coast, the rainfall is highest on the north coast and generally decreases towards the southern end of the coast:

Surface water drainage is predominantly westward from the mountains (41 rivers out of a total of 44). They are monsoon fed and fast flowing. Therefore, in periods of high rainfall the high volume of water in the rivers draining the highlands supplement the in-situ rainfall – making the relatively lower rainfall areas in the south as susceptible to flooding as the higher rainfall northern coastal cities.

Floods in Kerala have been increasing in severity because of land use changes and ill-planned flood protection works, which move the impact downstream. A major flood in 1992 in south Kerala resulted in 75 deaths, more than 7,000 houses lost, and Rs.1,000 crore in damages.

The annual runoff yield is 77,900 million m3, however not all runoff is usable for water supply. In the thickly populated coastal belt, water storage space is not available and in the summer salinity intrusion makes the waters of the coastal reaches of rivers unusable. “The entire runoff below the 15m contour may be considered un-utilizable. In the midlands between 15m and 75m contours experience has shown that about 50% of the runoff may be considered utilizable directly or through storage.” Whereas most of the runoff in the highlands is usable (Nampudripad, 1996).

### *Groundwater Resources*

Large groundwater resources exist in the coastal zone. These comprise three deep aquifers:

| | |
|---|---|
| Warkallai | Used for drinking water in Alleppey and Kuttanard – in south Kochi district |
| Kollam | Deeper than Warkallai aquifers and underlying them in parts |
| Vaikom | Large aquifer, between Kollam and Kayamkulam in the north. Brackish in its northern reaches. |

In addition, unconsolidated aquifers occur throughout the coastal strip under water table conditions are tapped by open wells, at a density of 100-250 wells/km2.

Overuse of groundwater has permanently lowered the water table and allowed subsequent intrusion of salinity into coastal aquifers. This is mainly due to bore wells withdrawing water directly from the water table rather than from the deeper aquifer. Sand quarrying from river beds throughout the coastal strip has also contributed to lowering of the water table.

### *Fisheries Resource*

Inland fisheries are made up of estuarine/backwater and freshwater fisheries.

“The vast stretch of brackish water lakes that exists along the coastal belt of Kerala consists of 30 identifiable backwaters. They constitute nearly 70% of the inland water resource of the state and are considered to be a life support system for about 2 lakh population belonging to more than 32,000 fisher families” (Nair, 1996).

It is estimated by Nair (Nair, 1996) that around 50,000 fisherman work full or part-time in these brackish waters. The take is 80% prawns (both marine and freshwater species). The fish are predominantly mullet, horse mackerel, pearl spot, milk fish, grassy perchlet, and anchovy. Clams, mussels and backwater oysters are also collected. All inland fisheries production is consumed within the state of Kerala (Jayakumar et al, 2002).

### *Mangroves*

Kerala mangroves have high species diversity (32 different mangrove species), although two species have disappeared over the last decades, and more are threatened.

The mangrove ecosystems are biologically rich. The zooplankton strata are represented by almost all groups of aquatic forms like protozoans, sponges, carnivorous coelenterates (clenophora, hydromedusae, and polychaetes). Fishes are plentiful. Crustaceans include crabs, shrimps and barnacles; mollusks include clams, oysters, mussels and their larvae. Decapod crustaceans like the *Uca* and *Scylla* are numerous. Otters, water snakes, tortoises, resident and migratory birds water fowls form the characteristic vertebrate fauna.

Indiscriminant reclamation of backwater wetlands during the past few decades has reduced the extent of mangroves from 700 km2 to only 50 km2. The majority of the remaining mangroves stands are distributed, unevenly, among the districts containing the five project cities.

### *Coastal Erosion*

Three hundred and seventy kilometers of the Kerala coast are subject to erosion. Beach abrasion rates are as high as 5.2 m/yr (at Chellanam) and 3.1 m/yr (at Thottappally). These are also small areas of accretion which offset this trend but do not balance it.

### B.6.1.2 Social and Cultural Resources

The state exhibits a steady increase in urban population from 16.24% in 1971 to 25.97% in 2001, which is slightly lower than the national average of 28% (Census 2001). However, the percentage of the urban population has witnessed a decline from 26.39% in 1991 to 25.97% in 2001 and accounts for lowest decadal urban growth rate of 7.6% in comparison to the decennial growth of 60.89% between 1981to 1991. The reason for the decline in the urban population in 2001 has been due to the reduction in number of census towns and the change in jurisdiction in statutory urban areas in the state.

Reflecting similar pattern of urban growth in the state, the trend of total population in Kerala also reveals a low decadal growth rate of 9.42% (1991-2001), which has been the least growth rate in comparison to all the states of India. It accounts for an increase of 0.94% annual growth rate during this period, which is significantly lower than the national average of 2% too. These growth rates of the state demonstrate that whilst net migration has been a contributing factor to urban population growth, natural increase has been the dominant explanatory factor in 1991-2001.

**Table B-12: Trend of Urban Population of India and Kerala: 1971-2001**

| Year | India | | | Kerala | | |
|---|---|---|---|---|---|---|
| | Total | Urban | % of Urban Pop | Total | Urban | % of Urban Pop |
| 1971 | 548,159,652 | 109,113,977 | 19.91 | 21,300,560 | 3,459,211 | 16.24 |
| 1981 | 683,329,097 | 159,462,547 | 23.34 | 25,453,680 | 4,770,020 | 18.74 |
| 1991 | 846,302,688 | 217,611,012 | 25.71 | 29,098,518 | 7,680,294 | 26.39 |
| 2001 | 1,027,015,247 | 285,354,954 | 27.78 | 31,838,619 | 8,267,135 | 25.97 |

Census of India: 1971, 1981, 1991, and 2001.

The spatial distribution of population in Kerala according to Census 2001 reveals that the majority of people reside in rural areas accounting for 74.03% (Census 2001). Despite this, Kerala has a large and growing urban population. In line with expected trends in India, urbanization in Kerala is expected to intensify over the coming decades. It has been estimated that over the twenty-year period (2001-2021), even after the estimating the current annual rate of 0.76% increase, the population growth would reveal 15.2% increase in absolute terms. Hence, the urban population would likely to exceed 9.53 million by the design year of the Project, 2021.

### *Poverty*

In 1973-74, Kerala was amongst the five poorest states, with nearly 62% urban poverty. Since then, conditions in Kerala have improved and it is now amongst the states with very low percentage of population below the poverty line. As per the NSSO (1999-2000) Kerala has poverty figures of 9.38% in rural areas and 20.27% in urban areas, where as the All India figures are 27.09% in rural areas and 23.62% in urban areas.

For the year 1999-2000, the Below Poverty Line (BPL) for urban areas of Kerala had been estimated at Rs.477.06 per capita per month. In 1999-2000, 20.27% of the State's urban population was living below the poverty line in comparison to 23.62% for the country as a whole. Urban poverty was higher than rural poverty with a 20.27% and rural reflecting 9.38%. In both the cases i.e. urban and rural the percentage of BPL population has been lower than national average respectively.

### *Cultural Heritage*

Items of cultural heritage, resources for traditional purposes, structures or sites that are of natural, historical, archaeological, scientific, or architectural significance have been listed in the Coastal Management Plan (1995). The IEEs have used this reference to check on potential impacts on heritage items.

### B.6.1.3 Developmental Setting

The first ever National Human Development Report (NHDR), 2001 by the Planning Commission estimated the value of Human Development Index (HDI) for the states and the UTs of India. HDI for the country as a whole has improved from 0.302 in 1981 to 0.472 in 2001. Kerala a middle income state remains at the top of the NHDR table with an achievement of HDI of 0.638, an increase from 0.500 in 1981.

So far as the urban-rural gap is concerned, the national index for rural areas has gone up from 0.263 to 0.340 and for urban areas from 0.442 to 0.511. The rural-urban gap was at the minimum in case of Kerala and maximum for Madhya Pradesh.

**Table B-13: Human Development Index of India and Kerala: 1981-2001**

| Year | Human Development Index | |
|---|---|---|
| | Kerala | India |
| 1981 | 0.500 | 0.302 |
| 1991 | 0.591 | 0.381 |
| 2001 | 0.638 | 0.472 |

Source: Tenth Five Year Plan 2002-2007.

**Infrastructure Index.** The infrastructure index brings out a composite comparative profile of the availability of physical, social and institutional infrastructure in the state. It has been viewed that amongst all the states, Goa had the highest infrastructure index of 200.57 and Kerala had the third highest infrastructure index of 178.68. The other states with highest infrastructure index include Punjab (187.57), Gujarat (124.31) and Haryana (137.54). The highest index means the best placed state in terms of infrastructure facilities.

The target for Net State Domestic Product (NSDP) growth is 7% per year, with primary, secondary and tertiary sectors targeted at 4%, 8% and 9% respectively. Plan outlays are focused heavily on social services, energy and irrigation, but in rural rather than urban sectors.

## B.6.2 City Environmental Settings

### B.6.2.1 Growth of Kollam

The current population of Kollam is 361,440, and is likely to grow to 400,000 by 2031. Kollam, previously the capital of Travancore, became the hub of governmental activities and projects such as the Neendakara Port and Titanium Complex. The main industries activities located at Kollam are still of medium/small scale e.g. cashew processing units, textiles, tiles, timberwork, tin containers manufacturing, oil mills etc.

### B.6.2.2 Physiography

The town is flanked by the Lakshadweep Sea on the west and south and the Ashtamudi Lake on the north, with a generally flat terrain. The ground level varies from sea level to about 10 m in the vicinity of the railway station. The cantonment and Asramam areas are the highest in Kollam. Kureepuzha, Thevally and Palace areas are reasonably flat, while the Manayilkulangara Punnathala area lying on the west of Kollam-Alleppey road is low lying with patches of paddy fields and depressions interspersed. In Kaikulangara, Pallithottam, Thamarakulam and Cantonment areas there are depressions, which are flooded during the monsoon reason.

### B.6.2.3 Geology, Soil and Vegetation

Of a total area of 18,485 km2 of Kollam town, nearly 1,194 km2 (6.46%) is under water, with 5.52% specifically classed as wetlands. The geological formation of Kollam district has the following major characteristics.

1) Recent deposit-marine or alluvial sands;
2) Sub-recent deposits-raised beaches and older alluvium;
3) Laterite formation; and
4) Crystalline rocks.

The Thankassery, Kureepuzha, Thevally and Palace areas have laterite sub soil to an average depth of 15m. The soil is gravelly on the lakeside at Thevally. Loamy soil is found in the paddy fields of Mundakkal, Manayilkulangara, Kaikulangara and pattathanam wards. In all other areas, especially along the coastline, the dominant soil type is sand. The soil in general is fertile and there is dense vegetation growth in all parts of the town. Coconut is the predominantly cultivated perennial crop in the town. The other common trees found are Betel nuts, Jackfruits, Mango, and Casuarinas.

### B.6.2.4 Climate

Kollam has a fairly uniform climate throughout the year, which is moderated by on-shore breezes. The hottest months are March to May. The average daily maximum temperature during this season ranges between $32^0$C to $33^0$C. With the onset of the south-west monsoon by the end of May, temperature decreases and the weather becomes cooler. The variation of temperature is small due to the proximity of the sea. The air is highly humid throughout the year with relative humidity varying between 63% in January to 87% in June and July.

Winds are moderate to strong from May to September and light to moderate in other months. In summer months northerly or north-westerly winds prevail in the morning while in the afternoon winds prevail in a westerly direction. For the year as a whole, the morning winds blow from the north- west and northerly directions while in the evenings the winds blow from westerly directions. Winds varying between two directions reflect the dominance of land and sea breeze phenomenon in the coastal areas.

The average annual rainfall for Kollam is 2,779 mm. During May to July there are heavy rains due to the South-West monsoon and in October due the North East monsoon. Nearly half of the annual rainfall is accounted for by the South-West monsoon and a little over one quarter by the North-East monsoon.

### B.6.2.5 Water Resources

The Kollam area is relatively poorly provided with water resources in comparison with other districts:

| | |
|---|---|
| Kozhikode | 3,100 mm/yr |
| Kochi | 2,900 mm/yr |
| Thrissur | 3,200 mm/yr |
| **Kollam** | **2,800 mm/yr** |
| Thiruvananthapuram | 1,800 mm/yr |

Drainage and Floods: The gently sloping terrain of the town is conducive to natural drainage, except for the low-lying areas between Asramam and Cantonment. The low-lying areas get flooded for most periods during the monsoon season, but as the soil is sandy, the water gets drained off in a few days.

Surface Water Resources: The Achankoil River which is a tributary of Pampa, the Kallada River and the Ithikkara River are the three important rivers of the district. The Kallada River flows through the taluks of Pathanapuram, Kunnathur, Kottarakara and Kollam. It falls into the Ashtamudi Lake a little north of Kollam. Its length is 112 KM of which 40 KM is navigable and the Ithikkara River (length 48 KM) rises in the hills near Madatharakkani and flowing though Pathanapuram, Kottarakkara and Kollam taluks falls into the Paravur Lake.

The coast is fringed with lakes. Canals have been constructed to link up the lakes. The Paravur Lake is small, but deep. The Ashtamudi Lake is 16 km, long and 14 km wide at the extreme points, its area being only 50 sq.km. There is also a smaller fresh-water lake at Sasthamkotta in Kunnathur taluk.

The long-term trends surface water monitoring carried out under Global Monitoring statistics are summarized in the table below.

**Table B-14: Designated Use and Existing Surface Water Quantity for Kollam City.**

| Location | Desired class | Existing class & Critical remarks | | | | |
|---|---|---|---|---|---|---|
| | | 1997 | 1998 | 1999 | 2000 | 2001 |
| Achankovil River at Thupmamon | | C | C | D (Totcoli) | C | C |
| Achankovil River at Chennithala | | C | C | D (Totcoli) | C | C |
| Ashtamudi Lake at Kollam | | Below-E, Conductivity, SAR | C | E, Conductivity DO, boron | E, DO, Conductivity | E, DO |

See **Annex A** for explanation of classes

The surface water quality area in Western Ghats is now having impacts of development which has changed the water quality to either C or D class which though is suitable for drinking but requires treatment. The water quality of the main backwater lake (Ashtamudi Lake) has been now categorized as E. This indicates that in recent years (since 1999) developmental activities around this backwater lake have deteriorated its quality and the DO levels have gone down to the extent that water is now only suitable for irrigation or industrial cooling. The quality of fresh water in Sasthamkotta Lake is also given below.

| Lake Name | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| Sasthamkotta Lake | C | C | C | C | C |

The fresh water quality of the lake has been consistent and is good for water supply after treatment and is the main source for Kollam Corporation.

### B.6.2.6 Wetland Resources

Although Kollam retains extensive backwater systems its wetlands have been extensively damaged by reclamation for coconut growing and foreshore developments. Consequently, Kollam has the lowest proportion of mangroves in the State's dwindling wetland resources.

| District | Mangroves |
|---|---|
| Kozhikode District | 3,500 ha |
| Thrissur District | 25 ha |
| Ernakulam District (Kochi) | 250 ha |
| **Kollam District** | **15 ha** |
| Thiruvananthapuram District | 15 ha |
| Total | 3,805 ha |

Ashtamudi Lake and Sasthamkotta Lake in Kollam District and Vembanad Backwater in Alappuzha District have been included on the Ramsar List of protected wetlands. No Project components are contemplated in the vicinity of the Vembanad Backwater. However the site of two projects at Kollam border a reach of Ashtamudi Lake and a third is concerned with a water supply scheme operating at Sasthamkotta Lake. The main features of the conservation zones proposed in the management plan for the Ramsar nomination of Ashtamudi Lake are:

- The nomination of conservation zones:
  - A marine bio-reserve to conserve fishery resources and for fisheries research;
  - Nature Conservation Park for small mammals and Birds on an uninhabited island within the marine reserve; and
  - Mangrove conservation-cum-rehabilitation in areas near the confluence point of the Kallada River and the Ashtamudi estuary.
- An objective "to create improved sanitation, reduction of industrial growth, reduction of urban waste and ensuring the sustainability of the water quality of the estuary".

There is no management plan currently proposed for the Ramsar nomination of Sasthamkotta Lake.

### B.6.2.7 Solid Waste

The physical composition of household waste and commercial waste in typical Kerala cities is shown below in **Figures B-7** and **B-8**. The data show the high potential for composting for both waste sectors.

*Figure B-7: Composition of Household Waste*

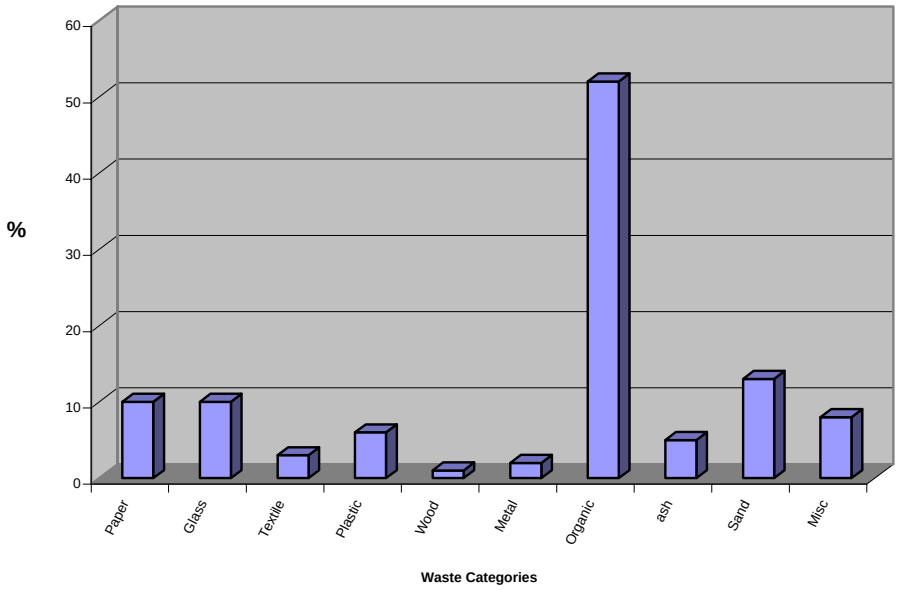
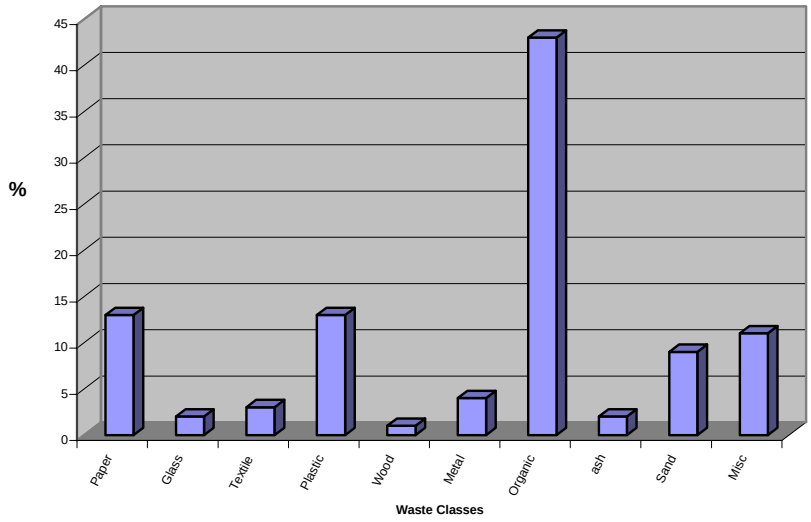


*Figure B-8 Composition of Commercial Waste*




### B.6.3 Site Environment Settings

#### B.6.3.1 Water Supply Rehabilitation

The renovation of the water treatment plants at Sasthamkotta by KWA and replacement of transmission line (26 km) is work within the same 'footprint" of existing structures and facilities. No increase in extraction is proposed, so there will be no net reduction in water in Sasthamkotta Lake to disturb biodiversity values. However, the detail design phase will investigate alternative water sources for serving the Sasthamkotta Lake water treatment plants, in order to provide further protection to the lake. No site environmental issues therefore arise. The installation of a reticulation / distribution network will be in urban areas along streets. The minimal impact involved and the built environment pose no site environmental issues.

#### B.6.3.2 Sewage Treatment Plant Site

***Site Description***

Among the most important environmental consideration for this sub-sector are the environmental sensitivities of the STP site. The salient feature of the environmental setting is setout below.

- The site for the STP is a 2.4 Ha. area acquired by the Kollam Corporation that has abandoned rural dwellings;
- The site has a tree cover of domesticated fruit species (coconut, cashew etc) as well as ornamental shrubs and trees;

- There is a 50m Coastal Regulation Zone Category II under the Kerala Coastal Zone Management Plan along the foreshores of Ashtamudi Lake. This zone adjoins the site but does not encroach upon it (see **Figure B-2**);
- The site is flat with an elevation of 2-3m ASL;
- The foreshores are reclaimed, with a seawall. Along the eastern shoreline, the backwater is fringed with coconut palms; and
- The backwater (Ashtamudi Lake) at this point is flushed slowely due to low water current and water quality along the immediate shoreline is poor.

#### *Ground Water Quality*

See groundwater testing for the adjoining landfill site (Section B6.3.4, (Ground Water Quality) below).

### B.6.3.3 Drainage System Rehabilitation Sites

The drains proposed for rehabilitation works are distributed over the city area (see **Figure B-4**). All drains proposed for rehabilitation are built structures which are currently heavily silted and clogged with floating and rooted vegetation. Drain walls and sides are also in disrepair.

### B.6.3.4 Solid Waste Management and Disposal Site

#### *Site Description*

The major environmental considerations specific to the site are guided by the environmental setting of the solid waste disposal / composting plant locations described below:

- The existing 1.9 Ha. site has been used for land disposal of un-segregated solid waste. Much of the site is covered in garbage to a height of 3-4m and is currently uncovered.
- The ground level of the site is slightly elevated (5m ASL) and undulating. The soil is a deep laterite with clay saprolitic subsoil at a depth of 2-3m. The water table is about 1.5 meters below the subsoil. There are number of wells on 2 sides of the site and these are being used by the neighboring residential population.
- There is a 50m Coastal Regulation Zone Category II under the Kerala Coastal Zone Management Plan along the foreshores of Ashtamudi Lake. The coastal zone covers the areas of houses of Thrikadavoor Village.
- The foreshores are reclaimed, with a seawall.
- Leachate from the garbage is uncontrolled and untreated – and flows into Ashtamudi Lake.

#### *Ground Water Quality*

The ground water data as summarized in **Table B-15** reflects the status of well water around the existing dumping site and also adjoining proposed site for new STP. The results represent one time observations taken by KSPCB in April 2000.

**Table B-15: Groundwater Qualities around MSW Disposal Site**

| Parameters | Name of Well Owner and Data of Samples | | | | |
|---|---|---|---|---|---|
| | Chellappan Asokan 29.04.2000 | Devaki 29.04.2000 | Mahadeva 29.04.2000 | Govinda Pillai 29.04.2000 | Sivanandan Pillai 29.04.2000 |
| PH | 4.51 | 6.73 | 6.84 | 6.24 | 8.33 |
| Color, mg pt/l of water | <5 | <5 | <5 | 5 | <5 |
| Odor, Ton | No Odor | No Odor | No Odor | No Odor | No Odor |
| Turbidity, Ntu | 0.05 | 0.05 | 0.05 | 1 | 0.05 |
| SS, PPm | 4 | 2 | NIL | 186 | 8 |
| Chloride, PPm | 54 | 44 | 54 | 174 | 308 |
| Fluoride, PPm | ND | ND | ND | 0.16 | 0.61 |
| Total Hardness, mg $CaCO_3$/L | 30 | 34.5 | 26 | 67 | 473.1 |
| Nitrite, PPm | 0.032 | ND | ND | ND | ND |
| Nitrate, PPm | 3.46 | 3.15 | 3.23 | 4.04 | 2.05 |
| Oil & Grease, PPm | ND | ND | ND | ND | ND |
| Total Residual Chlorine | ND | ND | ND | ND | ND |
| Total Coliforms, MPN/100 ml | 2,400 | 300 | 1,400 | 4,100 | 4,000 |

The results show that the well water, which is also fresh water quality, is only good for consumption following treatment. It is also vital that no further deterioration of the lake water takes place as a result of the MSW landfill.

### B.6.3.5 Road Upgrades Sites

There are environmental factors important for examination which is specific to road alignments. One such major issue concerns the on-site environmental sensitivities along the road alignment (i.e. the availability of road width to ensure safety of pedestrians as well as road side residential and commercial activities). Appropriate road width is essential not only for road safety but for the space required for implementing mitigation measures, such as protecting sensitive receptors from excessive traffic noise or air pollution.

The site environment summarized below is drawn from the findings of the road inventory survey, social assessment survey and the environmental recognition survey conducted during KSUDP.

### *Land Use*

The type of road side activities are presented in **Table B-16**. This information is analyzed from the traffic survey data generated in this project. The survey indicates the most prominent land uses are residential and commercial activities.

**Table B-16: Land use characteristics along Kollam project roads**

| Name of the Road Section | Land Use (%) | | |
|---|---|---|---|
| | Residential | Commercial | Industrial/Institutional |
| Inner Ring Road | 19 | 71 | 10 |
| Mundalamoodu Jn - Thirumullavaram Road | 100 | 0 | 0 |
| Road from Lakshminada Junction to Vellatiyambalam Junction | 100 | 0 | 0 |

### *Sensitive Receptors and other environmental concerns along proposed road sections*

Other sensitive receptors affected by road improvements are hospitals, schools/colleges and religious places. This road sub-project primarily aims to improve city road networks and also improve the prevailing environmental conditions associated with this infrastructure. Therefore the on-site plans drawn to implement mitigation measures should be practical and should be designed to accommodate in-situ practical limitation on land availability (see **Table B-17**).

### *Trees*

The road upgrading is limited to the existing available land on both sides of the proposed road sections. No new or additional land is used. The indicative number of trees on the proposed road sections is set out in Table B-17. The proposed activities on the selected road sections are planned to carry out limiting least disturbance to the trees (10-20%). The existing trees will be protected or relocated to the extent possible. The layout will be reviewed to minimize the loss of trees.

**Table B-17: Proposed Road sections and Prevailing Environmental Conditions on Alignments**

| Road Name | | Activities & Sensitive Receptor (including trees) | Available land width (m.) | Required land width (m.) |
|---|---|---|---|---|
| 1 | Inner Ring Road | | | |
| 1.1 | Kappalandimukku - Muneshwaran Temple | No of trees: 14<br>Mixed use | 20.00 | 19.30 |
| 1.2 | Ananthavalli Temple – Wadi Jn. | | 20.00 to 21.00 | 19.30 |
| 1.3 | Bazar Jn – Kappalandimukku Jn | | 11.00 to 12.00 | 10.50 |
| 1.4 | Kochupilamoodu Jn - AR Camp Jn on NH 47 (0.8 km) | No. of trees: 16<br>Institutional | 11.00 to 12.00 | 10.50 |
| 1.5 | AR Camp Jn on NH 47 - Kappalandimukku on NH 47 (1 km) | No. of trees: 13<br>Institutional | 20.00 | 19.30 |
| 2 | Mundalmoodu Jn – Thirumullavaram Road | No. of trees: 9<br>Residential | 8.50 | 8.50 |
| 3 | NH47 Lakshminada Jn – Vellatiyambalam Jn | No. of trees: 17<br>Residential | 8.50 to 11.50 | 8.50 to 11.50 |

## B-7 Screening of Potential Environmental Impacts and Mitigation Measures

The main purpose of the Kollam Sub-Project components assisted by KSUDP is to improve urban environmental conditions. As such, there are many environmental benefits to the proposed works. This section, however, focuses on the identification of potential adverse environmental impacts short and long term. Mitigation measures are proposed with recommended monitoring actions to be conducted during implementation to minimize any adverse environmental impacts. The mitigation measures will form the basis for an environmental monitoring plan during the implementation stages of the subproject components.

The screening for environmental impacts is broken down into four categories, coinciding with the major phases of the project:

- **Location impacts:** those impacts associated with site selection, and include loss of on-site biophysical array and encroachment either directly or indirectly on adjacent environments. It also includes impacts on people who will lose their homes or livelihood by the development of that site.
- **Design impacts:** those impacts arising from project design, including technology used, scale of operation/throughput, waste production, discharge specifications, pollution sources and ancillary services.
- **Construction impacts:** those impacts caused by site clearing, earthworks, machinery, vehicles and workers. Construction site impacts include erosion, dust, noise, traffic congestion and waste production.
- **O & M impacts:** those impacts arising from the operation and maintenance activities of the infrastructure facility. These include routine management of operational waste streams, and occupational health and safety issues.

### B.7.1 Water Supply Rehabilitation

#### B.7.1.1 Location Impacts

Since the location of rehabilitation works will be at existing facilities – no location-specific impacts are considered likely.

#### B.7.1.2 Design Impacts

Impact: Due to the planned refurbishment of the treatment plant and replacement of existing water transmission main, there is a potential for over extraction from the source. Since in this case, the source is a Ramsar listed wetland, Sasthamkotta Lake, any over extraction and subsequent diminution of aquatic habitat would be a significant impact.

Mitigation Measure: The WTPs are existing facilities with existing water allocations. The proposed water supply component will rehabilitate these plants to improve process monitoring for better operations efficiency and management. It will also replace defective water mains. These works will be designed to maintain extraction at previous design levels. No additional extraction of water from the source will therefore occur with extraction rates capped at the present rated level. The viability of developing alternate source for raw water to Sasthamkotta Lake will also be assessed.

### B.7.1.3 Construction Impacts

Impact: Silt runoff from construction causing soil erosion plus damage to water quality/land values. The Mitigation Measure to address this is the implementation of construction site management prescriptions (through provisions of a Site Management Plan in contracts) to cover:

- Site preparation, which minimizes the extent of work areas active at one time and disturbance to adjoining areas;
- Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization of exposed surfaces); and
- Careful siting of construction material stockpiles and access routes to avoid any disturbance to adjoining areas.

Impact: Noise and dust from construction activities. The Mitigation Measure to address this is the implementation of construction site management prescriptions (through provisions of a Site Management Plan in contracts) to cover dust management (including use of water spraying, dust curtains and scheduling of activities) and noise management (including noise suppressors on stationary machinery such as pumps and compressors and scheduling of activities).

Impact: Inconvenience to the local community. Mitigation Measures to address this are:

- Provide early information to most affected people;
- Preplanning of working site to minimize inconvenience; and
- Installation of barrier nets and warning signs.

Impact: Water pollution due to earth works and drainage. Mitigation Measures to address this include all those required to manage soil erosion (above) plus siltation protection (sediment barriers) at drainage points.

### B.7.1.4 Operation and Maintenance Impacts

The main potential impact is the recurrence of blockage and leakage problems. The Mitigation Measure to address this is the preparation and implementation of a maintenance program including continuation of timely leakage inspections.

## B.7.2 Sewage Treatment Plant and Sewerage Upgrade

### B.7.2.1 Location Impacts

Impact: Loss of on-site ecology or natural feature.

Mitigation Measures: Control of site layout to avoid or minimize loss of natural features. New and additional trees are planted wherever losses occur.

Impact: Loss of amenity (aesthetics, property values) to neighbors. Mitigation Measures to address this are the provision of a buffer zone on vulnerable perimeters (south and west boundaries) with earthworks and landscaping to provide physical separation and a visual screen for the development.

Impact: The proposed site lies adjacent to the 50m Coastal Regulation Zone Category II under the Kerala Coastal Zone Management Plan along the foreshores of Ashtamudi Lake. The CRZ II zone to the north has been reduced, by virtue of an existing foreshore road and developments are permitted on the landward side of the road. The proposed development is more than 50m from the eastern foreshore (on reclaimed land). Mitigation Measures: Site layout to ensure that no facilities encroach upon the restricted area in CRZ II area.

Impact: Quality of water in the wells and ponds of neighbor may be affected by pit latrines and community sanitation latrine blocks. Mitigation: Locate the latrines and sanitation blocks to minimize impact on ground water. Adopt proper design criteria.

### B.7.2.2 Design Impacts

Impact: Inadequate protection of receiving waters leading to impairment of downstream beneficial uses. Additionally, poor quality discharge to the lake has the potential to affect the estuarine water quality of Ashtamudi Lake, which is a nominated Ramsar site. Mitigation Measures: The FAB technology chosen for the STP not only allows a small, area-efficient design, but will also discharge a high quality outflow. Nevertheless, the plant will employ strict treatment technology and monitoring to ensure that there is a consistent discharge standard as per the Water Act, 1974.

- BOD <30mg/l
- TSS <50mg/l
- Fecal coliform <1000/100ml

Water quality in Ashtamudi Lake is generally low especially in the reach adjoining the site which drains all the built-up area of Kollam city. It currently receives all untreated domestic wastewater. The foreshore areas of this reach have long been reclaimed for development and coconut plantations and no natural foreshore or wetland areas remain.

The conservation zones proposed in the management plan for the Ramsar nomination do not affect the urbanized reach adjoining the site. The only part of the management plan which pertains to this area is the objective "to create improved sanitation, reduction of industrial growth, reduction of urban waste and ensuring the sustainability of the water quality of the estuary". The integrated landfill and STP are proposed in this context.

The establishment of the proposed STP at Kureepuzha is recognized by the KSPCB as an extended activity of the existing waste treatment and disposal activities and is in line with the special action plan to protect Ashtamudi Lake. The STP will be designed to treat domestic sewage from the high population density areas of the city as well as leachate from the adjacent solid waste disposal area, which presently flow into the lake without treatment.

Treated effluent will be pumped and discharged into the sea at Neendakara to avoid discharging of treated effluent into the lake. Predictive water current modeling will be required to ensure that the discharge does not have any adverse impact on the coastal waters or coastlines as well as no re-entry into the lake. Based on the result of the study, any restriction on discharge timing due to tidal flow

will be considered. Clerances from Coastal Zone Management Authority and KSPCB shall be obtained before commencing implementation

Impact: Overflow/bypassing hazards leading to contamination of environment. Mitigation Measures to address this are:

- Design must provide for high flows/volumes. Sewerage system to separate storm water flows.
- STP should be designed such that emergency overflow/bypass flow can be diverted to buffer storage to be returned to the inlet works for treatment.

Impacts: The incidence of industrial waste in the sewage will be low since the sewered zones which will be supplying the plant contain no industry with problematic discharges. Wastewater entering the plant will be primarily domestic and commercial in origin. Mitigation Measures: Confirm the make-up of sewage load. Identify potential for intractable industrial waste to enter sewage and if necessary design appropriate cut-outs in sewerage infrastructure.

Impact: Inadequate methods for sludge disposal may lead to environmental pollution. Mitigation Measures: FAB technology produces a small quantity of already digested sludge, which requires no further treatment. The sludge can be dried in sludge drying beds before final disposal. Before commissioning of the plant, appropriate sludge management and disposal will be determined. The majority of sludge will be directed to the adjoining compost plant for using in compost-making. A Sludge Management and Disposal plan will be prepared which includes provisions for on-site handling; maximized reuse for any surplus sludge not used in the composting plant; analysis the sludge for heavy metals; and locations and prohibitions on disposal for surplus sludge. Sludge will only be ultimately disposed of as compost or other agricultural use or in sanitary landfill.

Impact: Ground water may be affected due to the pollution flow from leach pits and community sanitation blocks. Mitigation: Make the bottom of the pit impervious to prevent the direct flow of pollution to ground water. Provide fine sand envelop around the leach pit to reduce the spread of pollutions. Provide septic tank and dispersion trenches of adequate capacity to community sanitation blocks.

### B.7.2.3 Construction Impacts

Impacts: Potential impacts during construction comprise:

- Silt runoff from construction operations causing soil erosion plus damage to water quality/land values;
- Noise and dust from construction activities;
- Road blocking and/or increased traffic during construction of facilities and laying/rehabilitation of sewerage carriers; and
- Construction wastes.

Mitigation Measures: Mitigation of silt runoff from exposed excavations includes scheduling works during the dry season to minimize the risks of silt runoff from excavations into adjacent streams. Mitigation of generation of dust from construction sites includes spraying water on dry sites or

covering sands to manage dust generation and controlling moisture content of fill and stockpiled materials for construction. Mitigation of noise from traffic and construction activities includes stockpiling construction materials in a manner to minimize traffic blockages.

The potential for the exacerbation of these impacts due to poor performance of contractor will be addressed by the use of qualified contractors to implement contracted works that includes a Site Management Plan. This site plan will be a prescription of required work practices to minimize the aforementioned potential adverse impacts and will cover construction activities at the STP site and the laying of sewer pipes and construction of other sewerage infrastructure through the city.

Interaction with the public will be encouraged through continuous dialogue and information exchange, establishing a procedure for recording and dealing with complaints, and workers instruction. Good health and hygiene practices at work and reduced work accidents will be achieved by means of an Occupational Safety Plan, which will include safety equipment, personnel basic training and first aid provisions. Most of these measures will also be enforceable during the operation stage of the site. Disposal of construction wastes to be determined on case to case basis. Recycled use or land fill disposal will be sought.

#### B.7.2.4 Operation and Maintenance Impacts

Impacts: Specific impacts in this phase include hazards to health/safety of workmen and sewer trench cave in hazards.

Mitigation Measures to address the health/safety of workmen are: preparation and implementation of an Occupational Safety Plan for workforce which will include:

- Provision of appropriate protective gear to workers on the site; and
- Training for workers on site dangers, including potential health effects from sludge.

Mitigation Measures to avoid sewer trench cave ins are the requirements for Quality Assurance (QA) of work to ensure appropriate quality of materials used and site finishing/drainage.

Operational monitoring of plant performance and quality of treated discharge will be key overall mitigation measures. Monitoring will ensure that effluent conforms to the standards as set out in the Water Act, 1974:

- BOD <30mg/l
- TSS <50mg/l
- Faecal coliform <1000/100ml

### B.7.3 City Drainage Refurbishment

#### B.7.3.1 Location Impacts

Since the location of rehabilitation works will be at existing drains – and since the existing environment is a built environment, no location impacts are considered likely.

### B.7.3.2 Design Impacts

Impacts: Original operational parameters of the system may have altered during the period of disuse or reduced capacity use, resulting in the rehabilitated system not fulfilling project purpose. The rehabilitated system may also deliver storm water volumes to receiving areas in excess of design or current absorption capacity.

Mitigation Measures: Ensure that the original operating parameters are taken into account in the design of the rehabilitation project. Investigate and confirm absorption capacity of receiving areas.

### B.7.3.3 Construction Impacts

Impact: Potential disturbance or dislocation to a number of unofficial commercial premises within the confines of the canal banks. The Mitigation Measure to address this is the temporary relocation of hawkers and vendors and ultimate reinstatement of original premises.

Impact: Exposure of workers to contaminated deposits in drains/canals during excavation and removal of excess soil before construction of side wall, drains or canal slopes. Mitigation Measure to address this are the provision of appropriate protective gear (waterproof boots, gloves) to workers on the site, and training for workers on site dangers, including potential health effects from spoil.

Impact: Accidental blockage of drainages/canals from stockpiles of soil and other material. Mitigation Measures to address this are the implementation of construction site management prescriptions (through provisions of a Site Management Plan in contracts) to cover:

- Siting and protection of construction material stockpiles;
- Use of temporary silt traps/pits along canal to prevent silt transport during activities; and
- Management of open cuttings (stabilization of surfaces and duration of exposure).

Impact: Damage to adjoining vegetation, from unstabilized cuttings. Mitigation Measures to address this are, again, the implementation of construction site management prescriptions (through provisions of a Site Management Plan in contracts) to cover:

- Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas; and
- Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining vegetation and natural areas.

Impact: Silt runoff from construction causing soil erosion plus damage to water quality/land values. The Mitigation Measure to address this is the implementation of construction site management prescriptions (through provisions of a Site Management Plan in contracts) to cover the protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization).

Impact: Noise from construction activities. The Mitigation Measure to address this is the implementation of construction site management prescriptions (through provisions of a Site Management Plan in contracts) to cover noise management (including noise suppressors on stationary machinery such as pumps and compressors and scheduling of activities).

Impact: Inconvenience to the local community. Mitigation Measures to address this are:

- Provide early information to most affected people;
- Preplanning of working site to minimize inconvenience;
- Installation of barrier nets and warning signs; and
- Make alternative arrangement for drainage and water flow in canals during construction period.

Impact: Environmental contamination from indiscriminate disposal of silt/spoil material. The Mitigation Measure to address this is the preparation and implementation of a Silt/Spoil Handling and Disposal Plan (through provisions of such a Plan in contracts, if used) to cover:

- Proper stock pilling of silt/spoil materials on site;
- Identification of re-use opportunities for silt/spoil (e.g. use for filling or erecting side slopes on site);
- Identification of sites for disposal of unused silt/spoil; (e.g. disposal to low lying area for land filling/road construction location/agricultural fields);
- Covering of disposal sites after completion of works;
- Proper transportation of waste material in vehicles with pollution control; and
- Regular maintenance of desilting and transportation equipment.

#### B.7.3.4 Operation and Maintenance Impacts

The main potential impact is the recurrence of siltation and blockage problems. The Mitigation Measure to address this is the preparation and implementation of a maintenance program including continuation of timely desilting operations.

### B.7.4 Solid Waste Management and Disposal

#### B.7.4.1 Location Impacts

Impact: Loss of on-site ecology or natural features. Mitigation: The solid waste disposal site is an existing and operating municipal waste dumping site.

Impact: The site abuts the 50m Coastal Regulation Zone Category II under Kerala Coastal Zone Management Plan along the foreshores of Ashtamudi Lake. Mitigation: Locate the compost plant and sanitary land fill operations to maintain set back as per Coastal Regulation Zone Notification. As developments exist upto the shoreline there will not be any objection to the proposed activities. However, clearance from the Coastal Zone Management Authority and KSPCB shall be obtained. Establish landscaped green belt and buffer zone between the development and lake.

#### B.7.4.2 Design Impacts

Impact: Loss of amenity (aesthetics, property values) to neighbors. The Mitigation Measure to address this is the Provision of a buffer zone on vulnerable perimeters with green belt and landscaping to provide physical separation and a visual screen for the development.

Impacts of road wear, traffic congestion and spillage associated with transport of wastes to the disposal site or treatment facility. Mitigation Measures to address this are:

- Ensure transport routes have adequate capacity for required truck movements;
- Provide enclosed refuse collection vehicles; and
- Design and maintain vehicles to prevent spillage of liquid effluent *en route*.

Impact: Contamination of ground and/or surface water by leachate. The Mitigation Measure to address this is the development of a scientific landfill disposal facility operated as per the provisions of the Municipal Solid Waste (Management and Handling) Rules 2000:

- Design of land fill cells as per MSW Rules, 2000;
- Design of interception drainage network uphill of landfill to divert runoff water from encroaching on landfill area;
- Drainage and pondage system to collect fugitive leachate and redirect back into cells and away from natural drainage lines; and
- Direct surplus leachate (i.e. that which cannot be reabsorbed by the landfill) to the adjacent STP for treatment.

Impact: Nuisance to neighboring areas due to foul odor and influx of insects, rodents, etc. The Mitigation Measures to address this are:

- The planning and implementation of adequate set-backs and buffer zones (where no refuse is deposited);
- Establishment of tree-planting and landscaping on boundaries with neighboring residential areas; and
- Daily compacting, spreading and covering of incoming refuse.

### B.7.4.3 Construction and Operation and Maintenance Impacts

For the landfill subcomponent of Solid Waste Management components, both construction and operational phases occur simultaneously as individual cells to accept waste are constructed and progressively filled.

Impact: Silt runoff from construction operations causing soil erosion plus damage to water quality/land values. Mitigation Measures to address this are the implementation of construction site management prescriptions (through provisions of a Site Management Plan in contracts) to cover:

- Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas;
- Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization);
- Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining vegetation and natural areas; and
- Disposal of construction wastes.

Impact: Deterioration of water quality as a result of contamination of receiving waters by leachate. The receiving water in this case is Ashtamudi Lake, which is a nominated Ramsar site.

Mitigation Measures: Water quality in Ashtamudi Lake is generally low especially in the reach adjoining the site which drains all the built-up area of Kollam city. It currently receives all untreated domestic wastewater. The foreshore areas of this reach have long been reclaimed for development and coconut plantations and no natural foreshore or wetland areas remain.

The conservation zones proposed in the management plan for the Ramsar nomination do not affect the urbanized reach adjoining the site. The only part of the management plan which pertains to this area is the objective "to create improved sanitation, reduction of industrial growth, reduction of urban waste and ensuring the sustainability of the water quality of the estuary". The integrated landfill and STP are proposed in this context.

The improvement of the current waste dumping facility at Kureepuzha is recognized by the KSPCB as an extended activity of the existing waste treatment and disposal activities and is in line with the special action plan to protect Ashtamudi Lake.

Drainage and pondage system to be designed and provided to collect fugitive leachate and redirect it away from natural drainage lines. No direct drainage to a stream, river or backwater will be permitted. Instead, leachate not reabsorbed on site will be directed to the adjacent STP for treatment. Additionally, monitoring of water quality parameters in selected downstream water bodies and groundwater will be undertaken to provide a check on the integrity of the system. Water quality parameters to be monitored are:

*pH, BOD, Nitrate, Arsenic, Fluoride and Heavy Metals (Cd, Pb, Hg).*

Their levels should conform to the standards in the Municipal Solid Wastes (Management and Handling) Rules, 2000 (see **Annex B**).

Impact: Pollution of surface and ground water from methane gas, and the loss of adjoining deep-rooted vegetation (e.g. trees) from landfill gas. The Mitigation Measures to address this is the provision of a gas control systems (gas vents) in landfill.

Impact: Dust from unloading and spreading/grading operations at landfill site. The Mitigation Measures to address this are:

- Pave access roads;
- Design location of working face to minimize truck movements; and
- Daily compacting, spreading and covering of incoming refuse.

Impact: Hazards to health/safety of workmen. Mitigation Measures to address this are the implementation of an Occupational Safety Plan for workforce which will include:

- Provision of appropriate protective gear to workers on the site.
- Training for workers on site dangers, including potential health effects from waste.

Impact: Social conflicts between workers from other areas and local community. The Mitigation Measure: As far as possible, employ local labor.

### B.7.5 Road Upgrades

#### B.7.5.1 Location Impacts

Impact: Loss of household, residence, business premises or livelihood (gardens, agricultural land). Mitigation: Plan underpass to existing ROB to minimize dislocation of community. Preparation and implementation of a resettlement plan which conforms to the stipulations and guidelines provided in Asian Development Bank's Policy on involuntary resettlement.

Impact: Encroachment on backwater areas or wetlands. Mitigation: Upgrading on all selected roads to be within existing right-of-way.

#### B.7.5.2 Design Impacts

Impact: Disruption of informal commercial activities. Mitigation: Temporary relocation of informal hawkers and vendors, followed by the reinstatement of original premises when work is completed.

Impact: Encroachment on and loss of natural heritage items. Mitigation: Loss of Street trees to be minimized. Replacement and additional trees planted where losses have occurred.

Impact: Encroachment on and loss of historical/cultural/monument/areas. Mitigation: Detailed inventory of items and their heritage significance required. Significant items should be avoided. Smaller items may be relocated in consultation with the community and the Archaeology Department. Include significantly large and/or old street trees.

#### B.7.5.3 Construction Impacts

Impact: The main construction impacts are road blocking and/or increased traffic, noise/dust or any hazardous material generated from construction activities, and silt runoff during construction leading to impairment of down stream water quality and land values. The mitigation of all these impacts is through the implementation of construction site management prescriptions (through provisions of a Site Management Plan in contracts) to cover the following:

- Traffic management measures applicable to different situations (including provision of side track access for traffic, signaling, speed limits, and detour signage). Coordination with other authorities and traffic police is essential;
- Dust curtains will be erected and maintained around hot mix plants, crushers and batching plants to reduce the level of dust emissions as per norms of KSPCB;
- Delivery vehicles will be covered. Mixing equipped as per existing standards as per EP Act 1986;
- The plants and equipment used for construction will conform to national noise standards;
- Workers will be provided with appropriate noise protection. The noise level will be monitored during the construction;
- Construction vehicles and equipment will be maintained and refueled so that spillage does not contaminate the soil;

- Fuel storage and refueling sites will be kept away from drainage channels and important water bodies;
- To avoid contamination from fuel and lubricants, the vehicles and equipment will be properly maintained and refueled;
- Waste petroleum products will be collected, stored, and disposed of at the approved sites as per Indian Hazardous Waste Management and Handling Rules, 1989 as amended;
- Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas;
- Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization); and
- Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining areas.

### B.7.5.4 Operation and Maintenance Impacts

Impact: Noise and vibrations due to traffic leading to nuisances to travelers and neighbors. Mitigation by barriers/earthworks, vegetation planting where possible.

Impact: Increased air pollution leading to nuisances and health hazards to travelers/workers. This is an unavoidable impact due to increased traffic using upgraded roads. Changes in transport fuel quality, compliance with environmental standards for vehicles at manufacturing stage, noise regulations, traffic control etc. will offset this impact.

## B.7.6 Summary of Mitigation Measures

**Table B-18** below summarizes the mitigation measures. It assigns responsibility for each and makes a preliminary estimate of costs.

**Table B-18: Summary of Mitigation Measures**

**Water Supply Rehabilitation**

| **Location Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
|---|---|---|---|
| None potentially significant | N/a | N/a | N/a |
| **Design Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Potential for over extraction of water source due to increased efficiency / capacity of treatment and mains | Cap extraction to present rated levels to protect biodiversity in source waterbody.<br>Investigate viability of alternate source | PIU, Corporation | PIU, PMO |
| **Construction Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Silt runoff from construction causing soil erosion plus damage to water quality/land values | Implement construction site management (through provisions in contracts) to cover:<br>Site preparation, which minimizes the extent of work areas active at one time and disturbance to adjoining areas. | PIU, Corporation | Costed in RP |

| | | | |
|---|---|---|---|
| | Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization).<br>Siting of construction material stockpiles and access routes to avoid any disturbance to adjoining areas. | | |
| Water pollution due to earth works and drainage. | Siltation protection (sediment barriers) at drainage points. | PIU, Corporation, or, depending on implementation arrangements, Head Contractor (responsible under contract for all sub-contractors). | Part of construction costs |
| Noise and dust from construction of disposal cells and other preparation activities. | Implement construction site management (through provisions in contracts) to cover dust and noise management (including water spraying and scheduling of activities). | PIU, Corporation, or, depending on implementation arrangements, Head Contractor (responsible under contract for all sub-contractors) | Part of construction costs |
| Inconvenience to local community. | Provide early information to most affected people.<br>Preplanning of working site to minimize inconvenience.<br>Installation of barrier nets and warning signs. | PIU, Corporation, or, depending on implementation arrangements, Head Contractor (responsible under contract for all sub-contractors) | Part of construction costs |
| **Operation and Maintenance Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Recurrence of leakage and blockage problems. | Prepare and implement maintenance program including continuation of timely leak detection operations | Corporation | Ongoing cost: $3000/year |

**Sewerage and Sanitation**

| Location Impacts | Mitigation Measures | Responsibility | Preliminary Costing |
|---|---|---|---|
| Loss of on-site ecology or natural features | Arrange site layout to minimize loss of nature features. New and additional trees are planted wherever losses occur. | PIU, PMO | Costed in RP |
| Damage to adjoining natural areas | Provision of a landscaped buffer zone to the north and east of the site to provide a physical and natural barrier between STP and Ashtamudi Lake foreshore | PIU, PMO | Part of design costs |
| Loss of amenity (aesthetics, property values) to neighbors | Provision of a buffer zone on vulnerable perimeters with green belt and landscaping to provide physical separation and a visual screen for the development. | PIU, PMO | Planting density and materials determined during design. Allow $\$2/m^2$ plus labor. |

| | | | |
|---|---|---|---|
| Proposed site lies in the restricted area under CRZ notification | Restrict the layout within the permitted area under statute. Provide green belt and buffer zone between the lake and development. | PIU, PMO | Part of design costs. |
| Water quality in wells and ponds of neighbor may be affected due to the leach pit and sanitation blocks | Locate the leach pit and sanitation level to minimize impact on ground water. Adopt proper design criteria. | PIU | Part of design costs. |
| **Design Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Overflow/bypassing hazards leading to contamination of environment plus flooding | Design must provide for high flows/volumes. Sewerage system to separate storm water flows. | PIU, PMO | Part of design costs |
| Discharge to the lake has the potential to affect the estuarine water quality. Water quality is currently low due to untreated wastewater entering lake. | Treated effluent will be pumped and discharged into the sea at Neendakara to avoid discharge of treated effluent into Ashtamudi Lake.<br>Predictive water current modeling will be required to ensure that the discharge does not have any adverse impact on the coastal waters or coastlines as well as no re-entry into the lake.<br>Based on the result of the study, any restriction on discharge timing due to tidal flow will be considered. | PIU, PMO<br><br>PIU, PMO | Nutrient modeling study of wetland. Data collection and modeling - $25,000<br><br>Part of design costs |
| Inadequate methods for sludge disposal leading to environmental pollution | Sludge will be directed to the adjacent Corporation composting plant.<br>Design to include appropriate sludge management and disposal. Sludge will only be disposed of as compost or other agricultural use or in sanitary landfill. A Sludge Management Plan will be produced which includes provisions for on-site handling; maximized re-use of sludge (for agricultural manure or composting); analysis the sludge for heavy metals; locations and prohibitions on the disposal of surplus sludge. | Corporation<br><br>PIU, PMO | Part of design costs<br><br>Plan preparation: Consultant time (2 person weeks)<br>Implementation of plan: Part of operational costs |
| Inadequate management of industrial wastes discharge to sewers | Investigate make-up of sewage load. Identify potential for intractable industrial waste to enter sewage and if necessary design appropriate cut-outs in sewerage infrastructure. | PIU, PMO | Industrial discharge survey (data collection and analysis): $5,000 |
| Ground water quality may be affected due to pollution flow from leach pit and community sanitation blocks | Design the bottom of leach pit impervious.<br>Provide fine sand envelope around leach pit.<br>Provide septic tank and dispersion trenching to community sanitation blocks. | PIU, PMO | Part of design costs. |

| Construction Impacts | Mitigation Measures | Responsibility | Preliminary Costing |
|---|---|---|---|
| Silt runoff from construction operations causing soil erosion plus damage to water quality/land values | Implement construction Site Management (through provisions in contracts for both STP construction and laying/rehabilitation of sewerage carriers and pumping stations) to cover:<br>Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas.<br>Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization)<br>Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining vegetation and natural areas.<br>Disposal of construction wastes to be determined on a case-by-case basis. Recycled use or landfill disposal should be sought. | Head Contractor (responsible under contract for all sub-contractors) | Preparation of Site Management Plan: Consultant time (1 person week)<br>Implementation of plan provisions: 1 day/fortnight of construction management time |
| Road blocking and/or increased traffic during construction of facilities and laying/rehabilitation of sewerage carriers | Implement construction Site Management (through provisions in contracts for both STP construction and laying/rehabilitation of sewerage carriers and pumping stations) to cover traffic management and nuisance minimization | Head Contractor (responsible under contract for all sub-contractors) | Implementation of plan provisions: 1 day/fortnight of construction management time |
| Noise and dust from construction activities | Implement construction Site Management (through provisions in contracts for STP construction and laying/rehabilitation of sewerage carriers and pumping stations) to cover dust and noise management (including water spraying and scheduling of activities). | Head Contractor (responsible under contract for all sub-contractors) | Implementation of plan provisions: 1 day/fortnight of construction management time |
| **Operation and Maintenance Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Hazards to health/safety of workmen | Operational management will include preparation and implementation of Occupational Safety Plan for workforce which will include:<br>Provision of appropriate protective gear to workers on the site.<br>Training for workers on site dangers, including potential health effects from sludge. | Corporation | Preparation of Plan: Consultant time (2 person days)<br>Implementation of plan provisions: Part of operational costs |
| Sewer trench cave in hazards | Quality assurance of work to ensure appropriate materials and site finishing/drainage | Corporation | Implementation QA: 1 day/fortnight of construction management time |

**Drainage Rehabilitation**

| Location Impacts | Mitigation Measures | Responsibility | Preliminary Costing |
|---|---|---|---|
| None potentially significant | N/a | N/a | N/a |
| **Design Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Original operational parameters of system may have altered during period of disuse or reduced capacity use, resulting in rehabilitated system not fulfilling project purpose | Ensure that these factors are taken into account in rehabilitation project design | PIU, PWD | Part of standard design costs |
| Rehabilitated system may deliver storm water volumes to receiving areas in excess of design or current absorption capacity | Ensure that these factors are taken into account in rehabilitation project design.<br>Investigate and confirm absorption capacity of receiving areas. | PIU, PWD | Part of standard design costs |
| **Construction Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Disruption of informal premises for hawkers and vendors. | Temporary relocation of hawkers and vendors. Reinstatement of original premises. | PIU, Corporation | Costed in RP |
| Exposure of workers to contaminated deposits in drains/canals during excavation and removal of excess soil before construction of side wall, drains or canal slopes | Provision of appropriate protective gear (waterproof boots, gloves) to workers on the site.<br>Training for workers on site dangers, including potential health effects from spoil. | Head Contractor (responsible under contract for all sub-contractors) and PIU (monitoring) | Implementation of OHS provisions: 1 day/fortnight of construction management time |
| Accidental blockage of drainages/canals from stockpiles of soil and other material. | Implement construction Site Management (through provisions in contracts) to cover:<br>Siting and protection of construction material stockpiles.<br>Use of temporary silt traps/pits along canal to prevent silt transport during activities.<br>Management of open cuttings (stabilization and duration of exposure). | Head Contractor (responsible under contract for all sub-contractors) and PIU (monitoring) | Part of construction costs |
| Damage to adjoining vegetation, from unstabilized cuttings. | Implement construction Site Management (through provisions in contracts) to cover:<br>Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas.<br>Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining vegetation and natural areas. | Head Contractor (responsible under contract for all sub-contractors) and PIU (monitoring) | Preparation of Site Management Plan: Consultant time (1 person week)<br>Implementation of plan provisions: 1 day/fortnight of construction management time |

| | | | |
|---|---|---|---|
| Silt runoff from construction causing soil erosion plus damage to water quality/land values | Implement construction Site Management (through provisions in contracts) to cover:<br>Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization) | Head Contractor (responsible under contract for all sub-contractors) and PIU (monitoring) | Preparation of Site Management Plan: Consultant time (1 person week)<br>Implementation of plan provisions: 1 day/fortnight of construction management time |
| Noise from construction activities | Implement construction Site Management (through provisions in contracts) to cover noise management (including noise suppressors on stationary machinery such as pumps and compressors and scheduling of activities). | Head Contractor (responsible under contract for all sub-contractors) and PIU (monitoring) | Preparation of Site Management Plan: Consultant time (1 person week)<br>Implementation of plan provisions: 1 day/fortnight of construction management time |
| Inconvenience to local community. | Provide early information to most affected people.<br>Preplanning of working site to minimize inconvenience.<br>Installation of barrier nets and warning signs.<br>Make alternative arrangement for drainage and water flow in canals during construction period | Head Contractor (responsible under contract for all sub-contractors) and PIU | Part of construction costs |
| Environmental contamination from indiscriminate disposal of silt/spoil material | Prepare and implement Silt/Spoil Handling and Disposal Plan including provisions for:<br>Proper stock pilling of silt/spoil materials on site.<br>Identification of re-use opportunities for silt/spoil (e.g. use for filling or erecting side slopes on site)<br>Identification of sites for disposal of unused silt/spoil; (e.g. disposal to low lying area for land filling/road construction location/agricultural fields)<br>Covering of disposal sites after completion of works.<br>Proper transportation of waste material in vehicles with pollution control<br>Regular maintenance of desilting and transportation equipment. | PIU, Corporation | Preparation of Silt/Spoil Handling and Disposal Plan: Consultant time (1 person week)<br>Implementation of plan provisions: 1 day/fortnight of construction management time |
| **Operation and Maintenance Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Recurrence of siltation and blockage problems. | Prepare and implement maintenance program including continuation of timely desilting operations | PIU, Corporation | Ongoing cost: $3000/year |

**Solid Waste Management**

| Location Impacts | Mitigation Measures | Responsibility | Preliminary Costing |
|---|---|---|---|
| The site abuts the 50m Coastal Regulation Zone II under Kerala Coastal Zone Management Plan along with foreshore of Ashtamudi lake. | Locate the compost plant and sanitary landfill operations to maintain minimum set back as per Coastal Regulation Zone notification.<br>As development exists upto the shoreline, there cannot be objection to the proposed activities.<br>Clearance from the Coastal Zone Management Authority and KSPCB shall be obtained.<br>Establish landscaped buffer zone and green belt between the lake and development. | PIU, PMO | Part of design costs. |
| **Design Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Loss of amenity (aesthetics, property values) to neighbors | Provision of a buffer zone on all perimeters with earthworks and landscaping to provide physical separation and a visual screen for the development. | PIU, PMO | Part of standard design costs |
| Impacts of road wear, traffic congestion and spillage associated with transport of wastes to the disposal site or treatment facility | Ensure transport routes have adequate capacity for required truck movements<br>Provide enclosed refuse collection vehicles or tarps to cover open vehicles<br>Design and maintain vehicles to prevent spillage of liquid effluent *en route* | PIU | Part of standard design costs<br>$200/truck/ per year for load covering. Included in operation costs. |
| Contamination of ground and/or surface water by leachate | Scientific landfill disposal facilities operated as per the provisions of the Municipal Solid Waste (Management and Handling) Rules 2000:<br>Design of land fill cells as impermeable clay vessels<br>Design of interception drainage network uphill of landfill to divert runoff water from encroaching on landfill area<br>Drainage and pondage system to collect fugitive leachate and redirect back into cells and away from natural drainage lines<br>Direct surplus leachate (i.e. that which cannot be reabsorbed by the landfill) to the adjoining STP for treatment | PIU, PMO | Part of standard design and development costs |
| Nuisance to neighboring areas due to foul odor and creation of habitats for insects, rodents, etc. | Plan and implement adequate set-backs and buffer zones (where no refuse is deposited).<br>Establish tree-planting and landscaping on boundaries with neighboring residential areas.<br>Daily compacting, spreading and covering of incoming refuse | PIU, PMO | Part of standard design and development costs<br>Planting density and materials determined during design. Allow $2/m$^2$ plus labor |

| Construction and Operation & Maintenance Impacts | Mitigation Measures | Responsibility | Preliminary Costing |
|---|---|---|---|
| Silt runoff from construction operations causing soil erosion plus damage to water quality/land values | Implement construction Site Management to cover:<br>Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas.<br>Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization)<br>Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining vegetation and natural areas.<br>Disposal of construction wastes. | Corporation | Preparation of Site Management Plan: Consultant time (1 person week)<br>Implementation of plan provisions: 1 day/fortnight of construction management time |
| Deterioration of water quality as a result of contamination of receiving waters by leachate | Drainage and pondage system will be designed and provided to collect fugitive leachate and redirect away from natural drainage lines. No direct drainage to a stream, river or backwater will be permitted.<br>Direct surplus leachate (i.e. that which cannot be reabsorbed by the landfill) to the adjoining STP for treatment<br>Monitoring of water quality parameters in selected downstream water bodies and groundwater will check integrity of system | Corporation | Part of operational costs |
| Pollution of surface and ground water from methane gas | Provide gas control systems in landfill. | Corporation | Part of operational costs |
| Loss of adjoining deep-rooted vegetation (e.g. trees) from landfill gas | Provide gas control systems in landfill | Corporation | Part of operational costs |
| Dust from unloading and spreading/grading operations at landfill site | Pave access roads<br>Design location of working face to minimize truck movements<br>Daily compacting, spreading and covering of incoming refuse | Corporation | Implementation of provisions: 1 day/fortnight of construction management time |
| Hazards to health/safety of workmen | Operational management will include Occupational Safety Plan for workforce which will include:<br>Provision of appropriate protective gear to workers on the site.<br>Training for workers on site dangers, including potential health effects from waste. | Corporation | Preparation of Plan: Consultant time (2 person days)<br>Implementation of OHS provisions: 1 day/fortnight of construction management time |

For the landfill component of Solid Waste Management components, both construction and operational phases occur simultaneously as individual cells to accept waste are constructed and progressively filled.

**Road System Upgrade**

| Location Impacts | Mitigation Measures | Responsibility | Preliminary Costing |
|---|---|---|---|
| Loss of household, residences, business premises or livelihood (gardens, agricultural land etc.) | Arrange the layout of under pass to existing ROB to minimize the dislocation of community.<br>Preparation and implementation of a Resettlement Plan which conform to the stipulation and guidelines provide in Asian Development bank's Policy on involuntary resettlement | PIU, PMO | Part of design on costs. |
| Encroachment on backwater areas or wetlands | Road upgrading to be within existing RoW to avoid any wetland encroachment. | PIU, PWD | Part of design costs |
| **Design Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Disruption of informal commercial activities. | Temporary relocation of hawkers and vendors. Reinstatement of original premises. | PIU, PWD | Costed in RP |
| Encroachment on and loss of natural heritage items | Loss of Street trees to be minimized. Replacement and additional trees planted where losses occur. | PIU, PWD | Inventory: Part of built heritage inventory below.<br>Tree replacement (established tree of same species from arboretum): $500/tree |
| Encroachment on and loss of historical/cultural/monument/areas | Detailed inventory of itms and their heritage significance required. Significant items should be avoided. Smaller items may be relocated in consultation with the community and the Archaeology Department. Include significantly large and/or old street trees. | PIU, PWD | Inventory: Consultant time (1 person week) |
| **Construction Impacts** | **Mitigation Measures** | **Responsibility** | **Preliminary Costing** |
| Road blocking and/or increased traffic during construction of facilities | Implement construction Site Management (through provisions in contracts) to cover traffic management.<br>Traffic management measures applicable to different situations (including provision of side track access for traffic, signaling, speed limits, and detour signage). Coordination with other authorities and traffic police is essential | Head Contractor (responsible under contract for all sub-contractors) and PIU (monitoring) | Preparation of Site Management Plan: Consultant time (1 person week)<br>Implementation of plan provisions: 1 day/fortnight of construction management time |

| | | | |
|---|---|---|---|
| Noise/dust or any hazardous material generated from construction activities | Implement construction Site Management (through provisions in contracts) to cover dust and noise management (including water spraying and scheduling of activities).<br>Dust curtains will be erected and maintained around hot mix plants, crushers and batching plants to reduce the level of dust emissions.<br>Delivery vehicles will be covered. Mixing equipped as per existing standards.<br>The plants and equipment used for construction will conform to national noise standards.<br>Workers will be provided with appropriate noise protection. The noise level will be monitored during the construction.<br>Construction vehicles and equipment will be maintained and refueled so that spillage does not contaminate the soil.<br>Fuel storage and refueling sites will be kept away from drainage channels and important water bodies.<br>To avoid contamination from fuel and lubricants, the vehicles and equipment will be properly maintained and refueled.<br>Waste petroleum products will be collected, stored, and disposed of at the approved sites as per Indian Hazardous Waste Management and Handling Rules, 1989 as amended. | Head Contractor (responsible under contract for all sub-contractors) and PIU (monitoring) | Preparation of Site Management Plan: Consultant time (1 person week)<br>Implementation of plan provisions: 1 day/fortnight of construction management time |
| Silt runoff during construction leading to impairment of down stream water quality and land values. | Implement construction Site Management (through provisions in contracts) to cover:<br>Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas.<br>Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization)<br>Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining areas. | Head Contractor (responsible under contract for all sub-contractors) and PIU (monitoring) | Preparation of Site Management Plan: Consultant time (1 person week)<br>Implementation of plan provisions: 1 day/fortnight of construction management time |

| Operation and Maintenance Impacts | Mitigation Measures | Responsibility | Preliminary Costing |
|---|---|---|---|
| Noise and vibrations leading to nuisances to travelers and neighbors. | Mitigation by barriers/earthworks, vegetation planting where possible. | PIU, Corporation | Depends on number and locations of sensitive receptors ($100-$300/m) |
| Increased air pollution leading to nuisances and health hazards to travelers/workers. | Unavoidable impact due to increased traffic using upgraded roads. Changes in transport fuel quality, compliance with environmental standards for motor vehicles at manufacturing stage, noise regulation, traffic control etc will offset this impact. | GoK, KSPCB | |

## B-8 Institutional Requirements and Environmental Monitoring Plan

### B.8.1 Institutional Requirements for Environmental Monitoring Plans

The executing agency for KSUDP subprojects is the Local Self Government Department (LSGD). It will set up a state-level Project Management Office (PMO) for this purpose. The implementing agency for components will be the Kollam Municipal Corporations. A Project Implementation Unit (PIU) will be established in the Corporation to oversee the implementation of all components under KSUDP in the Kollam Corporation area. The PIU will be supported by a city-level steering committee (SC) comprising relevant agencies including the Kerala Water Authority (KWA), Public Works Department (PWD) and the Pollution Control Board (PCB). It will also be assisted by a Design and Supervision Consultant. Operation and management of the assets will be vested in the Municipal Corporation.

During the planning and detailed design stages of the project, the Kollam Corporation will primarily be responsible for implementing mitigation measures and monitoring their performance. Technical and institutional mitigation measures will be incorporated into site layout planning and designs.

During the construction phase, the Project Implementation Unit (PIU) of the Corporation will monitor the performance of the contractor who will be contracted to construct the works in a manner that mitigates adverse environmental impacts during the construction phase. Mitigation measures of a planning, functional, institutional and procedural character will have been included in the tender documents and in the supplementary activity plans. The PIU, with the support of the Project Management Office (PMO), will be responsible for monitoring and enforcement during construction.

During the operational phase, the Corporation, with the assistance of KWA and the PCB will be responsible for monitoring the performance of the infrastructure components.

For monitoring of an issue which is critical to the environmental soundness of the activity, whether in response to potential locational, design, construction or O&M impacts, the PMO has been given a primary role.

The environmental monitoring capacity of Kollam Municipal Corporation is low. To assist the Corporation’s PIU in component planning, implementation and monitoring, an Environmental Officer

will be recruited by the PMO. The responsibilities of the Environmental Officer will be to work closely with the PIU in all project phases and will include training PIU personnel in environmental monitoring duties. Terms of reference for this position, which also cover duties in support of the KLGDF, are at Annex E of the SIEE.

### B.8.2 Environmental Monitoring Plan

The following tables provide a summary of recommended environmental monitoring programs for the four components in the Kollam corporation area, based on responses to potential adverse impacts identified in Chapter B-7.

### B.8.2.1 Water Supply Rehabilitation

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary Costing |
|---|---|---|---|---|---|---|
| Cap raw water extraction rates at the present rated level. | Pumping rate | Water works at Sasthamkotta | Visual inspection | Daily | KWA | |
| Investigate viability of alternate sources | Study of water resources | Kollam District | Examination records on water resources | Once | KWA | |
| Include construction Site Management provisions in contracts to cover:<br>Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas.<br>Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining vegetation and natural areas. | Inclusion of site management provisions in Contract and environmental performance of construction activities | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Include construction Site Management provisions in contracts to cover:<br>Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization) | Inclusion of site management provisions in Contract and environmental performance of construction activities | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Include construction Site Management provisions in contracts to noise management (including noise suppressors on stationary machinery such as pumps and compressors and scheduling of activities). | Inclusion of site management provisions in Contract and environmental performance of construction activities | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Preplanning of working site to minimize inconvenience.<br>Provide early information to most affected people.<br>Installation of barrier nets and warning signs. | Environmental performance of construction activities | All work sites | Visual inspection of activities and work methods<br>Interviews with affected residents | Weekly or at major changes in work stages | PIU (assisted by DSC) | PIU staff time as required |
| Maintenance program including continuation of timely leak detection operations | Existence of formal maintenance plan and evidence of implementation of same | Corporation offices | Inspection of documentation and work records of maintenance staff | Six-monthly | PMO, Corporation | N/a |

### B.8.2.2 Sewerage and Sanitation

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary Costing |
|---|---|---|---|---|---|---|
| Provision of a landscaped buffer zone to the north and east of the site to provide a physical and natural barrier between STP and wetland | Site design and site preparation | Corporation offices and STP site | Visual inspection of design plans and of site preparation activities | One-off inspection of plans. Weekly site inspection during site preparation | PIU (assisted by DSC) | N/a. Design checking |
| Provision of a buffer zone on vulnerable perimeters with green belt and landscaping to provide physical separation and a visual screen for the development. | Site design and site preparation | Corporation offices and STP site. | Visual inspection of design plans and of site preparation activities | One-off inspection of plans. Weekly site inspection during site preparation | PIU (assisted by DSC) | N/a. Design checking |
| Locate pour flush latrines and community sanitation block to minimize pollution of ground water. | Site design | Latrine and sanitation block sites | Visual inspection of the side condition | One-inspection of the site | PIU | N/a Design checking |
| Design must provide for high flows / volumes. Sewerage system to separate storm water flows. | Design and operational specifications | Corporation offices | Examination of documentation | One-off inspection of design documents. | PMO | N/a. Design checking |
| Employ strict treatment technology and monitoring to ensure consistent discharge standard | Water quality at discharge point and receiving waters | Treated water discharge points and in receiving waters just downstream of mixing zone | BOD, TSS and Faecal coliform levels will be measured and compared against notified standards:<br>BOD <30mg/l<br>TSS <50mg/l<br>Faecal coliform <1000/100ml | Continuous as part of plant operation.<br>Monthly as third party monitoring | Corporation<br>SPCB | Part of operational costs<br>Agency staff time as required<br>Sampling and laboratory costs (@$25/sample) : $300/mission |
| Predictive water current modeling will be required to ensure that the discharge does not have any adverse impact on the coastal waters or coast line as well as no re-entry into the lake. | Results of predictive water current modeling showing mixing and dilution of parameters | Corporation office | Examination of documentation. | One-off inspection of modeling results. | PMO | N/a. Design checking |

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary Costing |
|---|---|---|---|---|---|---|
| Sludge will be directed to the adjoining Corporation composting plant.<br>A Sludge Management Plan will be produced which includes provisions for on-site handling; maximized re-use of sludge (for agricultural manure or composting); analysis of sludge for heavy metals; locations and prohibitions on the disposal of surplus sludge. Sludge will only be disposed of as compost or other agricultural use or in sanitary landfill. | Sludge Management and Disposal Plan documentation and progress of implementation | STP and disposal areas. | Inspection of plan documentation<br>Inspection of sludge handling procedures<br>Inspection of sludge disposal sites checking for consistency with plan | Bi-monthly or more frequent if sludge production is higher than normal | PMO and PCB | PIU Agency staff time as required |
| Investigate make-up of sewage load. Identify potential for intractable industrial waste to enter sewage and if necessary design appropriate cut-outs in sewerage infrastructure. | Inventory of industrial discharges. | Kollam sewered areas | Examination of inventory. | Once | PIU, Corporation and KSPCB | Survey (data collection and analysis) costs. $2000 per survey |
| Design must provide proper protection to leach pit and community sanitation blocks. | Site design | All work sites | Visual inspection of drawings and activities at work site | One-off inspection of plan and weekly site inspection | PIU | PIU staff time as required. |
| Implement construction Site Management (through provisions in contracts for both STP construction and laying/rehabilitation of sewerage carriers and pumping stations) to cover:<br>Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas.<br>Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization)<br>Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining vegetation and natural areas.<br>Disposal of construction wastes. | Inclusion of site management provisions in Contract and environmental performance of construction activities | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary Costing |
|---|---|---|---|---|---|---|
| Implement construction Site Management (through provisions in contracts for both STP construction and laying/rehabilitation of sewerage carriers and pumping stations) to cover traffic management and nuisance minimization | Inclusion of site management provisions in Contract and environmental performance of construction activities. | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Implement construction Site Management (through provisions in contracts for STP construction and laying/rehabilitation of sewerage carriers and pumping stations) to cover dust and noise management (including water spraying and scheduling of activities). | Inclusion of site management provisions in Contract and environmental performance of construction activities. | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Operational management will include Occupational Safety Plan for workforce which will include:<br>Provision of appropriate protective gear to workers on the site.<br>Training for workers on site dangers, including potential health effects from sludge. | Inclusion of occupational safety provisions in Contract and environmental performance of construction activities. | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Quality assurance of work to ensure appropriate materials and site finishing/drainage | Materials used as per specifications | All work sites | Visual inspection of activities and work methods | At procurement milestones | PIU (assisted by DSC) | PIU staff time as required |

### B.8.2.3 Drainage Rehabilitation

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary Costing |
|---|---|---|---|---|---|---|
| Rehabilitated system may deliver storm water volumes to receiving areas in excess of design or current absorption capacity. Investigate and confirm absorption capacity of receiving areas. | Absorption capacity of receiving waters (from Master Plan Study) | Corporation offices. | Visual inspection of design plans and receiving waters absorption study | One-off inspection of plans. | PIU (assisted by DSC) | N/a. Design checking |
| Temporary relocation of hawkers and vendors. Reinstatement of original premises. | Relocation Plan documentation and progress of implementation | Corporation offices and road sites | Observation of relocation activities in field, interviews with affected residents | Weekly during relocation implementation | PIU (assisted by DSC) | PIU staff time as required |
| Provision of appropriate protective gear (waterproof boots, gloves) to workers on the site.<br>Training for workers on site dangers, including potential health effects from spoil. | Equipment and training of workforce | Work sites | Observation of work practices and interviews with workers | weekly | PIU | PIU staff time as required |
| Implement construction Site Management (through provisions in contracts) to cover:<br>Siting and protection of construction material stockpiles.<br>Use of temporary silt traps/pits along canal to prevent silt transport during activities.<br>Management of open cuttings (stabilization and duration of exposure) | Inclusion of site management provisions in Contract and environmental performance of construction activities | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Include construction Site Management provisions in contracts to cover:<br>Site preparation, which | Inclusion of site management provisions in Contract and | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary Costing |
|---|---|---|---|---|---|---|
| minimizes clearing and disturbance to adjoining vegetation and natural areas.<br>Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining vegetation and natural areas. | environmental performance of construction activities | | | | | |
| Include construction Site Management provisions in contracts to cover:<br>Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization) | Inclusion of site management provisions in Contract and environmental performance of construction activities | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Include construction Site Management provisions in contracts to noise management (including noise suppressors on stationary machinery such as pumps and compressors and scheduling of activities). | Inclusion of site management provisions in Contract and environmental performance of construction activities | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Preplanning of working site to minimize inconvenience.<br>Provide early information to most affected people.<br>Installation of barrier nets and warning signs.<br>Make alternative arrangement for drainage and water flow in canals during construction period | Environmental performance of construction activities | All work sites | Visual inspection of activities and work methods<br>Interviews with affected residents | Weekly or at major changes in work stages | PIU (assisted by DSC) | PIU staff time as required |

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary Costing |
|---|---|---|---|---|---|---|
| Implement Silt/Spoil Handling and Disposal Plan including provisions for:<br>Proper stock pilling of silt/spoil materials on site.<br>Identification of re-use opportunities for silt/spoil (e.g. use for filling or erecting side slopes on site)<br>Identification of sites for disposal of unused silt/spoil; (e.g. disposal to low lying area for land filling/road construction location/agricultural fields)<br>Covering of disposal sites after completion of works.<br>Proper transportation of waste material in vehicles with pollution control<br>Regular maintenance of desilting and transportation equipment. | Silt/Spoil Handling and Disposal Plan documentation and progress of implementation | Corporation offices and work sites | Inspection of plan documentation<br>Inspection of spoil handling procedures<br>Inspection of spoil disposal checking for consistency with plan | Bi-monthly | PMO and PCB | PIU and Agency staff time as required |
| Maintenance program including continuation of timely desilting operations | Existence of formal maintenance plan and evidence of implementation of same | Corporation offices | Inspection of documentation and work records of maintenance staff | Six-monthly | PMO, Corporation | N/a |

## Solid Waste Management

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary Costing |
|---|---|---|---|---|---|---|
| Control of site layout to maintain adequate setback from canals and foreshores. | Site design and site preparation | Corporation offices and STP site. | Visual inspection of design plans and of site preparation activities | One-off inspection of plans. Weekly site inspection during site preparation | PIU (assisted by DSC) | N/a. Design checking |
| Provision of a buffer zone on all perimeters with earthworks and landscaping to provide physical separation and a visual screen for the development. | Site design and site preparation | Corporation offices and MSW sites. | Visual inspection of design plans and of site preparation activities | One-off inspection of plans. Weekly site inspection during site preparation | PIU (assisted by DSC) | PIU staff time as required |
| Plan and implement adequate set-backs and buffer zones (where no refuse is deposited).<br>Establish tree-planting and landscaping on boundaries with neighboring residential areas.<br>Daily compacting, spreading and covering of incoming refuse | Site design and site preparation | Corporation offices and MSW sites. | Visual inspection of design plans and of site preparation activities | One-off inspection of plans. Weekly site inspection during site preparation | PIU (assisted by DSC) | PIU staff time as required |
| Ensure transport routes have adequate capacity for required truck movements<br>Provide enclosed refuse collection vehicles<br>Design and maintain vehicles to prevent spillage of liquid effluent *en route* | Truck routes<br>Vehicles | Corporation areas | Traffic counts<br>Condition of trucks and adequacy /maintenance of equipment | Monthly<br>Monthly | Corporation, PWD<br>PCB | PIU and Agency staff time as required |
| Scientific landfill disposal facilities operated as per the provisions of the Municipal Solid Waste (Management and Handling) Rules 2000:<br>Design of land fill cells as per MSW Rules, 2000. | Design and operational specifications | Corporation offices | Examination of documentation | One-off inspection of design documents. | PMO | PMO staff time as required |

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary Costing |
|---|---|---|---|---|---|---|
| Design of interception drainage network uphill of landfill to divert runoff water from encroaching on landfill area<br>Drainage and pondage system to collect fugitive leachate and redirect back into cells and away from natural drainage lines<br>Direct surplus leachate (i.e. that which cannot be reabsorbed by the landfill) to the adjacent STP for treatment | | | | | | |
| Include construction Site Management provisions to cover:<br>Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas.<br>Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization)<br>Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining vegetation and natural areas.<br>Disposal of construction wastes. | Inclusion of site management provisions in Contract and environmental performance of construction activities | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Drainage and pondage system will be designed and provided to collect fugitive leachate and redirect away from natural drainage lines. No direct drainage to Ashtamudi Lake will be permitted. | Design and operational specifications<br>Proper implementation | Corporation offices and MSW sites | Examination of documentation | One-off inspection of design documents. | PMO | PMO staff time as required |

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary Costing |
|---|---|---|---|---|---|---|
| Monitoring of water quality parameters in selected downstream water bodies and groundwater will check integrity of system. | of leachate management on site and monitoring of water quality parameters. | Nearest permanent surface water body downstream of landfill and three wells tapping groundwater resources within 500m of landfill boundary | Field inspection and monitoring of water quality parameters: PH, BOD, TDS Chlorides, Sulfates Nitrate arsenic, fluoride and heavy metals (Cd, Pb, Hg).<br>Monitoring and check against standards in the Municipal Solid Wastes (Management and Handling) Rules, 2000. | Monthly<br>Three-monthly | Corporation<br>PCB | Routine operational management<br>Agency staff time as required. Sampling and laboratory costs (@$25/sample): $300/mission |
| Provide gas control systems in landfill. | Design and operational specifications.<br>Implementation of gas control systems on the ground. | Corporation offices and MSW site | Examination of documentation<br>Field inspection | One-off inspection of design documents.<br>Monthly | PMO<br>PCB | PMO staff time as required<br>Agency staff time as required |
| Pave access roads<br>Design location of working face to minimize truck movements<br>Daily compacting, spreading and covering of incoming refuse. | Design and operational work practices. | MSW site. | Visual inspection of activities and work methods. | Monthly | PIU (assisted by DSC) | PIU staff time as required |
| Operational management will include Occupational Safety Plan for workforce which will include:<br>Provision of appropriate protective gear to workers on the site.<br>Training for workers on site dangers, including potential health effects from waste. | Plan documentation and equipment and training of workforce | All Work sites | Observation of work practices and interviews with workers | weekly | PIU | PIU staff time as required |

### B.8.2.4 Road System Upgrade

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary costing |
|---|---|---|---|---|---|---|
| Plan under pass to existing ROB to minimize dislocation of community. | Site design and site preparation | Corporation offices and road sites | Visual inspection of design plans and of site preparation activities | One-off inspection of plans and site inspection | PIU (assisted by DSC) | PIU staff time as required |
| Preparation and implementation of a Resettlement Plan, which confirms with the stipulation and guidelines provided in Asian Development Bank's Policy on Involuntary Resettlement. | Resettlement plan document and progress of implementation. | Corporation Office and work site. | Visual inspection and interview with affected parties. | Weekly | PIU and PMO | PIU and PMO staff time required. |
| Minimize intrusion on backwater foreshore areas | Site design and site preparation | Corporation offices and road sites | Visual inspection of design plans and of site preparation activities | One-off inspection of plans and site inspection | PIU (assisted by DSC) | PIU staff time as required |
| Temporary relocation of hawkers and vendors. Reinstatement of original premises. | Resettlement plan documentation and progress of implementation | Corporation offices and road sites | Observation of relocation activities in field, interviews with affected hawkers and vendors | Weekly during relocation | PIU (assisted by DSC) and PMO | PIU and PMO staff time as required |
| Detailed inventory of items and their heritage significance required. Significant items should be avoided. Smaller items may be relocated in consultation with the community and the Archaeology Department. Include significantly large and/or old street trees. | Inventory of heritage items included in site design. Referrals to Dept Archaeology. | Corporation offices and road | Visual inspection of design plans and of site preparation activities | One-off inspection of plans and site inspection | PIU (assisted by DSC) | PIU staff time as required |
| Loss of street trees to be minimized. New trees planted where losses have occurred. | Site design and site preparation | Corporation offices and road sites | Visual inspection of design plans and of site preparation activities | One-off inspection of plans and site inspection | PIU (assisted by DSC) | PIU staff time as required |
| Include construction site management provisions in contracts to cover traffic management. | Inclusion of site management provisions in Contract and environmental | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary costing |
|---|---|---|---|---|---|---|
| Traffic management measures applicable to different situations (including provision of side track access for traffic, signaling, speed limits, and detour signage). Coordination with other authorities and traffic police is essential | performance of construction activities | | | | | |
| Include construction Site Management provisions in contracts to cover dust and noise management (including water spraying and scheduling of activities).<br>Dust curtains will be erected and maintained around hot mix plants, crushers and batching plants to reduce the level of dust emissions.<br>Delivery vehicles will be covered. Mixing equipped as per existing standards.<br>The plants and equipment used for construction will conform to national noise standards.<br>Workers will be provided with appropriate noise protection. The noise level will be monitored during the construction.<br>Construction vehicles and equipment will be maintained and refueled so that spillage does not contaminate the soil.<br>Fuel storage and refueling sites will be kept away from drainage channels and important water bodies. | Inclusion of site management provisions in Contract and environmental performance of construction activities | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |

| Mitigation Measures | Parameters to be Monitored | Location | Measurements | Frequency | Responsibility | Preliminary costing |
|---|---|---|---|---|---|---|
| To avoid contamination from fuel and lubricants, the vehicles and equipment will be properly maintained and refueled.<br>Waste petroleum products will be collected, stored, and disposed of at the approved sites as per Indian Hazardous Waste Management and Handling Rules, 1989 as amended. | | | | | | |
| Include construction Site Management provisions in contracts to cover:<br>Site preparation, which minimizes clearing and disturbance to adjoining vegetation and natural areas.<br>Protection of unstable soil surfaces from high velocity runoff (interception drains and temporary stabilization)<br>Siting of construction material stockpiles and access routes to avoid and disturbance to adjoining vegetation and natural areas. | Inclusion of site management provisions in Contract and environmental performance of construction activities | All work sites | Visual inspection of activities and work methods | Daily | PIU (assisted by DSC) | PIU staff time as required |
| Mitigation by barriers/earthworks, vegetation planting where possible. | Detailed specifications of barriers / earthworks, and vegetation planting at all sensitive receptors included in site design | Corporation offices and sensitive receptor areas at road sites | Visual inspection of design plans and of site activities | One-off inspection of plans.<br>Site inspection of mitigation measures to ensure they are implemented as per design | PIU (assisted by DSC) and PMO | PIU and PMO staff time as required |

## B-9 Community Consultation and Information Disclosure

During the Project scoping exercise considerable dialogue was had with the Municipal Corporation Mayors and technical staff as well as state line agencies. At the Mid Term Workshop, as part of the working group session, the City Mayors and officers were requested to proportion any funding that might be available for infrastructure improvements as an indicator of civic priority. The results assisted the prioritization of component selection.

Community priorities were examined through a Baseline Socio-Economic Survey, which was undertaken in all 5 Project cities. The 1% sample household survey included questions on municipal service delivery and priorities for improvement.

**Table B-19: Community Municipal Service Priorities for Kollam**

| | MV | JV | UP | LIG | MIG | HIG |
|---|---|---|---|---|---|---|
| Water | 1 | 1 | 1 | 1 | 4 | 4 |
| Sewerage/ Sanitation | 3 | 3 | 3 | 3 | 3 | 3 |
| Drainage | 2 | 2 | 2 | 2 | 1 | 1 |
| SW disposal | 4 | 4 | 4 | 4 | 2 | 2 |
| Roads | 5 | 5 | 5 | 5 | 5 | 5 |

MV-Most Vulnerable; JV-Just Vulnerable; UP-Upper Poor; LIG-Low Income Group; MIG-Middle Income Group; HIG-High Income Group.

Source: Loyola College of Social Sciences, Thiruvananthapuram (2004). KSUDP - Socio-Economic Study 2004 - Kollam Corporation.

Where projects involved relocation or resettlement of on-site residents or commercial premises, community stakeholders were initially consulted as part of the R and R planning process. This is reported in **Annex E-2**.

The environmental safeguards and impact mitigation measures which have been formulated for the project via the EIA process were presented to a community meeting in Kollam on 26th February 2005. The summary report on the proceedings of environmental disclosure and public consultation is presented in **Annex F-2**. An important community consultation and information disclosure exercise following on from this will be a program of “Public Awareness and Benefit Monitoring”.

A domestic Community Mobilization and Awareness Consultant firm will be employed by the PMO to make the public aware of the short-term inconveniences and long-term benefits of the project in order to gain full support of the beneficiaries for the project. Beneficiaries will also be made aware of preventive care to avoid environmental health-related hazards.

In addition, a domestic Benefit Monitoring and Evaluation Consultant (BMEC) firm will be required to help the PMO in generating baseline data which will be monitored to assess impact of the Project and providing guidance for mid course correction, if required, and assess benefits on commissioning of the Project. Outline terms of reference for these consulting services are provided in the Draft Final Report Volume 1.

## B-10 Findings and Recommendations

### B.10.1 Findings

All sub-projects in the Kollam Corporation area as described in Chapter B-4 were found on the basis of environmental assessment in the PPTA stage to be environmentally acceptable and able to proceed to the implementation phase.

In most cases, particular environmental issues identified are those which are typical for the type of component, and a range of proven mitigation strategies exist to address them.

| Component | Environmental Impact Issues |
|---|---|
| **Kollam** | |
| Water Supply Rehabilitation | ▪ Capping of extraction to protect biodiversity in Sasthamkotta Lake |
| Sewage Treatment | ▪ Protection of receiving waters<br>▪ Sludge handling and disposal (sludge to compost plant)<br>▪ Appropriate EMP provisions for construction and operation |
| Drainage Rehabilitation | ▪ No outstanding issues |
| Solid Waste Management | ▪ Leachate control and integrated scientific landfill<br>▪ Special provision for scientific landfill of hazardous material<br>▪ Buffer / screening from backwater<br>▪ Appropriate EMP provisions for construction and operation |
| Roads System Upgrade | ▪ Space availability for road safety, residents, pedestrians and for installation of noise and air pollution mitigation measures<br>▪ Resettlement plan and implementation for underpass to existing ROB.<br>▪ Appropriate traffic management and noise buffers for underpass to ROB. |

An important set of mitigation measures which are relevant to most components is the fleshing out of comprehensive Activity Plans using the appropriate mitigation measures itemized in Chapter B-7. (It is noted in this section when a mitigation measure or set of measures pertains to an Activity Plan). These comprise:

- Site Management Plan (to address construction impacts, all sub-projects);
- Occupational Safety Plan (to address construction and operation impacts, all sub-projects);
- Sludge Management and Disposal Plan (to address sludge handling and dumping (operational) impacts at the STP); and
- Silt/Spoil Management and Disposal Plan (to address construction impacts, Drainage Refurbishment sub-project).

These activity plans should be prepared by the PIU as a compendium of the relevant mitigation measures identified in Chapter B-7. They should form part of the contractual arrangements with construction contractors, or directly implemented by the Corporation as facility operator, as required Work Practices.

The IEE has found that a particular technical study also needed to finalise the disposal of treated effluent in the most environmentally sound way.

*"Predictive water current modeling study at the discharge point to ensure that the discharge does not have any adverse impact on the coastal waters or coast line as well as no re-entry into the lake."*

It is estimated that the data collection and nutrient modeling study of the wetland will cost $25,000. This study is regarded as part of the environmental design of the component and not as an impediment to its implementation.

### B.10.2 Recommendations

The following additional study is recommended by the IEE as part of the environmental design of the sewerage component:

- A predictive water current modeling study at the discharge point to ensure that the discharge does not have any adverse impact on the coastal waters or coast line as well as no re-entry into the lake.

An additional recommendation is that the KSUDP PMO should be involved in monitoring the implementation of those mitigation measures, which are critical to the acceptable environmental performance of the component. These would include the proper interpreting of the results of the above additional study and the integration of the results into component planning.

### B.10.3 Conclusions

All proposed components in Kollam Corporation area will greatly improve the overall environmental quality of the Municipality. The Project is considered not to have significant environmental impacts and classification B is considered appropriate.

It is concluded that the proposed components should proceed, subject to the mitigation measures and monitoring programs identified in the IEE and the above recommendations.