THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF CITY PLANNING, WATER SUPPLY AND HIGHER EDUCATION
MINISTRY OF NATIONAL POLICIES, ECONOMIC AFFAIRS, RE-SETTLTEMENT & REHABILITATION, NORTHERN PROVINCE DEVELOPMENT AND YOUTH AFFAIRS
NATIONAL WATER SUPPLY AND DRAINAGE BOARD

PREPARATORY SURVEY ON SRI JAYAWARDENAPURA KOTTE SEWERAGE CONSTRUCTION PROJECT

THE PROJECT FOR THE STRATEGIC MASTER PLAN UNDER THE SEWERAGE SECTOR IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA (PHASE 2)

FINAL REPORT
- ADVANCE VERSION-
(MAIN REPORT)

DECEMBER 2019

JAPAN INTERNATIONAL COOPERATION AGENCY
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ABBREVIATIONS AND TERMINOLOGY

ADB	Asian Development Bank
Addi. GM	Additional General Manager
AFD	Agence Française de Development
AGM	Assistant General Manager
ARAP	Abbreviated Resettlement Action Plan
ATP	Affordability To Pay
BIQ	Basic Information Questionnaire
BNR	Biological Nutrient Removal
BOD	Biochemical Oxygen Demand
BOI	Board of Investment
B/C	Benefit Cost Ratio
CBO	Community Based Organization
CCNUCC	Convention-Cadre des Nations Unies sur les Changements Climatiques
CEB	Ceylon Electricity Board
CEA	Central Environmental Authority
CMC	Colombo Municipal Council
COD	Chemical Oxygen Demand
DB	Design Build Method
DGM	Deputy General Manager
DSD	Divisional Secretary Division
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EPC	Environmental Pollution Control
EPL	Environmental Protection License
EPZ	Export Processing Zone
ERD	Department of External Resource
FIRR	Financial Internal Rate of Return
F/S	Feasibility Study
GAP	Gender Action Plan
GCS	Greater Colombo Sewerage Section
GND	Grama Niladhari Division
GOSL	Government of Sri Lanka
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
IBRD	International Bank for Reconstruction and Development
ICB	International Competitive Bidding
IEE	Initial Environmental Examination
IFRS	International Financial Reporting Standard
IPCC	Intergovernmental Panel on Climate Change
IRP	Income Restoration Program
IRR	Internal Rate of Return
JCC	Joint Coordinating Committee
JET	JICA Expert Team

JICA	Japan International Cooperation Agency
JPU	Japan Project Unit
JPY	Japanese Yen
LAA	Land Acquisition Act
LCB	Local Competitive Bidding
LKR	Sri Lanka Rupee
M&E	Mechanical and Electrical
M/M	Minutes of Meeting
MASL	Mahaweli Authority in Sri Lanka
MC	Municipal Council
MCF	Methane Correction Factor
MEPA	Marine Environmental Protection Authority
MO	Sewerage Management Office
MOCPWS	Ministry of City Planning and Water Supply
MOF	Ministry of Finance
MoHNIM	Ministry of health, nutrition & indigenous medicine
MOPPEA	Ministry of Policy Planning and Economic Affairs
MRT	Minimum Rate Test
NIRP	National Involuntary Resettlement Policy
NPV	Net Present Value
NWSDB	Notional Water Supply & Drainage Board
O&M	Operation and Maintenance
OD	Oxidation Ditch
OECD	Organization for Economic Co-operation and Development
PAA	Project Approving Agencies
PAPs	Project Affected Persons
PAU	Project Affected Units
PMU	Project Management Unit
PPP	Public Private Partnership
PS	Pradeshiya Sabha
RAP	Resettlement Action Plan
RDA	Road Development Authority
ROA	Return on Asset
ROE	Return on Equity
RSC	Regional Support Centre
SC	Statutory Compensation
SCADA	Supervisory Control And Data Acquisition
SCAPC	Standing Cabinet Appointed Procurement Committee
SHIFT	Sanitation and Hygiene Initiative for Towns
SJK	Sri Jayawardenepura Kotte
SLAS	Sri Lankan Accounting Standard
SLS	Sri Lanka Standard
SS	Suspended Solids
STEP	Special Terms for Economic Partnership
STP	Sewage Treatment Plant
TA	Technical Assistance
TN	Total Nitrogen
TOR	Terms of Reference

TSS	Total Suspended Solids
UC	Urban Council
UDA	Urban Development Authority
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
WAS	Waste Activated Sludge
WB	World Bank
WHO	World Health Organization
WTP	Willingness to Pay

EXECUTIVE SUMMARY

1. BACKGROUND

In Sri Lanka, water pollution caused by rapid population increase and land development is becoming a serious problem. To face this challenge the Government of Sri Lanka (GOSL) sought assistance from the Government of Japan to develop a Strategic Master Plan in the sewerage sector to improve the water environment in Sri Lanka. The Japanese government undertook the study for the Strategic Master Plan under the sewerage sector as a technical cooperation project. It was performed in two phases.

During Phase I, (from January 2016 to May 2017), two master plan studies were carried out. The first study, called the “Strategic Sewerage Master Plan for Sri Lanka,” investigated the entire country to identify cities with high necessity of sewerage systems. This Master Plan (2017) set the target for sewerage population coverage at 7.0% by 2035 nationally. It presented the development process of sewerage systems for the 15 cities, including Sri Jayawardenapura Kotte MC after the evaluation of cities and towns by key criteria such as population and population density (Urbanization), water supply coverage ratio and water born disease ratio (Sanitation), city development importance grade (Urban Development), water bill collection ratio (Sustainability of sewerage service), and impact on drinking water supply source (Water Environment).

The second study was called the “City Sewerage Master Plans (M/P) for 5 cities”. It built upon the findings of the first study, further narrowing the selection from 15 cities to 5 cities which did not already have donor assistance for sewerage development in order to avoid overlapping international assistances.

Based on the “City Sewerage M/P for 5 cities”, GOSL selected two cities, Sri Jayawardenapura Kotte MC and Nuwara Eliya MC for sewerage development due to the above criteria as well as land availability for sewage treatment plant and sludge disposal sites. GOSL requested two yen loans for the implementation of sewerage projects for the two cities under the special terms for economic partnership (STEP) in the year 2017. Phase II started in June 2017 at the request of the GOSL to collect information for the evaluation of project feasibility.

2. OBJECTIVE OF THE STUDY

This study examines the feasibility of a Japanese ODA project based on the “City Sewerage M/P for Sri Jayawardenapura Kotte MC”. The purpose of the project, project components and costs, institutional arrangements for project implementation and O&M, environmental and social considerations were analyzed and compiled in the study report.

3. SEWERAGE SECTOR STATUS AND ISSUES

Currently, only 2.4%[1] of the population of Sri Lanka has access to sewerage collection systems, mainly in the Colombo MC area and its suburbs. Some 96.0% of the population relies on on-site sanitation systems, which are mainly toilets connected to septic tanks. Type of sanitation facility for the remaining 1.6% is unknown. Due to inappropriate sizing and installation, many septic tanks are not effective[2] for sewage treatment. Effluent from septic tanks is discharged to drains and groundwater, eventually contaminating rivers and other water bodies. Therefore, fecal coliform levels caused by human waste were found to be 70,000 times higher than the water environment standards (1,000

[1] Population of sewage treatment is 0.2% in 2.4% sewerage system population. There are four sewage treatment plants (Ratmalana/Moratuwa, Ja-Ela/Ekala, Kataragama, Hikkaduwa) excluding small housing and industrial park scheme plants in Sri Lanka.

[2] Insufficient tank capacity cannot secure the treatment time and /or septic tanks installed below ground water level directly discharge sewage to ground water and pollute water.

MPN/100 ml) at Badulla MC of Uva Province, 10 times higher in Maya Oya, in northern Negombo MC, and 700 times higher in Anuradhapura MC, North Central Province. Also, ammonia-nitrogen levels were five times higher than the standard. The deterioration of water quality throughout Sri Lanka is significant.

4. POLICY AND PROJECT

The GOSL (2016) identified the sewerage system for Sri Jayawardenapura Kotte MC and its surrounding areas as an important infrastructure for creating an environment for the economic growth in the "Western Region Master Plan 2030" and listed this project in the "Public Investment Programme 2017 – 2020".

Following the Sustainable Development Goals (SDGs) (2015) to improve sewage treatment quality for water quality improvement of public water bodies, National Water Supply & Drainage Board (NWSDB) (2017) prepared the "Strategic Sewerage Master Plan for Sri Lanka" in which 15 priority cities including Sri Jayawardenapura Kotte MC were identified as priority cities for sewerage system development with sewage treatment plants.

In its "Vison 2025" (2017), the GOSL identified sanitation facilities for the treatment of sewage as one of the key infrastructures required for sustainable economic growth of the nation.

Hence, this sewerage project has strong relevance to the national government policy and NWSDB's higher level planning.

5. NEED FOR THE PROJECT

Sri Jayawardenapura Kotte MC has been the administrative capital of Sri Lanka since 1982. This has driven recent population increase in the area, about 7.0% during 30 years. The project area, which includes Sri Jayawardenapura Kotte MC and its surrounding areas, has a population of 200,000 with high population density, about 6,000 population / km^2. Due to nearly 100% piped water supply and about 18% water use increase in latest 5 years, about 30,000 m^3/d of sewage is discharged through drains to Diyawanna Oya, the waterbody surrounding the Parliament House.

According to water quality survey of Diyawanna Oya, the fecal coliform levels are 17 times higher than the standard (1,000MPN/100ml) and ammonia-nitrogen values are 15 times higher than the standard (0.59 mg/l). Water quality is seriously deteriorated.

Therefore, the area was flagged as a priority area for sewerage development in the "The Megapolis Western Region Master Plan-2030" published in 2016, with Sri Jayawardenapura Kotte MC and its surround areas being the key areas of influence. There are many infrastructure development projects mentioned in the "The Megapolis Western Region Master Plan-2030" and "Vision 2025" such as railway, road, and water transportation projects. As these development projects are implemented, it is expected that the increase in the daytime population of the area will increase and further accelerate deterioration of the water environment.

As a result of the above, the project is highly necessity for the promotion of sustainable economic development of the area while providing improved living environment through the development of a sewerage system in Sri Jayawardenapura Kotte MC and its surrounding areas.

Source: JET

Figure S- 1 Map of Service Area

6. CONDITIONS OF PROJECT PLANNING

(1) Phased Development Plan

The planned sewerage service area covers approximately 2,920 ha (excluding 480ha surface water area) across Sri Jayawardenapura Kotte MC and the surrounding areas, including parts of Kaduwela MC, Dehiwala-Mount Lavinia MC, Maharagama UC, and Kotikawatta-Mulleriyawa PS in the Colombo District of the Western Province. However, it is not practical to execute the entire area at once in terms of project scale. Based on discussion between NWSDB, it was decided that the sewerage development should be conducted in three stages, giving priorities to the areas where sewage can be collected by gravity with fewer pumping stations while maximizing the number of beneficiaries. The proposed stage-wise coverage area is as follows:

- 1st stage: 1,790 ha (Population Coverage: 62%)
- 2nd stage: 680 ha (23%)
- 3rd stage: 450 ha (15%)
- Total service area: 2,920 ha (100%)

Among the above, Japanese Yen-loan project intends to cover the 1st stage.

(2) Planned Sewage Volume

Sewage volume in the entire service area is estimated as follows based on the population projection.

- The population of the total service area = 218,800 (136,100 for the 1st stage).
- Sewage volume of the total service area (daily maximum) = 39,320 m^3/d (23,970 m^3/d for the 1st stage).

7. FACILITY PLANNING

(1) Sewer and Pumping Station

A total of 639 km of sewer pipes will be required to collect sewage in the service area. Among them, about 351 km will be installed in the 1st stage. The required collection facilities including sewer pipes and pumping stations are as shown in **Table S-1**.

Table S-1 Required Sewer Pipes and Pumping Station in Each Stage

Major Item	Detail or Major Equipment	1st Stage (This Project)	2nd Stage	3rd Stage	Total
Trunk Sewer for Gravity Pipe	φ200-700mm by Open Cut Method	38.4 km	5.9 km	0.0 km	44.3 km
	φ200-1200mm by Micro Tunnelling Method	71.6 km	-	-	71.6 km
Trunk Sewer for Force Main Pipe	Φ80-400mm by Open Cut Method	9.1 km	40.2 km	68.2 km	117.5 km
	φ300-600mm by Micro Tunnelling Method	11.4 km	-	-	11.4 km
	Φ80-500mm by Pipe Bridge	0.2 km	-	-	0.2 km
	φ600mm by Rehabilitation of Existing Pipe	0.3 km	-	-	0.3 km
Pumping Station	Major Pumping Stations	7	-	-	7
	Manhole Type Pumping Stations	63	240	938	1,241
	Office Building Renewal at Jayawadanagama	1	-	-	1
Branch (Secondary) Sewer		219.4 km	109.4 km	65.3 km	394.1 km
House connection		27,000 (25,000)	10,000	7,000	44,000

Source: JET

Micro Tunnelling Method has been considered for the areas/sections where it would be difficult to apply the open-cut method, such as:

- underground depth more than 4.5 m
- high security areion byas, and
- heavy traffic areas

(2) Sewage Treatment Plant (STP)

The sewage treatment process is selected based on the treated water quality required by Central Environmental Authority (CEA). Main processes were selected by the following reasons;

- Step-feed biological nutrient removal process is chosen for its nitrogen removal potential and low energy costs.
- UV disinfection is selected for its low operation cost and lack of harmful disinfection byproducts.

- Sludge treatment is planned for agricultural reuse (as fertilizer).

The entire civil structure will be constructed in the 1st stage, considering overall cost of civil work and convenience of O&M. As for Mechanical & Electrical (M&E) equipment, the 1st stage will cover the equipment that can accommodate 26,400 m^3/d. **Table S-2** outlines required scale of civil structure and M&E equipment in each stage.

Table S-2 Required Scale of Civil Structure and M&E Equipment in Each Stage

Name of Facility	1st Stage (This Project)	2nd Stage	3rd Stage	Total
Civil and Architectural Structures	39,600 m^3/d*1	-	-	39,600 m^3/d*1
Mechanical & Electrical Equipment	26,400 m^3/d	13,200 m^3/d	-	39,600 m^3/d

Note:*1 Daily maximum flow is presented. Daily average flow is 35,000m^3/d.
Source: JET

8. INSTITUTIONAL ARRANGEMENTS FOR PROJECT IMPLEMENTATION

This sewerage project is implemented through the Ministry of City Planning, Water Supply and Higher Education as the executing agency and NWSDB will be the implementing agency. NWSDB has implemented a number of water and sewerage projects nationwide funded by foreign funds and is aware of international bidding procedures as well as Japanese ODA loan processing.

As with other projects, a Project Management Unit (PMU) will be established under the Sewerage Division of NWSDB during the design and construction stage to supervise design and construction works, procurement, reporting, and monitoring etc.

After due deliberation between Sri Jayawardenapura Kotte MC and NWSDB, NWSDB was entrusted to own and manage the sewerage facilities constructed in the project. Sri Jayawardenapura Kotte Sewerage Management Office (MO) will be established under the Sewerage Division and will implement O&M of STP, sewer networks, pumping stations, and customer services.

NWSDB is currently operating and maintaining the STP at Moratuwa/Ratmalana near Colombo MC, which has a comparable treatment capacity to that of the planned Sri Jayawardenapura Kotte STP. NWSDB can make full use of its experience in this STP. Contractors will implement training on operational procedures, preventive maintenance procedures, and responses to malfunctions for O&M staff during the commissioning stage. NWSDB has invested appropriate human resources, materials, and budget for the existing sewerage projects and similar arrangements will be made for this project. Therefore, NWSDB will implement O&M of the project properly.

9. IMPLEMENTATION SCHEDULE AND PROJECT COST

This project (the 1st stage) includes construction works and consulting services. Construction works are divided into 4 packages, considering various factors including type of works, required technologies, and scale of contract amount.

The procurement of all construction works are carried out under the Japan tied condition. The latest Standard Bidding Documents (hereinafter SBDs) under Japanese ODA Loans for Goods and Services prepared by JICA should be used for the bidding. The bid operation rule of “Japan tied” is applied to all packages. Only if no Japanese company is expected to bid in certain package, subject to the consent of the Government of Japan, the bilateral tied condition (i.e. not only Japanese companies but also companies in a recipient country are eligible for a prime contractor) may be applied to that package according to STEP rules. **Table S-3** outlines possible packaging and respective bidding method.

(1) Construction contracts

Construction contracts are undisclosed.

(2) Consulting services

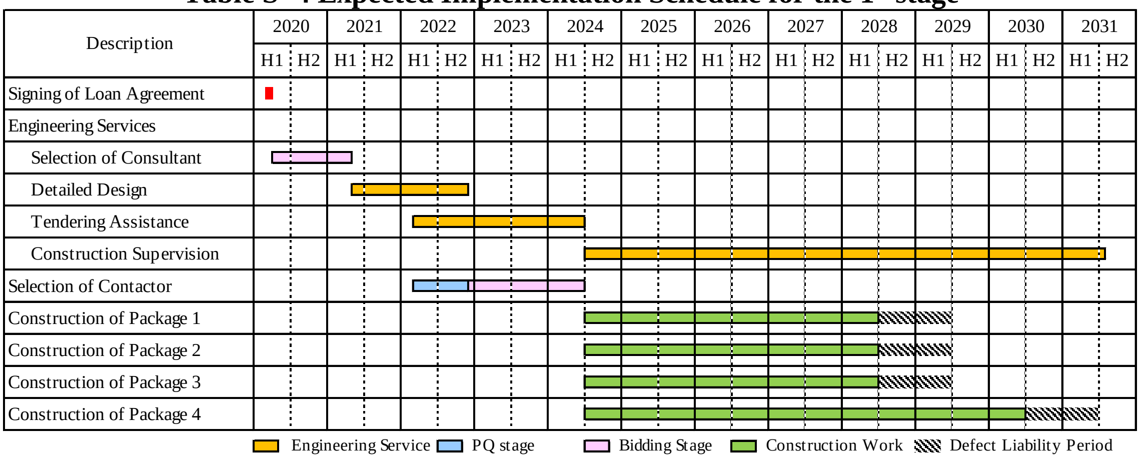
- Detailed design
- Tender Assistance (pre-qualification, tendering and contract negotiation)
- Construction supervision
- Capacity building for sewerage system management
- Public relations activities for benefit and usage of sewerage including promotion of house connecting

Table S- 3 Packaging of Project Components and Bidding Methods

Table S-3 is undisclosed**.**

It will take about 10 years to implement the 1st stage starting with consultant selection to the completion of house connections as shown in **Table S-4**. Assuming the Project (the 1st stage) starts after the signing of loan agreement in March 2020, the main facilities in the sewerage treatment plant and pumping stations should be commissioned by 2028.

Table S- 4 Expected Implementation Schedule for the 1st stage



Source: JET

Consulting services are undisclosed.

Project costs including indirect costs and price escalation over the duration of the Project are presented in **Table S-5**.

Table S- 5 Estimated Project Costs for the 1st Stage

Table S-5 is undisclosed.

10. FINANCIAL AND ECONOMIC ANALYSES

Financial and Economic analyses are undisclosed.

Table S-6 Results of Economic Analysis

Table S-6 is undisclosed.

11. ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

(1) IEE/EIA Study

IEE study was conducted by JICA Expert Team (JET) according to the JICA Guidelines for Environmental and Social Considerations of April, 2010. An EIA study was conducted by NWSDB according to local regulations, based on study outcomes from JET. The studies concluded that the Project has many positive social and environmental impacts, and effective mitigation measures are available for any negative impacts. The significant negative impacts such as water pollution, waste / odour generation, land acquisition, etc. are expected and mitigation measures are considered.

(2) Land Acquisition/Resettlement

Efforts are always taken to minimize private land acquisition and involuntary resettlement, through consideration of alternative design options. Nevertheless, land acquisition is necessary for STP and Major Pumping Stations. Thus, NWSDB is following procedures set forth in the Land Acquisition Act of Sri Lanka and in accordance with project policy, for the lawful acquisition of required lands.

All concerned parties (NWSDB, Urban Development Authority (UDA), and Sri Lanka Land Reclamation and Development Corporation (SLLRDC)) have agreed to the location of the STP and gazette notification has been published. Compensation will be based on full replacement costs. Grievance redress mechanism has been established to handle disputes in compensation or delays in payment.

(3) Stakeholder Consultation

A stakeholder meeting was held on 17th-Sep, 2019 to explain the Project and maintain transparency, and obtain social acceptance. Latest results of this study including IEE/EIA findings were also presented to promote understanding and gather feedback.

12. Measures for Anticipated Effect of the Project

Effect indicators are recommended to monitor and evaluate progress in achieving the intended benefits of the Project (the 1st stage).

Targets for the proposed indicators are determined according to the nature of the project and should generally be achieved 2 years after the project becomes operational. The project is expected to achieve its intended targets by the year 2032. Indicators and proposed targets are shown in **Table S-7**.

Table S- 7 Indicators and Targets

Indicator	Present (year 2019)	Target (year 2032)
Volume of Sewage Treated (m^3/d)	0	23,970
Population Served (Persons)	0	136,100
Percentage of the Population Served in the Service Area (%)	0	About 62
Quality of Treated Effluent	BOD_5: – COD: – SS: – NH_4^+-N: – NO_3-N: – Org-N: – TP:	BOD_5 < 10 mg/l COD < 100 mg/l SS < 15 mg/l NH_4^+-N < 1.0 mg/l NO_3-N < 10 mg/l Org-N < 1.0mg/l T-P < 1.0 mg/l

Source: JET

13. CONCLUSIONS AND RECOMMENDATION

This Project (the 1st stage) will reduce pollution of public water bodies, improve sanitation and public health conditions, and subsequently bring about further sustainable economic development. The Project satisfies national priorities for this area and has many positive environmental/social impacts.

The following recommendations are made for project implementation:

(1) Detailed geotechnical investigations should be carried out during the detail design stage.

(2) NWSDB should conduct public awareness activities for people in this project area on the importance of sewage treatment and hold frequent meetings to share information on the Project for deepening the understanding of the project’s purpose, promoting land acquisition and the resettlement of residents, and accelerating house connections during the detailed design and construction stages.

(3) NWSDB should share information and coordinate with relevant agencies to avoid potential delays. In particular, it is important for SLLRDC and the Ministry of Megapolis and Western Development to understand the STP construction schedule to ensure that the drainage channels are built before STP construction starts.

(4) NWSDB should accept sludge from septic tanks in pumping stations and treat them with sewage in the STP to bring the benefit of the project to people without sewerage services.

CHAPTER 1 BACKGROUND AND OBJECTIVES

1.1 BACKGROUND

In Sri Lanka, water pollution caused by rapid population increase and land development is becoming serious problem. To face this challenge the Government of Sri Lanka (GOSL) sought assistance from the Government of Japan to develop a Strategic Master Plan in the sewerage sector to improve the water environment in Sri Lanka. The Japanese government undertook the study for the Strategic Master Plan under the sewerage sector as a technical cooperation project performed in two phases.

During Phase I, (from January 2016 to May 2017), two master plan studies were carried out. The first study, called the "Strategic Sewerage Master Plan for Sri Lanka," investigated the entire country to identify cities with high necessity of sewerage systems. This Master Plan (2017) set the target for sewerage population coverage at 7.0% by 2035 nationally. It identified 15 priority cities for sewerage system development by the year 2035 by considering key criteria such as population and population density (Urbanization), water supply coverage ratio and water born disease ratio (Sanitation), city development importance grade (Urban Development), water bill collection ratio (Sustainability of sewerage service), and impact on drinking water supply source (Water Environment). It presented the development process of sewerage systems for the 15 cities, including Sri Jayawardenapura Kotte MC.

The second study was called the "City Sewerage Master Plans (M/P) for 5 cities". It built upon the findings of the first study, further narrowing the selection from 15 cities based on above five criteria to just two. One important requirement for selection was that the city did not already have donor assistance for sewerage development in order to avoid overlapping international assistances.

The study resulted in the selection of two cities, Sri Jayawardenapura Kotte MC and Nuwara Eliya MC for sewerage development due to the above criteria as well as land availability for sewage treatment plant and sludge disposal sites. GOSL requested two yen loans for the implementation of sewerage projects for the two cities under the special terms for economic partnership (STEP) in the year 2017. Phase II started in June 2017 at the request of the GOSL to collect information for the evaluation of project feasibility.

1.2 OBJECTIVES AND SCOPE

This study examines the feasibility of a Japanese ODA project based on the "City Sewerage M/P for Sri Jayawardenapura Kotte MC". The purpose of the project, project components and costs, institutional arrangements, environmental and social considerations were analyzed and compiled in the study report. **Figure 1.2-1** shows the map of service area.

Source: JET

Figure 1.2-1 Map of Service Area

1.3 TERMS OF REFERENCE OF THE STUDY

The Terms of Reference of the study are summarized below.

(1) Collection and analysis of relevant materials and information
(2) Preparation of inception report (IC/R)
(3) Explanation and discussion of IC/R
(4) The status of and problems with the sewerage sector in Sri Lanka, and the impact of this project on its development
(5) Assistance from other donors
(6) Social and economic conditions in the service area
(7) Status and prospect of water supply system development
(8) Volume of sewage generation and sewage treatment capacity
(9) Long-term projection of sewage generation
(10) Sewage discharge and impacts on sanitation, living environments and economic activities
(11) Contributions from the project
(12) Facility design
(13) Environmental and social considerations

(14) Measures against climate change
(15) Gender issues and poverty reduction
(16) Procurement plan
(17) Permits and licenses for the project implementation
(18) Implementation schedule
(19) Estimated project costs
(20) Evaluation of executing agency and organization for operation and maintenance
(21) Review of organization for project implementation
(22) Examination of organization for operation and maintenance
(23) Project outcomes
(24) Needs for technical assistance
(25) Risk identification and mitigation measures
(26) Safety measures
(27) Invitation program in Japan
(28) Additional study on sewerage development in Nuwara Eliya
(29) Preparation, explanation and discussion of second interim report (SITR)
(30) Preparation, explanation and discussion of draft final report (DFR)
(31) Preparation, explanation and discussion of final report (FR)

1.4 STRUCTURE OF THE REPORT

The JICA Expert Team (JET) carried out the investigations and analyses as listed in the above TORs from June 2017. The field investigation was conducted in Sri Jayawardenapura Kotte MC and surrounding areas from June 2017 to March 2018. This report presents the project scope, cost estimates, procurement schedules, environmental and social considerations, and economic analyses for the Project. The four key components of the report are:

(1) Chapter 1, 2 and 3

These chapters describe the general background, objectives and scope, Terms of Reference, and sanitation sector status including laws and regulations relevant to the projects in the survey area, national policy related to sanitation, and NWSDB program. Chapter 3 describes the physical, socio-economic, environmental conditions, an existing sewerage system, and the justification for the project.

(2) Chapters 4, 5 to 11

The planning basis for the sewerage system, including the design for type of sewage collection system, sewage flow and quality are presented and discussed in Chapter 4. Chapter 5 describes the proposed sewage collection and treatment facilities, their operation and maintenance requirements. Construction packages for the project as Sri Jayawardenapura Kotte Sewerage Construction Project are identified. Institutional arrangements for the construction and maintenance stages are presented in Chapter 6. Other project components, including engineering services, such as detailed design and construction supervision, capacity building (C/B), are presented in Chapter 7. Total project costs and required funding are calculated based on estimated construction and maintenance costs. Chapter 8 covers the financial and economic analysis and Chapter 9 covers the environmental and social considerations including screening, assessment of environmental impacts and monitoring according to JICA guideline. Chapter 10 describes abbreviated resettlement action plan, including scope of land acquisition and resettlement, compensation, implementation and monitoring, and measures for vulnerable households and individuals. The expected outcomes of the Project are described in Chapter 11.

(3) Chapter 12

The final chapter presents the conclusions of the study and the recommendations for the project, including risk and mitigation measures.

CHAPTER 2 NATIONAL POLICY AND STANDARDS

2.1 OUTLINE

- The sewerage system coverage is only 2.4% of the national population. 96.0% use septic tanks. Type of sanitation facility for the remaining 1.6% is unknown (2.2.1).

- Sewage from only 0.2% of the domestic population is treated in sewage treatment plants. The rest of the collected sewage is discharged to the ocean without biological treatment (2.2.1).

- Fecal Coliform values in public water bodies of Sri Lanka exceed that of “Revised Ambient Water Quality Standards”. Because fecal coliform is related to human waste, water pollution by human is strongly suspected (2.2.2).

- Laws and regulations relevant to the sewerage sector have been developed after the National Environmental Act No 47 (1980) (2.2.3).

- The National Water Supply & Drainage Board (NWSDB) is the implementing authority for the national policies for the water supply and sanitation sector except for the local authorities (LAs) that have their own water supply and sewerage systems (2.2.4).

- The government of Sri Lanka (GOSL) established “Vision 2025” (2017) for new developments in different industries based the government’s economic vision. In it sewage pollution reduction was identified as one of the key infrastructures necessary to support sustainable economic growth with equity (2.3.1).

- NWSDB set a target of 7.0% sewerage coverage for the entire nation by 2035 in the “Strategic Sewerage Master Plan for Sri Lanka” (2017) (2.3.2).

- The “Strategic Sewerage Master Plan for Sri Lanka” surveyed 79 cities, including all Municipal Councils, Urban Councils, and selected Pradeshiya Sabhas. Subsequently, 15 cities to achieve 7.0% sewerage coverage were identified as having urgent needs for sewerage investment based on the following criteria: urbanization, sanitation, urban development, service sustainability, and water environment factors (2.3.3).

- Of the 15 cities, 5 cities which did not have assistance of other donors but did have urgent sewerage needs in terms of urbanization, sanitation, urban development, service sustainability, and water environment factors were selected for the formulation of the “City Sewerage Master Plans (M/P) for 5 cities”. They were Sri Jayawardenapura Kotte, Dehiwala-Mount Lavinia, Anuradhapura, Badulla, and Nuwara Eliya Municipal Council areas (2.3.3).

- Of the City Sewerage M/P for 5 cities, Sri Jayawardenapura Kotte and Nuwara Eliya were selected as candidates for feasibility study for sewerage development because they met the judgement criteria (urbanization, sanitation, urban development, service sustainability, and water environment factors), had no donor, and land was available for sewage treatment plant and sludge disposal sites. Since the sewerage project in Sri Jayawardenapura Kotte MC was high priority than Nuwara Eliya MC , Sri Jayawardenapura Kotte MC was a candidate for feasibility study for Japanese assistance, and Nuwara Eliya MC was a candidate for additional survey (2.3.3).

- World Bank (WB) and Asian Development Bank (ADB) are supporting sewerage system development in Colombo MC. JICA, AFD, and China are supporting sewerage system developments in other locations (2.3.2).

2.2 SANITATION SECTOR STATUS

2.2.1 Existing Sanitation Situation

Table 2.2-1 describes the sanitation infrastructure in Sri Lanka. Most sewerage systems consist only of sewers and pumping stations, with no treatment. The sewerage system coverage is only 2.4% of the national population. 82.3% of the population relies on on-site sanitation, such as septic tanks. 13.7% have shared toilets or use public toilets. A total of 96.0% use septic tanks. There is no information on sanitation for the remaining 1.6%.

Table 2.2-1 Sanitation Infrastructure in Sri Lanka

Type of Sanitation	Estimated Population Coverage	
	Nos.	%
Pipe-borne sewerage facility (off-site)	510,339	2.4
On-site sanitation facility	17,731,171	82.3
Other sanitation***** (including sharing with another household, common/public toilets)	2,947,298	13.7
Unknown sanitation types	344,483	1.6
Total Population in 2017	21,533,291	100

Source: NWSDB Corporate Plan 2016-2020,
*Note: It is assumed that the number of other sanitation is modified by the sum of 2,411,383 of 2012 Data and the differences of population, 709,643 between 2012 and 2017 population. Other data are 2017 data. Population of 2012 is 20,277,597.

Regarding septic tanks, about 80% of the septic tanks in use do not meet Sri Lanka Standards (SLS) on septic tank (SLS 745) in terms of structure and installation, according to a survey conducted in Gampaha City (Source: Journal of Environment Professionals Sri Lanka, V0.2, 2013). Therefore, septic tanks are not effective in achieving their pollution reduction purpose. The main reason for this deficiency is that although septic tanks are inspected and approved on paper, most are not inspected on site at the time of construction and inferior or undersized units are installed to save costs or accommodate the small land plot sizes.

Sewerage systems used by 2.4% of the population in Sri Lanka are presented in **Table 2.2-2**. Generally, sewerage systems in Sri Lanka do not have sewage treatment plants. Sewage collected by the systems is discharged to the ocean through sea outfalls. Sewage in Colombo, Dehiwala-Mount Lavinia, and Kolonnawa is discharged to the ocean without biological treatment.

In the 1980's when sea outfall without treatment was first regulated, the natural purification capacity of rivers and the sea exceeded the volume of untreated sewage. Sewage naturally decomposed in rivers and sea with minimal environmental impact. However, rapid population growth has caused rapid increase in sewage volumes. The natural purification capacity has been exceeded, and untreated sewage has started to accumulate and pollute water bodies. There is an urgent need to start treating the collected sewage.

At present, sewage from Ratmalana/Moratuwa, and Ja-Ela/Ekala, and a handful housing schemes is biologically treated in sewage treatment plants. This accounts for a mere 0.2% of the national domestic population.

Table 2.2-2 Population Coverage by Sewerage Systems

Sewerage System	City	Total Population	Population Covered	Population of Sewage Treatment	STP Process
Greater Colombo Sewerage System	Colombo	561,314	428,014	-	Screen + Ocean Outfalls
	Dehiwala/Mt. Lavinia	184,468	26,250	-	
	Kolonnawa	60,044	20,355	-	
	Ratmalana/Moratuwa	168,280	15,445	15,445	Extended Aeration with BNR*
	Ja-Ela/Ekala	9,000	8,483	6,600	Extended Aeration with BNR
Kataragama	Kataragama	18,220	5,045	5,045	Waste Stabilization Pond
Hikkaduwa	Hikkaduwa	27,075	3,490	3,490	Waste Stabilization Pond
Hantana / Digana Village Housing Schemes	Kandy/Senkadagala	163,244	3,257	3,257	Trickling Filter / Waste Stabilization Pond
Total			510,339 (2.4%=510,339/ 21,533,291*100)	33,837 (0.2%=33,837/ 21,533,291*100	

Note: * BNR: Biological Nutrient Removal
Population Coverage is calculated based on the year 2017.
Source: MIS Report (December, 2017) of Sewerage Division of NWSDB, NWSDB Corporate Plan 2016-2020 and Statistical Information of District Secretariats.

2.2.2 Water Quality of Public Water bodies

The Sri Lanka National Water Development Report (2006) pointed out a variety of water quality concerns in Sri Lanka, including contamination by nitrate and bacteria in underground and surface waters, mainly due to poor sanitation and untreated wastewater or insufficient wastewater treatment. Eutrophication of lakes and reservoirs was also pointed out (Source: UNESCO and Ministry of Agriculture, Rural Economic Affairs, Livestock Development, Irrigation and Fisheries & Aquatic Resources Development).

According to the City Sewerage M/P for 5 cities (2017), fecal coliform levels 70,000 times higher than allowed in the "Revised Ambient Water Quality Standards[3)]" (1 x 10^3 MPN/100 ml) were recorded in Badulla MC, Uva Province located in central Sri Lanka. In Maha Oya, located in northern Negombo, fecal coliform levels were 10 times higher (Source: CEA Web-site, Surface Water quality Monitoring). In Anuradhapura MC located northern central Sri Lanka, fecal coliform levels were 700 times higher, and Ammonia-nitrogen level of 3.2 mg/l was recorded, 5 times higher than the standard value of 0.59 mg/l. These findings confirm water pollution due to human waste exists and is significant in Sri Lanka.

2.2.3 Laws and Regulations Relevant to the Sewerage Sector

After the National Environmental Act No 47 (1980) was enacted, effluent quality regulations were developed. The Sri Lanka Standards (SLS) regulate effluent quality standards to different water bodies, as summarized in the table below. Currently, the tightening of effluent quality standards for sea outfalls is under discussion in the Ministry of Mahaweli Development and Environment.

[3]) Revised Ambient Water Quality Standards are Water Quality Standards to discharge wastewater to water bodies under revision by Ministry of Mahaweli Development and Environment, Central Environmental Agency and other related institutions. As of May 2017, this is waited for the Cabinet Approval.

Table 2.2-3 Effluent Quality Standards

Receiving Water Body	Standard
Tolerance Limits for Industrial and Domestic Effluents discharged into Marine Coastal Area	SLS 721 of 1985
Tolerance Limits for Inland Surface Waters used as Raw Water for Public Water Supply	SLS 722 of 1985
Tolerance Limits for Industrial Effluents discharged on Land for Irrigation Purposes	SLS 776 of 1987

Source: JET

NWSDB has developed design guidelines for sewerage systems based on the effluent quality regulations. In 1989, NWSDB Manual D7 describing design factors of sewer and pumping stations and outlining sewage treatment was prepared. The sewage treatment section was revised in 2012. These relevant Sri Lankan laws and regulations are summarized in **APPENDIX 2-1**.

2.2.4 Organization Relevant to the Sewerage Sectors

Central Government Ministries and Agencies related to the sewerage sector and their respective functions and responsibilities are shown in **Table 2.2-4**.

Ministry of City Planning, Water Supply and Higher Education formulates the national policies for the water supply and sanitation sector while managing the National Water Supply & Drainage Board (NWSDB) as its implementing authority. NWSDB, being the principle organization, is responsible for implementing the Central Government’s policies and water supply and sewerage projects in the country.

According to Municipal Council Ordinance No. 29 of 1947, the Urban Council Ordinance No. 61 of 1939 and Pradeshiya Sabha Act No. 15 of 1987, all Local Authorities (LAs) have the responsibility to carry out regulatory and administrative functions related to public health and utility services such as waste collection aiming to promote public health. However, only the Colombo MC is currently implementing sewerage project independently. Other LAs depend on NWSDB to implement sewage projects. According to the NWSDB, it is because the budgets of most LAs are insufficient for the implementation of meaningful sewage projects.

The construction and O&M of sewerage facilities must comply with the environmental standards regulated by the Central Environmental Authority (CEA) which comes under the authority of the Ministry of Mahaweli Development and Environment. Especially with respect to O&M of sewerage facilities, operators must meet CEA requirements and obtain Environmental Protection Licenses (EPL) to ensure that those requirements are complied with.

As for sites of sewage treatment plants and pumping stations in this project, the Urban Development Authority (UDA) and the Sri Lanka Land Reclamation and Development Corporation (SLLRDC) under the Megapolis and Western Development Ministry are the key urban planning and implementing agencies to issue permission for securing these sites.

Table 2.2-4 Ministries/Agencies in Sewerage Sector

Ministry	Department/Statutory Organization	Responsibilities
Ministry of City Planning, Water Supply and Higher Education	1.National Water Supply & Drainage Board (NWSDB)[*1]	NWSDB has the following responsivities to municipal council areas and urban council areas. 1. Formulation of policies, programs and projects based on national policies and assistance in implementation of programs and projects in urban area 2. Investigation, planning, design, construction and O&M of water supply and sewerage projects in urban area

Ministry	Department/Statutory Organization	Responsibilities
	2. Community Water Supply and Sanitation Project (CWSSP)*2	CWSSP has the following responsivities to Pradeshiya Sabhas (PSs) areas. 1. Formulation of policies, programs and projects based on national policies and assistance in implementation of programs and projects in rural area. 2. Investigation, planning, design, construction and O&M of water supply and sewerage projects in rural area.
Ministry of Internal & Home Affairs and Provincial Councils & Local Government	1. Provincial Councils (PCs)	1. Granting loans to LAs for public utility works. 2. Government functions relating to local authorities.
	2. Municipal Councils (MCs)	MCs have the following responsibilities to only their MC. The contents of their responsibilities are same as other local authorities, but the region under their jurisdiction is different. 1. Implementation of policies, plans and programs related to sanitation services. 2. Government functions relating to local authorities.
	3. Urban Councils (UCs)	UCs have the following responsibilities to their USs. 1. Implementation of policies, plans and programs related to sanitation services. 2. Government functions relating to local authorities.
	4. Pradeshiya Sabhas (PSs)	PSs have the following responsibilities to their PSs. 1. Implementation of policies, plans and programs related to sanitation services. 2. Government functions relating to local authorities.
Ministry of Mahaweli Development and Environment	1.Central Environmental Authority (CEA)	1. Implementation of policies, plans and programs related to environmental and natural resources. 2. Environmental protection and management. 3. Conservation of river catchments and major reservoirs. 4.Conservation and sustainable development of natural resources.
	2.Marine Environmental Protection Authority (MEPA)	1. Prevention of marine pollution.
Ministry of Megapolis and Western Development	1.Urban Development Authority (UDA)	1.Formulation of policies, programs and projects in physical planning, urban development and assistance in implementation of such programs and projects. 2. Urban planning and development.
	2.Urban Development and Low Income Housing Project (UDLIHP)	1. Urban planning and development. 2. Provision of public utility services to under-served settlements.
	3.Colombo Environment Improvement Project (CEIP)	1.Environmental improvement in Colombo Metropolitan Area.
	4.Sustainable Cities and Township Development Project (SCTDP)	1.Assistance to LAs in improvement of urban infrastructure facilities and housing. 2.Provision of water supply and sanitation services in rural areas.

*1: NWSDB is responsible for water supply and sanitation mainly in urban area
*2: CWSSP is responsible for water supply and sanitation mainly in rural community area
Source: NWSDB

2.3 NATIONAL POLICY, NWSDB PROGRAM AND JICA STUDY

2.3.1 National Policy

In the Western Region Master Plan-2030 (2016), the government of Sri Lanka set the Western Region of Sri Lanka, consisting of Gampaha, Colombo and Kalutara districts, as a key region for development in its strategy of lifting the status of the nation to that of an upper middle income country (Source:Megapolis and Western Development Ministry). In this plan, sewerage was an important infrastructure for creating an environment for economic growth while preventing water pollution. A sewerage project for Sri Jayawardenapura Kotte MC and its surrounding areas was identified.

Public Investment Programme 2017 – 2020 (Source: Ministry of National Policies, Economic Affairs, Re-settltement & Rehabilitation, Northern Province Development and Youth Affairs) showing the development plans in Sri Lanka during 4 years was established in 2016. In these programme, sewerage in the western province area including Colombo, Gampaha and Kalutara Districts was explained to be vital in order to support economic activities which have already been planned under the above the Western Region Master Plan. Sri Jayawardenapura Kotte Wastewater Disposal System was planned as one of major projects for the improvement of sewerage sector.

Also in 2017, the GOSL established its "Vision 2025" (Source: Ministry of Mass Media) for development of different industries, describing the government's economic vision. In it sewage pollution reduction was identified as one of the key infrastructures necessary to support sustainable economic growth with equity.

In this context, sewerage development is relevant and supported by national policies.

2.3.2 NWSDB Program

The "NWSDB Corporate Plan for 2016 – 2020" (2015) aimed to develop sewerage systems to achieve 3.3% sewerage coverage target using funds from JICA, World Bank, AFD, China, and other donors.

NWSDB sets the following objectives in "NWSDB Corporate Plan for 2016 – 2020":

- Objective 1.1: To achieve piped water supply coverage of 60.0% (49.1% by the NWSDB) and piped sewerage coverage of 3.3 % of the total population of Sri Lanka by 2020
- Objective 1.2: To prepare water safety plans to ensure high degree of water security with respect to quality and quantity for all water supply schemes

The following projects shown in **Table 2.3-1** and **Table 2.3-2** are described in "NWSDB Corporate Plan". Regarding projects in **Table 2.3-2**, source of financing has not been decided yet.

Table 2.3-1 On-going Sewerage Projects and Financing Sources

Project Name	Population	Source of Fund	Project Description
Kandy City Wastewater Disposal Project	205,000 (including floating population)	JICA	Location: Kandy MC Type of finance: loan Components: construction of trunk sewers, branch sewers, house connections, pumping stations, and sewage treatment at 14,000 m³/day capacity.
GPOBA (The Global Partnership on Output Based Aid)	35,000	World Bank	Location: Colombo MC Type of finance: grant Components: construction of house connections for low income settlements in the Greater Colombo area to connect to the sewerage networks

Project Name	Population	Source of Fund	Project Description
Greater Kurunegala Water Supply & Sewerage Project	25,000	China EXIM Bank	Location: Kurunegala MC Type of finance: loan Components: construction of trunk sewers, branch sewers, pumping stations, and sewage treatment at 4,500 m^3/day capacity.
Kataragama Wastewater Disposal Project	110,000 (including floating population)	Austria	Location: Kataragama MC Type of finance: loan Components: construction of trunk sewers, branch sewers, pumping stations, and sewage treatment at 3,000 m^3/day capacity (Aerated Lagoon Maturation Pond).
Expansion of sewerage coverage of Moratuwa & Ratmalana	45,500	AFD	Location: Moratuwa MC Type of finance: loan Components: construction of trunk sewers and branch sewers to increase sewage volume to meet the treatment capacity of 17,000 m^3/d of the Ratmalana /Moratuwa STP.
Sanitation and Hygiene Initiative for Towns (SHIFT) Project (Galle, Negombo, Kelaniya-Peliyagoda)	200,000	AFD	Location: Negombo MC Type of finance: loan Components: construction of trunk sewers, branch sewers, house connections, pumping stations, a sewage treatment at 33,600 m^3/d capacity, feasibility study for Galle and Kelaniya-Peliyagoda, and capacity development of NWSDB sewerage section
Greater Colombo Wastewater Management Project	Rehabilitation Work	ADB	Location: Colombo MC, Dehiwala/Mt Lavinia MC and Kollonnawa UC Type of finance: loan Components: construction of trunk sewers and branch sewers Note: The Project in Colombo MC is carried out by Colombo MC and projects in the other two municipalities are carried out by NWSDB.

Source: JET

Table 2.3-2 Projects Ready for Implementation and Expected Funding Sources

Project Name	Population	Expected Source of Fund	Project Description
Hambantota Wastewater Disposal Project	117,000	China EXIM Bank	Location: Hambantota MC Type of finance: loan Components: construction of sewers and pumping stations for Hambantota Town including Sea Port area with a sea-outfall of 12,000 m^3/day capacity
Kattankudy Wastewater Disposal Project	47,000	China EXIM Bank	Location: Kattankudy UC Type of finance: loan Components: construction of sewers and pumping stations for a 10,000 m^3/day capacity. Construction of a sewage treatment plant is unknown.
Maharagama-Borelesgamuwa Wastewater Disposal Project	45,000	China EXIM Bank	Location: Maharagama MC Type of finance: loan Components: construction of sewers leading to the sea-outfall of 6,675 m^3/day capacity
Chilaw & Puttalam Wastewater Disposal Project	63,000	China EXIM Bank	Location: Chilaw UC/Puttalam UC Type of finance: loan Components: construction of sewers leading to the sea-outfall of 2,700 m^3/day capacity
Expansion of Sewerage Coverage in Dehiwala/Mt Lavinia area.	50,000	ING Bank, Netherlands	Location: Dehiwala/Mt.Lavinia MC Type of finance: loan Components: construction of sewers for 50,000 people leading to the sea-outfall of 26,000 m^3/d capacity in Mt. Lavinia

Source: JET

NWSDB set a target of 7.0% sewerage coverage for the nation by 2035 in the "Strategic Sewerage Master Plan for Sri Lanka" (2017), based on the Sustainable Development Goal (SDG) of improving sewage treatment quality for water quality improvement of public water bodies. The reduction of pollution to improve water quality is one of the sanitation targets in the SDGs (2015). The specific targets quoted from SDGs are as follows:

- By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
- By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

In the "Strategic Sewerage Master Plan for Sri Lanka" (2017), the 15 priority cities including Sri Jayawardenapura Kotte MC were identified as priority cities for sewerage system development with sewage treatment plants.

Thus, the sewerage project in Sri Jayawardenapura Kotte MC and its surrounding areas is relevant to the NWSDB program.

Table 2.3-1 and **Table 2.3-2** show donors active in sewerage development. JICA, AFD, and China are supporting sewerage system development projects in Municipal Councils managed by NWSDB. World Bank (WB) and ADB are supporting sewerage developments in Colombo MC. WB is supporting a house connection project for low income households, and ADB is supporting sewerage system development in Colombo MC. Except for Colombo MC, there is no overlap of the sewerage projects by other donors. Currently, several major government buildings located in Sri Jayawardenaura Kotte are included in the ADB supported Colombo sewerage development project. Sewerage from these buildings is collected and sent to the sea outfall through the Colombo sewerage system. Since ADB has implemented sewerage projects in the area, coordination with them for the implementation of the current project will be considered.

There is no Public Private Partnership (PPP) project on sewerage, but NWSDB has planned a Weliwita Water Supply Project as a PPP project. As of February 2019, the selection of a suitable partner was implemented under conditions with Design-Build-Operation for 30 years. NWSDB is assisted with Technical Assistance by a consultancy Team provided through the World Bank.

2.3.3 Strategic Sewerage Master Plan

The Strategic Master Plan was formulated in 2 stages. First, NWSDB formulated the "Strategic Sewerage Master Plan for Sri Lanka" (2017) with assistance of JICA. The "Strategic Sewerage Master Plan for Sri Lanka" surveyed 79 cities, including all Municipal Councils and Urban Councils, and some selected Pradeshiya Sabhas in certain districts where no Municipal or Urban Councils exist. Subsequently, it identified 15 priority cities (**Table 2.3-3**) for sewerage system development by the year 2035 by considering key criteria (**Table 2.3-4**) such as population and population density (Urbanization), water supply coverage ratio and water born disease ratio (Sanitation), city development importance grade (Urban Development), water bill collection ratio (Sustainability of sewerage service), and impact on drinking water supply source (Water Environment). It presented the development process of sewerage systems for the 15 cities, including Sri Jayawardenapura Kotte MC.

Table 2.3-3 Cities for Sewerage System Development to 2035

Local Government Authority	Population (2012)	Population served by water supply system (2012)	Necessity of Sewerage System	Note
Colombo MC	561,314	561,314	Biggest city in Sri Lanka National growth centre District capital	Sewerage system has been developed (ADB and WB)
Kandy MC	98,828	96,060	Regional growth centre District capital World famous tourist area Water intake located downstream	Sewerage system is under construction (JICA).
Sri Jayawardenapura Kotte MC	107,925	107,925	National capital Significant impact of pollution load on public water body	Sewerage system has been planned.
Anuradhapura MC	65,345	47,676	National growth centre District capital World famous tourist area Water intake located downstream Significant impact of pollution load on public water body	Sewerage system is being planned (AFD)
Badulla MC	42,237	42,237	Regional growth centre District capital Water intake located downstream	Sewerage system has been planned.
Kelaniya PS	109,603	109,603	Regional growth centre Famous tourist area Water intake for Colombo located downstream Significant impact of pollution load on public water body	Sewerage system has been planned (AFD).
Nuwara Eliya MC	23,804	23,804	District capital World famous tourist area Ground water as a water source	
Galle MC	86,333	86,333	Regional growth centre District capital World famous tourist area Water intake located downstream	Sewerage system has been planned (AFD).
Dehiwala/Mt. Lavinia MC	184,468	184,468	Large population Adjoining city to Colombo	Sewerage system partially has been developed and has been planned (Netherlands).
Negombo MC	142,449	142,449	World famous tourist area	Sewerage system has been planned (AFD).
Kotikawatta-Mulleriyawa PS	131,643	131,643	Water intake for Colombo located downstream	
Rathnapura MC	47,105	36,112	District capital World famous tourist area Water intake located downstream	
Hambantota MC	23,236	23,326	National growth centre District capital World Famous Tourist Area	Sewerage system has been planned (China).
Trincomalee UC	48,351	48,351	National growth centre District capital World famous tourist area	
Maharagama UC	196,423	169,902	Significant impact of pollution load on public water body	Sewerage system has been planned (China).
Total		1,811,103		7.1%(=1,811,103*0.9/22,645,723*100)

Note: It is assumed that sewerage served population in 2035 is 90% of water served population in 2012.
Source: JET

Table 2.3-4 Criteria for Selection of Priority Cities

Criteria	Parameter
1. Urbanization	Population density (Water Supply area)
	Population (Equivalent population based on water supply)
2. Sanitation	Incidence of water borne diseases
	Water supply coverage ratio
3. Urban Development	Presence of tourist attractions
	Presence of growth centres and industrial zones
4.Sustainability of Sewerage Services	Water bill collection ratio as indication of willingness to pay
	Median household income as ability to pay sewerage services
5. Water Environment	Presence of drinking water supply source and environmental protection area
	Potential pollution to public water body

Source: JET

The second study was called the “City Sewerage M/P for 5 cities”. It built upon the findings of the first study, further narrowing the selection from 15 cities to just two. One important requirement for selection was that the city under consideration did not already have donor assistance for sewerage development in order to avoid overlapping international assistances.

The study resulted in the selection of two cities, Sri Jayawardenapura Kotte MC and Nuwara Eliya MC for sewerage development due to the above criteria as well as land availability for sewage treatment plant and sludge disposal sites. GOSL requested two yen loans for the implementation of sewerage projects for the two cities under the special terms for economic partnership (STEP) in the year 2017. Phase II started in June 2017 at the request of the GOSL to collect information for the evaluation of project feasibility.

In consultation with the Ministry of City Planning, Water Supply and Higher Education, and NWSDB, 5 cities without assistance from other donors (**Table 2.3-3**) were selected from the 15 cities with high necessity based on criteria given in the “City Sewerage M/P for 5 cities” (**Table 2.3-4)**. These 5 cities were Sri Jayawardenapura Kotte, Dehiwala-Mount Lavinia, Anuradhapura, Badulla and Nuwara Eliya Municipal Council areas.

Table 2.3-5 Five Cities for City Sewerage Master Plan

Local Government Authority	Description
Sri Jayawardenapura Kotte MC	National capital Significant impact of pollution load on public water body
Anuradhapura MC	National growth centre District capital World famous tourist area Water intake located downstream Significant impact of pollution load on public water body
Badulla MC	Regional growth centre District capital Water intake located downstream
Nuwara Eliya MC	District capital World famous tourist area Ground water as a water source
Dehiwala/Mt. Lavinia MC	Large population Adjacent to Colombo

Source: JET

Of the City Sewerage M/P for 5 cities, Sri Jayawardenapura-Kotte and Nuwara Eliya were selected as candidates for feasibility studies for Japanese financial assistance for sewerage development. The major justifications are as follows:

- Sri Jayawardenapura Kotte MC is the national capital. It has no sewerage system and no other potential donor. Its large and growing population with its associated environmental impacts are affecting the area, including pollution of the lake surrounding the parliament. Many infrastructure development projects are planned in this area, which are expected to exacerbate pollution issues. Currently, high fecal coliform values related to waterborne disease have been found. Since water quality is expected to decrease in the future, a sewerage system to reduce pollution load and coliform causing waterborne disease is considered to be highly necessary. Therefore, Sri Jayawardenapura Kotte MC was selected as a candidate for feasibility study for Japanese assistance.

- Nuwara Eliya MC is a world renowned tourist destination and is recognized as an emerging tourist hub in Sri Lanka, evidenced by the increasing number of international and domestic tourists. This increase is expected to bring about further deterioration of public water bodies and other touristic resources. Therefore, sewerage development is necessary to protect and improve the water environment. Moreover, Japan has supported solid waste management and water supply projects in the MC. These two projects are expected to produce synergistic effects on environment conservation in Nuwara Eliya. However, in terms of city development importance grade, population, and population density, the sewerage development at Nuwara Eliya MC was less priority than Sri Jayawardenapura Kotte MC. The sewerage project of Nuwara Eliya MC will be implemented after the completion of the sewerage project of Sri Jayawardenapura Kotte MC. Since the feasibility study for Nuwara Eliya MC prepared at the same time of Sri Jayawardenapura Kotte MC seemed to become old fashioned, Nuwara Eliya MC was selected as a candidate for additional survey instead of feasibility study.
- Regarding Anuradhapura MC and Dehiwala/Mount Lavinia MC, other donors expressed intentions for assistance in sewerage development during the preparation of City Sewerage M/P for 5 cities. Therefore, they were not considered for Japanese assistance to avoid overlapping of international assistance. Regarding Badulla MC, there is no appropriate solid waste disposal site. Disposal of sludge from sewage treatment will present a problem that has to be resolved before any development can be considered. Therefore, the further feasibility study of the project was not considered at that time.

Consequently, Jayawardenapura Kotte MC is a candidate for further study for the formulation of ODA projects for sewerage development, and Nuwara Eliya is for additional survey.

CHAPTER 3 PRESENT CONDITIONS AND NEED FOR THE PROJECT

3.1 OUTLINE

- The service area of this Project covers approximately 2,920 ha, consisting of Sri Jayawardenapura Kotte MC and its surrounding areas, including parts of Kaduwela MC, Dehiwala/Mount Lavinia MC, Maharagama UC, and Kotikawatta-Mulleriyawa PS (3.2.1).

- Increasing population in the border areas of the service area is confirmed, while population at the centre of Sri Jayawardenapura Kotte MC is relatively stable. 5% to 15% population growth at Kotikawatta-Mulleriyawa PS and Maharagama UC were found during 10 years. Total population in the service area is about 250,000, which is stable in the past 10 years (3.2.3 (2)).

- With almost 100% pipe borne water coverage, about 30,000 m^3/d of sewage discharge is expected based on water supply volume (3.2.6).

- At present, high fecal coliform values are recorded throughout the service area. Pollution of public water bodies is possibly caused by human waste contamination (3.2.4). Waterborne diseases are on the rise. Similarly, the social condition survey found that diarrhea, typhoid, and other waterborne diseases are frequently experienced by residents (3.2.3 (5)).

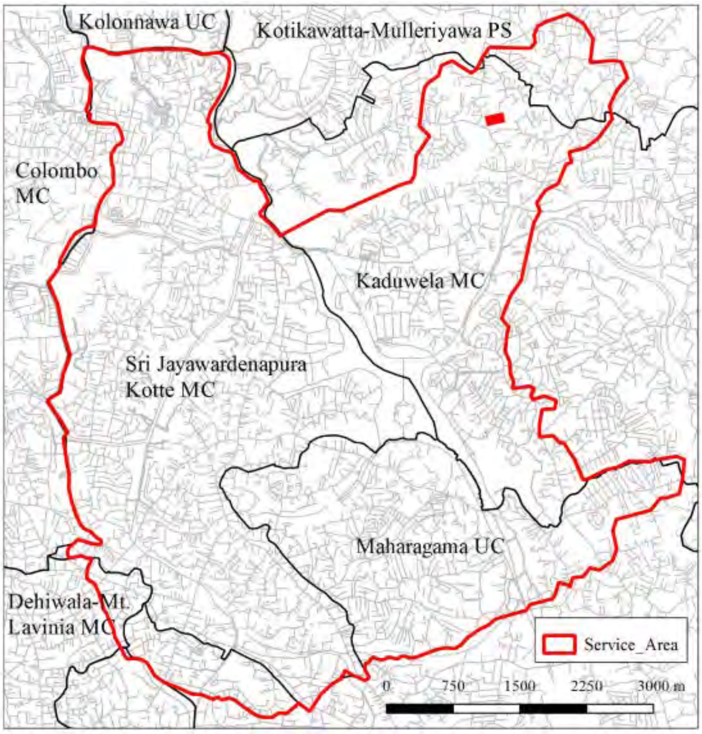
- There are some low-income areas in the service area, but the poverty rate is well below that the national average (3.2.3 (4)). The household income of service area is relatively high compared with the national average (3.2.3 (6)).

3.2 DESCRIPTION OF THE SERVICE AREA

3.2.1 Location

Sri Jayawardenapura Kotte MC is the national capital and Colombo MC is the district capital. Based on the City Sewerage M/P of Sri Jayawaredenapura Kotte MC, the service area was decided by including Sri Jayawaredenapura Kotte MC, its suburbs where population recently has increased, and surrounding area of a STP site through the consultation with NWSDB. The service area covers approximately 2,920 ha, consisting of Sri Jayawardenapura Kotte MC and its surrounding areas, including parts of Kaduwela MC, Dehiwala/Mount Lavinia MC, Maharagama UC, and Kotikawatta-Mulleriyawa PS in the Colombo District of Western Province. The area around the STP was added as described in the City Sewerage M/P.

Figure 3.2-1 shows geological relationship between the service area and surrounding areas. The service areas bordered by Kolonnawa UC and Kotikawatta-Mulleriya PS to the north, Kaduwela MC to the east, Maharagama UC to the south, Dehiwala-Mount Lavinia MC to the southwest, and Colombo MC to the west.



Source: JET

Figure 3.2-1 Location of Relevant MC and UC

3.2.2 Climate

In the Sri Jayawardenapura Kotte MC area and its surroundings, average monthly minimum temperature is around 23 degree Celsius. Average monthly maximum temperature is around 31 degree Celsius. The service area gets a significant amount of rain during the year, receiving the most precipitation in May and October. As much as 377 mm can be recorded in May. Details are described in **APPENDIX 3-1**.

The service area consists mainly of scattered hills between 1 and 35 meters above sea level. The soil consists of loose to medium dense soft clayey sand up to an average depth of 2 - 5 m, on top of 2 - 6 m of medium dense to dense gravelly sandy clay with weathered laterite particles. The soil in marshy areas also consists of peat. Completely weathered rock can be encountered 12 - 15 m from the surface.

3.2.3 Socio-Economic Conditions

(1) Administration

Sri Jayawardenapura Kotte MC area having been the national capital of Sri Lanka in the 15th century is a city with a great heritage. After several centuries of neglect the city has once again risen to prominence after its declaration as the administrative capital of Sri Lanka in 1982. The Parliament and most Ministries and Public Institutions were shifted from Colombo and are now located there and its immediate neighbourhood. The city was accorded Municipal Status in 1997. The MC is located in the Colombo District, in the Western Province of Sri Lanka. It has 20 GNDs and a total area of 17 km^2. Colombo District is 699 km^2 in size, while the Western Province is 3,684 km^2. The forest areas of the District versus the Province are 15 km^2 and 195 km^2 respectively. The Colombo District has 23 km^2 of inland water while the Western Province has 91 km^2.

Table 3.2-1 shows Divisional Secretary Divisions (DSDs) and Grama Niladhari Divisions (GNDs) in the service area. The service area consists of Sri Jayawardhanepura kotte MC (Sri Jayawardenapura

Kotte DSD) including 20 GNDs, Dehiwala/Mount Lavinia MC (Dehiwala DSD) including 2 GNDs, Kaduwela MC (Kaduwela DSD) including 13 GNDs, Maharagama MC (Maharagama DSD) including 11 GNDs, and Kotikawatta-Mulleriya PS (Kolonnawa DSD) including 3 GNDs.

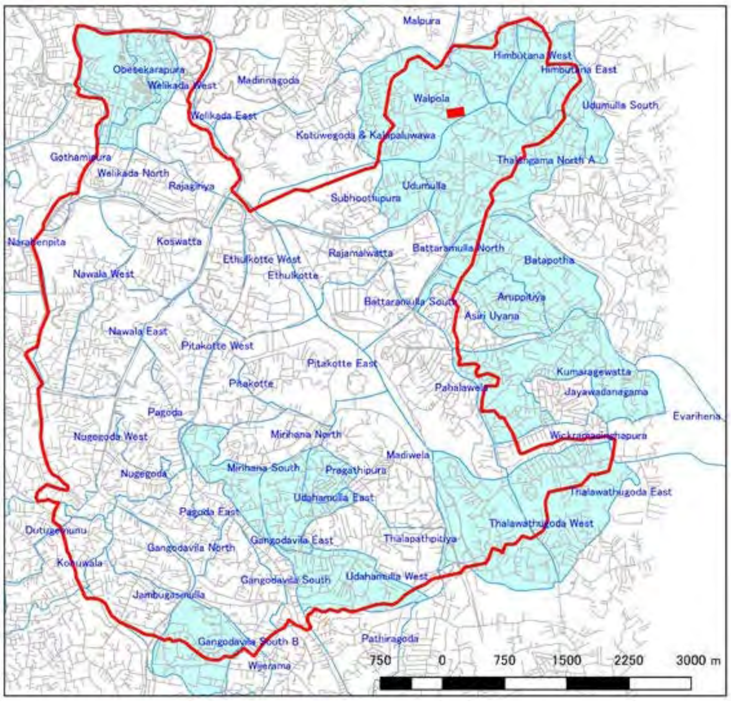
Table 3.2-1 DSDs and GNDs in the Service Area

No.	Name of DSD & GND	No.	Name of DSD & GND
1	Sri Jayawardenapura Kotte DSD	4	Kaduwela DSD
1.1	Obsekarapura	4.1	*Aruppitiya*
1.2	Welikada West	4.2	*Batapotha*
1.3	Welikada East	4.3	Walpola
1.4	Rajagiriya	4.4	Subhoothipura
1.5	Welikada North	4.5	Battaramulla South
1.6	Nawala West	4.6	Battaramulla North
1.7	Koswatta	4.7	Udumulla
1.8	Ethulkotte West	4.8	Rajamalwatta
1.9	Ethulkotte	4.9	Thalangama North A
1.10	Pitakotte East	4.10	Asiri Uyana
1.11	Pitakotte	4.11	Pahalawela
1.12	Pitakotte West	4.12	Kumaragewatta
1.13	Nawala East	4.13	Wickramasinghapura
1.14	Nugegoda West	5	Maharagama DSD
1.15	Pagoda	5.1	Mirihana North
1.16	Nugegoda	5.2	Mirihana South
1.17	Pagoda East	5.3	Pragathipura
1.18	Gangodavila North	5.4	Thalapathpitiya
1.19	Gangodavila South	5.5	Udahamulla East
1.20	Gangodavila East	5.6	Udahamulla West
2	Dehiwala DSD	5.7	Madiwella
2.1	*Dutugemunu*	5.8	Thalawathugoda West
2.2	*Kohuwala*	5.9	Thalawathugoda East
3	Kolonnawa DSD	5.10	Gangodavila South B
3.1	Udumulla South	5.11	Jambugasmulla
3.2	Himbutana East		
3.3	Himbutana West		

Note: S/No 1-3 refers to "PROJECT IDENTIFICATION REPORT" prepared by Megapolis and Western Development Ministry" and "PROJECT PROPOSAL FOR SRI JAYEWARDENEPURA KOTTE WASTEWATER DISPOSAL SYSTEM" prepared by NWSDB.
Source: JET based on data of Department of Census and Statistics

(2) Population and Demography

According to the Census and Statistics Department of Sri Lanka, the population of Sri Jayawardenapura Kotte MC has increased about 7% in the 30 years, but has been mostly stable for the past 10 years. In Kotikawatta-Mulleriya PS, and Maharagama UC, the population has increased about 5% to 15% in the last 10 years. Sri Jayawardenapura Kotte MC has 6,300 persons per km^2, while the selected service area has 8,500 per km^2. **Figure 3.2-2** shows the population growth areas, highlighted in blue. They are located northern border areas of Sri Jayawardenapura Kotte MC, Kotikawatta-Mulleriya PS, Kaduwela MC and Maharagama UC. The population of the service area in 2012 for the Sri Jayawardenapura Kotte MC (Sri Jayawardenapura Kotte DSD) was 107,925 and Dehiwala-Mount Lavinia MC (Dehiwala DSD) was 10,281 (**Table 3.2-2**). Populations of Kaduwela MC (Kaduwela DSD), Maharagama UC (Maharagama DSD), and Kotikawatta-Mulleriya PS (Kolonnawa DSD) were 54,043, 65,450, and 9,631, respectively. Total population in the service area is 247,330.



Note: This figure is modified based on the map of Sri Lanka Survey Department by JET.

Figure 3.2-2 GNDs in the Service Area

Table 3.2-2 Census Population Data for GNDs

No.		Population 2001	Population 2012	No.		Population 2001	Population 2012
1	**Sri Jayawardenapura Kotte DSD**	***116,366***	***107,925***	**4**	**Kaduwela DSD**	***54,087***	***54,043***
1. 1	Obsekarapura	11,517	11,963	4. 1	*Aruppitiya*	1,893	2,354
1. 2	Welikada West	5,532	7,004	4. 2	*Batapotha*	6,546	7,582
1. 3	Welikada East	7,343	6,749	4. 3	Walpola	7,899	8,518
1. 4	Rajagiriya	4,291	3,591	4. 4	Subhoothipura	2,628	2,568
1. 5	Welikada North	5,151	4,834	4. 5	Battaramulla South	2,257	1,580
1. 6	Nawala West	4,517	4,059	4. 6	Battaramulla North	3,331	2,001
1. 7	Koswatta	6,424	5,707	4. 7	Udumulla	2,447	2,465
1. 8	Ethulkotte West	3,516	3,371	4. 8	Rajamalwatta	2,449	2,014
1. 9	Ethulkotte	6,229	5,929	4. 9	Thalangama North A	8,383	9,250
1. 10	Pitakotte East	4,121	3,984	4. 10	Asiri Uyana	3,599	3,057
1. 11	Pitakotte	3,771	3,634	4. 11	Pahalawela	5,283	4,442
1. 12	Pitakotte West	5,400	5,301	4. 12	Kumaragewatta	4,150	5,076
1. 13	Nawala East	5,811	5,473	4. 13	Wickramasinghapura	3,222	3,136
1. 14	Nugegoda West	6,238	5,627	**5**	**Maharagama DSD**	***63,330***	***65,450***
1. 15	Pagoda	6,363	5,446	5. 1	Mirihana North	6,339	6,222
1. 16	Nugegoda	5,517	3,365	5. 2	Mirihana South	5,745	6,043
1. 17	Pagoda East	6,014	5,944	5. 3	Pragathipura	5,420	5,838
1. 18	Gangodavila North	6,418	5,352	5. 4	Thalapathpitiya	7,373	7,086
1. 19	Gangodavila South	8,198	7,305	5. 5	Udahamulla East	6,042	6,309
1. 20	Gangodavila East	3,995	3,287	5. 6	Udahamulla West	4,261	4,780
2	**Dehiwala DSD**	***13,449***	***10,281***	5. 7	Madiwella	6,472	6,244
2. 1	*Dutugemunu*	5,941	4,806	5. 8	Thalawathugoda West	4,876	5,492
2. 2	*Kohuwala*	7,508	5,475	5. 9	Thalawathugoda East	5,351	6,217
3	**Kolonnawa DSD**	***8,479***	***9,631***	5. 10	Gangodavila South B	6,541	7,391
3. 1	Udumulla South	2,217	2,408	5. 11	Jambugasmulla	4,910	3,828
3. 2	Himbutana East	3,261	3,879		**Grand Total**	**255,711**	**247,330**
3. 3	Himbutana West	3,001	3,344				

: GNDs where population increased from 2001 to 2012

Source: Census of Population & Housing-2012, Department of Census and Statistics

(3) Religion/Ethnicity

Most of the population in the Colombo District is Buddhist (**Table 3.2-3**). (Note: Since there are no data on Sri Jayawardenapura Kotte MC, the data of Colombo District are used as representative data for the service area.)

Table 3.2-3 Population by Religion

Buddhist	Hindu	Islam	Roman Catholic	Other Christian	Other	Colombo District Total
1,631,659	185,944	274,267	162,701	67,405	2,324	2,324,300
70.2%	8.0%	11.8%	7.0%	2.9%	0.1%	100%

Source: Economic and Social Statistics of Sri Lanka -2014, Central Bank of Sri Lanka, April 2014

Ethnicities of the population are summarized in the table below.

Table 3.2-4 Population by Ethnicity

Sinhala	SL Tamil	Indian Tamil	SL Moor	Other	Colombo District Total
1,778,090	234,754	23,243	248,700	37,189	2,324,300
76.5%	10.1%	1.0%	10.7%	1.6%	100%

Source: Economic and Social Statistics of Sri Lanka -2014, Central Bank of Sri Lanka, April 2014

(4) Poverty Rate

The Household Income and Expenditure Surveys (HIES) carried out by the Census and Statistics Department of Sri Lanka estimated poverty rates at the district, provincial, and national levels. The results are presented below:

Table 3.2-5 Poverty Rate

	Poor Households %		
	2006/2007	2009/2010	2012/2013
Sri Lanka	12.6	7.0	5.3
Western Province	6.5	3.0	1.5
Colombo District	3.9	2.5	1.1

Source: Department of Census and Statistics

There are some low-income areas in the service area, but the poverty rate is well below the national average. (Note: Since there are no data on Sri Jayawardenapura Kotte MC, the data of Colombo District are used as representative data for the service area.)

(5) Public Health Conditions

The following incidents on waterborn diseases in the service area were reported through Social Condition Survey and a local official’s homepage. Key issues that emerged are summarized below.

- Out of 451 interviewees from Social Condition Survey, the 13.7% of people suffered from waterborn diseases. The majority were Dengue (11.3%) and others included Typhoid and Diarrhoea.
- There are many water borne diseases reported in Maharagama. In 2016, 10 cases of dysentery, 6 of enteritis, and 5 of hepatitis were counted. In 2017, uncategorized 1,681 cases (approximately 2.5% of the population) were reported. (Source: http://maharagama.ds.gov.lk/index.php/en/)

Based on these things, improving water quality enhances public conditions by reducing waterborn diseases.

(6) Economy

Sri Jayawardenapura Kotte MC, Colombo MC, and Dehiwala/Mount Lavinia MC areas are the most urbanized parts of the Colombo District. Nugegoda Town is the major commercial centre, where head offices of major commercial banks and financial companies are located. **Table 3.2-6** shows the GDP by industry sector of the Western Province. (Note: Since there are no data on Sri Jayawardenapura Kotte MC, the data of Colombo District are used as representative data for the service area.)

Table 3.2-6 GDP by Industry Sector of Western Province (Current Prices)

Unit: LKR Million

No	Sector	2012		2013*1		2014*1		2015*2	
1	Agriculture	93,187	2.9%	87,427	2.3%	88,819	2.2%	79,986	1.9%
2	Industry	1,135,586	35.0%	1,420,948	37.7%	1,473,137	36.2%	1,596,914	37.3%
3	Services	2,015,081	62.1%	2,265,326	60.0%	2,502,037	61.6%	2,605,532	60.8%
	Provincial GDP	3,243,854	100.0%	3,773,701	100.0%	4,063,993	100.0%	4,282,432	100.0%
	% Share of National GDP		42.8%		42.2%		41.7%		41.2%

Source: CBSL Annual Report 2016
Notes: *1; Revised, *2; Provisional

The Western Province is responsible for 41% to 43% of the national GDP.

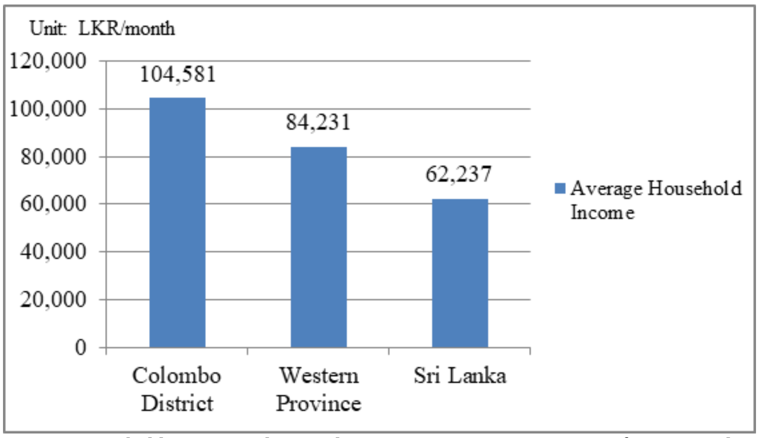
The service sector is the largest and is responsible for 60 to 62% (national average: 59.8%) of the total GDP of the Province and the industry sector 35 to 38% (national average: 31.0%).

Average household income is available from "Household Income and Expenditure Survey 2016". Some of the data are presented in **Table 3.2-7** and **Figure 3.2-3.** The average monthly household income in Colombo District is 104,581 LKR (2016). Household income of Colombo District is 68% higher than the national average and 24% higher than the provincial average. The sewerage tariff structure must be designed with consideration for the affordability to pay.

Table 3.2-7 Monthly Household Income - Colombo District (2016)

No.	Sector	Colombo District
1	Average Household Income per Month	104,581
2	Income Receivers' Mean Income per Month	51,962
3	Ave. No. of Income Receivers	2.0

Source: Household Income and Expenditure Survey 2016, Department of Census and Statistics, Ministry of National Policies, Economic Affairs Re-settlement & Rehabilitation, Northern Province Development and Youth Affairs



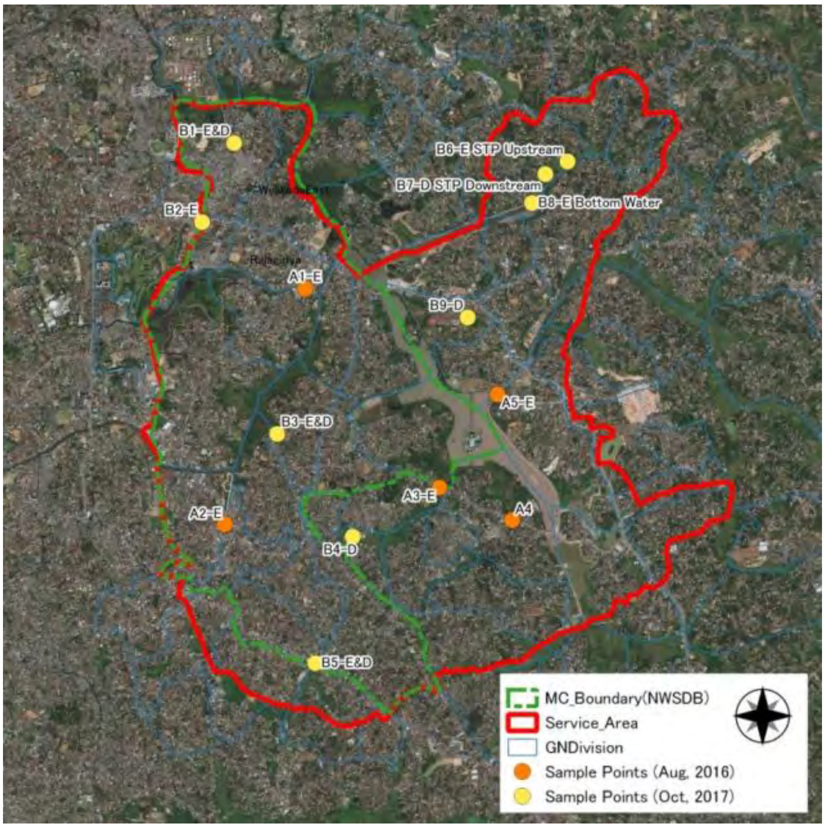
Source: Household Income and Expenditure Survey 2016, Department of Census and Statistics, Ministry of National Policies, Economic Affairs Re-settlement & Rehabilitation, Northern Province Development and Youth Affairs

Figure 3.2-3 Comparison of Monthly Household Income

3.2.4 Water Environment Conditions

(1) Water Quality Sampling

Water quality at nine points in **Figure 3.2-4** was investigated in different seasons in **Table 3.2-8**. Details of the surveys are available in **APPENDIX 3-2**.



E: Environmental Sample
D: Discharge Sample
Source: JET

Figure 3.2-4 Sampling Locations

Table 3.2-8 Water Quality Survey

No.	Survey	Sampling date	Season
1	Environmental-1	Aug-18, 2016	Dry season
2	Discharged	Oct-9, 2017	Wet season
3	Environmental-2	Oct-12, 2017	Wet season

Source: JET

(2) Water Quality Results

Poor water quality of the water bodies in the service area is clearly indicated by the abundance of nutrients and organic materials. Fecal coliform values, almost 10 times higher than water environment standards (1,000 MPN/100 ml), were recorded over the service area. Especially at sample station B1 (Northern area of Sri Jayawardenapura Kotte, high population growth area in Figure 3.2-2), fecal coliform levels were 17 times higher than the standard and ammonia-nitrogen levels were 15 times higher than the standard (0.59 mg/l). In high population density areas (sample points B1, B3 and A3), the water is anaerobic and/or eutrophic. Pollution of public water bodies are possibly caused by human waste contamination. Locations B1 and B4 (Northern Sri Jayawardenapura Kotte and Maharagama) appear to be the most contaminated areas where low-income households are located (**Table 3.2-9**).

There is no evidence of salt water intrusion. Full results are shown in **APPENDIX 3-2**.

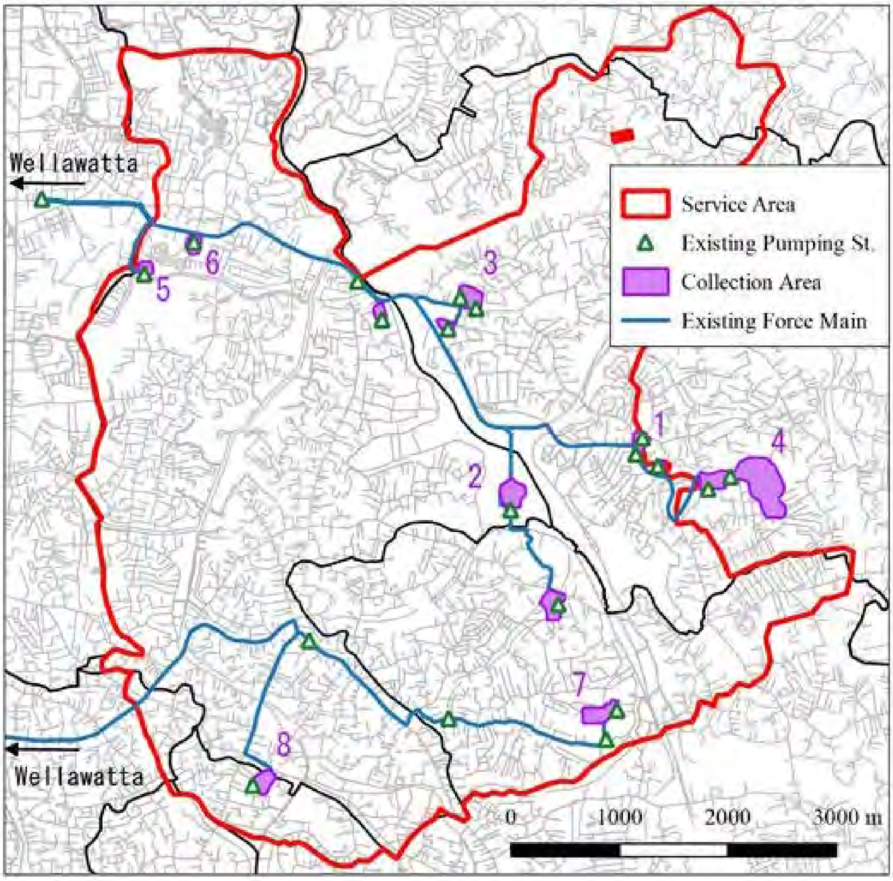
Table 3.2-9 Water Quality Sewage at B1 and B4

Contents	B1	B4	Standards*1
Fecal Coliform (MPN/100 ml)	17,000	5,000	1,000
Ammonia-Nitrogen (mg/ml)	7.5	4.0	0.59

Note: *1 Revised Ambient Water Quality Standards
Source: JET

3.2.5 Sewerage System Development

Sewage in the service area is collected from government complexes and housing schemes (**Figure 3.2-5**) and sent to the sewerage system in Colombo MC (**Table 3.2-10**). This sewage is eventually discharged to the ocean at the Wellawata outfall.



Source: JET prepared based on NWSDB data.

Figure 3.2-5 Existing Sewer Layout of the Service Area

Table 3.2-10 Sewage Collected by the Existing Sewer system

	AREA	Estimated Sewage Volume, m^3/day
1	Isurupaya	85
2	Parliament	170
3	Sethsiripaya	210
4	Jayawadanagama Housing Scheme (out of the service area)	730
5	Royal Park	160
6	Central Park	75 (60-90)
7	Sri Jayawardenapura Hospital	630
8	Maddumagewatta Housing Scheme	210
Total		2,270

Source: Hearing Data from Greater Colombo Sewerage section of NWSDB Sewerage

Most houses in the service area use septic tanks or sewerage pits for sanitation. Sewage treatment by septic tanks is usually insufficient due to improper desludging and contaminants percolate into the groundwater. Household wastewater such as kitchen and bathroom wastewater, is collected separately and flows to road side drains, which are also used for storm water drainage. Both types of waste water eventually end up on local streams and water bodies. In the dry season, drains and channels in low lying areas are seriously polluted (**Figure 3.2-6)** and emit foul odours. Sewerage development is necessary to improve water quality and the living environment.

Source: JET

Figure 3.2-6 Existing Drainage

3.2.6 Present Water Supply

Pipe borne water coverage is nearly 100% in the service area. Problems related to pipe borne water supply are decrease of water pressure during peak consumption hours and water leakage from the supply network.

Table 3.2-11 shows water consumption volume of the service area of NWSDB, including some amount of water supplied to Maharagama UC and Kesbewa UC. Daily water consumption in the service area is approximately 34,700 m^3/d (=12,666,835/365). Based on water consumed in the service area, about 30,000 m^3/d is expected to be discharged as sewage.

Table 3.2-11 Water Consumption Volume in Service Area of NWSDB (m^3/year)

Year	2011	2012	2013	2014	2015	2016
Domestic	9,085,408	9,412,708	9,423,291	9,691,889	9,924,752	10,529,243
Non Domestic	1,605,666	1,674,836	1,802,600	1,952,096	2,036,315	2,137,592
Total	10,691,074	11,087,544	11,225,891	11,643,985	11,961,067	12,666,835

Source: NWSDB

3.2.7 Other Development Plans in the Service Area

According to Megapolis and Western Development Ministry, there are three ongoing projects in the area that may influence or be influenced by the Project, as shown in **Table 3.2-12**.

Table 3.2-12 Other Projects in the Service Area

Project Name	Description of Project
Construction of new Expressways[*1]	Elevated road from New Kelani Bridge to Battaramulla (New elevated urban expressway) to provide high mobility between urban and suburban areas. Implementing Agency: Road Development Authority (RDA)
Implementation of New Inland Water Transport System[*1]	New transport system from Wellawatta to Battaramulla by ships for both public transport and echo tourism. Implementing Agency: SLLRDC
Light Rail Transit (LRT) Project[*2]	Fort-Malabe route: total 15.8km, Fully Elevated railway Implementation Agency: Megapolis and Western Development Ministry

Source: [*1] "Western Region Master Plan -2030", Megapolis and Western Development Ministry
[*2] "Vision 2025", Megapolis and Western Development Ministry

Sewage increase in the service area is expected by the influx of people by new expressway, and water transport system. These projects are expected to increase the influx of people to the area and therefore increase sewage loads to the surrounding environment. Moreover, the large volume of sewage inducing odour and water quality problems will be produced at stations of Light Rail Transit (LRT). To maintain living environment surrounding stations and facilities built under a series of development activities, sewerage system is needed to increase the quality of life of the people living.

3.3 PROJECT JUSTIFICATION

Sri Jayawardenapura Kotte MC has been the administrative capital of Sri Lanka since 1982. This has driven population growth in the area. The project area, which includes Sri Jayawardenapura Kotte MC and its surrounding areas, has a population of 250,000 with high population density. Although water supply service in the area is nearly 100%, sewage coverage is low and about 30,000 m^3/d of sewage is discharged through drains to Diyawanna Oya, the waterbody surrounding the Parliament House.

According to water quality survey of Diyawanna Oya, the fecal coliform levels are 17 times higher than the standard (1,000MPN/100ml) and ammonia-nitrogen values are 15 times higher than the standard (0.59 mg/l). Water quality is seriously deteriorated.

Therefore, the area was flagged as a stage 1 for sewerage development in the "Western Region Master Plan-2030" published in 2016, with Sri Jayawardenapura Kotte MC and its surround areas being the key areas of influence. There are many infrastructure development projects mentioned in the Western Region Master Plan-2030 and "Vision 2025" such as railway, road, and water transportation projects. As these development projects are implemented, it is expected that the daytime population of the area will increase and further accelerate deterioration of the water environment.

As a result of the above, the development of a sewerage system in Sri Jayawardenapura Kotte MC and its surrounding areas as outlined in the project is a significant contributor for sustainable economic development of the area while providing an improved living environment.

CHAPTER 4 PLANNING BASIS

4.1 OUTLINE

- 2046 is the target year for this study. According to the NWSDB design manual, this is when the population and development would reach the saturation point for the service area (4.2).

- The service population in 2046 is estimated to be 219,000. The sewerage system development will take place in 3 stages, with consideration for effective wastewater collection at each stage. 62% of the population will have coverage at the completion of the 1st stage. A further 23% and 15% will have coverage at the completion of the 2nd and 3rd stages (4.3.3).

- Based on actual consumption data, 120 lpcd per capita water consumption is used to determine the design wastewater flow, which is estimated to be 39,400 m^3/day (4.5.2).

4.2 DESIGN PERIOD

To match the target year of 2046, the design period for the collection network, pumping stations, treatment plant, effluent disposal and utilization is 30 years (Source: NWSDB Design Manual D7 Wastewater Collection, Treatment, and Disposal & Re-Use 2012).

4.3 POPULATION PROJECTION

Population in the target year is one of the most critical factors in determining sewage flow for facility design. This is estimated based on historical population trends obtained from census data.

4.3.1 Census Data

The Department of Census and Statistic has been taking census every 10 years since 1871 (with the exception of 1991), the latest being 2012. This study will use the following census documents:

- Census of Population and Housing 2012 - Final Report
- Census of Population and Housing, 2001 (required data provided by the Department in March, 2016 and August, 2017)

Table 4.3-1 presents the population data and **Table 4.3-2** presents population growth for Sri Lanka, Colombo District, Sri Jayawardenapura Kotte (SJK) MC, Kaduwela MC, Maharagama UC, Dehiwala/Mt Lavinia MC, and Kolonnawa UC, from 1946 to 2012.

Table 4.3-1 Population Data

Year	Sri Lanka	Colombo District	SJK MC (Kotte MC*1)	Kaduwela MC	Maharagama UC	Dehiwala/Mt Lavinia MC	Kolonnawa UC
1946	6,657,339	-	-	-	-	-	-
1953	8,097,895	-	-		-	-	-
1963	10,582,064	-	-	-	-	-	-
1971	12,689,897	-	-	-	-	-	-
1981	14,846,750	1,675,847	101,039 (Kotte MC*1)	-	-	173,529	41,005
2001	18,797,257	2,251,274	116,366	209,251	185,193	210,546	56,396
2012	20,277,597	2,323,826	107,925	252,041	196,423	184,468	60,044

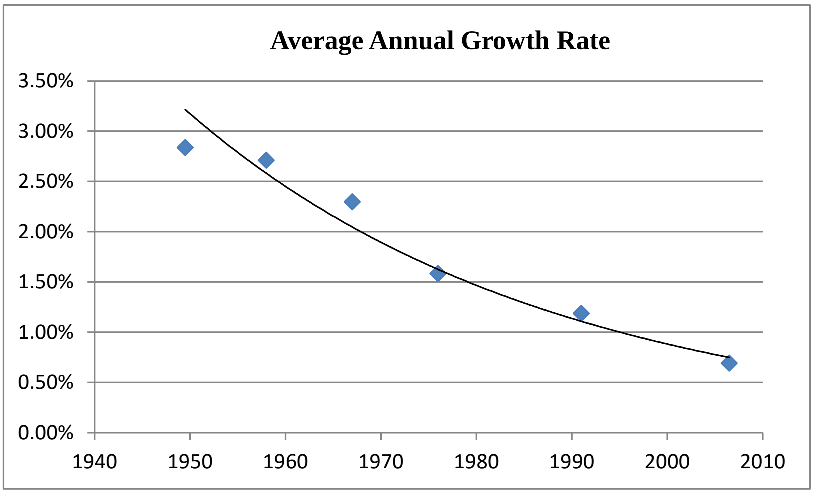
*1 Before the relocation of the national capital in year 1982, SJK MC was called as Kotte MC.
Source: Census results

Table 4.3-2 Average Annual Population Growth

Period	Sri Lanka	Colombo District	SJK MC (Kotte MC[*1])	Kaduwela MC	Maharagama UC	Dehiwala/Mt Lavinia MC	Kolonnawa UC
1946-1953	2.84	-	-				
1953-1963	2.71	-	-				
1963-1971	2.30	-	-				
1971-1981	1.58	-	-				
1981-2001	1.19	1.49	1.01	-	-	1.01	1.02
2001-2012	0.69	0.29	-0.68	1.73	0.54	-1.19	0.57

[*1] Before the relocation of the national capital in year 1982, SJK MC was called as Kotte MC.
Source: JET calculated the growth rates based on Census results

Similar to some other developing countries, population growth rate in Sri Lanka is declining as shown in **Figure 4.3-1.** While Colombo District shows lower population growth, the total population in Sri Jayawardenapura Kotte MC and Dehiwala-Mount Lavinia MC did not decline over the last decade.



Source: JET calculated the growth rates based on Census results
Figure 4.3-1 Average Annual Population Growth in Sri Lanka since 1946

The population of the 49 GNDs fully or partially included in the entire service area is shown in **Table 3.2-2. Figure 3.2-2** shows the population growth at each GND in the service area. Population of GNDs highlighted in blue shows increase in the last decade, while the rest remains stable or shows some decline.

4.3.2 Population Projection for Sewerage Planning

"The Megapolis Western Region Master Plan-2030 (2016)" projected the population of the Western Region up to 2030, using the average annual growth of 2.3 % based on the estimated maximum population of around 9 million by 2040. Significant growth is expected in the Gampaha District due to the increase of employment opportunities and in Colombo city with continual development.

"The Megapolis Western Region Master Plan-2030 (2016)" assumes a high target for average annual growth of 2.3 %, while the actual growth rate has been decreasing over the last half century shown as **Figure 4.3-1**. Population projections for this sewerage planning study should be based on a more realistic growth rate to determine a more appropriate project scale.

Population of the GNDs to be covered by the Sri Jayawardenapura Kotte sewerage system is projected to 2046 considering the actual average annual population growth shown in **Figure 4.3-1**, following the manner shown in **Table 4.3-3**:

Table 4.3-3 Estimating GND Population Growth

GNDs	Population Growth	Rationale
with population decrease from 2001 to 2012	0.0%	The Megapolis M/P expects the reversal of the downward trend with increase in development and employment opportunities, and population would be stable at year 2012 level.
with population increase from 2001 to 2012	follow the same trend as the District	starting with the rate between 2001 and 2012, growth will slow as the population approaches the saturation value.

Source: JET

The population projections for each GND are shown in **Table 4.3-4**. Annual population growth in each GND is estimated to be around 1.69% to 0.02% based on the actual population from 2001 to 2012. The details of the projections are presented in **APPENDIX 4-1**.

Table 4.3-4 Population Projection by GND

No.	GND Name	Population in GND			No.	GND Name	Population in GND		
		Year					Year		
		2001	2012	2046			2001	2012	2046
1	**Sri Jayawardenapura Kotte DSD**				4	**Kaduwela DSD**			
1. 1	Obsekarapura	11,517	11,963	12,670	4. 1	*Aruppitiya*	1,893	2,354	3,277
1. 2	Welikada West	5,532	7,004	10,021	4. 2	*Batapotha*	6,546	7,582	9,472
1. 3	Welikada East	7,343	6,749	6,749	4. 3	Walpola	7,899	8,518	9,548
1. 4	Rajagiriya	4,291	3,591	3,591	4. 4	Subhoothipura	2,628	2,568	2,568
1. 5	Welikada North	5,151	4,834	4,834	4. 5	Battaramulla South	2,257	1,580	1,580
1. 6	Nawala West	4,517	4,059	4,059	4. 6	Battaramulla North	3,331	2,001	2,001
1. 7	Koswatta	6,424	5,707	5,707	4. 7	Udumulla	2,447	2,465	2,492
1. 8	Ethulkotte West	3,516	3,371	3,371	4. 8	Rajamalwatta	2,449	2,014	2,014
1. 9	Ethulkotte	6,229	5,929	5,929	4. 9	Thalangama North A	8,383	9,250	10,736
1. 10	Pitakotte East	4,121	3,984	3,984	4. 10	Asiri Uyana	3,599	3,057	3,057
1. 11	Pitakotte	3,771	3,634	3,634	4. 11	Pahalawela	5,283	4,442	4,442
1. 12	Pitakotte West	5,400	5,301	5,301	4. 12	Kumaragewatta	4,150	5,076	6,890
1. 13	Nawala East	5,811	5,473	5,473	4. 13	Wickramasinghapura	3,222	3,136	3,136
1. 14	Nugegoda West	6,238	5,627	5,627		***Sub Total 4***	***54,087***	***54,043***	***61,213***
1. 15	Pagoda	6,363	5,446	5,446	5	**Maharagama DSD**			
1. 16	Nugegoda	5,517	3,365	3,365	5. 1	Mirihana North	6,339	6,222	6,222
1. 17	Pagoda East	6,014	5,944	5,944	5. 2	Mirihana South	5,745	6,043	6,523
1. 18	Gangodavila North	6,418	5,352	5,352	5. 3	Pragathipura	5,420	5,838	6,532
1. 19	Gangodavila South	8,198	7,305	7,305	5. 4	Thalapathpitiya	7,373	7,086	7,086
1. 20	Gangodavila East	3,995	3,287	3,287	5. 5	Udahamulla East	6,042	6,309	6,735
	Sub Total 1	***116,366***	***107,925***	***111,649***	5. 6	Udahamulla West	4,261	4,780	5,689
2	**Dehiwala DSD**				5. 7	Madiwella	6,472	6,244	6,244
2. 1	*Dutugemunu*	5,941	4,806	4,806	5. 8	Thalawathugoda West	4,876	5,492	6,576
2. 2	*Kohuwala*	7,508	5,475	5,475	5. 9	Thalawathugoda East	5,351	6,217	7,804
	Sub Total 2	***13,449***	***10,281***	***10,281***	5. 10	Gangodavila South B	6,541	7,391	8,893
3	**Kolonnawa DSD**				5. 11	Jambugasmulla	4,910	3,828	3,828
3. 1	Udumulla South	2,217	2,408	2,729		***Sub Total 5***	***63,330***	***65,450***	***72,132***
3. 2	Himbutana East	3,261	3,879	5,046		**Grand Total**	**255,711**	**247,330**	**266,989**
3. 3	Himbutana West	3,001	3,344	3,939					
	Sub Total 3	***8,479***	***9,631***	***11,714***					

4.4 SEWERAGE CATCHMENT AREA

4.4.1 NWSDB Pre-F/S

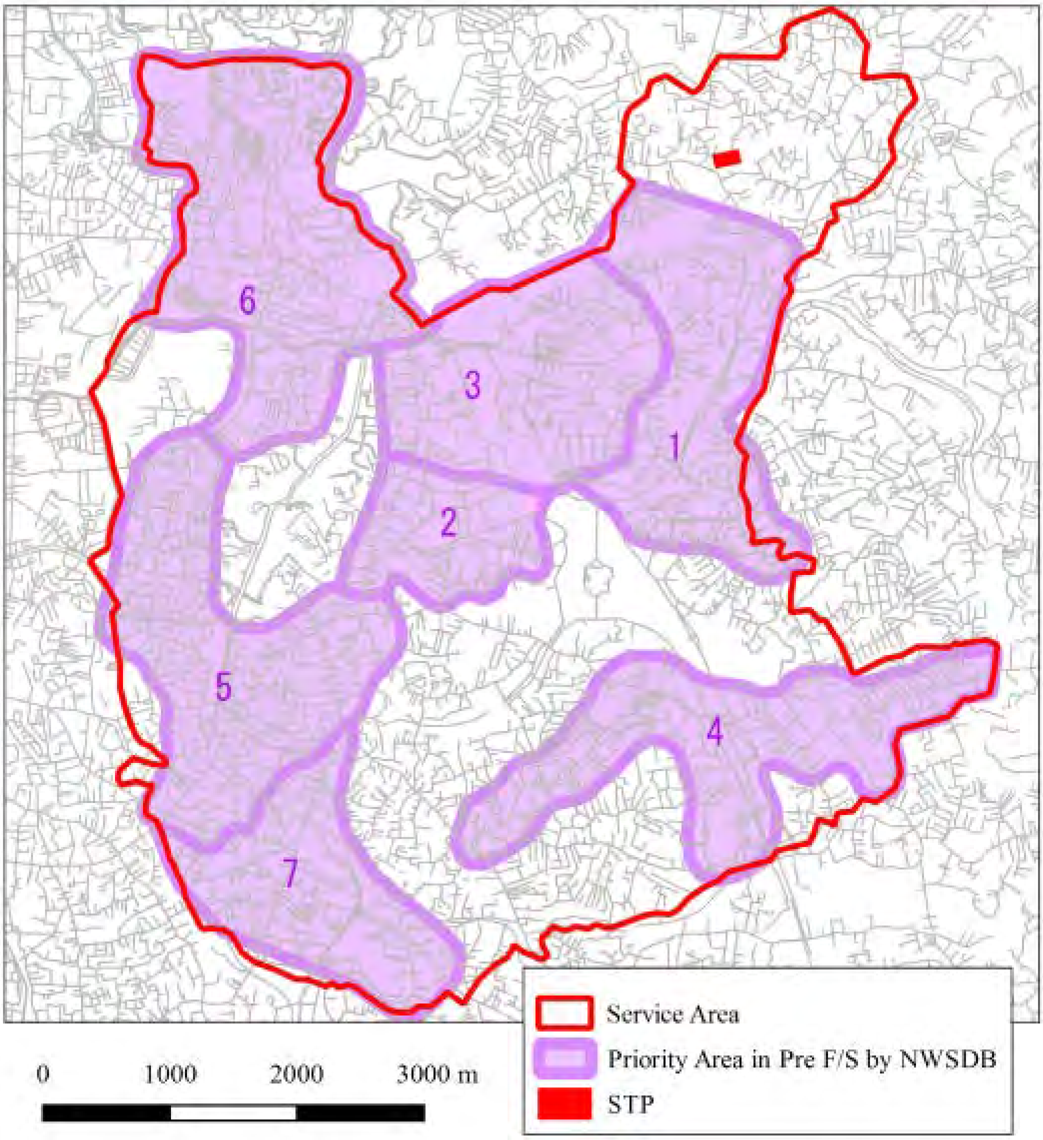
In October 2010, NWSDB prepared the "Project Proposal for Sri Jayawardenapura Kotte Wastewater Disposal System" with financial support from the government of Sri Lanka. This Pre-F/S identifies approximately 47 km of gravity sewer and 15 km of force main to be developed by 2040. The estimated maximum daily flow is 21,500 m^3. Wastewater would receive primary treatment before being discharged to the sea via a 1.7 km, 1,500 mm diameter HDPE pipe. The projected served population is based on the 2009 population from the 2001 census and the annual report of the Sri Jayawardenapura Kotte statistics bureau.

This study will draw on the previous project proposal, 2012 census data, as well as the "The Megapolis Western Region Master Plan-2030 (2016)". The latter stipulates that sewerage systems must be planned for each area to ensure full coverage and that each area must be served by at least one STP. The study covers future service areas as well as high density priority areas identified in the Pre-F/S by NWSDB.

4.4.2 Service Area

The area considered in this study covers the wastewater treatment service area decided in the City Sewerage Master Plan (M/P), and includes areas in the vicinity of the STP that can be served by a centralized sewerage system and can be included cost effectively.

In **Figure 4.4-1** the boundary of the service area covered by this study is shown in red. The 7 priority areas in the NWSDB Pre-F/S are shown in purple. The proposed location of the STP is as identified in the City Sewerage M/P. Land acquisition for the STP will be carried out by the Sri Lankan side during the F/S phase.



Source: JET

Figure 4.4-1 Project Service Area and Priority Areas in NWSDB Pre-F/S

4.4.3 Area Prioritization and Project Stages

The population in Sri Jayawardenapura Kotte MC and surrounding areas is expected to increase and this will result in more pollution for public water bodies. The proposed project will develop the sanitation infrastructure needed to keep pace with the accelerated economic activities and improve water quality to maintain acceptable public health conditions as explained in **Section 3.3**.

The sewerage system to be developed in middle-term will provide 80 to 85% coverage as targeted by the NWSDB. The sewerage system will:

- utilize large diameter trunk sewers and require considerable land for the STP and MTPSs
- collect a sewerage tariff to cover O&M cost.

The system for the 2,900 ha service area has to be developed in several stages because of the size of the project and the cost involved:

- To determine the area to be covered in the 1st stage, the following points are deemed important based on discussions with NWSDB:

  - Population coverage: over 60% in 2029
  - Number of pump stations: less than 70 (including 7 major pumping stations)
  - Wastewater collection from low income area of Obsekarapura
  - Wastewater collection from the area around the STP
  - Coverage for most of the priority area identified in the Pre-F/S

- The 2nd stage should achieve 85 % population coverage in total.

- The 3rd stage will provide coverage for the remaining areas, including locations not considered to be cost effective for receiving sewerage service.

- Septage generated from the 2nd and 3rd stage areas will be transported to and treated at the STP until the installation of the sewerage network is completed.

Actual areas and population for each stage are summarized in **Table 4.4-1**. Population at each stage was determined by the GNDs area and its population density.

Table 4.4-1 Covered Area/Population in Each Stage

Stage	**Actual Area**		**Population (2046)**	
	Total (ha)	**Coverage (%)**	**Total (person)**	**Coverage (%)**
1st Stage	1,791	61.3	136,100	62.2
2nd Stage	675	23.1	49,000	22.4
3rd Stage	458	15.6	33,700	15.4
Total	2,924	100.0	218,800	100.0

Source: JET

Table 4.4-2 shows the population projections. There will be a slight overall population growth in the entire service area. Although the population of Sri Jayawardenapura Kotte is stable, the population in Kolonawa DSD and Maharagama DSD is expected to increase.

Table 4.4-2 Population Projections by GND in the 1st Stage Area and Entire Service Area

No.	GND Name	Population in GND			% within GND	Population in Priority Area			% within GND	Population in Surrvice Area		
		Year				Served Population in Year				Served Population in Year		
		2001	2012	2046		2001	2010	2046		2001	2012	2046
1	**Sri Jayawardenapura Kotte DSD**											
1. 1	Obsekarapura	11,517	11,963	12,670	100%	11,517	11,963	12,670	100%	11,517	11,963	12,670
1. 2	Welikada West	5,532	7,004	10,021	69%	3,817	4,833	6,915	100%	5,532	7,004	10,021
1. 3	Welikada East	7,343	6,749	6,749	79%	5,772	5,305	5,305	100%	7,343	6,749	6,749
1. 4	Rajagiriya	4,291	3,591	3,591	100%	4,291	3,591	3,591	100%	4,291	3,591	3,591
1. 5	Welikada North	5,151	4,834	4,834	98%	5,033	4,723	4,723	100%	5,151	4,834	4,834
1. 6	Nawala West	4,517	4,059	4,059	52%	2,348	2,110	2,110	100%	4,517	4,059	4,059
1. 7	Koswatta	6,424	5,707	5,707	20%	1,282	1,139	1,139	100%	6,424	5,707	5,707
1. 8	Ethulkotte West	3,516	3,371	3,371	29%	1,018	976	976	100%	3,516	3,371	3,371
1. 9	Ethulkotte	6,229	5,929	5,929	70%	4,351	4,141	4,141	100%	6,229	5,929	5,929
1. 10	Pitakotte East	4,121	3,984	3,984	32%	1,305	1,262	1,262	100%	4,121	3,984	3,984
1. 11	Pitakotte	3,771	3,634	3,634	57%	2,147	2,069	2,069	100%	3,771	3,634	3,634
1. 12	Pitakotte West	5,400	5,301	5,301	28%	1,503	1,475	1,475	100%	5,400	5,301	5,301
1. 13	Nawala East	5,811	5,473	5,473	35%	2,023	1,905	1,905	100%	5,811	5,473	5,473
1. 14	Nugegoda West	6,238	5,627	5,627	73%	4,533	4,089	4,089	100%	6,238	5,627	5,627
1. 15	Pagoda	6,363	5,446	5,446	53%	3,373	2,887	2,887	100%	6,363	5,446	5,446
1. 16	Nugegoda	5,517	3,365	3,365	95%	5,245	3,199	3,199	100%	5,517	3,365	3,365
1. 17	Pagoda East	6,014	5,944	5,944	57%	3,456	3,416	3,416	100%	6,014	5,944	5,944
1. 18	Gangodavila North	6,418	5,352	5,352	88%	5,641	4,704	4,704	100%	6,418	5,352	5,352
1. 19	Gangodavila South	8,198	7,305	7,305	60%	4,909	4,374	4,374	100%	8,198	7,305	7,305
1. 20	Gangodavila East	3,995	3,287	3,287	54%	2,166	1,782	1,782	100%	3,995	3,287	3,287
	Sub Total 1	***116,366***	***107,925***	***111,649***		***75,729***	***69,943***	***72,732***		***116,366***	***107,925***	***111,649***
2	**Dehiwala DSD**											
2. 1	*Dutugemunu*	5,941	4,806	4,806	6%	330	267	267	6%	356	288	288
2. 2	*Kohuwala*	7,508	5,475	5,475	14%	1,046	763	763	35%	2,628	1,916	1,916
	Sub Total 2	***13,449***	***10,281***	***10,281***		***1,376***	***1,030***	***1,030***		***2,984***	***2,205***	***2,205***
3	**Kolonnawa DSD**											
3. 1	Udumulla South	2,217	2,408	2,729	16%	366	397	450	26%	576	626	710
3. 2	Himbutana East	3,261	3,879	5,046	28%	929	1,105	1,437	77%	2,511	2,987	3,885
3. 3	Himbutana West	3,001	3,344	3,939	43%	1,294	1,442	1,698	91%	2,731	3,043	3,584
	Sub Total 3	***8,479***	***9,631***	***11,714***		***2,588***	***2,943***	***3,585***		***5,818***	***6,656***	***8,179***
4	**Kaduwela DSD**											
4. 1	*Aruppitiya*	1,893	2,354	3,277	4%	74	92	128	3%	57	71	98
4. 2	*Batapotha*	6,546	7,582	9,472	0%	-	-	-	15%	982	1,137	1,421
4. 3	Walpola	7,899	8,518	9548	40%	3,184	3,434	3,849	70%	5,529	5,963	6,684
4. 4	Subhoothipura	2,628	2,568	2,568	63%	1,652	1,614	1,614	100%	2,628	2,568	2,568
4. 5	Battaramulla South	2,257	1,580	1,580	87%	1,960	1,372	1,372	100%	2,257	1,580	1,580
4. 6	Battaramulla North	3,331	2,001	2,001	77%	2,564	1,540	1,540	100%	3,331	2,001	2,001
4. 7	Udumulla	2,447	2,465	2,492	48%	1,182	1,191	1,204	100%	2,447	2,465	2,492
4. 8	Rajamalwatta	2,449	2,014	2,014	88%	2,149	1,767	1,767	100%	2,449	2,014	2,014
4. 9	Thalangama North A	8,383	9,250	10,736	44%	3,718	4,103	4,762	80%	6,706	7,400	8,589
4. 10	Asiri Uyana	3,599	3,057	3,057	38%	1,357	1,153	1,153	50%	1,800	1,529	1,529
4. 11	Pahalawela	5,283	4,442	4,442	92%	4,850	4,078	4,078	85%	4,491	3,776	3,776
4. 12	Kumaragewatta	4,150	5,076	6,890	9%	392	479	650	10%	415	508	689
4. 13	Wickramasinghapura	3,222	3,136	3,136	23%	730	711	711	50%	1,611	1,568	1,568
	Sub Total 4	***54,087***	***54,043***	***61,213***		***23,812***	***21,533***	***22,828***		***34,702***	***32,578***	***35,008***
5	**Maharagama DSD**											
5. 1	Mirihana North	6,339	6,222	6,222	63%	3,996	3,922	3,922	100%	6,339	6,222	6,222
5. 2	Mirihana South	5,745	6,043	6,523	32%	1,842	1,938	2,092	100%	5,745	6,043	6,523
5. 3	Pragathipura	5,420	5,838	6,532	80%	4,318	4,651	5,204	100%	5,420	5,838	6,532
5. 4	Thalapathpitiya	7,373	7,086	7,086	78%	5,736	5,513	5,513	100%	7,373	7,086	7,086
5. 5	Udahamulla East	6,042	6,309	6,735	42%	2,511	2,622	2,799	100%	6,042	6,309	6,735
5. 6	Udahamulla West	4,261	4,780	5,689	48%	2,058	2,309	2,748	100%	4,261	4,780	5,689
5. 7	Madiwella	6,472	6,244	6,244	71%	4,578	4,417	4,417	100%	6,472	6,244	6,244
5. 8	Thalawathugoda West	4,876	5,492	6,576	47%	2,286	2,575	3,083	60%	2,926	3,295	3,946
5. 9	Thalawathugoda East	5,351	6,217	7,804	15%	817	950	1,192	50%	2,676	3,109	3,902
5. 10	Gangodavila South B	6,541	7,391	8,893	37%	2,404	2,717	3,269	60%	3,925	4,435	5,336
5. 11	Jambugasmulla	4,910	3,828	3,828	44%	2,148	1,675	1,675	92%	4,517	3,522	3,522
	Sub Total 5	***63,330***	***65,450***	***72,132***		***32,696***	***33,288***	***35,914***		***55,695***	***56,882***	***61,736***
	Grand Total	**255,711**	**247,330**	**266,989**		**136,202**	**128,738**	**136,089**		**215,566**	**206,246**	**218,777**

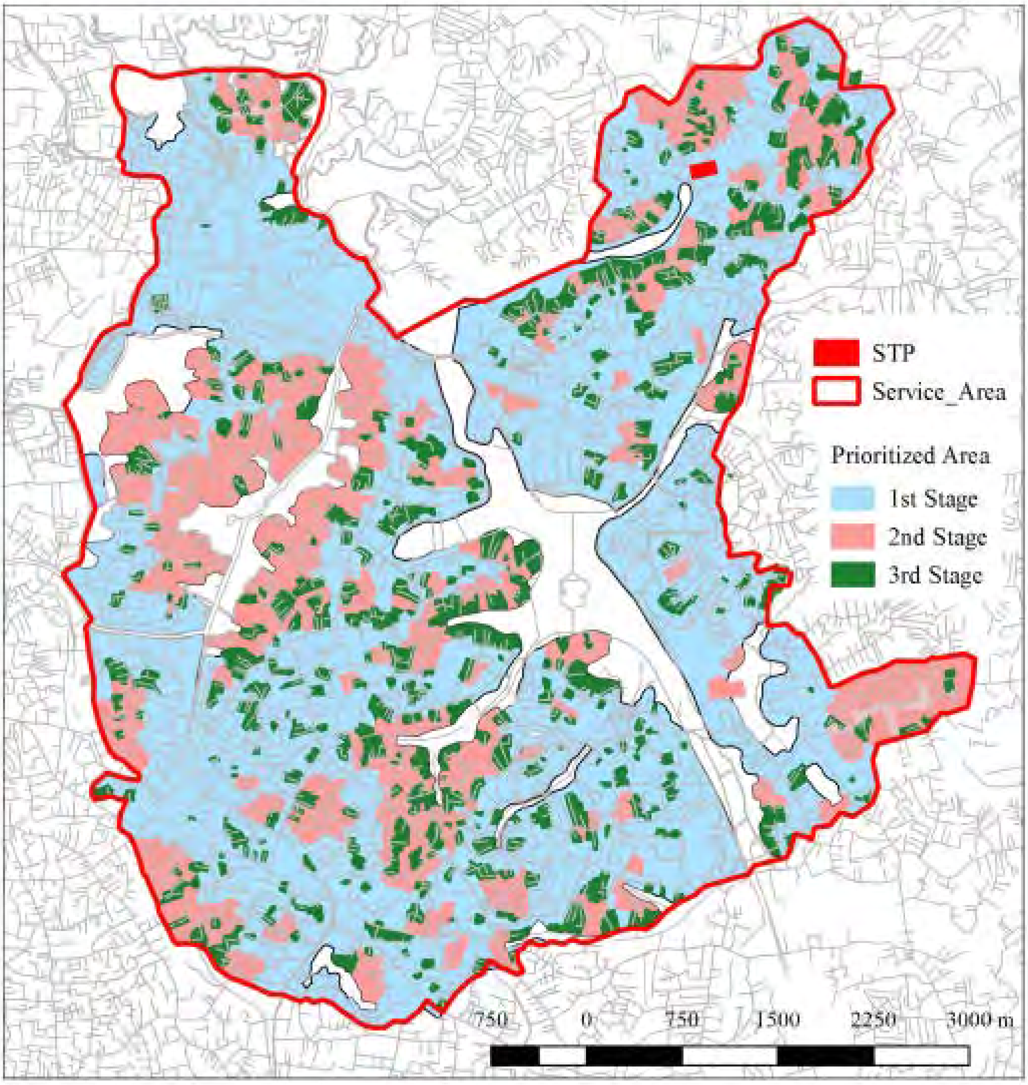
Source: JET, based on census data

The Sri Lankan side requested over 60% coverage at the completion of the 1st stage, at the JCC meeting held on October 2017 and the coverage was finalized at the JCC meeting held on December 2017. **Table 4.4-3** shows the coverage and served population for this stage. The coverage in Sri Jayawardenapura Kotte MC, the national capital, and Kaduwela MC will be slightly higher than other areas. The coverage area (%) in **Table 4.4-3** describes the ratio covered by 1st stage area in service area.

Table 4.4-3 Break down of Covered Area/Population in the 1st Stage Area

MC/UC/PS	Actual Area			Population (2046)		
	Service Area (ha)	1st stage Area (ha)	Coverage (%)	Service Area (person)	1st stage Area (person)	Coverage (%)
Sri Jayawardenapura Kotte MC	1,377	812	59.0	111,649	72,732	65.1
Dehiwala/Mt. Lavinia MC	33	15	45.5	2,205	1,030	46.7
Kotikawatta-Mulleriyawa PS	103	45	43.7	8,179	3,585	43.8
Kaduwela MC	714	513	71.8	35,008	22,828	65.2
Maharagama UC	697	406	58.2	61,736	35,914	58.2
Total	2,924	1,791	61.3	218,777	136,089	62.2

Source: JET



Source: JET

Figure 4.4-2 Prioritized Area

4.5 PLANNING BASIS FOR SEWERAGE SYSTEM

4.5.1 Collection System

Separate wastewater collection is proposed for this service area based on the following considerations:

- A separate wastewater collection system is more effective than a combined system for improving the water environment of surrounding water bodies especially during the rainy season.
- "NWSDB Design Manual D7 Wastewater Collection, Treatment, Disposal & Re-Use 2012" recommends the implementation of separate collection systems where possible.
- Sewage Flow

(1) Summary

The parameters for sewage flow estimate are shown in **Table 4.5-1**. The values are obtained through discussions with TC and from the NWSDB Design Manual.

Table 4.5-1 Design Basis for Estimation of Sewage Flow

Item	Value	Remarks
Per capita water consumption	120 lpcd	
Return Factor	80%	of water consumption
Non-domestic Flow	35%	of Domestic Flow
Average Dry Weather Flow (ADWF)	Domestic + Non-domestic flow	
Daily maximum dry weather flow	1.15 times	of ADWF
Peak Dry Weather Flow (PDWF)	1.6 times	of ADWF
Infiltration	20%	of ADWF

Planning of Sewer Pipe System: Peak Dry Weather Flow (PDWF) + Infiltration
Planning of Pumping Station: Hourly Maximum Dry Weather Flow + Infiltration
Source: JET

(2) Per Capita Water Consumption

Per capita water consumption is one of the important criteria for determining the capacity of the sewerage system. The 120 lpcd per capita water consumption stated in the City Sewerage M/P is based on the following:

- Actual per capita consumption for the previous 5 years in the service area.
- NWSDB Design Manual's range of 120 to 140 lpcd.
- Coverage of water supply in the service area is saturated and there is no plan to expand the service.

Detail explanation is shown in **APPENDIX 4-2**.

(3) Non-domestic Flow

Non-domestic flow is estimated to be 35% in 2046 based on the following:

- yearly non-domestic water consumption of 20% was 2016 in the service area.
- this rate has been increasing from 18% in 2011 to 20 % in 2016
- non-domestic consumption is expected to continue to grow at a similar rate.

Detail explanation is shown in **APPENDIX 4-2**.

(4) Point Sources

NWSDB requested that point sources located in and outside the service area be included in the calculation of sewage flow. Sewage from point sources will be part of the wastewater flow for sizing the STP and sewerage system design.

Table 4.5-2 shows the existing and planned point sources obtained in the data collection survey. Ethul Kotte pumping station collects wastewater from 4 point sources: Jayawadanagama, Parliament, Isurupaya and Sethsiripaya, and the wastewater is pumped to the Wellawatte sewerage system. Sri Jayawardenapura Hospital and Madduwatta housing scheme have their own wastewater drainage systems. The wastewater from these sources is pumped to the Wellawatte outfall. These point sources located in the service area are included in the domestic and non-domestic wastewater flow estimates. The point sources that are identified in **Table 4.5-2** will contribute an estimated 903 m^3/day. The flow from point sources is fixed and is not multiplied by the infiltration factor because ADWF shown in **Table 4.5-2** is based on the capacity of the pumps.

Table 4.5-2 Existing/ Planned Point Sources

Project/ Name of pumping station	Status	Location	ADWF (m^3/day)	Consideration
Jayawadanagama	Existing	Out of Service Area. (S.A.)	730	Point source (housing scheme)
Parliament	Existing	Inside of S.A.	170	Included in domestic & non- domestic flow
Isurupaya	Existing	Inside of S.A.	85	Included in domestic & non- domestic flow
Sethsiripaya	Existing	Inside of S.A.	210	Included in domestic & non- domestic flow
Sri Jayawardenapura Hospital	Existing	Inside of S.A.	630	Included in domestic & non- domestic flow
Madduwatta housing scheme	Existing	Inside of S.A.	210	Included in domestic & non- domestic flow
Royal Park	Existing	Inside of S.A.	160	Included in domestic & non- domestic flow
Central Park	Existing	Inside of S.A.	75	Included in domestic & non- domestic flow
Station discharge from LRT project	Planned	Inside of S.A.	91	Included in non- domestic flow
Depot discharge and station discharge from LRT project	Planned	Outside of S.A.	173	Point source

Source: JET, LRT project

(5) Total Sewage Flow

The estimated sewage flow shown in **Table 4.5-3** is calculated assuming the installation of the sewerage system in the entire service area. The daily maximum flow of 39,400 m^3/day is for the total design capacity of the STP.

Table 4.5-3 Estimated Sewage Flow

	Item	Service Area	1st Stage	Remarks	
a	Population	218,800	136,100		
b	Water Consumption (l/d/cap)	120	120		
c	Return Factor (%)	80	80		
d	Domestic Flow (m^3/d)	21,005	13,066	d = a x b x c	
e	Non-Domestic Flow (m^3/d)	7,352	3,920	e = d x 35% (30% for 1st stage)	
f	Point source flow (m^3/d)	903	903		
g	Infiltration (m^3/d)	5,671	3,397	g = (d + e) x 20%	
h	Daily Average Flow (m^3/d)	34,931	21,286	h = d + e + f + g	
i	Daily Maximum Flow (m^3/d)	39,320	23,969	i = (d + e + f) x 1.15 + g	For STP design
Remark: Point source of 903 m^3/day is based on **Table 4,5-2**, highlighted 2 point sources of 730 and 173 in table.					

Source: JET

4.5.2 Sewerage Network

(1) Sewers

The size of each sewer is determined by hydraulic calculations based on the manning equation. The parameters decided through discussions with NWSDB are similar to national standards of other countries, including Japan.

a) Hydraulic Calculation

The Manning formula is adopted for the hydraulic calculation of gravity sewers, and the Hazen William formula is used to calculate friction loss for determining the size of force main pipes.

Manning Formula

$Q = A \times V$, $V = 1/n \times R^{2/3} \times S^{1/2}$

Where,
Q: Flow (m^3/sec),
V: Velocity of Flow (m/sec),
n: Roughness Coefficient
R: Hydraulic Radius (m)
S: Hydraulic Gradient
A: Cross Section Area (m^2)

Hazen William Formula

$Q = A \times V$, $V = 0.84935 \times C \times R^{0.63} \times S^{0.54}$

where,
Q: Flow (m^3/sec)
V: Velocity of Flow (m/sec),
C: Flow Velocity Coefficient
R: Hydraulic Radius (m),
S: Hydraulic Gradient
A: Cross Section Area (m^2)

Table 4.5-4 Coefficients for Sewer Design

Type of Pipe	n (Roughness Coefficient)	C (Flow Velocity Coefficient)
Concrete Pipe	0.013	
PVC Pipe	0.013	
HDPE Pipe	0.013	120
GRP Pipe	0.013	
DI Pipe (Ductile Cast Iron Pipe)	0.013	120

Note: The design slopes of gravity sewers are checked based on tractive force required to flush the sand particles expected in sewage flow.
Source: JET

b) Flow Velocity

Minimum Velocity: 0.65 m/s
Maximum Velocity: 3.0 m/s

c) Sewer Capacity

The water depth in the sewer pipes should be as shown in **Table 4.5-5**, based on the technical discussions held on March 2018.

Table 4.5-5 Maximum Water Depth for Each Diameter

Pipe Diameter (mm)	Fullness (h/H)
150	0.5
200	
250	0.55
300	
375	0.6
450	0.65
525	0.7

Pipe Diameter (mm)	Fullness (h/H)
600	0.7
675	
750	0.75
900	
1050	0.8
1200	0.8
1350	

Note: h: Water Depth, H: Internal Diameter of pipe.
Source: NWSDB

d) Minimum Earth Covering

1.2 m

e) Minimum Sewer Diameter

Trunk sewer: 200 mm, Branch sewer: 150 mm, House connection: 100 mm

f) Pipe Material

PVC, HDPE and GRP will be used for open cut sections of gravity flow pipes. Polymer concrete will be used for micro tunnelling sections, for its anti-corrosion property.

Table 4.5-6 Pipe Material

Type	Diameter	Pipe Material	Remark
Gravity Sewer	225 mm or less	PVC Pipe	Open cut
	250 to 400 mm	HDPE Pipe	Open cut
	450 mm or above	GRP	Open cut
	200 mm or above	Polymer Concrete Pipe	Micro Tunnelling
Force Main	All	DI pipe	Open cut
	80 to 400 mm	HDPE with Casing Pipe	Micro Tunnelling
	450 mm or above	DI Pipe for Micro Tunnelling	Micro Tunnelling

Source: JET

(2) Pumping Station

Table 4.5-7 shows the types of pumping stations classified roughly as manhole type pumping station (MTPS) and major pumping station (MPS). Ceylon Electricity Board (CEB) does not require the installation of a transformer for pumping facilities with an electrical demand of 42 kVA or less. When the electrical demand exceeds 42 kVA and a transformer becomes necessary, an MPS is more suitable and land acquisition is needed to build the pumping station.

An MTPS can be installed under roadways and does not usually require land acquisition, depending on the surrounding environment and location.

Table 4.5-7 Types of Pumping Station

Types of Pumping Station	Site	Electricity
MTPS: Manhole Type Pumping Station	Under Road	Less than 42 kVA
MPS: Major Pumping Station	Property Required	42 kVA and above

Source: JET

(3) Manhole Type Pumping Station(MTPS)

The MTPS is usually used for branch sewers:

- which are over 4.5 m deep, as requested by NWSDB.
- In places where installation of deep sewers by open cut method in narrow lanes can cause the collapse of walls of adjacent houses even though the sewer depth would be less than 4.5m. Kandy sewerage project is facing this private property damage problem.
- In places where micro tunnelling, using driving shaft of 5 x 3 m, is also not feasible such as in narrow lanes, where additional space for construction set up is not available.

Each MTPS requires the installation of space saving power supply units which is set off the ground, similar to those for telecommunication services as shown in **Figure 4.5-1.** These are commonly used in Sri Lanka, and there is no issue with theft or vandalism.

Source: JET

Figure 4.5-1 Power Supply Unit for Manhole-type Pump Stations and Telecommunication Services

4.5.3 Sewage Treatment

(1) Influent and Effluent Standards

The proposed sewerage treatment plant would discharge about 39,400 m^3/d (**Table 4.5-3**) of treated wastewater to Diyawanna Oya.

The Diyawanna Oya is an enclosed water body used as a rowing course. Its water environment is sensitive and fragile. It is important to prevent water quality deterioration from various types of discharges. Wastewater treatment will reduce the pollution load.

The following steps are taken to estimate the influent concentration:

- consultations with NWSDB
- review of Moratuwa/Ratmalana STP and Jaela/Ekala STP operational data
- review of domestic wastewater quality of several small-scale wastewater treatment plants for housing schemes near Colombo city.

The influent wastewater concentration of these plants is summarized in **Table 4.5-8**.

Table 4.5-8 Influent Wastewater Concentration of Existing Plants

Parameter	Unit	Raddolugama※	Maththegoda※	Hikkaduwa※	Moratuwa/ Rathmalana※※	Ja-Ela/ Ekara※※※	Average
pH	-	6.7	6.4	7.0	6.6-8.5	-	6.7
TSS	mg/l	163	90	139	232	-	156.0
COD_{cr}	mg/l	609	473	446	274	628	485.8
S-COD_{cr}	mg/l	241	241	206	-	-	229.2
BOD_5	mg/l	383	247	240	87	187	229
S-BOD_5	mg/l	159	116	149	-	-	141
NO_2+NO_3-N	mg/l	2.3	2.5	5.7	1.0	-	2.9
NH_4-N	mg/l	26	28	24	14	-	23
T-N	mg/l	39	34	33	42	-	37
T-P	mg/l	5.9	3.3	2.8	2.8	-	3.7

※Average values of the three measurements which were conducted from December 2016 to January 2017(Annex1)
※※Data taken between October 2013 and February 2016
※※※Average of 1-year measurements
Source JET

CEA and NWDDB approved the proposed effluent quality for the Sri Jayawardenapura Kotte wastewater treatment project, with the following conditions:

- The allowable discharge limits are being amended and a draft will be made available to the public. The effluent quality from the proposed treatment plant will have to comply with the amended discharge limits. The allowable limits for organic substances in the amended version are not expected to change much. Limits for heavy metals will be stricter. There will be an allowable discharge limit for nitrates set at 10 mg/L as NO_3-N. This new requirement will have a significant impact on the selection of the treatment process.

- All wastewater shall be treated to meet the following limits: BOD <10 mg/l, COD <100 mg/l, TSS <15 mg/l, total Kjeldahl nitrogen < 1.0 mg/l, ammonia nitrogen < 1.0 mg/l, soluble phosphate < 0.5 mg/l and total phosphate < 1 mg/l (as stated in letter No. AGM/P&D/SEW /SJKSP/17-08 and NWSDB letter at 11.2.2019 as attached in APPENDIX 4-3 and 4-4).

- Other parameters not included in the above shall comply with the tolerance limits for discharge of effluent to surface waters as specified in the gazette notification No. 1534/18 dated 2008.02.01.

Design influent and treated effluent qualities are presented in **Table 4.5-9**.

Table 4.5-9 Influent and Effluent Quality

Parameter	Influent wastewater Characteristics	Treated Effluent quality
BOD_5	240	<10*
COD	600	<100
TSS	160	<15
T-N	45	
Organic N		<1.0*
Ammonia N		<1.0*
NO_3-N		<10*
T-P	6	<1 (0.6) *2
Soluble P		<0.5 (0.3) *2
Organic P		<0.5 (0.3) *2

Note*: These values are decided by the NWSDB letter at 11.2.2019 based on EIA report.
*2: These values may be applied by the stringent requirement of CEA in future.
Source: CEA

CHAPTER 5 PRELIMINARY PLAN AND DESIGN OF THE SEWERAGE

5.1 OUTLINE

- Total sewer length in the 1st Stage area is about 351 km, including the 83 km section to be installed by micro-Tunnelling (5.2.1).
- Both open cut and micro-Tunnelling methods have advantages and disadvantages with regard to traffic congestion, construction period, resettlement and public acceptance (5.2.1 (2)).
- Japanese micro-Tunnelling technology has the advantage of high construction accuracy, particularly for the weak soil condition in this area (5.2.1(2)).
- 90% of the households are already connected to the existing drainage system. Bringing these connections to the new sewerage network will greatly reduce the overall effort on house connections (5.2.2).
- The 25,000 house connections to be installed in 1st Stage should be included in this project (5.2.2).
- Step-feed biological nutrient removal (BNR) is effective in nitrogen and phosphorus removal, requires modest equipment space, is easy to maintain and has low O&M costs (5.3.2).
- The three-stage step-feed BNR process developed in Japan is recommended for this project (5.4.1).

5.2 SEWERAGE SYSTEMS

5.2.1 Collection Network

(1) Sewer Layout and Length

Sewer GEMS software is used for modelling the sewer network as requested by NWSDB. It is a multi-platform, sanitary and combined sewer modelling solution.

The main trunk sewer network is decided based on land acquisition for major pumping stations. The design lengths of the sewers are summarized in **Table 5.2-1** and the sewerage development plan for Sri Jayawardenapura Kotte is shown in **Figure 5.2-1**. Consideration of staging has been shown in **Section 4.4.3**.

The sewerage collection network is installed under the public road so as to avoid any unforeseen delay of construction. Utilization of private land or other authorities land for sewer installation will make behind schedule by the confliction between land owners or updating of other relevant authority’s plan, such as the Kandy sewerage project.

Table 5.2-1 Sewer Length in Service Area

Type	Dia (mm)	Sewer Length (m) 1st Stage	2nd Stage	3rd Stage	Total
Gravity Sewer	200	297,711	114,959	65,231	477,901
	225	2,133	415	78	2,626
	250	5,558			5,558
	300	3,149			3,149
	350	2,921			2,921
	400	7,219			7,219
	450	129			129
	500	853			853
	600	3,066			3,066
	700	5,116			5,116
	800	501			501
	900	20			20
	1200	1,073			1,073
	sub-total	329,448	115,374	65,310	510,132
Force Main	80	6,087	37,750	68,232	112,070
	100	3,849	2,158		6,007
	150	1,094	245		1,338
	200	1,257	56		1,313
	300	6,125			6,125
	400	68			68
	500	283			283
	600	2,186			2,186
	sub-total	24,024	37,133	68,232	129,389
Total		351,092	154,887	133,542	639,521

Source: JET

The number of manholes was calculated based on the maximum and average distances between Manholes for cost estimation (**Table 5.2-2**). Although Sewer GEMS software automatically calculates the number of manhole by one manhole distance value, the actual number will be increased 10% or 20% of manholes because the manhole distances are decided by the maintainability in the detail design. Therefore, the maximum and average distances in **Table 5.2-2** are set for each pipe diameter to estimate the manhole number.

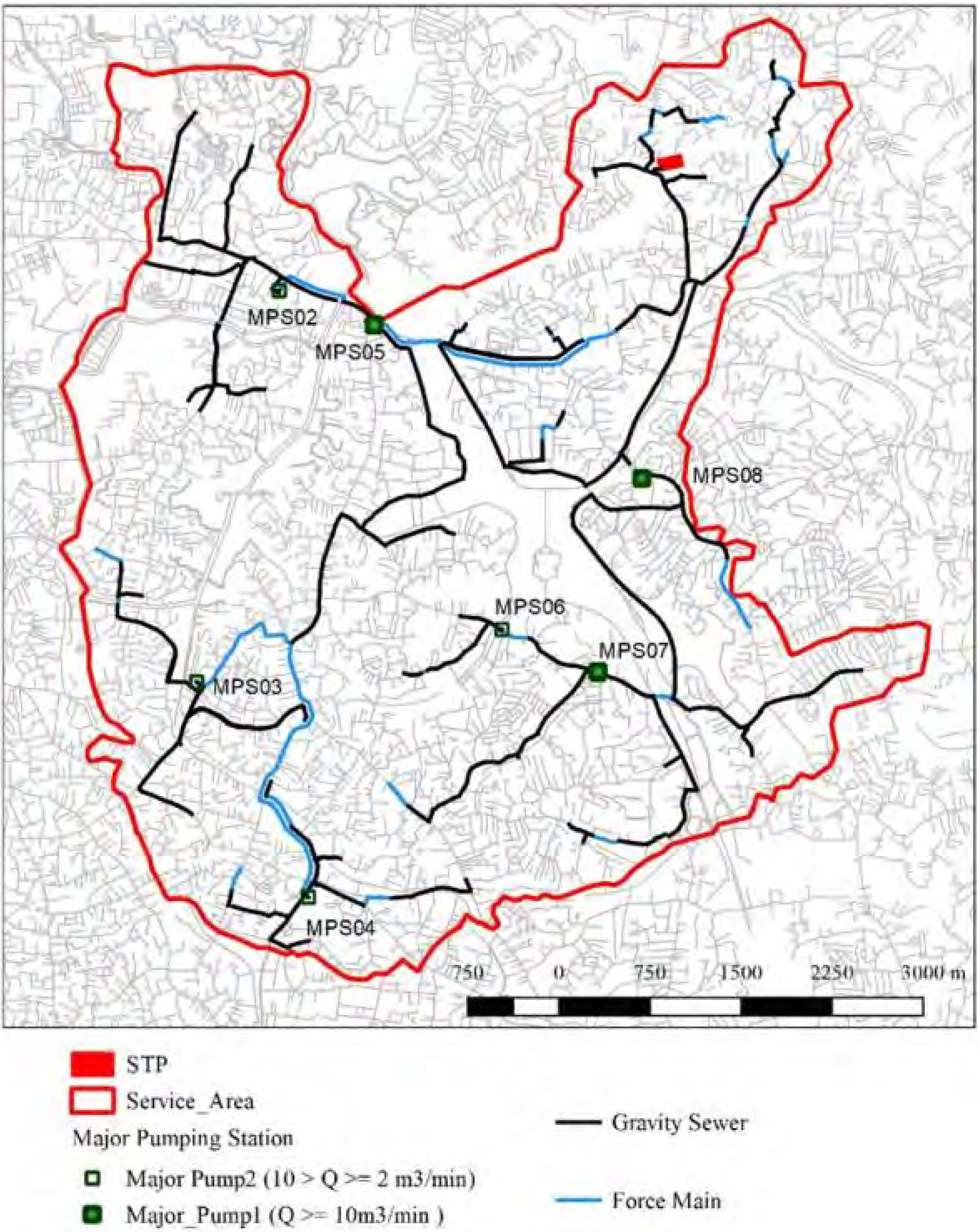
In addition, the average manhole distance for small diameter range (200 - 900) of Binh Duong Project in Vietnam is approximate 30 m. The range of manhole distances in three experiences in Japanese projects under similar conditions is between 25m and 35m.

Table 5.2-2 Maximum and Average Distances between Manholes for Cost Estimate

Pipe Diameter (mm)	Maximum Distance for Design (m)	Average Distance for Cost Estimate (m)	Average Distance in Sewer GEMS (m) For reference
200-600	75	30	(38)
700-1000	100	60	(64)
1100-1500	150	100	(100)

Source: JET

Based on the above table, 10,403 manholes are estimated.



Source: JET

Figure 5.2-1 Main Trunk Sewers Routing

(2) Sewer Construction Method

The total length of sewers is about 636 km, with diameters ranging from 200 to 1,200 mm. The following installation methods can be used:

- Open cut
- Micro- Tunnelling

Micro-Tunnelling needs construction space at the drive and arrival shafts, but none in between. It has the following advantages compared to the open cut method:

- less obstruction to traffic
- no interruption to land or river traffic at crossings
- requiring less construction space
- shorter construction period for deep or large diameter sewers

Table 5.2-3 summarizes the construction periods, impacts on traffic and resettlement for the two methods. Considering the respective advantages and disadvantages, open cut should be used for shallow and small sewers such as branch sewers, and micro-Tunnelling for deep and large sewers.

Table 5.2-3 Comparison of Open Cut vs Micro-Tunnelling in Service Area

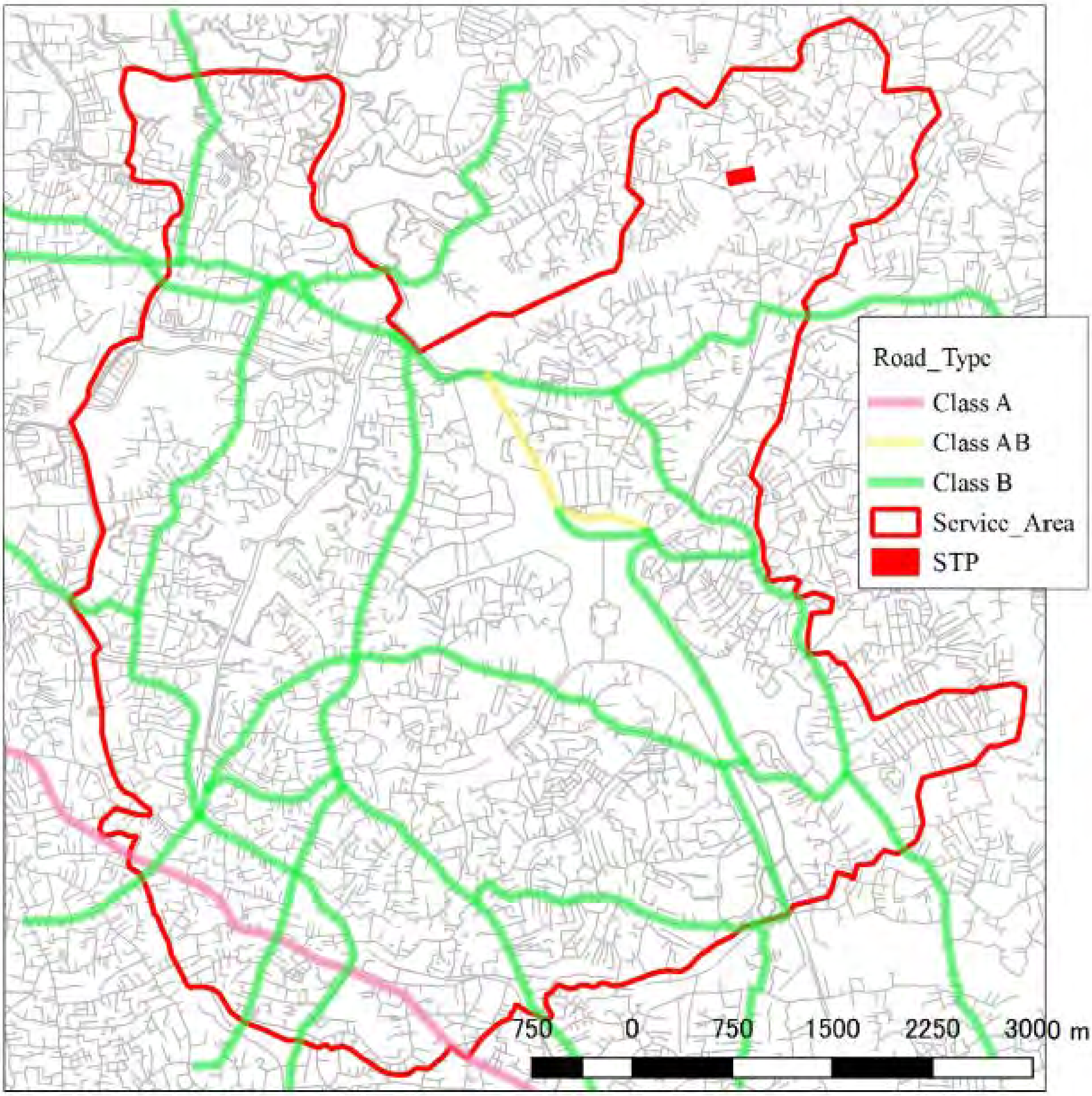
Impacts on	Construction Method	
	Open Cut	Micro-Tunnelling
Traffic	Will cause serious traffic congestion. (especially for deep or large sewers)	No impact. (except around driving/ arrival shafts)
Construction Period	10 to 20 m/day (depending on pipe size and depth)	5 to 10 m/day (depending on pipe size and soil condition)
	Suitable for shallow sewers	Suitable for deep sewers
Resettlement	No resettlement required. Sewer is installed under roads or along the side of roads.	
Nearby Residents	Low	Low
	Need to avoid property damage during construction.	Need to avoid property damage only around shafts during construction.
Construction Cost	Low	High
	80 to 1,500 USD/m (depending on pipe size and depth)	1,200 to 8,500 USD/m (depending on pipe size and soil condition)

Source: JET

The choice of installation method depends on the depth of the sewer and the traffic condition in the area. Class “A”, “AB” and “B” roads are classified as “National Road” connecting major cities and major urban areas, and have very heavy traffic. The administration of “National Road” is Ministry of Highways & Road Development and Petroleum Resources Development. Open-cut trenching will exacerbate the congestion along these trunk roads. Micro-Tunnelling should be used to minimize disruption. **Figure 5.2-2** shows the road classification by RDA in the service area. Based on discussions and joint site survey in January 2019 with NWSDB, the construction method was determined as shown in **Figure 5.2-3**.

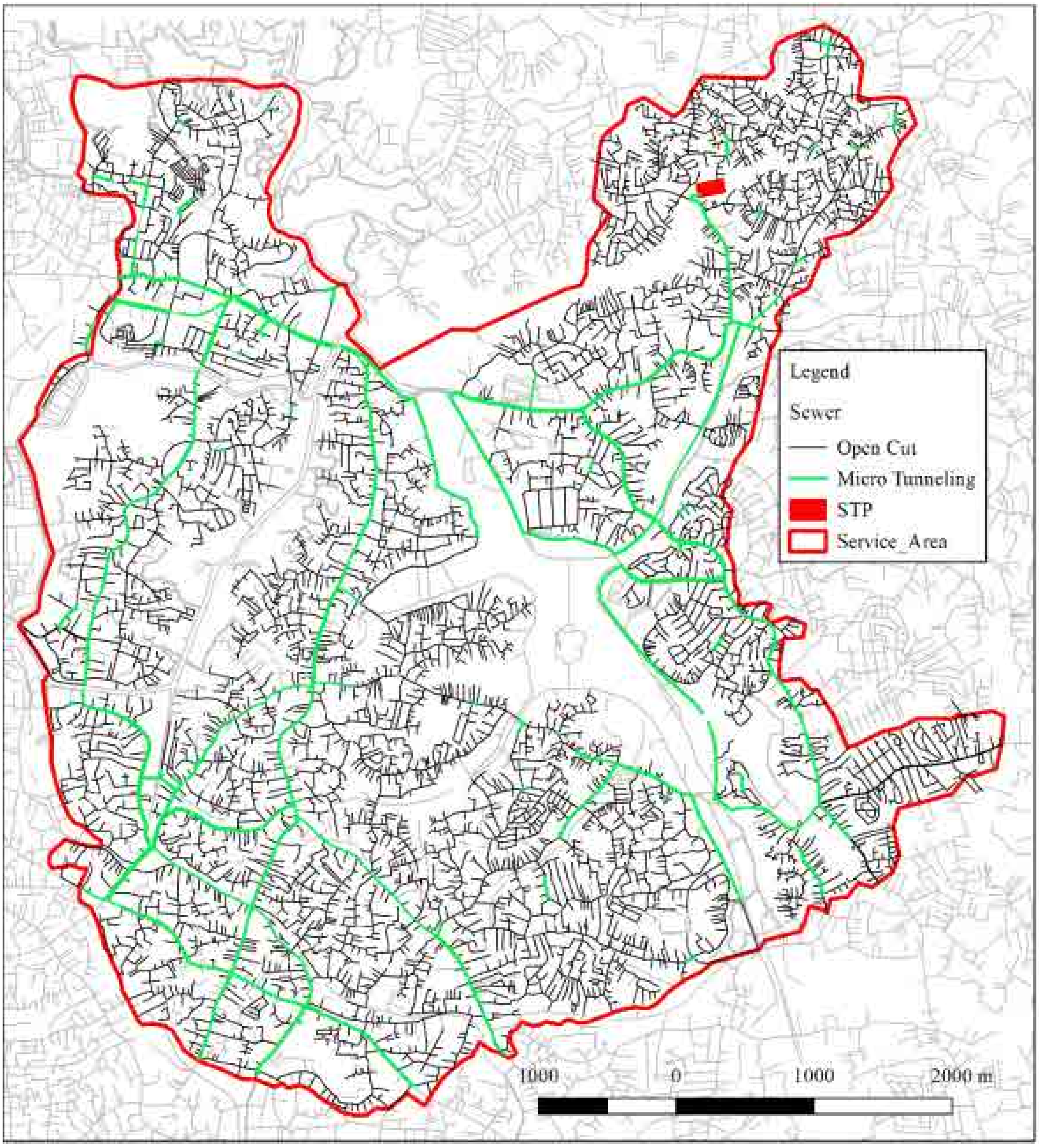
The sections where micro-tunnelling will be used are summarized as follows:

Classified road “A”, “AB” or “B”	• Section where excavation depth exceeds 4.5m, or • Traffic will be affected if open-cut method is applied even though the sewer depth is less than 4.5m
Non-classified road	• Section where excavation depth exceeds 4.5m



Source: JET

Figure 5.2-2 Road Classification in Service Area



Source: JET

Figure 5.2-3 Sewer Installation Method

Table 5.2-4 shows the length for each pipe diameter and the method of installation for gravity sewers and force mains for the 1st Stage.

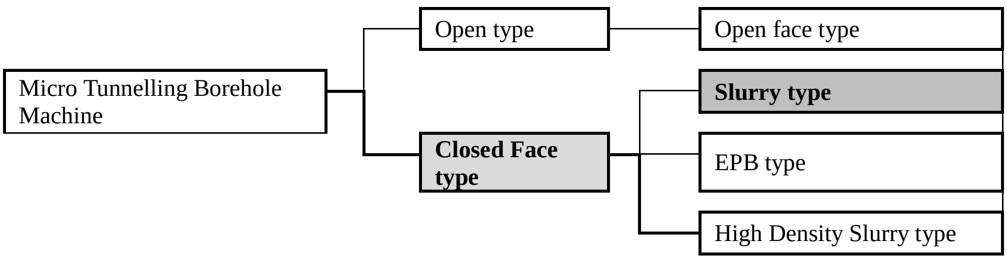
Table 5.2-4 Lengths of Sewer by Diameter and Construction Method for the 1st Stage

Type	Dia	Sewer Length (m)		
	(mm)	Open Cut	Micro Tunnelling	Total
Gravity Sewer	200	251,087	46,623	297,711
	225	2,133		2,133
	250	781	4,776	5,558
	300	1,664	1,486	3,149
	350	470	2,451	2,921
	400	641	6,578	7,219
	450		129	129
	500		853	853
	600		3,066	3,066
	700	1,038	4,078	5,116
	800		501	501
	900		20	20
	1200		1,073	1,073
	sub-total	257,813	71,635	329,448
Force Main	80	5,265	822	6,087
	100	1,789	2,060	3,849
	150	502	592	1,094
	200	41	1,216	1,257
	300	1,453	4,672	6,125
	400	68	-	68
	500		283	283
	600		2,186	2,186
	sub-total	9,117	11,831	20,949
Total		266,930	83,466	350,397

Source: JET

(3) Type of Micro Tunnelling Method

The types of Micro Tunnelling Borehole Machine (MTBM) are summarized in **Figure 5.2-4**. Since it is essential to prevent ingress of water, the Closed Face type is recommended for the construction. Closed Face type is classified into 3 types, which are Slurry type, Earth Pressure Balance (EPB) type and High Density type. Comparison of the Closed Face machine is shown in **Table 5.2-5**. Based on the comparison in **Table 5.2-5**, Slurry type is recommended in this study. At the detailed design stage, the selection of micro tunnelling type should be revised based on detail soil investigations.



Source: JET

Figure 5.2-4 Type of Micro Tunnelling Borehole Machine

Table 5.2-5 Comparison of Each Type of Closed Face Micro Tunnelling Boring Machine

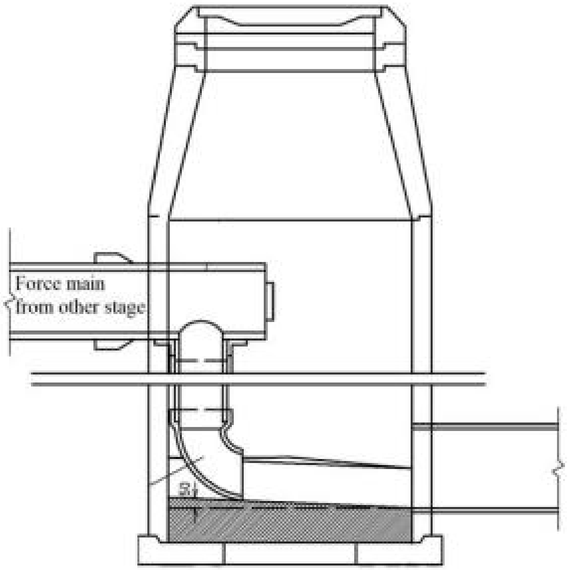
	Slurry Type	Earth Pressure Balance (EPB) Type	High Density Slurry Type
General	Slurry pressure balance consists of slurry machine, pipe jacking facility, slurry circulation, pipe, slurry treatment plant excavation control facility and so on. Cutter face is shielded by bulkhead to keep constant pressure balance. Excavated material is mixed with slurry and transported as slurry. Slurry mud is separated into the sand, mud and slurry by slurry treatment plant at open area.	Earth pressure balance type is shielded by bulkhead as same as the slurry type. Cutting mud of chamber is taken out while keeping earth pressure balance. Additives are added to the mud to accelerate the plastic flow through the cutter head. Mud is taken out as same as excavated volume in order to maintain pressure of chamber.	High density slurry type is same as slurry type. High density type uses higher density slurry to achieve higher pressure balance. Discharge valve is opened at intervals to maintain the pressure balance of chamber. The pressure of slurry pipe drops down until air pressure after passing through the discharge valve. Mud is transported by vacuum through separator.
Applicable Diameter	Dia. From 200mm and over	Dia. From 200 mm and over	Dia. 800mm and over: standard
Applicable Distance	Relatively long jacking length	Shorter jacking length than others	Relatively long jacking length
Characteristic	・Since cutter face is shielded by bulkhead, cutter face is stable, does not require many countermeasures, and excavation has few effects on peripheral areas. ・Excavated mud is pushed out with slurry. ・It requires wide area around driving shaft compared with other methods in order to operate the slurry treatment plant. ・Separated mud is considered as industrial waste.	・Since cutter face is shielded by bulkhead, cutter face is stable, does not require many countermeasures, and excavation has few effects on peripheral areas. ・Wide application to many conditions, and achieves high performance in silt or clay excavation. ・Lighter equipment compared with slurry and high density slurry type. ・Most excavated mud is considered as industrial waste.	・Since cutter face is shielded by bulkhead, cutter face is stable, does not require many countermeasures, and excavation has few effects on peripheral areas. ・Wide application to many conditions, especially getting high performance in collapsed sandy soil condition. ・Slightly lighter equipment compared with slurry type. ・All excavated mud is considered as industrial waste.
Applicable soil conditions and water pressures	・High capability in varied ground condition ・High capability under high water pressure such as 0.15MPa ・In case of clay or silt excavation, second classified treatment ratio is increasing rather than first classified treatment ratio.	・High capability in varied ground condition ・Capability under 0.06MPa water pressure ・High performance in fluidized ground conditions such as clay or silt since pressure balance of cutter face is maintained.	・This machine is applicable in collapsed sandy ground condition while maintaining pressure balance of cutter face and high density slurry. ・Since the control of cutter face pressure is difficult, surface of ground could be affected in silt or clay ground condition.
Experience in overseas country	Many experiences	Less experiences	Less experiences
Total assessment	Applicable in various ground conditions, wide range of diameters, and has been widely used in overseas countries (much experience) (Recommended)	Because of relatively short jacking length and less experiences in oversees, it is not recommended.	Since pipe installation by micro tunnelling under relatively low earth covering is planned, ground surface disruption is expected by the difficulties on pressure balance under low earth cover depth. Therefore, it is not recommended.

Source: JET

(4) Connection Between the Each Stage

Sewage from the 2nd stage and the 3rd stage collection areas will be pumped to the 1st stage system because of the drastic changes in ground elevations. Force mains will be connected to discharge manholes installed at the 1st stage. Therefore the depth of the gravity sewers in the 1st stage collection area will not be affected by the depth of sewers in the 2nd stage and the 3rd stage.

The discharge manholes in the 1st stage must have sufficiently large internal dimensions to accommodate the incoming force mains. When the discharge manholes are deeper than 4m, the discharge manholes need extra space for an internal drop pipe as shown in **Figure 5.2-5**.



Source: JET

Figure 5.2-5 Discharge Manhole with Drop Pipe

(5) Micro-tunnelling for Force Main

The installation methods of force main by micro-tunnelling can select from following two methods.

Case 1: Installation with Large Casing Pipe
Case 2: Installation by special ductile iron pipe for micro-tunnelling

The installation costs of both methods are compared in **Table 5.2-6**. The cheaper unit cost will be applied in this project cost estimate.

Table 5.2-6 Comparison of Construction Methods ling Boring Machine

	Case 1			Case 2		Result	
Required Main Pipe Diameter	HDPE Main Pipe	Concrete Casing Pipe	Unit Cost (JPY/m)	Special DI Main Pipe	Unit Cost (JPY/m)	Applied Unit Cost (JPY/m)	Applied Case
80mm	80mm	300mm	142,817	-	-	142,817	1
100mm	100mm	350mm	153,598	-	-	153,598	1
150mm	150mm	400mm	165,626	-	-	165,626	1
200mm	200mm	450mm	178,187	-	-	178,187	1
300mm	300mm	600mm	225,550	300mm	265,320	225,550	1
400mm	400mm	700mm	264,124	400mm	310,202	264,124	1
500mm	500mm	800mm	740,268	500mm	350,575	350,575	2
600mm	600mm	900mm	764,586	600mm	418,944	418,944	2

Source: JET

5.2.2 House Connection

(1) Current Situation

The existing sewage collection system, shown in **Figure 3.2-5**, can serve about 10% of the households in the entire service area. Of this 10%, about 70% of the households are connected to the sewer system shown in **Figure 3.2-5**. The remaining 30% are connected to existing drains although the sewers are developed in front of houses.

About 90% of the households in the service area discharge wastewater (black water) from toilets to septic tanks with soil infiltration, and grey water from kitchens and bathrooms to existing drains along the street because there are no sewers (see **Table 5.2-7**).

Table 5.2-7 Existing Connection Ratio

Existing networks	Ratio of households in service area	Connect to	Source
Sewer network (Figure 3.2-5)	10 %	Sewer network (70%)	NWSDB
		Existing drains (30%)	
Drain network along the roads	90 %	Existing drains (90%)	Census of Population and Housing 2012, Department of Census and Statistics
		Soil infiltration (10%)	

Source: JET

(2) House Connection Installation and Cost

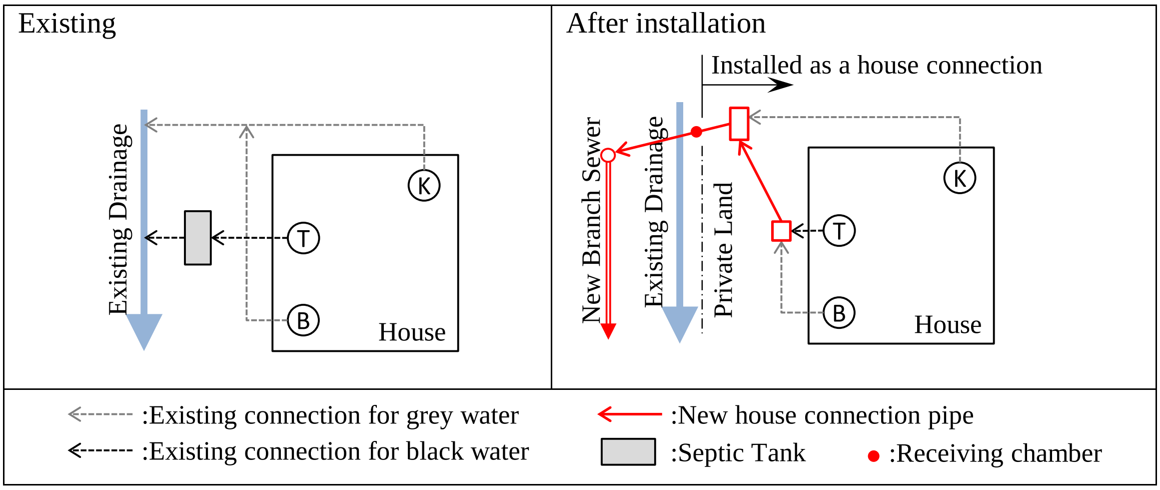
Households which are not connected to the sewerage system discharge greywater to the drain along the street. The new house connection can be installed by putting an intercepting pit upstream of the existing drainage network and connecting this to the new manhole of the branch sewer. The same arrangement can be made with the existing connection to the septic tank.

The configuration of house connection for the Kandy sewerage project is shown in **Figure 5.2-6** and the average cost for each house connection is estimated to be 150,000 LKR.

Installation of house connections is carried out in 2 steps to get enough flow at the commissioning stage of STP. Because if all house connection work would be started after the completion of STP construction works, sewage flow to the STP will be minimal at the initial phase and the commissioning of STP could not be effective.

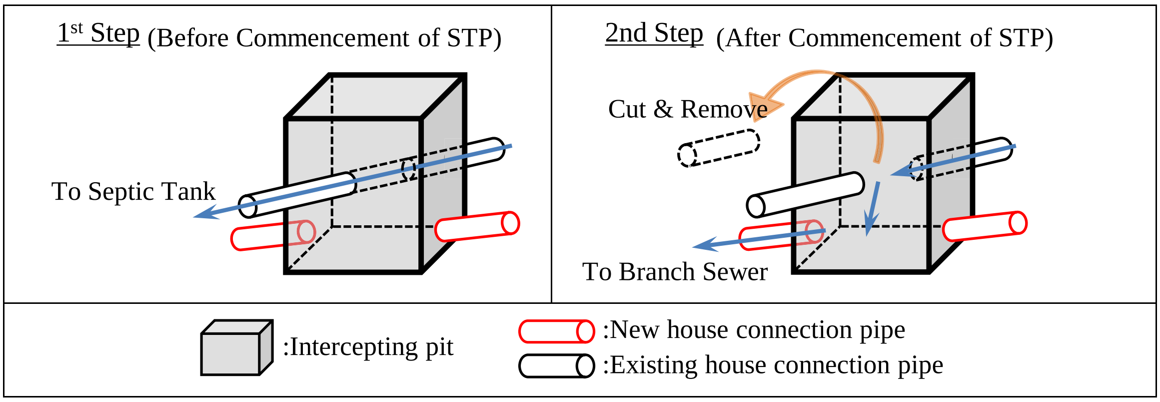
In the 1st step, before the commencement of STP operation, the new house connection pipe and intercepting pit are installed during keeping the existing house connection pipe and septic tank in operation. The existing house connection pipe runs through the intercepting pit. In the 2nd step, after the commencement of STP operation, the house connection would be switched to the system by cutting the existing house connection pipe in intercepting pit so that the sewage is diverted from the septic tank to branch sewer. After this switching works, the septic tank is abandoned. This switching of the house connection would be carried out easily and quickly (see **Figure 5.2-7)**.

The receiving chamber, locating at the downstream end of house connection, will be basically installed at just outside of the private land to ensure the smooth construction progress of sewerage network as shown in **Figure 5.2-6**. When the receiving chamber locates at inside of private land, the contractor must get the approval of installation from all house owners and spend the much time for the approval.



Source: JET

Figure 5.2-6 Configuration of House Connection



Source: JET

Figure 5.2-7 Switching of House Connection

(3) Number of House Connections

Every household will be connected to the sewer network. Although the average number of people in each household is estimated to be approximately 4 based on census data, 5 as the average number of people in each building including apartment type is used based on NWSDB's experiences. The required number of house connections at each stage is shown in **Table 5.2-8**.

Table 5.2-8 Number of House Connections

Item	Population in 2046*	Estimated # of Households	Planned Required House Connections
1st Stage	136,100	27,220	27,000 (including 2,000 existing connections)
2nd Stage	49,000	9,800	10,000
3rd Stage	33,700	6,740	7,000
Total	218,800	43,800	44,000

Note:*Population of each stage is mentioned in Table 4.4-1.
Source: JET

8% of the households (2,000 connections) in the 1st Stage has been already connected to the existing sewer system as shown in **Figure 3.2-5**. The required number of new house connections in the 1st Stage is 25,000.

(4) House Connections as a Component of this Project

92% of the households will be connected to the sewerage system in the 1st Stage. This installation cost must be included in the project cost estimate because:

- many home owners will hesitate to connect to the sewer network if they have to pay for the connection, especially low income households who cannot afford this cost.
- If house connections are installed as part of the project and not at an uncertain pace based on home owners' choice, the influent flow to the STP would be predictable and the treatment processes and system operations can be managed efficiently and effectively from the start.

As a project component, the following conditions should be fulfilled based on the NWSDB LAW No.2 of 1974 – Part 2 SECTION 12 when NWSDB provide free house connections under the ODA Project. Both conditions should be met before the loan agreement.

1. To have a consultation with the Minister of City Planning, Water Supply and Higher Education (i.e. incumbent Subject Minister) to waive off the connection fee.

2. To get the Cabinet approval having obtained the concurrence of Minister of Finance after the Minister agrees to the above condition.

In Kandy wastewater project, house connections are carried out under Municipal Council Ordinance since the asset owner of sewerage facility is Kandy Municipal Council (MC). Therefore, a new ordinance to provide house connection in Kandy MC (Extraordinary Gazette Notification No. 1708/10, 2011) was prepared before the detailed design after the approval of Ministry of Internal & Home Affairs and Provincial Councils & Local Government.

5.2.3 Major Pumping Station

(1) Location of MPSs and Its Necessity

Major pumping stations (MPSs) shown in **Figure 5.2-1**. The purpose for each MPS is described in **Table 5.2-9**. This satisfies NWSDB's requirement that sewers should cross the rivers or channels by force main so that it can be easily replaced when the bridge is expanded in future.

Table 5.2-9 Purpose for Each MPS

MPS	Site Condition
MPS-01	To be changed from MPS to manhole type pumping station by modifying the catchment area of City Sewerage Master plan. There is no land requirement.
MPS-02	To cross the channel by force main and lift wastewater from deep sewer.
MPS-03	To lift wastewater to elevated discharging point.
MPS-04	To lift wastewater to elevated discharging point.
MPS-05	To cross the part of the lake by force main and lift wastewater from deep sewer.
MPS-06	To lift wastewater to elevated discharging point.
MPS-07	To cross the part of the lake l by force main and lift wastewater from deep sewer.
MPS-08	To cross the channel by force main and lift wastewater from deep sewer.

Source: JET

Location of MPSs have been discussed with RDA and other relevant authorities to minimize the delay of the construction works by changing the planned location of MTPSs. Further updating of any information relating to the location of MTPs must be collected from RDA and other relevant authorities in the detailed design phase.

(2) Specifications

The major pumping stations are shown in **Table 5.2-10**.

Table 5.2-10 Major Pumping Stations

MPS	Design Flow	Total Pump Head	Unit	Land Requirement
MPS-02	Approximately 5.7 m^3/min	40 m	2+(1)	0.30 ha
MPS-03	Approximately 5.4 m^3/min	40 m	2+(1)	0.24 ha
MPS-04	Approximately 3.8 m^3/min	40 m	2+(1)	0.29 ha
MPS-05	Approximately 19.6 m^3/min	20 m	3+(1)	0.65 ha
MPS-06	Approximately 1.3 m^3/min	40 m	1+(1)	0.29 ha
MPS-07	Approximately 6.2 m^3/min	40 m	2+(1)	0.31 ha
MPS-08	Approximately 13.1 m^3/min	20 m	3+(1)	0.63 ha

Notes; MPS-01 was changed to manhole type pumping station, but No. for other MPSs have not been changed to avoid confusion.
(1): one stand-by unit
Source: JET

All sites for the major pumping stations with no requirement for resettlement of residents are recommended by UDA. Four sites (MPS-04, MPS-05, MPS-06, and MPS-07) are on government land (UDA, SLLRDC, and NWSDB). MPS-02, MPS-03 and MPS-08 are on private land. The land acquisition process is being carried out by NWSDB.

(3) Profile of Land for Construction of Major Pumping Stations

The profile of land for the construction of MPSs is shown in **APPENDIX 5-1.**

(4) Sludge Receiving Facility from Septic Tank

Originally it was planned to receive sludge from septic tanks (septage) in the service area and was treated in STP. Due to the odour, a receiving point for septage will be changed to MPS no 5 from the STP. Under this situation, the effects of septage on pumping capacity of the MPS and sewage quality are considered. As the result of study, septage does not affect the function of MPS05 and nature of sewage. Also, in terms of preventing odour emission on septage, odour control system will be installed in pumping stations with septage receiving facility.

1) Receiving MPS capacity

1-a) Pump Pumping capacity is checked by the comparison between pumping ability and sewage volume with septage. At peak flow, the total pumping duration of sewage and septage is slightly more than the sewage pumping duration. The calculation below shows that the time different is only one minute. Therefore, the change of pump capacity is not required under receiving septage at MPS. The calculation is as follows;

The total pump capacity at MPS no.5: 19.8 m^3/min (= 6.6 m^3/min/pump x 3 pumps)

Sewage volume to be pumped at MPS 5: 19.6 m^3/min for peak

Maximum septage volume = Discharged septage volume / discharging time
= 175 m^3 / 8hours = 21.9 m^3/hour =0.36 m^3/min

Septage volume : 175 m^3/day (=0.5 % of 35,000 m^3/day)
(0.5% is decided from sewage treatment ability.)

Septage receiving work hours : 8 hours (assuming septage is received for day time, 8 hours)

Peak flow of mixed sewage with septage at MPS05 = 19.96 m^3/min for peak (=19.6+0.36)

Assuming peak flow continues for 60 minutes, pump running time is 60.5 minutes (=19.96 *60/ 19.8).

Extra running time of pumps = 1 minute (=60.5-60)

2) Sewage Quality with septage

The high concentration of solid in sewage with septage may affect the design capacity and specification of main pump. In case that total suspended solid (TSS) in sewage is higher than 5,000 mg/L (0.5%), the sludge pump with abrasion-resistance and high-lift capacity may be considered. However the normal sewage pump is applied for the sewage under 5,000 mg/L of TSS normally. (For example: circulation pump or sewage draw pump in reactor are used normal sewage pump due to the concentration of SS is from 1,500 to 4,000 mg/L.)

Therefore, it is studied whether the sewage quality with septage is lower than 5,000mg/L. Based on the following calculations, pump capacity in MPS5 is not affected by the septage because the TSS of sewage with septage is lower than 5,000 mg/L.

Although the quality of sewage with septage does not affect the pump capacity, an automatic bar screen unit with clearance of 10 mm and sand pit is installed in MPS5 to prevent the clogging and trouble of pumps at the inlet of septage due to trash and large grit.

3) Sedimentation of Sewage quality with septage

The sewage quality with septage in MPS 5 is calculated based on the septage quality at 2007 in **Table 5.2-11**. Taking account in 8 hours of the septage receiving work hours, TSS of sewage with septage is about 350 mg/L which is between the common range of sewage. The sedimentation of TSS is not expected under this TSS concentration.

Table 5.2-11 Quality of Septage in Kandy City at year 2007

(mg/L = g/m^3)

	TSS	SS	TDS	COD	BOD5	pH
Case1	7,417	6,015	1,402	12,890	1,140	9.4
Case2	9,554	8,365	1,189	11,620	1,020	8.9
Case3	11,741	6,556	5,186	45,000	437	9.2
Case4	4,785	2,355	2,430	10,250	444	8.7
Case5	1,495	1,045	450	2,240	152	9.3
Case6	6,938	2,660	4,278	7,900	495	8.7
Case7	3,734	1,460	2,274	3,700	123	8.2
Average	6,523	4,065	2,458	13,371	544	8.9

Source: JET

The quality of sewage with septage is calculated as follows;

Assuming septage is discharged in MPS 5 at day time, 8hours,

Average flow of sewage at MPS 5: 17,640 m^3/day

Sewage volume for 8 hours: 5,880 m^3 (=17,640 /24 *8)

Maximum flow of septage: 175 m^3 (=0.5 % of 35,000 m^3/day)

Sewage volume with septage for 8 hours: 6,055 m^3 (=5,880+175)

TSS volume of sewage at MPS 5 = 5880 m^3 x 160 g/m^3 (Design Value) = 940 kg

TSS volume of septage = 175 m^3/day x 6,523 g/m^3 (**Table 5.2-11**) = 1,142kg

Total TSS volume of sewage with septage = 2,082 kg (=940 + 1,142)

The quality of TSS of sewage with septage = 344 mg/L (=2,082 / 6,055) < 5,000 mg/L

Since quality of septage is different from sewage, the mixing time at wet well is checked. Based on the volume of wet well, the mixing time is 15.8 minutes. This time is enough to homogenize the quality of sewage with septage.

The calculations are as follows;

The volume of wet well in MPS05 is 200 m^3 (30 minutes of Retention time for 6.6 m^3/min of one pump capacity).

Sewage flow with septage:12.6 m^3/min (=756m^3/hr=(5,880+175)/8 hours)

Mixing time = 15.8 minutes (=200/12.6)

5.2.4 Manhole Type Pumping Stations

(1) Number and Location of Manhole Type Pumping Stations

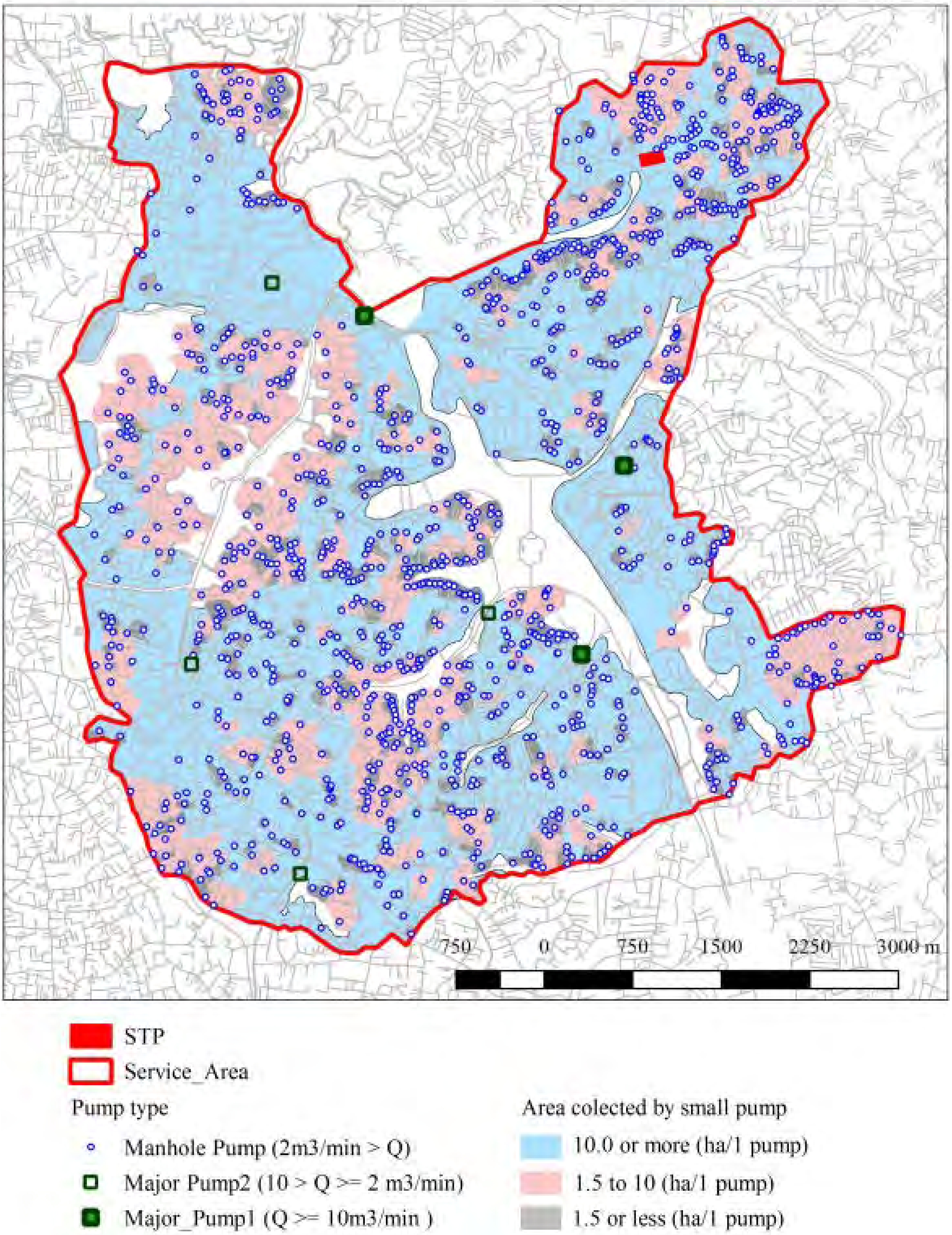
Manhole type pumping stations (MTPSs) are installed where branch sewers are more than 4.5 m deep. The number of MTPSs is shown in **Table 5.2-12** and their locations are shown in **Figure 5.2-8**. Most of the MTPSs are installed on the branch sewer network. Therefore the number of MTPSs may appear to be significantly higher than that proposed in the City Sewerage M/P for main trunk sewers.

Table 5.2-12 Number of Manhole Type Pumping Stations

	Type 1 Less than 2.0 m^3/min	Type 2 Less than 1.0 m^3/min	Type 3 Less than 0.5 m^3/min	Type 4 Less than 0.2 m^3/min	Total
1st Stage	6	9	48	0	63
2nd Stage			240	0	240
3rd Stage				938	938
Total	6	9	298	938	1,241

Source: JET

Initial discussion of the location of MTPSs for the 1st stage has been started between NWSDB and RDA to share the candidate of each MTPSs location for smooth implementation of the project.



Source: JET

Figure 5.2-8 Location of Manhole Pumps in Each Catchment

Effectiveness of MTPSs at each stage is described in **Table 5.2-13**. MTPSs at the 1st Stage is more cost effective because one MTPS lifts sewage from more than 800 person.

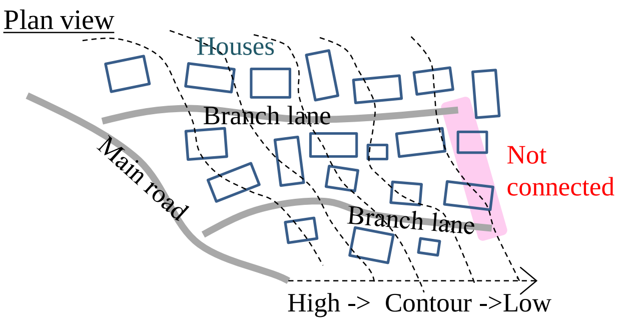
Table 5.2-13 Effectiveness of Manhole Type Pumping Stations at Each Stage

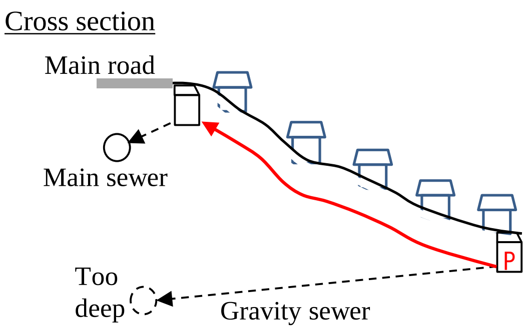
Effectiveness of	1st Stage	2nd Stage	3rd Stage
Catchment Area (ha)	Over 10 ha/ 1 MTPS	Less than 10 ha/ 1 MTPS	Less than 2 ha/ 1 MTPS
Equivalent population (persons)	Over 800 / 1 MTPS	around 400 / 1 MTPS	Less than 100 / 1 MTPS

Source: JET

(2) Topography and Road Configuration

This service area is characterized by many steep dead-end lanes branching off the main road. These side roads do not connect with each other when they reach the low-lying area. To cope with this topographical feature and road configuration (**Figure 5.2-9**), many small manhole pumps would be required to avoid installing sewers more than 4.5 m deep. Fewer pumps would be needed if a connecting road would be developed in the low area in the future.





Source: JET

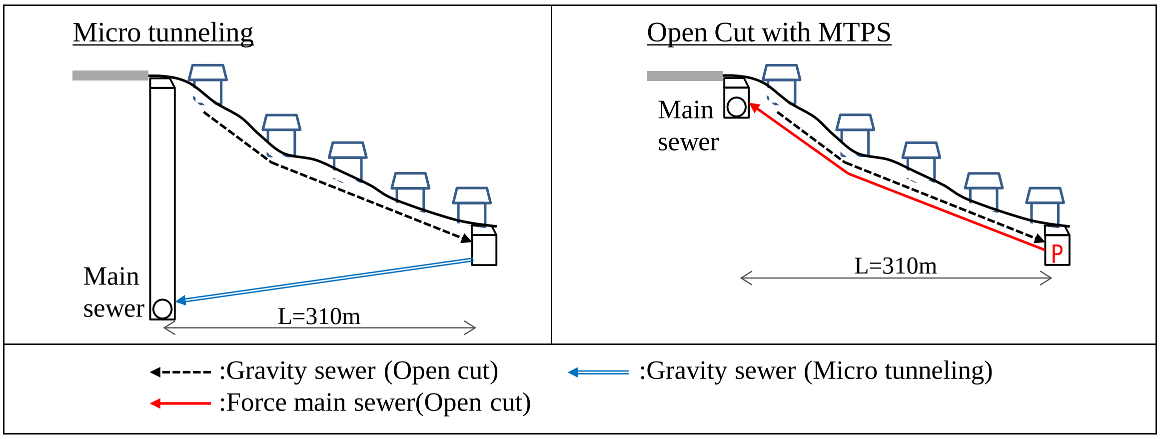
Figure 5.2-9 Typical Topographical Feature and Road Configuration

Developing the sewerage system such a narrow and steep dead-end lanes, following 2 types of installation system were studied.

- the open-cut installation method with MTPS
- the micro- Tunnelling installation method without MTPS,

The result of the cost comparison between 2 cases shows that the later method has an advantage in case of the length of sewer within 310m as shown in **Figure 5.2-10**. Cost comparison is shown in **APPENDIX 5-8**. However the open cut installation method is feasible under this condition although the micro Tunnelling installation method is advantageous aspect of the cost. Reasons are summarized as below:

- Installing the shaft for the micro Tunnelling works takes long days and makes the traffic unavailable because the width of lane has few allowance space compared with the required shaft width of 3m or more.
- Open cut method has only shallow sewers with minimum cover depth and each of gravity sewer and force main sewer will be installed in one trench. That can make the construction period so earlier.



Source: JET

Figure 5.2-10 Condition of Cost Comparison between Micro- Tunnelling and Open cut

(3) Collection System using MTPSs

As described earlier, there will be more than 1,200 MTPSs, with the largest number in the 3rd stage collection area. Various options for the collection system were considered:

Current Plan:	Separate collection systems for the entire service area with sewer installation under public roads and centralized treatment. The number of MTPSs is estimated to be 1,200.
Alternative 1:	Separate collection systems for the entire service area with sewer installation under public roads and private land, and centralized treatment. The number of MTPSs is estimated to be 400.
Alternative 2:	Separate collection systems for the 1st and 2nd Stages and decentralized system for the 3rd Stage with Modified Septic Tank. The number of MTPSs is estimated to be 300.

The current plan is the most feasible for the following reasons:

- Most effective and efficient in improving the water environment and living conditions with centralized sewage treatment.
- Fewer risks during project implementation because all sewers will be installed under public roads.
- The sewer has to be installed under public roads in this F/S phase because currently there is no Act/Code/Law which allows the installation of sewers through private land.

Based on above considerations, NWSDB expressed their intention to implement the current plan in the meeting with JICA for the pre-Fact Finding mission on January 31st,2019.
A detailed comparison of options is shown in **Appendix 5-10**.

(4) Future Development of the Collection System in the 3rd Stage Area

As discussed in this subsection, the current plan requires a large number of MTPSs. There are some key issues that are contributing to the number of pumping stations:

1) Details of the road master plan, the development plan and its implementation schedule, are all not available to and shared with the sewerage development authorities. For example, there is a possibility that a lakeshore road could be constructed to link some of the low-lying housing developments presently serviced by dead end lanes. This would enable the installation of trunk sewers along the lakeshore and greatly reduce the number of smaller MTPSs required to service dead end lanes in 3rd Stage.
2) The service area is characterized by many small lanes that dead-end at the bottom of a hill. These lanes do not interconnect with each other. These lanes are usually only separated by a single plot of private land (about 10m). MTPS in such low-lying dead-end pockets cannot be avoided unless sewers can be routed through private land to interconnect the adjacent lanes.
3) Currently there is no Act/Code/Law which allows the installation of sewers through private land. Current NWSDB's Law, Act No.2 of 1974 stipulates the possibility for installation of water supply pipes only. NWSDB has not yet dealt with the need to lay sewer pipes through private land.

Resolving these key issues represents considerable challenges and will require the following actions:

1)-1 Coordination between road authorities and sewerage authorities for the planning and implementation of road development projects, especially in the low-lying lakeshore area.
1)-2 Discussions between the road and sewerage authorities based on approved planning information regarding sewer installations under newly planned road.

2)-1 Joint survey and confirmation of the servicing requirements for low-lying pockets with the staff from all relevant authorities. Surveys should take into consideration the installation of a short length of sewer on private land to reduce the number of MTPSs.
3)-1 Establishing a council for discussing how to proceed with sewer installation under the private land. Try to establish the Act/Code/Law enabling the installation of sewers through private land in the future.

Implementing these activities, in parallel with the development of the sewerage system for the 1st stage and 2nd stage, will make it easier to reduce the number of MTPSs in the 3rd stage.

(5) MTPS Design and Management

The MTPS design is relatively simple. It consists of a pump underground in the manhole and an above ground electric panel nearby. At the detailed design stage, the internal dimension of the underground unit is determined and a submersible pump suitable for the design flow and required total head is selected. Five mobile generators will be provided in case of power failure.

MTPSs will be managed by the Sewerage Division in Sri Jayawardenepura Kotte Sewerage Management Office (MO) as one of the sewerage facilities.

Many Japanese cities experience fewer problems when non-clogging MTPS is used. After a failure is detected, corrective maintenance should be initiated immediately similar to the practice in Japan. This involves the mobilization of MO staff for prompt investigation.

The simplest and most practical monitoring system can be achieved by installing a signal light on the power supply unit for each MTPS. Nearby residents would call the MO when the pump stops and the signal light comes on. SCADA system can be considered as more MTPSs are installed in detailed design phase.

NWSDB understands the following matter relating to the MTPSs:

- the proposed monitoring system and maintenance for MTPSs to maintain the performance of large number of MTPSs, including over 1200 number of MTPSs when the stage 3 could be completed.
- the replacement of its mechanical part of MTPS would be necessary in each 20 year life cycle, for approximately 1200 number of MTPS in operating 3rd Stage.
- the life cycle cost of MTPS is relatively high and estimated to be around 9,000 USD/year/MTPS. In principle, the investment for replace of these MTPSs would be necessary for next coming 20 years.

5.3 SEWAGE TREATMENT PLANT

The sewage treatment plant of Sri Jayawardenapura Kotte is named “Water Reclamation Center” by NWSDB. However the abbreviated name is “STP” in this report.

5.3.1 Basic Considerations

The following factors will affect the preliminary design and cost of the facilities:

- Historic peak flood level at the STP site
- Land elevation
- Soil conditions
- Reliability of power supply and need for stand-by system
- Treatment of sludge from septic tanks
- Solid waste

(1) Peak Flood Level at STP Site

Water levels were taken at five points around Diyawanna Lake. The highest flood level recorded was +2.6 m MSL (mean sea level) in November 2010. **Table 5.3-1** shows the flood levels used by the Sri Lanka Land Reclamation & Development Corporation (SLLRDC) for the parliament area. The STP design will use the flood level for 50 and 100-year recurrence intervals.

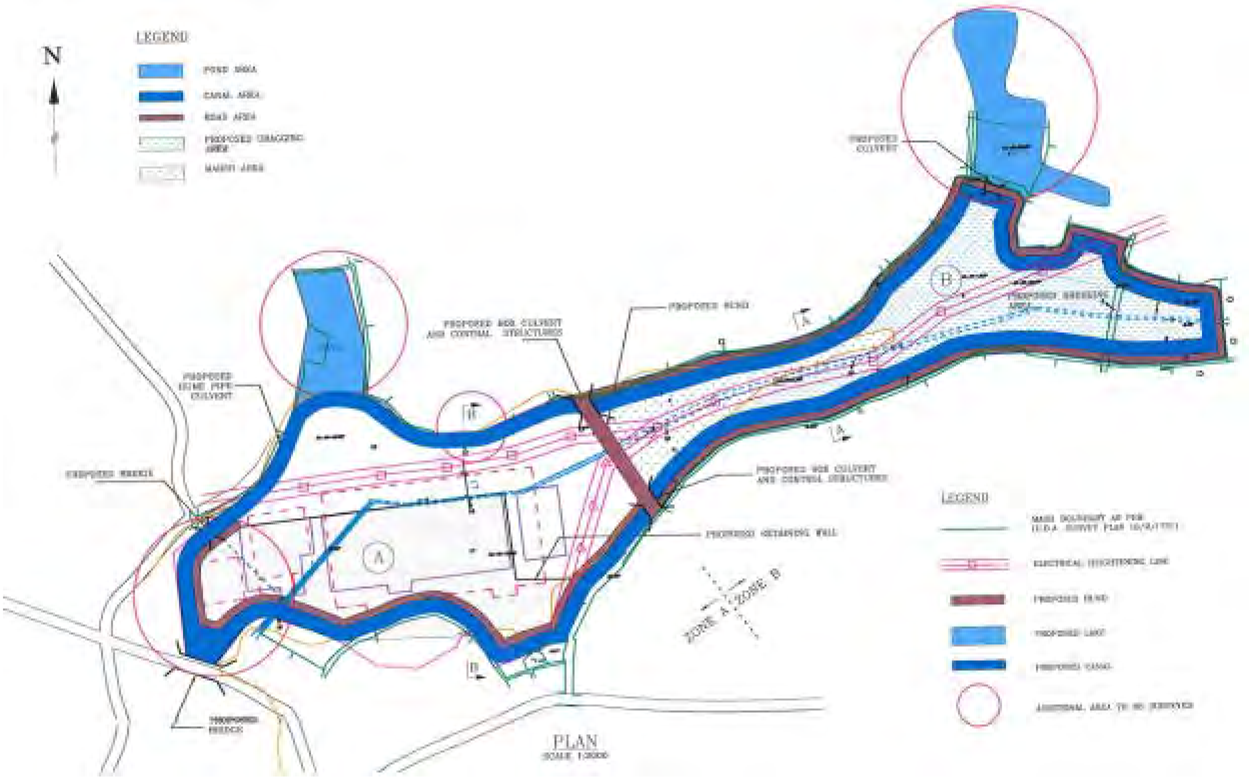
Table 5.3-1 Design Flood Levels at Parliament Area

Return Period (1time/year)	High Flood Level for Existing System under Worse Hydrological Condition (m MSL)
100	3.19
50	2.87
25	2.48
10	2.00

Source: SLLRDC

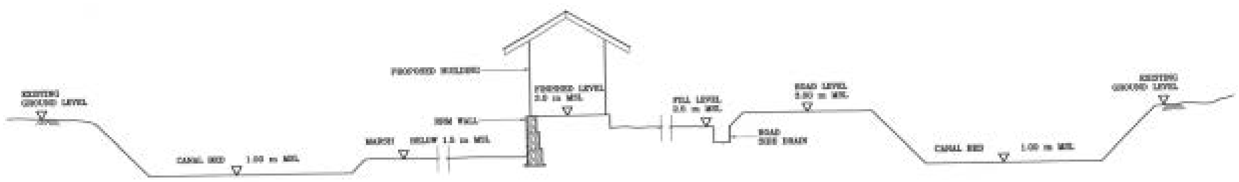
(2) Land elevation

SLLRDC has a plan for river improvement and rainwater storage pond in the surrounding area of the STP site, as shown in **Figure 5.3-1** and **Figure 5.3-2**.



Source: SLLRDC

Figure 5.3-1 SLLRDC Plan for River Improvement



Source: SLLRDC

Figure 5.3-2 Section of River Improvement

The SLLRDC plan shows a land elevation of 3.00 m MSL, which is lower than the flood level for the 100-year recurrence interval. The elevation of the STP site will use flood level for the 50-year recurrence interval (+2.87 m MSL) plus 0.6 m allowance (JET estimate).

Design elevation of the STP site:
+2.87 m (planned flood level for 50 years) + 0.60 m (allowance) = 3.47 m
≒ 3.50 m > 3.19 m (planned flood level for 100-year recurrence interval)

The design elevation at +3.50 m MSL is higher than the flood level for 100-year recurrence interval.

(3) Soil conditions

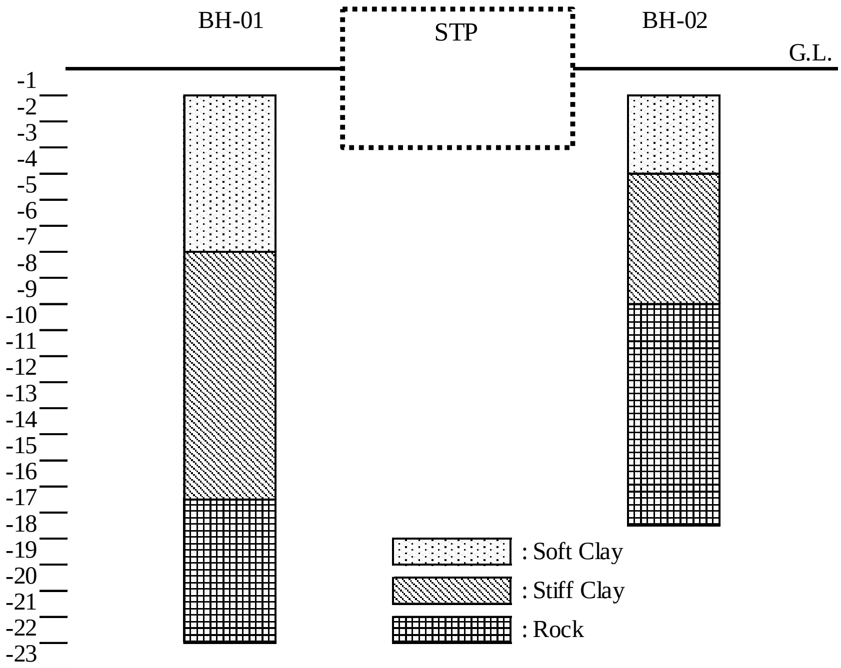
The characteristics of the soil condition at two points nearby the site of STP (**Figure5.3-3**) are summarized as follows.

- The thickness of top soil is around 1 m.

- The depth of the bearing layer is approximate 10 ~ 17 m from the ground level of the site.
- The bearing layer consists of rock.
- The middle layer consists mostly of stiff clay. The N values for cohesive soil are between 10 and 40.

Source: JET

Figure 5.3-3 Location of Boreholes



Source: JET

Figure 5.3-4 Outline of Positional Relation between Bearing Layer and Structure]

Taking the above soil conditions into account, foundation pile works are required for the constructions of STP, because the basement of the structures cannot reach the bearing layer.

(4) Power supply and need for stand-by system

The power failures at the Sri Jayewardenepura and Sapugaskanda substations near the STP site during 2015-2017 are shown in **Table 5.3-2**, according to information obtained from the Ceylon Electricity Board (CEB).

Table 5.3-2 Power Failures at Two Substations during 2015-2017

Time of Power Failure	Sri Jayewardenepura			Sapugaskanda		
Year	2015	2016	2017	2015	2016	2017
More than 10 hours	0	1	2	0	2	3
5 hours < T ≦10 hours	2	0	0	4	6	1
2 hours < T ≦5 hours	0	0	1	0	3	0
10 minutes < T ≦2 hours	4	3	4	7	16	11
T ≦ 10 minutes	21	27	37	88	153	120
Total number	27	31	44	99	180	135

Source: CEB

Most power failures lasting less than 10 minutes would not affect plant operations. An uninterruptible power supply can be installed to protect computer systems and preserve the operation data. More problematic is the power failures lasting over 5 hours. The longest disruption reported was 12 hours and 49 minutes at the Sri Jayewardenepura Substation on 20th of July 2017. Long down times will cause serious operational problems and emergency generators must be available to cope with these situations.

(5) Treatment of sludge from septic tanks

Most households have septic tanks. The STP can receive sludge from septic tanks in the project area. Processing large amount of sludge will raise nitrogen and COD levels of the effluent and darken its colour. Sludge from septic tanks should be limited to less than 2% of influent so that treated water quality is not compromised ("Strategic Sewerage Master Plan for Sri Lanka" May 2015, JICA). The volume of sludge is estimated 182 m^3/day. This amount is about 0.8% (182/23,969*100% = 0.76%) of the capacity of STP at the 1st Stage. The sludge production for septic tanks in the service area is shown in **APPENDIX 5-9**.

Sludge from septic tanks usually carries large quantities of grit which have to be removed before entering the treatment system. A grit chamber will be required as shown in **Figure 5.3-5** for the Moratuwa/Ratmalana STP.

Source: JET

Figure 5.3-5 Receiving Facility at Moratuwa/Ratmalana STP

(6) Solid Waste

Since the available land cannot accommodate composting facilities, dried sludge should be disposed of through the private company Green Force Agriculture. SLLRDC could grant permission to deliver dried sludge to the compost production facility at Kerawalapitiya, as an alternative that can be helpful under exceptional circumstances.

The letter of acceptance received from SLLRDC for composting of dried sludge is provided in **APPENDIX 5-2**.

5.3.2 Process Design

(1) History of Candidate Sites for Sewage Treatment Plant

The STP site selected from the four suggestions by UDA, is located at Heenetikumbura near Kalapaluwa/Koswatta Road. The site can accommodate all the project components. Detail evaluation is shown in **Table 9.5-1**.

The use of this land for a sewage treatment plant is officially stated in "The Gazette of the Domestic Socialist Republic of Sri Lanka" issued on 28th of December, 2017. The land acquisition process is being carried out by NWSDB.

(2) Sewage Treatment process

Two steps are involved in treatment process selection. Candidate processes are assessed qualitatively on removal efficiency, space requirement and ease of O&M. Promising ones are further evaluated quantitatively on construction and O&M costs.

1) Qualitative Evaluation

a) Effluent Quality

Effluent quality must meet CEA and NWSDB tolerance limits shown in **Table 4.5-8**.

b) Removal Efficiency

The tolerance limits for removal efficiency are presented in **Table 5.3-3.**

Table 5.3-3 Required Removal Efficiency

	Influent to the STP (mg/L)	Influent to the reactor* (mg/L)	Tolerance limit values for effluent (mg/L)	Required Removal efficiency (%)
BOD5	240	262	10	97
COD	600	655	100	85
TSS	160	188	15	92
T-N	45	47	-	-
Ammonia N	34	35.9	1.0	98
NO_3-N	1.0	1.0	10	-
Org-N	8.7	8.7	1.0	-
T-P	6	7	1.0 (0.6)*2	86 (92)*2
Soluble P	-	-	<0.5 (0.3) *2	-
Organic P	-	-	<0.5 (0.3) *2	-

Note: * Includes the side stream load
*2 These values may be applied by the stringent requirement of CEA in future and achieved by rapid sand filtration.
Source: JET

c) Required Land

The candidate site for the STP is about 23,000～24,000 m^2. All treatment facilities must fit in this space.

d) Treatment Method

The following four treatment processes can remove nitrogen and phosphorus as well as organic matter and are candidates for further evaluation. All can meet the required effluent tolerance limits.

- Step-feed biological nutrient removal (BNR)
- A_2O
- Modified Ludzack-Ettinger process with coagulant addition
- Nutrient removal type oxidation ditch process with coagulant addition

e) Evaluation Results

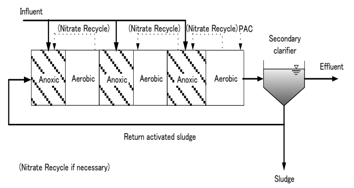
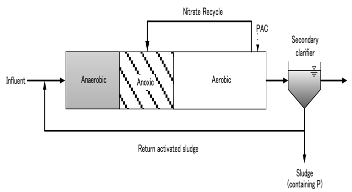
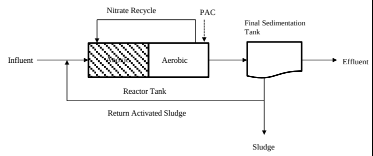
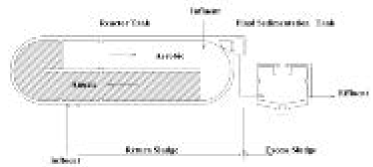
The four treatment processes were evaluated on effluent quality and space requirement for the design capacity of 39,400 m^3/day. The results are summarized in **Table 5.3-4**.

Step-feed BNR process and the A_2O process are selected for quantitative evaluation for the following reasons:

- Biological phosphorus removal is preferable to chemical treatment because of the lower O&M cost.

- Nutrient removal type oxidation ditch process could not be accommodated in the available space.

Table 5.3-4 Qualitative Evaluation of Four Treatment Methods

Treatment Method	Step-Feed BNR Process with coagulant addition	A_2O Process with coagulant addition	Modified Ludzack-Ettinger Process with coagulant addition	Nutrient Removal Type Oxidation ditch process with coagulant addition
Treatment process				
Type of Reaction in Reactor Tank	Biological nitrification-denitrification	Biological nitrification-denitrification	Biological nitrification-denitrification	Biological nitrification-denitrification
	Biological phosphorus remove with Simultaneous chemical precipitation	Biological phosphorus remove with Simultaneous chemical precipitation	Simultaneous chemical precipitation	Simultaneous chemical precipitation
	Satisfied	Satisfied	Not satisfied for O&M cost reduction	Not satisfied for O&M cost reduction
Removal Efficiency (Water Quality)	BOD: 92-94% (97%)*	BOD: 92% (97%)*	BOD: 93-95 (97%)*	BOD: 93-95% (97%)*
	SS: 90-95%	SS: 93%	SS: 90-95%	SS: 92-96%
	T-N: 83,78,67%	T-N: 60-70%	T-N: 65-70%	T-N: 85%
	T-P: 40-50% (90%)*	T-P: 70-80% (90%)*	T-P: 90%*	T-P: 40-70% (90%)*
		Depending on circulation ratio		Depending on circulation ratio
	Satisfactory	Satisfactory	Satisfactory	Satisfactory
Required Space ($Q=39{,}000m^3/day$)	Enough space	Enough space	Enough space	Need bigger space
Evaluation	Excellent	Excellent	Fair	Bad

Note*: All processes require the coagulant addition to achieve the effluent quality of BOD and T-P.
Source: JET

2) Quantitative Evaluation

a) Nitrogen Removal

The step-feed BNR and A_2O processes use nitrification and denitrification reactions for biological nitrogen removal. Nitrified liquor is circulated from the nitrification tank to the denitrification tank. Both processes can remove more than 80% of the nitrogen and satisfy the effluent tolerance limit. However, they differ significantly in recirculation ratio. Step-feed BNR uses multi-stage nitrification – denitrification tanks, and has lower recirculation ratio and power consumption. The recirculation ratios of each process are:

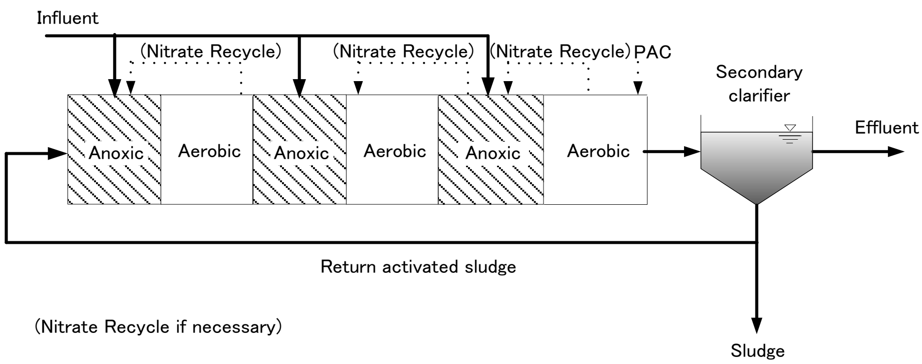
- Step-feed BNR process: 0.5
- A_2O process: 2.7

b) Phosphorus Removal

Biological phosphorous removal depends on the activity of phosphorus-accumulating organisms (PAOs) in the activated sludge. PAOs release phosphate in the bulk liquid under anaerobic condition and then take up phosphate under aerobic conditions. By repeatedly alternating these processes, the phosphorus content of PAOs rises resulting in P removal. PAOs require easily degradable substrate such as volatile fatty acids (VFA) to release phosphate under anaerobic condition.

The anaerobic cell is installed differently in the step-feed BNR and A_2O processes.

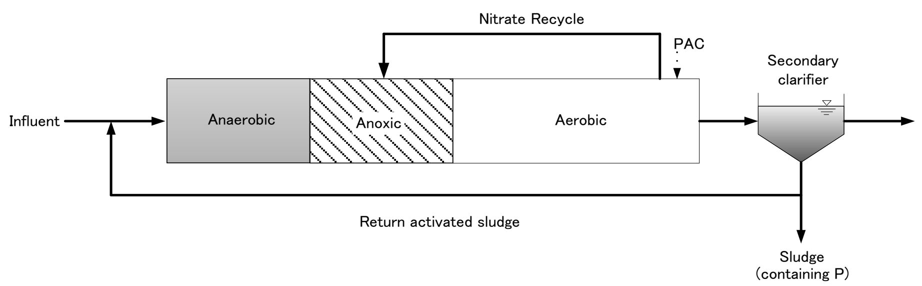
- Step-feed BNR process: the anaerobic cell is integrated in the first anoxic tank. Part of the anoxic tank becomes anaerobic depending on the denitrification condition in the tank.



Source: JET

Figure 5.3-6 Step-feed BNR Process

- A_2O process: the anaerobic cell is installed independent from the anoxic tank.



Source: JET

Figure 5.3-7 A_2O Process

c) Quantitative Analysis

The quantitative evaluation results are summarized in **Table 5.3-5.**

Step-feed BNR process has an economical advantage over A_2O:

- Slightly lower construction cost
- Much lower operation cost because of the low recirculation ratio (0.5 versus 2.7 for A_2O process) and significantly lower power consumption

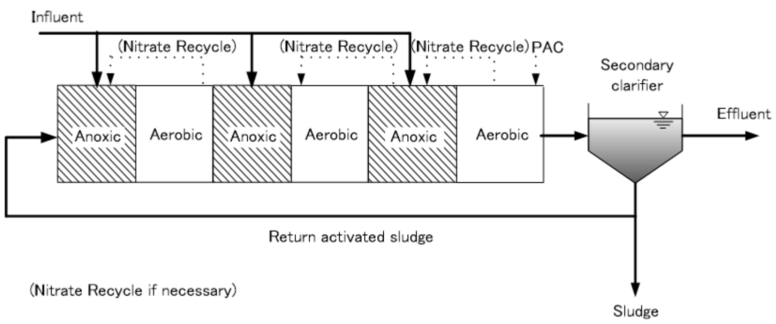
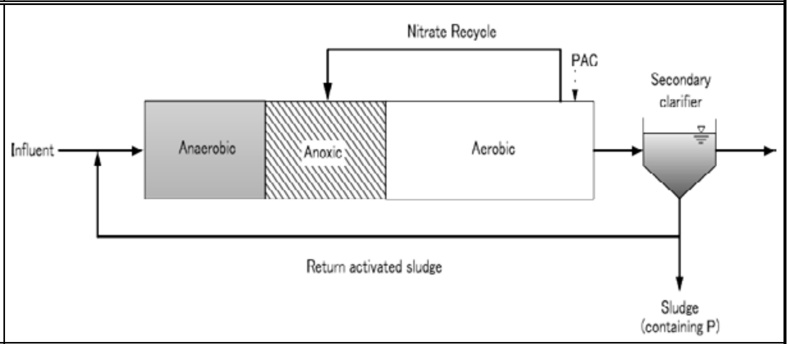
Step-feed BNR process is the preferred option.

d) Other Considerations

Significant biological phosphorous removal is expected from the biological process. Simultaneous chemical precipitation is added in the third stage to ensure that the target P concentration is met under the worst condition.

Structural drawings for each treatment process are shown in **APPENDIX 5-3**.

Table 5.3-5 Comparison of Step-feed BNR and A_20 Processes

Items	Three-stage Step-feed Biological Nitrogen Removal Process（Step-feed BNR）			Anaerobic-Anoxic-oxic Process（A_2O）		
Brief Summary of Treatment process						
	In this process, the stage combining the anoxic tank and the oxic tank is lined up in the downward flowing direction from the first stage to the third stage. An equal amount of inflow water is supplied to each anoxic tank.			In this process, the Reactor tank is placed in the order of the anaerobic tank, the anoxic tank, the oxic tank. The nitrified liquid in the oxic tank is circulated to the anoxic tank.		
Facility area※)		**Good (2)**	5,100 m2 （1.0）		**Fair (1)**	5,900 m2 （1.2）
Construction Cost※)	Total ＝Civil structures cost ＋Machine and Electric facilities cost	**Good (2)**	3,315 Million LKR （1.0）	Total ＝Civil structures cost ＋Machine and Electric facilities cost	**Good (2)**	3,411 Million LKR （1.0）
Operation Cost※)	Electric power cost for Reactor Tank	**Good (2)**	19,890 LKR/day （1.0）	Electric power cost	**Fair (1)**	45,030 LKR/day （2.3）
Equivalent Annual Cost※)	Total ＝Operation Cost（Electric power cost） ＋Civil structures cost (per 50years) ＋Machine and Electric facilities (per 15years)	**Good (2)**	121 Million LKR/year （1.0）	Total ＝Operation Cost（Electric power cost） ＋Civil structures cost (per 50years) ＋Machine and Electric facilities (per 15years)	**Fair (1)**	130 Million LKR/year （1.1）
Result	**Recommended (○)**					

Source: JET

(3) Disinfection

Treated wastewater is disinfected before discharge to minimize health risks associated with pathogens.

a) Alternatives

- A: Chlorination
- B: UV Radiation

b) Evaluation of Alternatives

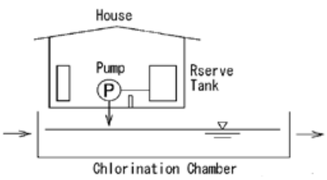
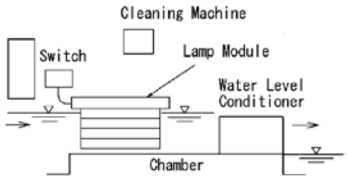
Table 5.3-6 shows the comparison between the two alternatives. UV radiation is the method of choice for the following reasons:

- Although construction cost is higher, O&M cost is lower.
- The water body downstream of the discharge point is used for boat training and the water is used for landscaping in Diyatha Uyana Park and Water Edge.
- Any disinfection byproduct or over injection of chlorine must be avoided for the health and safety of users of these parks.

c) Other Considerations

- UV disinfection would not work well if the effluent is colored or if it contains too much suspended particles. The step-feed BNR process produces clear effluent; therefore no sand filtration is necessary prior to UV disinfection.
- As a contingency measure, chlorine dosing facility must be installed as part of the facility. The necessary contact time for the chlorine reaction can be achieved in the discharge channel.

Table 5.3-6 Comparison of Disinfection Methods

Disinfection Methods	Chlorination	UV Radiation
Figure		
Facility	Simple	Little Complex
	Excellent (3)	**Good (2)**
Operation & Maintenance	Making chemical weekly. Confirmation of the concentration by densimeter.	Exchanging the lamp annual. Confirmation of the lamp by watching equipment.
	Good (2)	**Good (2)**
Byproduct	Trihalomethanes (THMs)	No
	Fair (1)	**Excellent (3)**
Contact Time (Required Area)	15 minutes (Large)	5～20 seconds (Small)
	Good (2)	**Excellent (3)**
Risk of impact for Human (Administrator)	Low danger (Leakage of chlorine gas)	Low danger （Expose the lamp directly）
	Good (2)	**Good (2)**
Risk of impact for Downstream	Some risks of damage for ecosystem	No risks for ecosystem
	Good (2)	**Excellent (3)**
Construction Cost	241 Million LKR (100%)	1,060 Million LKR (400 %)
	Excellent (3)	**Fair (1)**
O&M Cost	30 Million LKR/year (250%)	12 Million LKR/year (100%)
	Good (2)	**Excellent (3)**
Equivalent Annual Cost	36 Million LKR/year (100%)	64 Million LKR/year (180%)
	Good (2)	**Fair (1)**
Evaluation		Construction cost is higher than Alternative-A. However O&M cost was less than Alternative-A and other environmental aspects are better than Alternative-A. In addition, the required area is smaller than Alternative-A and it match to the limited site area.
		Recommended (○)

Source: JET

5.3.3 Overall Layout of the Treatment Facilities

The overall layout is shown in **Figure 5.3-8** and **Figure 5.3-9**. Layout plan for sewage treatment plant is shown in **APPENDIX 5-4**.

5.3.4 Mechanical Design

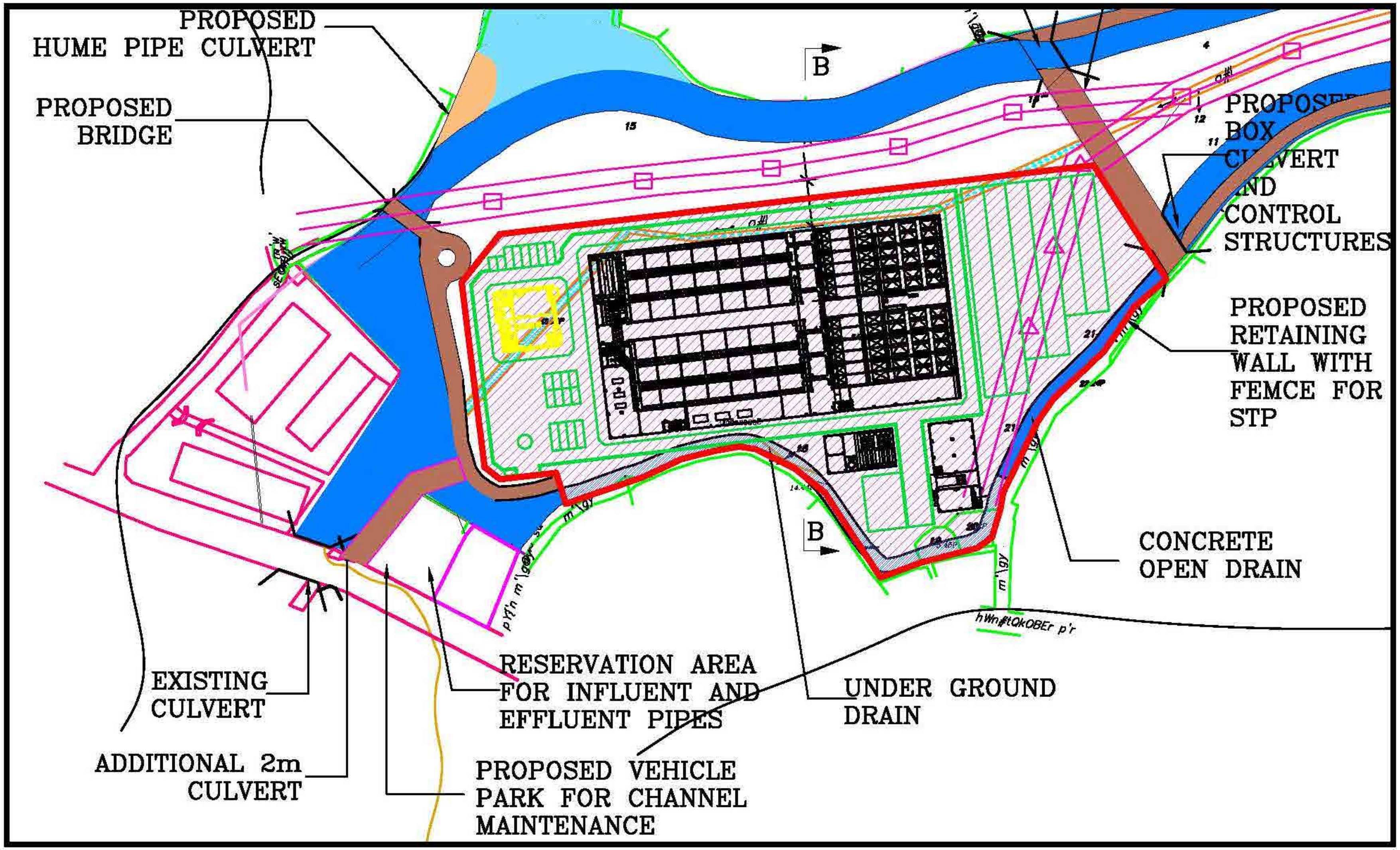
(1) Sewage and Sludge Treatment Process Details

Details of the sewage and sludge treatment process are shown in **Figure 5.3-10**.

Mass balance is shown in **APPENDIX 5-5** and the capacity calculations of facilities are shown in **APPENDIX 5-6**.

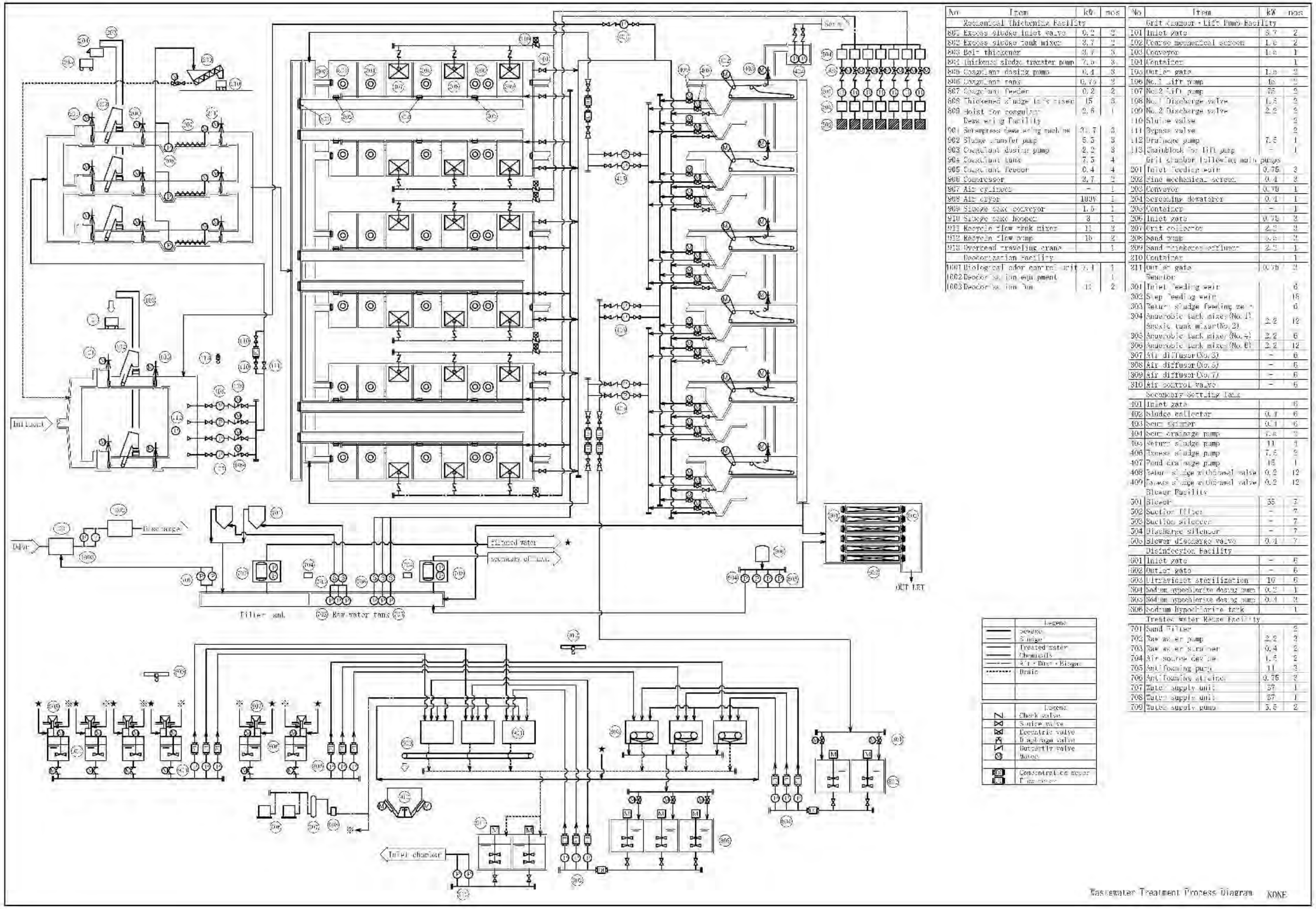
Source: JET

Figure 5.3-8 Draft Overall Layout of Treatment Facilities



Source: JET

Figure 5.3-9 Draft Overall Layout of STP Site



Source: JET

Figure 5.3-10 Flow Diagram of Sewage and Sludge Treatment

(2) Mechanical Design

1) Sludge Thickening

Sludge thickening reduces the free water content and the volume of sludge before dewatering.

a) Gravity versus Mechanical Thickening

Since there is no primary settling tank, only waste activated sludge (WAS) is produced from the STP. Traditional gravity thickening that works well for primary sludge is not effective for WAS. Mechanical thickening is more efficient.

b) Mechanical Methods

The following mechanical methods are considered:

- A: Belt filtration
- B: Centrifuge
- C: Normal effective pressure floatation

The comparison of these alternatives is given in **Table 5.3-7**. Belt filtration is selected for the following reasons:

- most cost-effective
- does not cause noise and vibration problems
- simple O&M

2) Sludge Dewatering

a) Alternatives

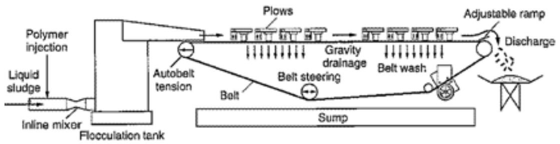
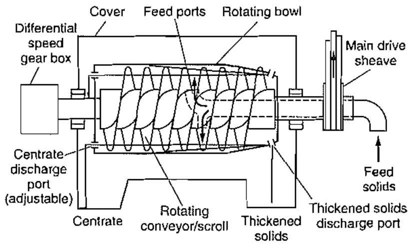
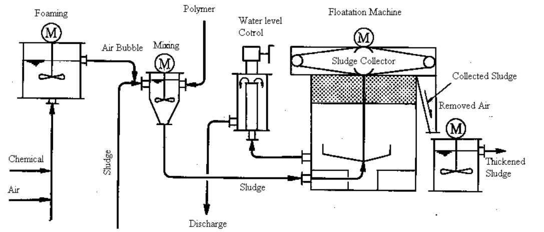
Three types of dewatering machines are evaluated:

- A: Screw press
- B: Belt press
- C: Centrifugal

b) Comparison of Alternatives

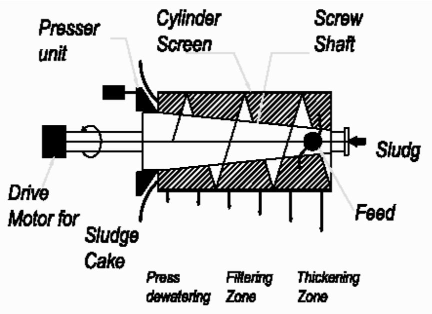
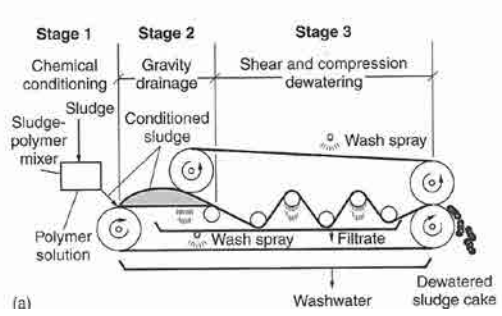
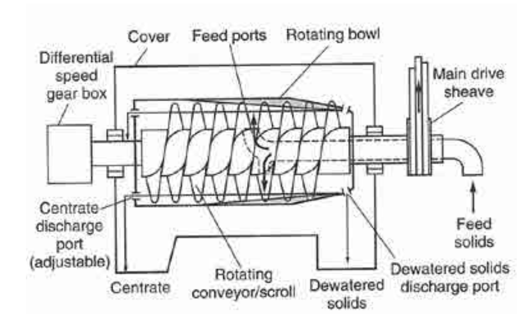
Table 5.3-8 shows the comparison of the alternatives for dewatering. Screw press dewatering is selected because of its low O&M cost.

Table 5.3-7 Comparison of Mechanical Thickening of Sludge

Alt / Item	Alternative-A Belt Filtration Thickening	Alternative-B Centrifugal Thickening	Alternative-C Normal Pressures Floatation Thickening
Description			
	Sludge aggregated with polymer flocculant is placed on a running mesh belt. Sludge is filtrated by the belt within 20 to 30 seconds.	Sludge is placed between outer tube, called bawl, and inner tube, called screw, both of which are rotating at high speed. Sludge is separated into solids and liquid by the strong centrifugal force of 700 to 2,000G.	Water with foaming agent is mixed with air (microscopic bubble) is generated. Generated bubble and sludge solids forms aggregation with polymer flocculant in mixing tank. Aggregation floats and sludge is thickened in floatation tank.
Performance	Density of Thickened Sludge: More than 4% Solids Capture Rate: More than 95% Excellent (3)	Density of Thickened Sludge: More than 4% Solids Capture Rate: More than 90% Good (2)	Density of Thickened Sludge: More than 4% Solids Capture Rate: More than 95% Excellent (3)
Chemical Consumption	Chemical Injection Ratio: Polymer flocculant not larger than 0.3% Good (2)	No Necessary Excellent (3)	Chemical Injection Ratio: Polymer flocculant not larger than 0.3% Foaming Agent Injection Ratio: Not smaller than 0.1% Fair (1)
Number of Machine (Required Area)	3 sets of 30 m3/h (including one standby) Fair (1)	3 set of 30m3/h (including one standby) Fair (1)	3 set of 7.2m2/machine (including one standby) Fair (1)
Operation and Maintenance	Automatic operation with Less inspection items Good (2)	Automatic operation and Less inspection items Good (2)	Automatic operation and Many inspection items Fair (1)
Odor	Protected by Cover Good (2)	Protected by Cover Good (2)	Protected by Cover Good (2)
Noise and Vibration	Less Good (2)	Loud Fair (1)	Less Good (2)
Construction Cost (Alt-A: 100)	518 Million LKR (100%) Excellent (3)	1,853 Million LKR (360%) Fair (1)	670 Million LKR (130%) Good (2)
O&M Cost (Alt-A: 100)	14.0 Million LKR/year (100%) Electricity + Polymer Flocculant Excellent (3)	16.8 Million LKR/year (120%) Electricity Fair (1)	16.1 Million LKR/year (115%) Electricity + Polymer Flocculant + Foaming Agent Good (2)
Equivalent Annual Cost (Alt-A:100)	48 Million LKR/year (100%) Excellent (3)	140 Million LKR/year (290%) Fair (2)	61 Million LKR/year (125%) Good (2)
Evaluation	It is the most cost-effective and its environmental impact is less. In addition, operation and maintenance works are simple **Recommended (○)**		

Source: JET

Table 5.3-8 Comparison of Sludge Dewatering Methods

Item \ Alt	Alternative-A: Screw Press Dewatering	Alternative-B: Belt Press Dewatering	Alternative-C: Centrifugal Dewatering
Description			
	Sludge is served between outer tube and screw shaft. Space between the tube and shaft is narrow as it closes to outlet, which presses and dewaters the sludge.	Served sludge is firstly filtrated at gravity dewatering zone. After that, filtrated sludge is dewatered at pressure dewatering zone, in which two filter cloths press the sludge and transfer it outside	Sludge is served to a bawl which rotates at high velocity. Sludge is dewatered by the strong centrifugal force generated by rotation, which is from 1,500G to 3,000G.
Performance	Water content of Thickened Sludge: More than 84%	Water content of Thickened Sludge: More than 84%	Water Content of Thickened Sludge: More than 84%
	Solids Capture Rate: More than 90%	Solids Capture Rate: More than 90%	Solids Capture Rate: More than 95%
	Good (2)	Good (2)	Excellent (3)
Chemical Consumption	Chemical Injection Ratio: Polymer Flocculent not larger than 1.7%	Chemical Injection Ratio: Polymer Flocculent not larger than 1.5%	Chemical Injection Ratio: Polymer Flocculent not larger than 1.5%
	Good (2)	Excellent (3)	Excellent (3)
Number of Machine (Required Area)	3 sets of φ1200mm (app. 14.3 m3/h)	9 sets of width 3m (app. 4.88 m3/h)	3 sets of app. 15 m3/h
	Good (2)	Fair (1)	Good (2)
Operation and Maintenance	Automatic operation. Rehabilitation of Screw is necessary at every 8 years	Automatic operation. Rehabilitation of filter is necessary at every 8 years	Automatic operation. Rehabilitation of bowl is necessary at every 3 years
	Excellent (3)	Excellent (3)	Good (2)
Odor	Protected by Cover	Protected by Cover. However leakage of odor is more than others.	Protected by Cover
	Good (2)	Fair (1)	Good (2)
Noise and Vibration	Lower than Alternative-C.	Least of all	Loud
	Good (2)	Excellent (3)	Fair (1)
Construction Cost	2,105 Million LKR (100%)	3,261 Million LKR (155%)	1,727 Million LKR (85%)
(Alt-A: 100)	Good (3)	Fair (1)	Excellent (3)
O&M Cost	57 Million LKR/year (100%)	67.9 Million LKR/year (120%)	82.4 Million LKR/year (145%)
	Electricity + Polymer Flocculant	Electricity + Polymer Flocculant	Electricity + Polymer Flocculant
(Alt-A: 100)	Excellent (2)	Good (2)	Fair (1)
Equivalent Annual Cost	197 Million LKR/year (100%)	285 Million LKR/year (145%)	197 Million LKR/year (100%)
(Alt-A:100)	Good (2)	Fair (1)	Good (2)
Evaluation	Construction cost is more than Alternative-C. However O&M cost and other performance are better than other alternatives. In addition, annual cost is best as same as Alternative-C.		
	Recommended (○)		

Source: JET

3) Odour Control

Since the STP is located near a residential area, minimizing the source of odour is important.

Odour can come from preliminary treatment and sludge treatment facilities. Since the STP has no primary settling tank, odour control measures are required primarily for sludge treatment facilities.

a) Alternatives

There are many types of odour control systems. In large-scale STPs, the following are commonly used:

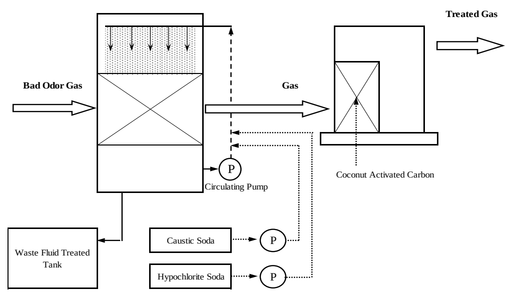
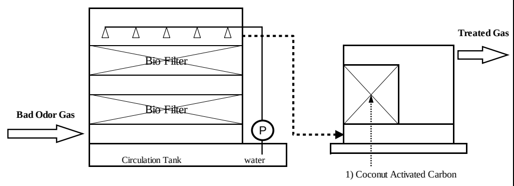
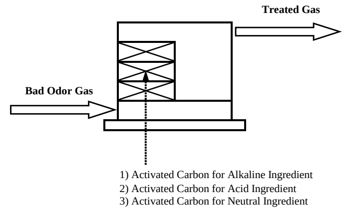
- A: Chemical scrubber with Activated carbon absorption for finishing
- B: Biological filter treatment with Activated carbon absorption for finishing
- C: Activated carbon absorption

b) Comparison of Alternatives

As shown in **Table 5.3-9**, biological filter has the following advantages:

- low O&M cost and smallest work volume
- stable odourless operation

Table 5.3-9 Comparison of Odour Control Systems

Item / Alt	Alternative-A: Chemical Scrubber	Alternative-B: Biological Filter Treatment	Alternative-C: Activated Carbon Absorption
			
	It is a deodorization system, in which chemical washing unit and activated carbon unit are combined. Chemical scrubber removes odorous substance by chemical reaction. Activated carbon adsorbs odorous substances which cannot be chemically removed for safety.	It is a deodorization system, in which biological filter unit and activated carbon unit are combined. Biological filter unit removes odorous substance by bacteria ' s decomposition. Activated carbon adsorbs odorous substances which cannot be biologically removed for safety.	It is a deodorization system where odorous compounds are removed by activated carbon and chemicals attached to surface of the activated carbon. Odorous substances are removed by both physical absorption and chemical reaction.
Performance	It can remove main odorous substances. Coconut activated carbon can be adapted.	It can remove main odorous substances. However some removal efficencies of bad odor are less than Alternative-A.	It can remove main odorous substances if apply activated carbon with chemicals. In case to apply coconut activated carbon only, the removable substances are limited (Evaluation result is changed to "Fair").
	Excellent (3)	Good (2)	Excellent (3)
Required Space	It requires larger space than Alternative-B, because larger number of accessory machines is necessary.	It requires larger space than Alternative-C.	It is the most compact system.
	Fair (1)	Good (2)	Excellent (3)
Maintenance	It is most complex and difficult because of many accessory machines such as various kinds of pumps and controlling equipment, and that storage, handling and dispose of chemicals are necessary.	It is simpler than Alternative-A. The biological condition will be changed by density of odor and the low density condition will cause low performance of odor treatment system.	It is most simple. However, activated carbon should be changed frequently, which costs much.
	Frequency of change of activated carbon	Frequency of change of activated carbon	Frequency of change of activated carbon
	High odor condition: Every year	High odor condition: Every year	High odor condition: Every six months
	Low odor condition: Every two years	Low odor condition: Every two years	Low odor condition: Every year
	Fair (1)	Good (2)	Fair (1)
Operation	It is easy to operate automatically.	It is easy to operate automatically.	It is easy to operate automatically.
	Good (2)	Good (2)	Good (2)
Construction Cost	175 Million LKR (100%)	270 Million LKR (150%)	98 Million LKR (60%)
(Alt-A: 100)	Good (2)	Fair (1)	Excellent (3)
O&M Cost	5.6 Million LKR/year (100%)	3.8 Million LKR/year (70%)	60.2 Million LKR/year (1000%)
	Electricity + Chemicals + Coconut Activated Carbon	Electricity + Coconut Activated Carbon	Electricity + Activated Carbon with Chemical
(Alt-A: 100)	Good (2)	Excellent (1)	Fair (1)
Equivalent Annual Cost	17 Million LKR/year (100%)	22 Million LKR/year (125%)	67 Million LKR/year (350%)
(Alt-A:100)	Excellent (3)	Good (2)	Fair (1)
Evaluation		The construction cost is highest in all. However the O&M cost and work volume are smallest in all. It will provide the stable operation with odor less condition.	
		Recommended (○)	

Source: JET

5.3.5 Electrical Design

(1) Electrical Service Entrance and Power Distribution

Power receiving and distributing system is illustrated in **Figure 5.3-11**. The 3.3kV power supply from the Ceylon Electricity Board (CEB) is converted to 400V when it passes through a main transformer with a capacity of about 1000kVA. The cost of the transformer stipulated by CEB is included in the ODA project cost.

Electricity at 400V is distributed from the main transformer to the electrical rooms. There will be one electrical room in each pumping station, sewage treatment facility and sludge treatment facility. Each room has a main control centre.

(2) Emergency Power Generator

Emergency power supply will be needed to maintain the operation of the facilities when long duration power failures occur. The generator must have a target load of about 500 kVA to sustain continuous operation of the essential or critical functions and should be located in the administration building for easy access and maintenance.

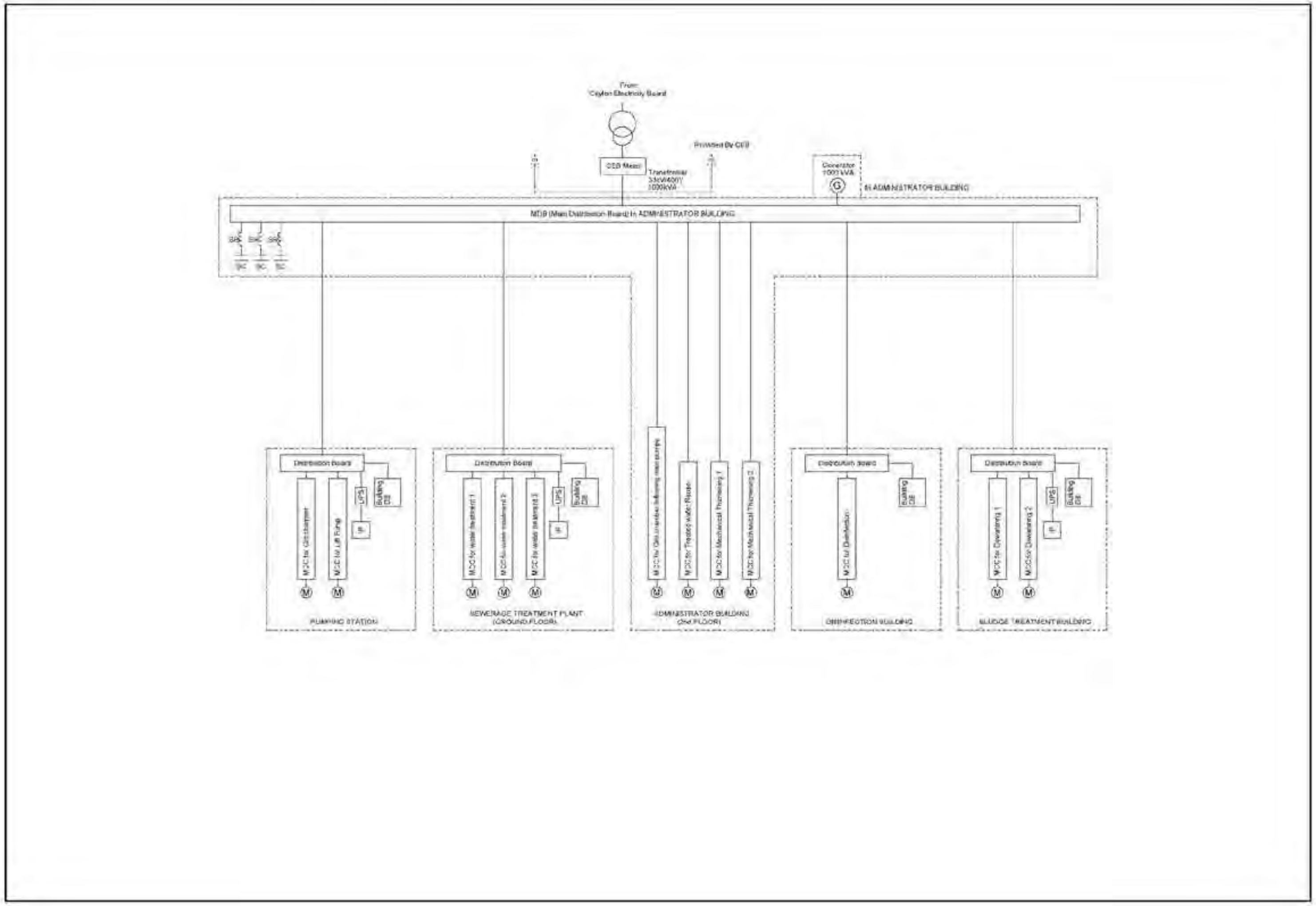
(3) Instrumentation and Control System

Measuring equipment for monitoring operations include water level gauges, flow meters and water quality meters.

(4) SCADA System

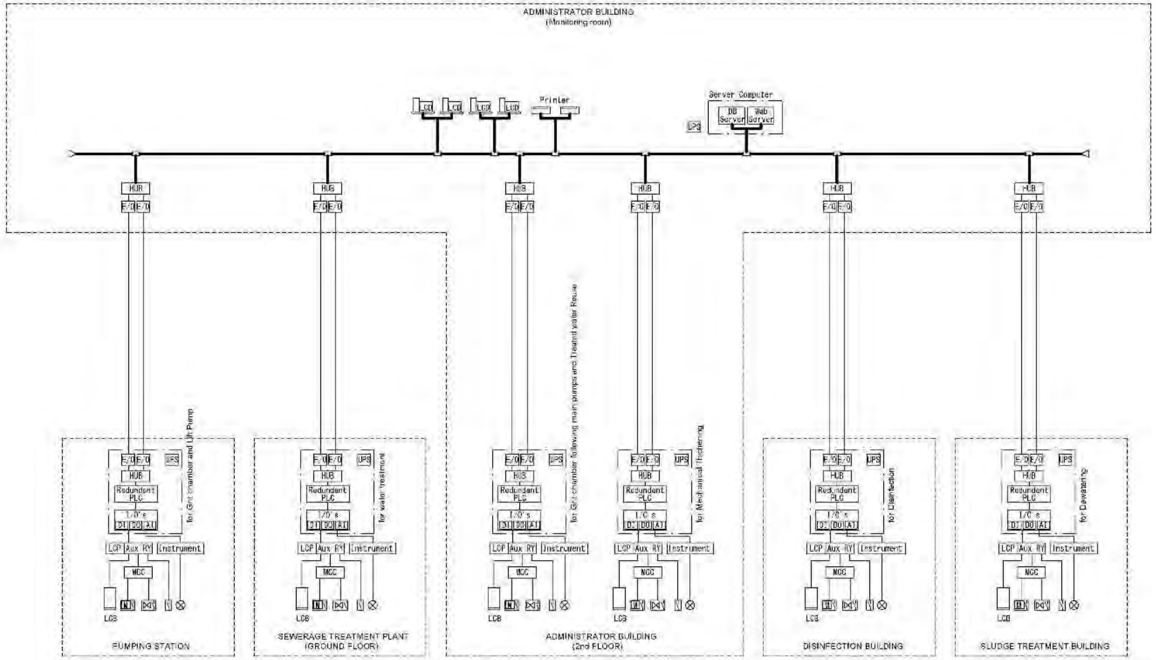
Monitoring and control of treatment plant operations and 7 major pumping stations are carried out by SCADA system which can provide high level supervisory management of processes in multiple sites. The computer server for the SCADA system installed in the monitoring room of the STP will interface with networked data communication units to display conditions of the equipment operation, measurement data, and issue process commands. Programmable logic controllers (PLC) are installed in pumping stations, various locations in the STP, administration, disinfection and sludge treatment buildings. GSM modem provides communication with the 7 major pumping stations. The signals from 63 manhole type station also will be gathered by telecommunication network and monitored by SCADA system.

SCADA system is shown in **Figure 5.3-12.**



Source: JET

Figure 5.3-11 Single Line Diagram of Wastewater Treatment Plant



SCADA System	
DB	Data Base Server
WeS	Web Server
HUB	Network Hub Unit
PLC	Programmable Logic Controller
I/O'S	Input Output Units
AI	Analog Input Unit (DC4-20mA 1-5V,etc)
DI	Digital Input Unit (On/off,etc)
AO	Analog Output Unit
RTU	Remote Terminal Unit
E/O	Electrical-to-Optical Converter
TRX	Transceiver for Wireless Communication
CTR	Control Unit for IP Camera

Control System	
HV/LV	High Voltage/Low Voltage Switch gear
MCC	Motor Control Center
Aux RY	Auxiliary Relay Cubicle
Instrument	Instrument Cubicle
LCP	Local Control Panel
LCB	Local Control Box
PDA	Personal Digital Assistant

Source: JET

Figure 5.3-12 SCADA System

5.3.6 Discharging Way of Treated Wastewater

According to the result of Environmental Impact Assessment, the discharge points of treated wastewater should be provided two points to reduce the impact to water body of water course in dry season. Two discharge points are shown in **Figure 5.3-13.** The point B is the location to discharge normally. The point C is the location to discharge in dry season during one or two months.

Source: JET

Figure 5.3-13 Alternative Discharge Points of Treated Wastewater in EIA reports

The two discharging ways are considered as shown as **Table 5.3-10**. The option A is recommended.

Table 5.3-10 Comparison Table between Option A and B of Discharge Method

	Option A	**Option B**
Discharging Way	Gravity flow at point B and Pump discharge at Point C	Gravity flow at Point B and C
Required Facility	For B: Pipe (1350mm) x 800m + Outlet x 1 set For C: Pipe (φ600mm) x 2500m + Outlet x 1set and Pumping Station	Pipe (φ1350mm) x 2500m Outlet x 1 set
Construction Cost	1,100 Million LKR (950 Million LKR for Two Pipe Line) (150 Million LKR for Equipment)	1,500 Million LKR
Operation Cost	1.0 Million LKR/year (For pump operation during 2 months)	-
Equivalent Annual Cost	27.5 Million LKR/year (=950/50+150/20/+1.0/1)	30 Million LKR/year (=1,500/50)
Recommendation	**Recommended**	
	To minimize the capital cost and annual cost, combination discharging of gravity flow and pump discharge is recommended. Frequency at point C discharge should be decided based on the treated water quality and received water quality.	

Source: JET

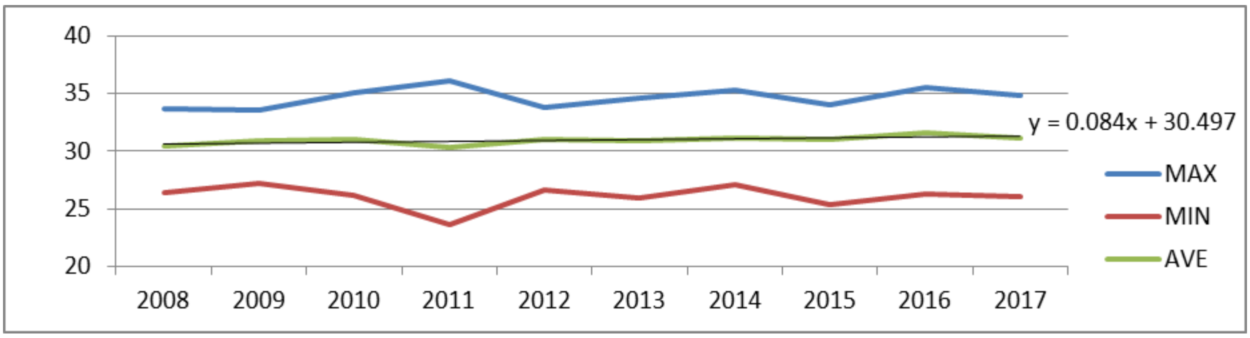
5.3.7 Climate Change Considerations

- The following two components in a JICA reference document address climate change issues for projects in developing countries:
- Guidance on estimating GHG emission reduction or absorption in climate change mitigation projects.
- Concepts and guidelines for integrating climate change adaptation in projects for vulnerability and risk reduction, and/or increasing adaptive capacity and resilience.

JET considers the mitigation and adaptation measures as follows:

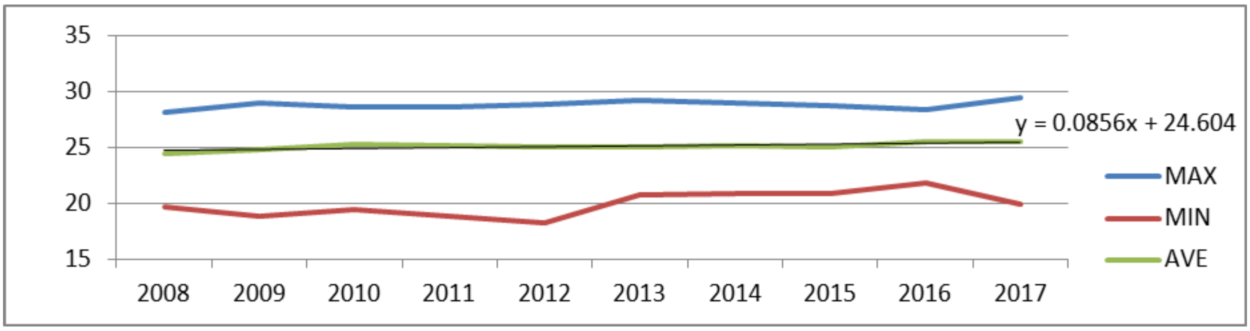
(1) Climate Change Adaptions

The JET survey shows the records of temperature at Colombo Station (station no. 43466) for 2007-2017 (**Figure 5.3-14** and **Figure 5.3-15**).



Source: JET

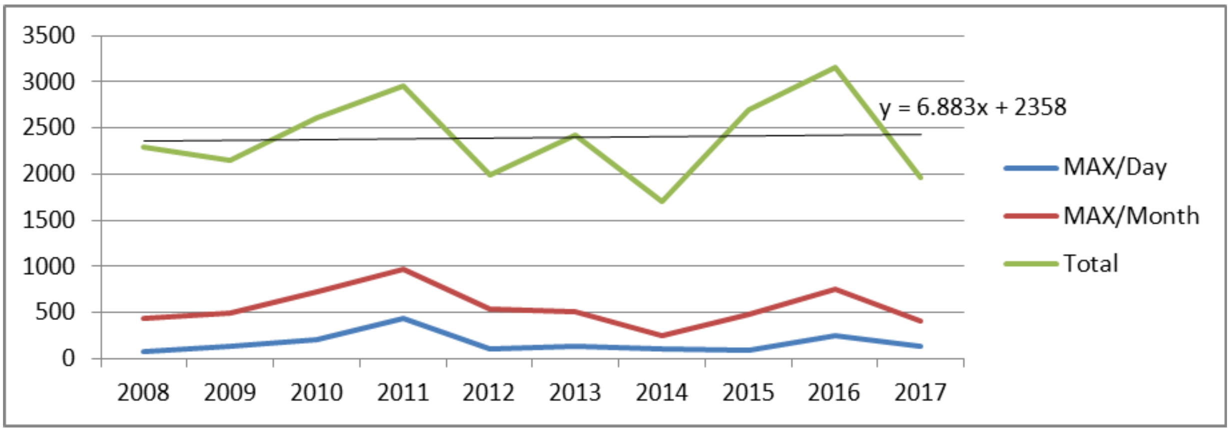
Figure 5.3-14 Maximum Temperatures at Colombo Station Sep 2007- Aug 2017



Source: JET

Figure 5.3-15 Minimum Temperatures at Colombo Station Sep 2007- Aug 2017

Maximum and minimum average temperatures show slight yearly increase (0.085°C) between 2007 and 2017, while there is no increase in total annual rainfall and maximum daily or monthly precipitation as shown in **Figure 5.3-16**. The risk of more flooding due to climate change is considered low.



Source: JET

Figure 5.3-16 Rainfall Record at Colombo Station Sep 2007 - Aug 2017

The impact of climate change in this area is evaluated as shown in **Table 5.3-11**.

Table 5.3-11 Evaluation of Climate Change Impacts

Considerations and Adaptive Measures	Observation	Impact
Likelihood of Climate Change Impacts in Future	Low	Medium
Preventive Measures against Infectious Diseases	Some actions taken.	Medium
Medical Care Facility	5.7 inpatient beds per 1,000 population.	Medium
Functional Status and Maintenance of Sewerage System	Most households have septic tanks.	Medium

Source: JET

This project will not contribute any significant positive outcome on the anticipated impacts of climate change in the service area. Therefore, it cannot be considered for "ODA loan for projects on adaptation to climate change". However, JET will consider the following measures for protection of sewerage facilities from future flooding.

- The flood level for 100-year recurrence interval will be used for facilities design.
- Electric and control panels for equipment including manhole type pumps will be protected from flooding to the extent possible.

(2) Mitigation Measures

Climate change mitigation is considered in the calculation of CO_2 emissions.

Greenhouse gas reduction is studied based on the UNFCCC/CCNUCC III.I./Version08. The detail calculation of green gas emission is shown in **APPENDIX 5-7**

Comparing emission baseline (3,568 t CO_2/year) with project activity (5,346.5 t CO_2/year), it is evident that there is no reduction of greenhouse gas by this project.

5.4 APPLICATION OF JAPANESE TECHNOLOGIES

5.4.1 Advanced Technologies Applicable for the Project

The following advanced technologies are selected for this project:

- Micro-Tunnelling
- Three-stage step-feed biological nutrient removal (BNR) process
- Belt filtration sludge thickening
- Screw press sludge dewatering
- High Efficiency Pump
- Automatic Bar Screen

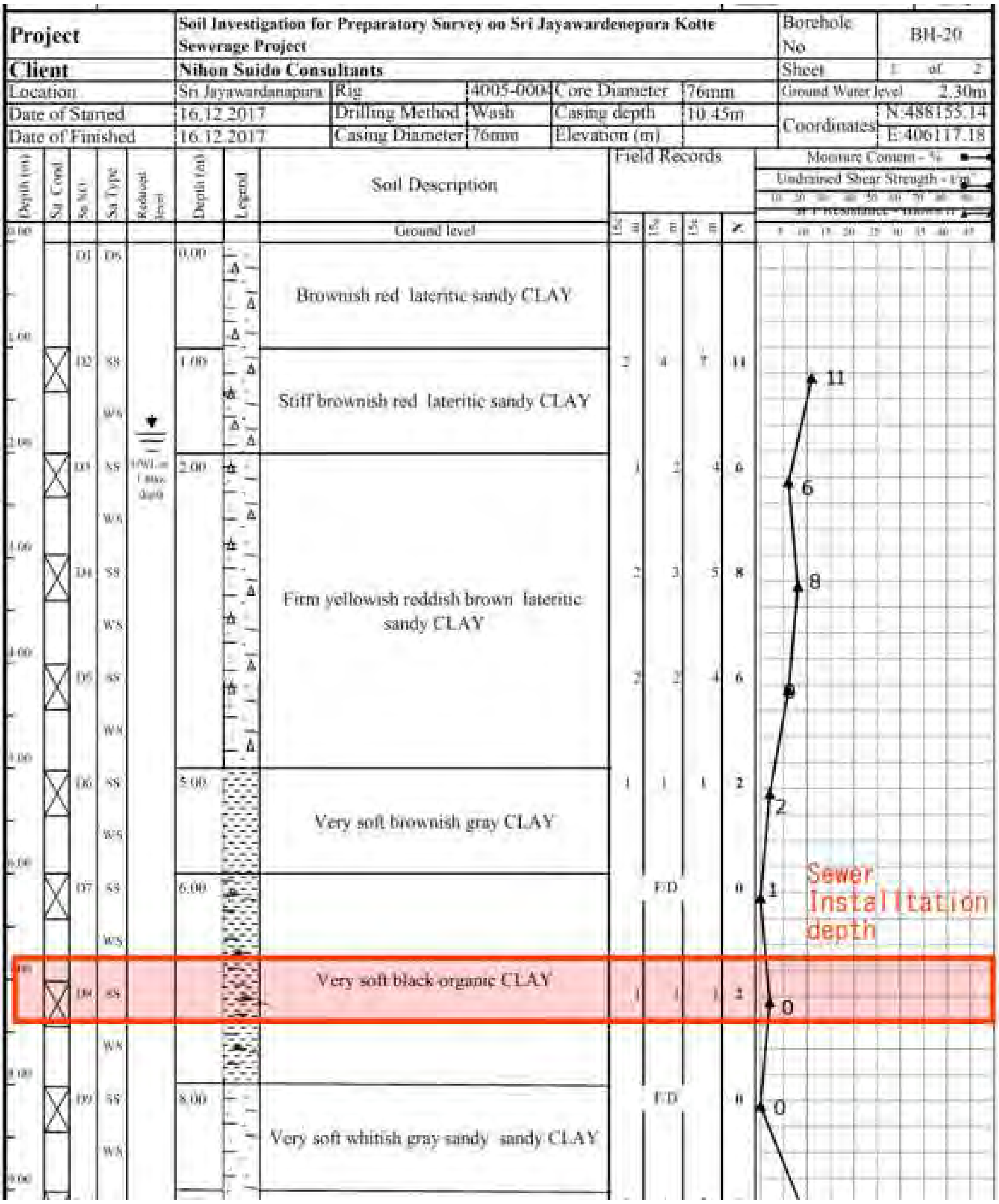
Japanese technologies have some advantages compared to those of other countries:

(1) Micro-Tunnelling

There are two major advantages of this Japanese method.

1) Weak Soil Condition

In Japan, micro-Tunnelling is main technology commonly used over long distance and on winding and congested roads. Japanese companies have developed and accumulated extensive experience in perfecting the accuracy of pipe invert level under weak soil conditions. Automation as well as development of measuring and control equipment contributes to the improvement in curved and long distance jacking. This Japanese know-how can accomplish the task with high construction accuracy for the weak soil condition shown in soil surveys (**Figure 5.4-1**). JET recommends this technology for the relative ease of implementation and low operation cost.



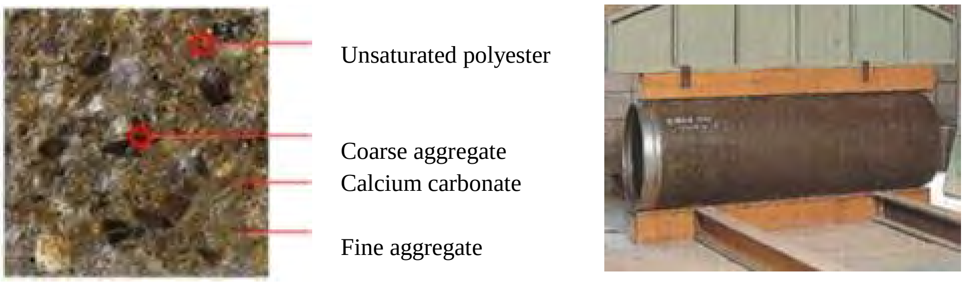
Source: JET

Figure 5.4-1 Weak Soil Layers in Pipe Installation Depth in Priority Area

2) Polymer (Resin) Concrete Jacking Pipe

Concrete corrosion for sewerage facilities is a chemical corrosion through the metabolic reaction of sulfate-reducing and sulfur-oxidizing bacteria on sulphate ions in wastewater and sludge. It is prevalent not only where H_2S gas is produced with turbulent and mixed flow but also where ventilation is not facilitated.

The facilities that are prone to sulfuric acid corrosion are the release ends of pressure force mains in sewer networks. The sewer network in this study area will have many pumping stations, including manhole-type pumping stations. Therefore, anti-corrosion measures must be considered in design phase.



Source: JET

Figure 5.4-2 Polymer Concrete Jacking Pipe

Polymer concrete pipe is moulded with aggregate, filler and reinforcing bar using centrifugal strength and unsaturated polyester. As a binding agent, it is resistant to acid compared to cement concrete. It will give the network a longer service life against sulphate corrosion. Japanese polymer concrete jacking pipes can also withstand high compression force.

3) Ductile Iron Pipe for Micro-Tunnelling Method

The force main pipes under the RDA classified road is also requested to be installed by micro-Tunnelling method. Basically such force main pipes will be installed by micro-tunnleing using larger casing pipe than actual force main pipe. The main force main pipes is inserted by jacking or traction after the larger casing pipe is installed.

The cost of larger casing type depends on the casing pipe installation cost, and is higher than the cost of micro-Tunnelling by ductile iron pipe in some case. The micro-Tunnelling by ductile iron pipe needs the special jacking pipe made of ductile iron pipe and provide the simple jacking works compare the larger casing type.

Japanese ductile iron pipe for micro-Tunnelling method has the long history of more than 20 years and has the advantage of toughness against avulsion on internal lining.

Source: JET

Figure 5.4-3 Ductile Iron Pipe for Micro-Tunnelling Method

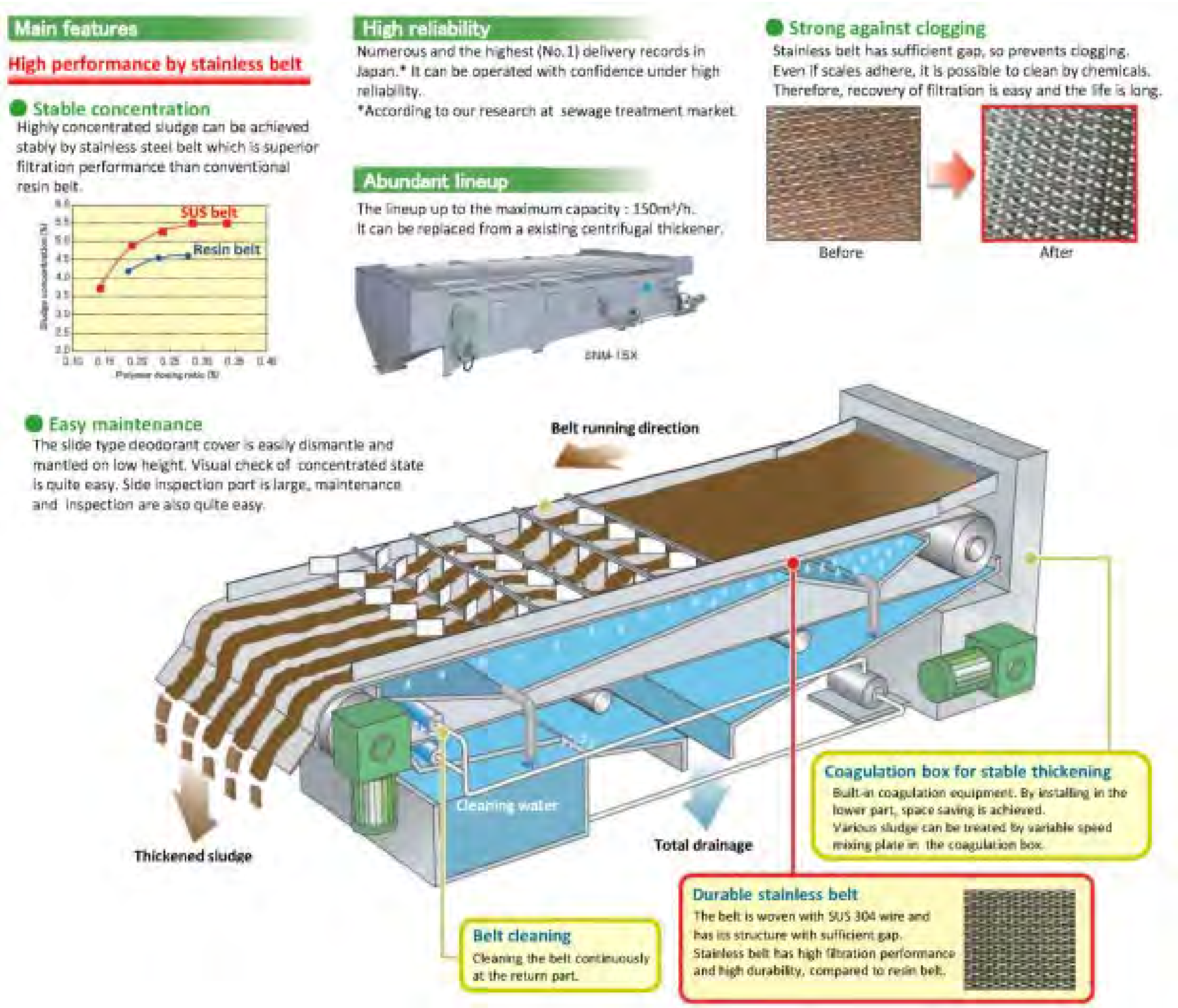
(2) Three-stage Step-Feed Biological Nutrient Removal (BNR)

The step-feed BNR process is described in many manuals and guidebooks such as "Wastewater Engineering" by Metcalf & Eddy and is used worldwide. The three-stage process was developed in Japan and made practicable in the last half of the 1980s. The process is described in detail in the chapter on "Advanced treatment technology" in "the Design Standard and Explanation for Sewerage Facilities" published by Japan Sewage Works Association in 2001 and the specialized design guideline was issued by the Japan Sewage Works Agency in 2002.

The three-stage BNR process is widely used in many STPs in Japan. Japanese companies have extensive experience with this technology. Excellent operational performance can be assured by following the standards and guidelines developed from long history of operational experience.

(3) Belt Filtration Sludge Thickening

Most of belt filtration sludge thickening machines use resin belts. Stainless steel belt machines offered by some Japanese companies perform better than resin belt machines. The advantages and disadvantages of stainless steel belt type sludge thickening machine are as follows:



Source: KUBOTA corporation

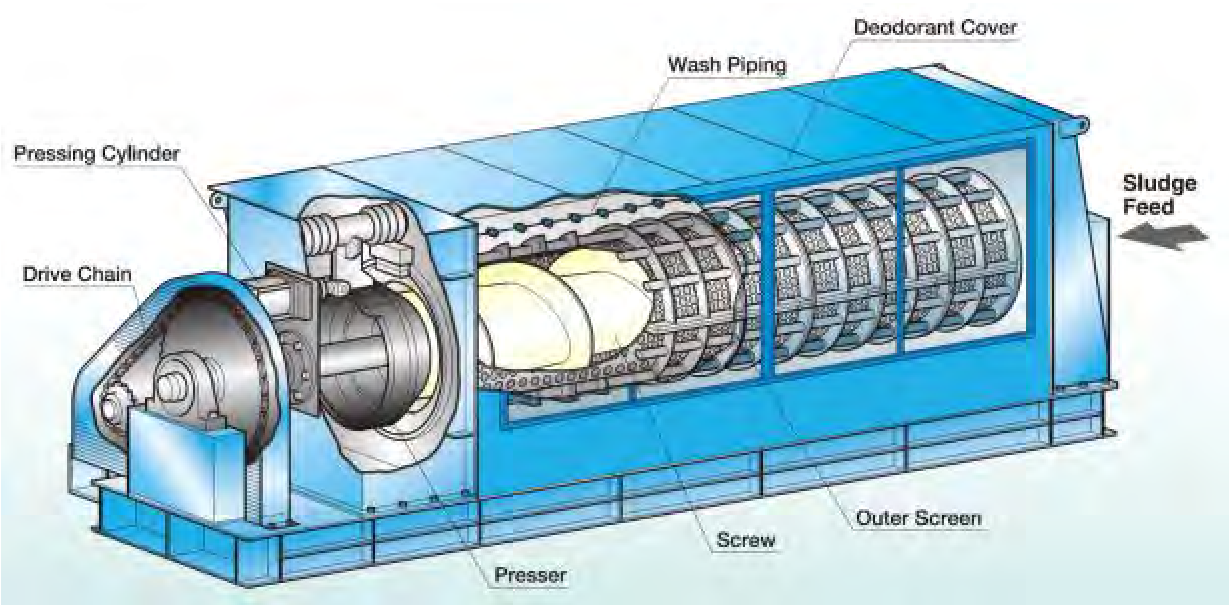
Figure 5.4-4 Stainless Steel Belt Sludge Thickening Machine

- Advantages: long belt service life, higher separation performance, less coagulant consumption
- Disadvantages: more manpower required for replacement of the heavy belt

JET recommends the use of stainless steel belt type filtration sludge thickening in this project because of its lower operation cost and less frequent filter replacement.

(4) Screw Press Sludge Dewatering

Most screw press machines have limited dewatering capacity. Japanese companies offer large capacity or twin-screw machines with rotary outer cylinder screw presses that are more effective in sludge dewatering.



Sources: ISHIGAKI COMPANY, Ltd.

Figure 5.4-5 Rotary Outer Cylinder Screw Press

The rotary outer cylinder screw press sludge dewatering machine has compact design and easy maintenance compared to other types of screw press machines. JET recommends this machine because of its lower cost and less space requirement.

(5) High Efficiency Sewage Pump with Flywheel

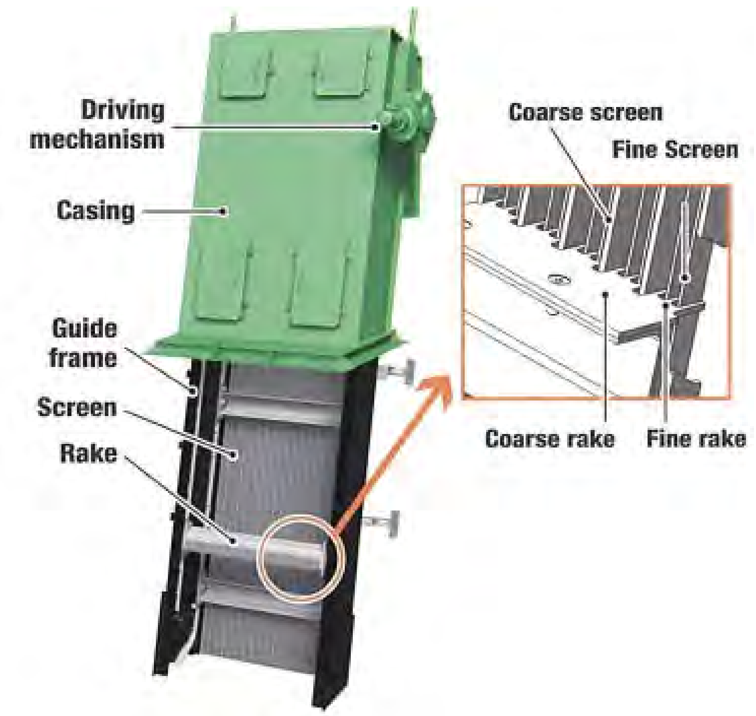
Many Japanese manufactures can supply high performance flywheel submersible sewage pumps. They are required in most Japanese projects to prevent water hammer. The efficiency, quality and reliability of these pumps will affect the O&M cost. Savings on O&M cost with the use of high efficacy pumps can be significant for the large number of pumps required in this project. JET recommends the use of fly-wheel sewage pumps in this project. NWSDB accepted to adopt all main pumps including manhole type pumps and spare parts of a Japanese company in terms of O&M.

(6) Automatic Bar Screen

Most automatic bar screens are either coarse (≥ 50 mm) or fine (≤ 50 mm). Japanese companies can supply dual type screen systems that have the following advantages and disadvantages:

- Advantages: high water flow capacity, lower cost and less space requirement compared to using two sets of screens with different mesh size.
- Disadvantage: higher cost compared to using just one single screen.

JET recommends the dual screen system to lower construction cost and save equipment space. NWSDB accepted to adopt all automatic bar screen systems including conveyers, dehydrators and spare parts of a Japanese company in terms of low capital cost and small size.



Source: Hitach, Ltd.

Figure 5.4-6 Dual Type Automatic Bar Screen

5.4.2 Use of Advanced Japanese Technologies

Table 5.4-1 shows the Japanese technologies recommended for this project because of their high performance, easy maintenance and low operation cost. If more than 30% of the total construction cost is for the procurement of Japanese products, “Special Terms for Economic Partnership (STEP)” of Japanese ODA loans can be applied for the project. The calculation for share of Japanese product is attached in **Appendix 7-6** for reference.

Table 5.4-1 Recommended Japanese Technologies

Technology	Advantages	Disadvantage
Micro-Tunnelling	- Long service life using polymer concrete jacking pipe - Simple work and high reliability of Ductile Iron Pipe for Micro-Tunnelling Method - Curved and long distance jacking with high construction accuracy for weak soil conditions	- Higher cost compared with other normal concrete jacking pipe - Casing method of pipe jacking is lower cost for small diameter - Special technic and engineer are necessary.
Three-stage BNR Process	- Lower operation and maintenance cost - High nitrogen removal efficiency - Good performance and proven track record	- Required number of mechanical parts is more than other treatment processes.
Belt filtration sludge thickening	-Long belt service life -High separation performance -Less chemical consumption	- Heavy belt filter compared with other resin belt filter.
Screw press sludge dewatering	- Compact design (large capacity) - Easy maintenance	- Heavy machine compared with other small screw press type machines.
High efficiency sewage pump with flywheel	- High efficiency - High reliability	- Flywheel can reduce the water hammer but some energy losses are caused compared with other sewage pump.
Dual Type Automatic Bar Screen	- High water flow capacity - Low cost and require less space (compared to two screens of different mesh size)	- Mechanism is complicated compared with other normal automatic bar screen.

Source: JET

NWSDB accepted that the recommended Japanese Technologies in **Table 5.4-1** will be adopted in this project, and explained them in the Stakeholder Meeting on 17 September 2019.

CHAPTER 6 INSTITUTIONAL ARRANGEMENTS FOR PROJECT IMPLEMENTATION

6.1 OUTLINE

- The sewerage project is implemented by the Ministry of City Planning, Water Supply and Higher Education as the executing agency and NWSDB as the implementing agency. NWSDB has sufficient experience and expertise in water and sewerage project and is aware of international bidding of projects using foreign funds, including Japanese ODA loans. Therefore, NWSDB is judged to have the capacity to implement the project (6.3).

- As with other projects, a Project Management Unit (PMU) will be established under the Sewerage Division of NWSDB during the design and construction stage to supervise design and construction works, procurement, reporting, and monitoring etc. (6.4).

- Sri Jayawardenapura Kotte MC and NWSDB agreed that NWSDB will own and manage the sewerage facilities constructed in the project because the budget scale of the MC is too small to manage the sewerage project. Furthermore, since NWSDB already manages the water supply of the MC, human resources and tasks such as accounting, personnel affairs, and customer services of water supply can be utilized in the sewerage project. Sewerage Management Office (MO) is established under the Sewerage Division and will implement O&M of STP, sewer networks and pumping stations, construction of sewer pipes, and customer services (6.5).

- NWSDB is currently operating large scale STPs. This experience is applicable to the project. Contractors will implement training for O&M staff during the commissioning and NWSDB has invested proper human resources, materials and budget for the existing sewerage projects. Therefore, NWSDB is judged to have the capacity to implement O&M of the project (6.5).

6.2 FRAMEWORK FOR IMPLEMENTATION OF SEWERAGE PROJECT

6.2.1 Considerations for Implementing the Sewerage project in Sri Jayawardenapura Kotte

(1) Public Works in Relevant Municipalities

According to the Municipal Council Ordinance No. 29 of 1947, the Urban Council Ordinance No. 61 of 1939 and the Pradeshiya Sabha Act No. 15 of 1987, all local authorities have the responsibility to carry out public works including water supply and sewerage projects.

However, NWSDB established under the Ministry of City Planning, Water Supply and Higher Education by the NWSDB Establishment Law No.2 1974 substantially has been the principle implementing agency for water and sewerage project nationwide mainly due to poor capacity of local authorities for implementing water supply and sewerage works.

Table 6.2-1 shows the authorities responsible for water supply, solid waste, on-site sanitation, road works and storm-water in Sri Jayawardenapura Kotte MC and other relevant local authorities (Maharagama MC, Kaduwela UC, Dehiwala-Mt. Lavinia MC and Kotiksestts-Mulleriya PS).

Table 6.2-1 Public Works in Local Authorities

Municipality	Water Supply	Solid Waste	On-site Sanitation	Road Works	Storm-water
Sri Jayawardenapura Kotte MC	NWSDB	MC	House Owner	MC	MC
Maharagama UC		UC		UC	UC
Kasduwera MC		MC		MC	Mc
Dehiwala-Mt. Lavinia MC		MC		MC	MC
Kotiksestts-Mulleriya PS		PS		PS	PS

Source: JET

NWSDB owns the water supply systems in all of the local authorities. RSC (Western Central) of NWSDB manages these together with other water supply schemes. The other public works are generally managed by the local authorities, from planning to O&M, with no outsourcing to the private sector. Municipal budget and some government subsidies are used as financial sources.

(2) Preferred Management Structure for Sewerage Project

The budgets of Sri Jayawardenapura Kotte MC and the relevant local authorities in the project are insufficient to effectively implement sewerage projects independently. NWSDB is currently implementing sewerage projects nationwide, and has relevant experience and expertise. Moreover, because NWSDB manages water supply of the Project area and tasks such as accounting, personnel affairs, and customer services of water supply can be easily incorporated in to the sewerage project.

Therefore, management of the sewerage project, not by the individual MCs, but by NWSDB is considered to be the effective option.

(3) Ownership and Management of Sri Jayawardenapura Kotte Sewerage Project

The issue of ownership and management of the sewerage project was on the agenda of JCC held on 27th July 2017. In October 2017, the local authorities and the NWSDB agreed that the sewerage project would be owned and managed by the NWSDB, similar to water supply and exchanged letters to confirm the agreement.

6.3 NWSDB CAPABILITY IN SEWERAGE PROJECT

6.3.1 NWSDB- Implementation Agency of the Sewerage Project

(1) History

NWSDB was established by the NWSDB Establishment Law No. 2 of 1974 to provide sustainable water and sanitation solutions for the country. NWSDB has been the principal implementing agency for water supply and sewerage project nationwide.

(2) Mission

Serve the nation by providing sustainable water and sanitation solutions ensuring total user satisfaction.

(3) Functions

Ministry of City Planning, Water Supply and Higher Education is the executing agency. As the implementing agency NWSDB undertakes the following functions under the supervision of Ministry of City Planning, Water Supply and Higher Education.

- Investigation, planning, designing, and construction supervision of water supply and sewerage

projects using local funds and donor assistance.
- Carry out feasibility study, cost estimation and environmental impact assessment for such projects.
- O&M of water supply and sewerage facilities to provide satisfactory service to customers.
- Billing and collection through affordable tariff setting.

(4) Budget

NWSDB is a financially independent organization. O&M is covered by the water and sewerage service charges, while the construction cost of the sewerage project is borne by the national government and granted to NWSDB. The budget allocation of projects for each type is described in **Table 8.2-2**. Regarding the financial problems of NWSDB, NWSDB's sewerage sector has made losses most for the past few years excluding the O&M contract services which make profits in sewerage sector (Refer to **Section 8.2.4 (3)**). For financial improvement of sewerage sector, sewerage tariff revision is required (Refer to **Section 8.3.3 (2)**).

(5) Organization

The organization of NWSDB is shown in **Figure 6.3-1.**

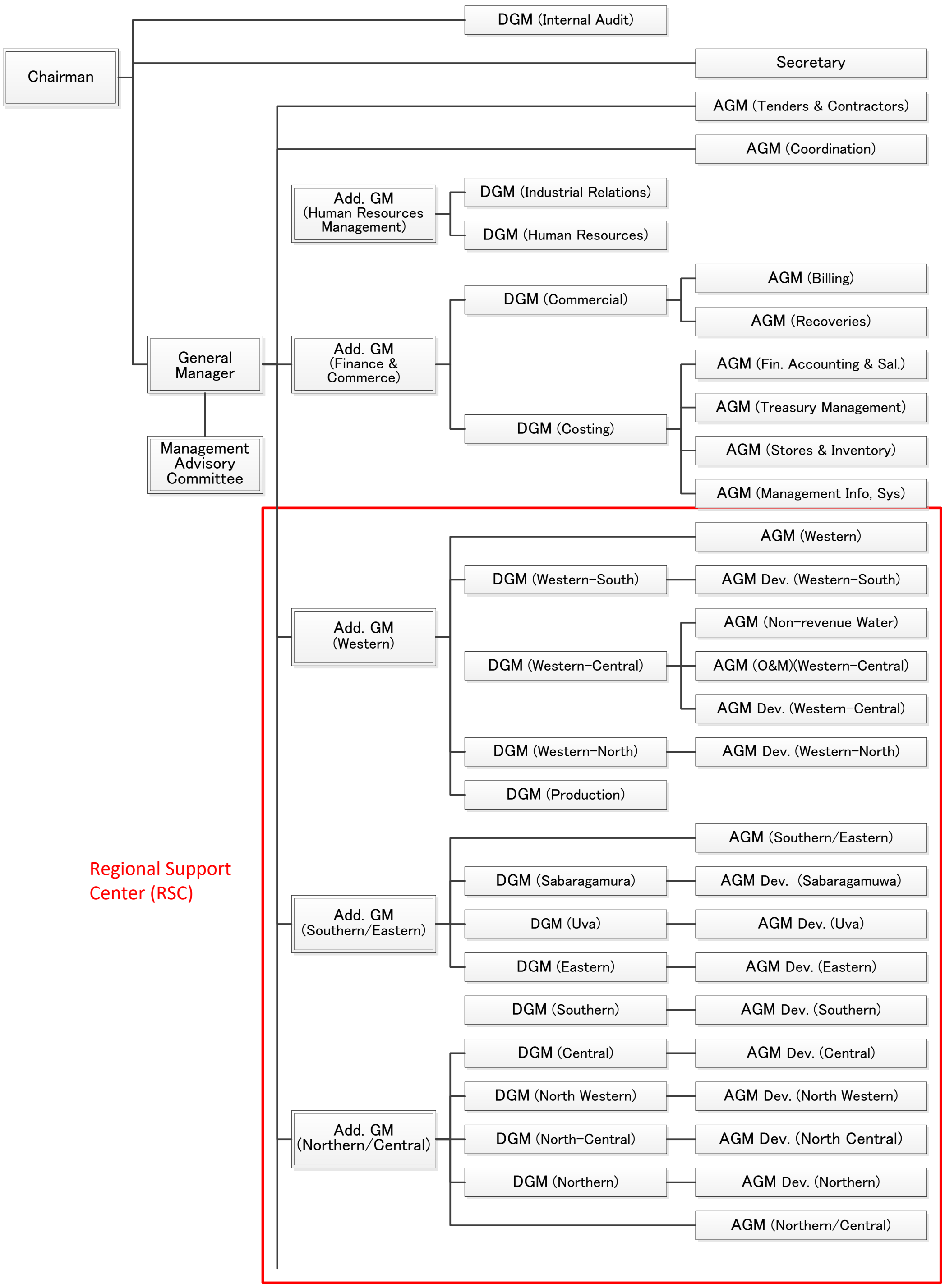
The Sewerage Division plans, designs, and constructs sewerage projects nationwide, as well as operates and maintains sewerage projects in the Greater Colombo (GC) area, while the RSCs operate and maintain those in the regions.

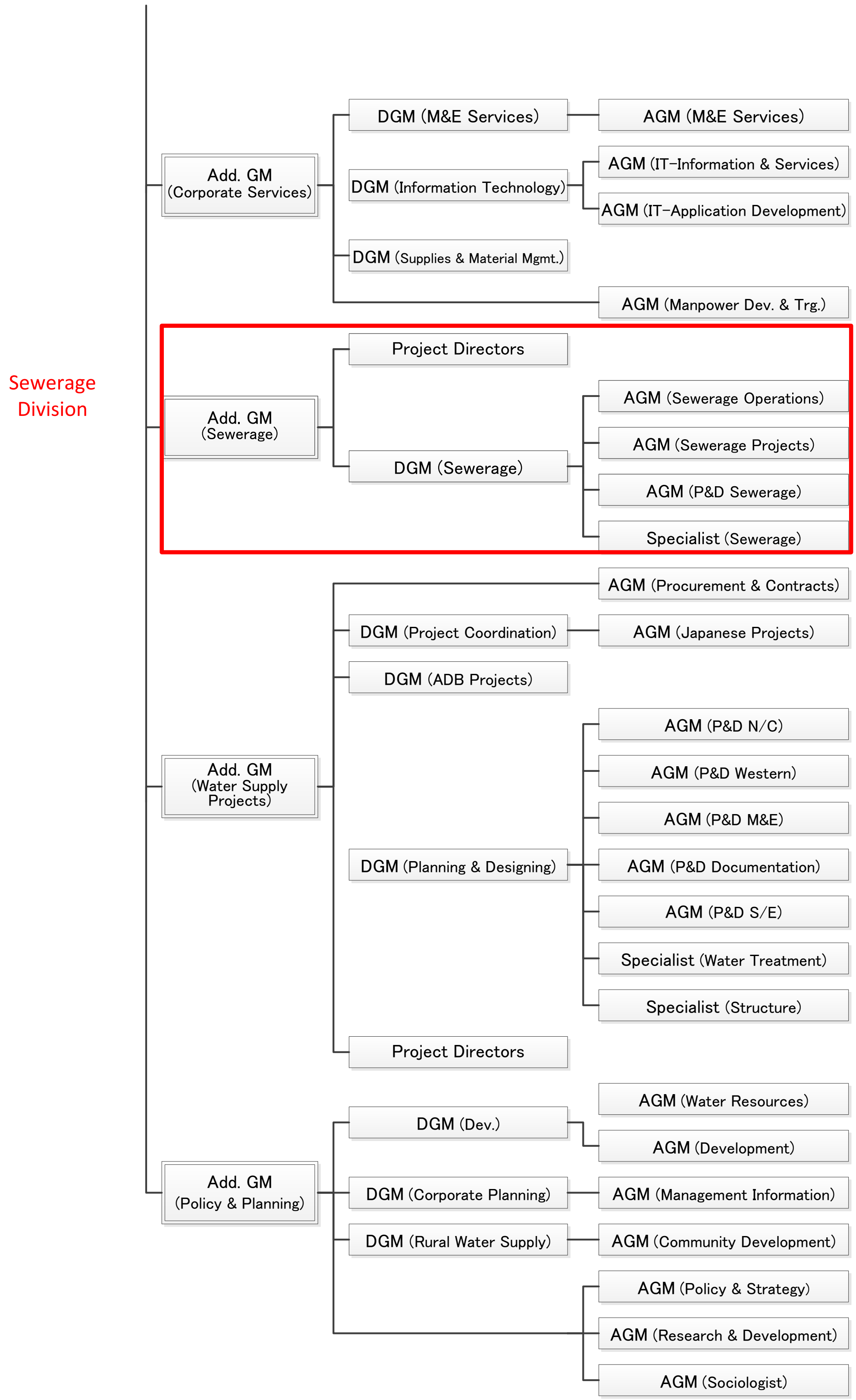
Table 6.3-1 shows the responsibilities of the organizations in the sewerage sector.

Table 6.3-1 Responsibilities of Organizations in the Sewerage Sector

Sewerage Division	Planning & designing of sewerage projects nationwide
	Construction of sewerage facilities
	O&M of sewerage project in the GC area
Regional Support Centres (RSCs)	O&M of sewerage project in each region

Source: JET


Chairman
DGM (Internal Audit)
Secretary
AGM (Tenders & Contractors)
AGM (Coordination)
Add. GM (Human Resources Management)
DGM (Industrial Relations)
DGM (Human Resources)
General Manager
Management Advisory Committee
Add. GM (Finance & Commerce)
DGM (Commercial)
AGM (Billing)
AGM (Recoveries)
DGM (Costing)
AGM (Fin. Accounting & Sal.)
AGM (Treasury Management)
AGM (Stores & Inventory)
AGM (Management Info, Sys)
Add. GM (Western)
AGM (Western)
DGM (Western-South)
AGM Dev. (Western-South)
AGM (Non-revenue Water)
DGM (Western-Central)
AGM (O&M)(Western-Central)
AGM Dev. (Western-Central)
DGM (Western-North)
AGM Dev. (Western-North)
DGM (Production)
Regional Support Center (RSC)
Add. GM (Southern/Eastern)
AGM (Southern/Eastern)
DGM (Sabaragamura)
AGM Dev. (Sabaragamuwa)
DGM (Uva)
AGM Dev. (Uva)
DGM (Eastern)
AGM Dev. (Eastern)
DGM (Southern)
AGM Dev. (Southern)
Add. GM (Northern/Central)
DGM (Central)
AGM Dev. (Central)
DGM (North Western)
AGM Dev. (North Western)
DGM (North-Central)
AGM Dev. (North Central)
DGM (Northern)
AGM Dev. (Northern)
AGM (Northern/Central)



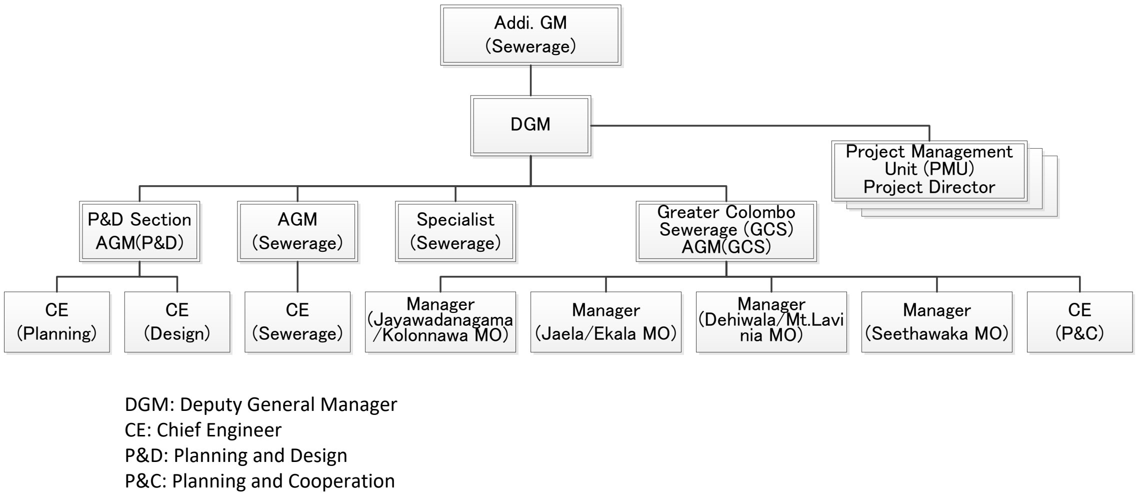
Source: JET

Figure 6.3-1 Organization of NWSDB

6.3.2 Institutional Capability

(1) Sewerage Division in NWSDB

Figure 6.3-2 shows the organization of the Sewerage Division under Addl. GM (Sewerage). Planning and design of sewerage projects are carried out by the Planning and Design Section. Construction is implemented by the Project Management Unit (PMU) of each project. PMU for the Sri Jayawardenapura Kotte project will be established in the construction stage.



Source: JET

Figure 6.3-2 Organization of Sewerage Division

O&M of the sewerage projects in the Greater Colombo area is implemented by the Greater Colombo Sewerage (GCS). Sewerage Management Offices (MOs) are established in the GCS for managing the sewerage projects. There are 4 MOs for Jayawadanagama/Kolonnawa, Ja-Ela/Ekala, Dehiwala/Mt. Lavinia and Seethawaka. MO for the Sri Jayawardenapura Kotte project will be established in the O&M stage of the project.

(2) NWSDB Process for Implementation of Sewerage Project

The process from planning to design and O&M is shown in **Table 6.3-2**.

The Sewerage Division prepares the planning documents for the approval of the Ministry of City Planning, Water Supply and Higher Education and the Board of Directors of NWSDB after these are reviewed by the project appraisal committee established in NWSDB for deciding the project viability. The Sewerage Division with the help of consultants prepares the facilities design for the approval of the GM of NWSDB after these are checked by the AGM (P&D).

NWSDB prepares the construction budget which is reviewed by the Ministry of City Planning, Water Supply and Higher Education, before these are sent to the Department of National Planning for approval. The Sewerage Division prepares the O&M budget which is reviewed by Addl. GM (Finance), before it is sent to the General Manager of NWSDB for approval. The Sewerage Division also prepares the human resources requirement and this is reviewed by the Addl. GM (Human Resources Management), and sent to the Management Service Department of the Ministry of Finance for approval.

The process described above will be followed in the implementation of the Sri Jayawardenapura Kotte sewerage project.

Table 6.3-2 NWSDB Process for Implementation of Sewerage Project

Works		Documentation	Check	Approval
Planning	Sewer System	Sewerage Division	Project Appraisal Committee of NWSDB	Ministry of City Planning, Water Supply and Higher Education / Board of Director of NWSDB
	STP	Sewerage Division with the assistance of MC		
Designing	Sewer System	Sewerage Division/ Consultants	AGM (P&D)/ Design Consultants	GM of NWSDB
	STP			
Budgeting	Construction	NWSDB	Ministry of City Planning, Water Supply and Higher Education	Department of National Planning
	O&M	Sewerage Division	Addl. GM (Finance),	GM of NWSDB
Human resources		Sewerage Division	Addl. GM (Human Resources Management)	Management Services Department of Ministry of Finance

Source: JET

6.3.3 Human Resources

(1) Staff in Sewerage Project

Table 6.3-3 shows the number of technical staff above the engineer assistant level in the existing sewerage projects in NWSDB.

Table 6.3-3 Number of Technical Staff above Engineer Assistant in Existing Sewerage Projects

Categories		Sewerage Division		
		Planning & Design	Construction (in PMUs)	O&M (in MOs)
DGM (Civil)		-	1	-
AGM (Civil)		1	3	1
Manager		-	3	3
Chief Engineer	Civil	2	9	1
	M/E	-	1	-
Engineer	Civil	6	17 (Temporary 3)	5
	M/E	-	5	3
Engineer Assistant	Civil	-	13 (Temporary 35)	20
	M/E	-	4 (Temporary 2)	10

M/E: Mechanical/Electrical
Source: NWSDB

The staff in the planning and design section is sufficient even when the Sri Jayawardenapura Kotte project starts. However, arrangement for PMU and MO for the project must be arranged. Because sufficient experience and expertise is necessary for efficient management of the PMU and MO, the main staff of those offices, such as managers, chief engineers, engineers, and chief operators, should be arranged by transfer from other NWSDB's offices. Other staff such as operator, mechanic, electrician and workers will need to be newly employed in conformity to the NWSDB's employment process which has been used in the existing PMU and MO.

(2) Staff Training

The Training Centre of the Human Resources Management and Training Division has carried out many training programs for executive staff and field workers. 47 technical training programs were conducted in 2017. NWSDB also offers university graduate, masters, and doctoral degree courses as external training.

6.3.4 Experience

(1) Implementation of Sewerage Project

The on-going sewerage projects implemented by NWSDB are shown in **Table 6.3-4** and the ones they manage are shown in **Table 6.3-5**.

Table 6.3-4 On-going Sewerage Project Implemented by NWSDB

	Title of Project	MC involved	Donor
1	Greater Colombo Wastewater Management Project	(CMC: Project in CMC area is implemented by CMC.) Kolonnawa Dehiwala/Mt. Lavinia	ADB
2	Global Partnership for Output Based Aid Project for Expanding Sewerage Services in Greater Colombo Area	Dehiwala/Mt. Lavinia Moratuwa Ratmalana, Ja-Ela/Ekala Kolonnawa	WB
3	Kandy City Wastewater Management Project	Kandy	Japan
4	Jaffna/Kilinochchi Water Supply and Sanitation Project	Jaffna Kilinochchi	ADB France
5	Greater Kurunegala Water Supply and Sanitation Project	Greater Kurunegara	China
6	Kataragama Wastewater Disposal Project	Kataragama	Austria

Source: JET

Table 6.3-5 Sewerage Project Managed by NWSDB

Name		Start of Operation	Owner of Sewerage project	Organization in Charge of O&M
1	Ratmalana-Moratuwa	2013	NWSDB	Dehiwala/Mt. Lavinia MO
2	Ja-Ela/Ekala	2012		Ja-Ela/Ekala MO
3	Hikkaduwa	2010		Southern RSC
4	Maddumagewatte Housing Scheme	1990		Jayawadanagama/Kolonnawa MO
5	Jayawadanagama Housing Scheme	1985		Jayawadanagama/Kolonnawa MO
6	Kataragama	1983		Southern RSC
7	Dehiwala/Mt. Lavinia	1983		Dehiwala/Mt. Lavinia MO
8	Kolonnawa	1982		Jayawadanagama/Kolonnawa MO
9	Hantana Housing Scheme	1981		Central RSC
10	Raddolugama Housing Scheme	1980		Ja-Ela/Ekala MO
11	Mattegoda Housing Scheme	1980		Jayawadanagama/Kolonnawa MO
12	Biyagama EPZ	2012	BOI	Ja-Ela/EkalaMO
13	Seethawaka EPZ	1999		Seethawaka MO
14	Koggala EPZ	-		Southern RSC
15	Modarawila Housing Scheme	2007	UDA	Dehiwala/Mt. Lavinia MO

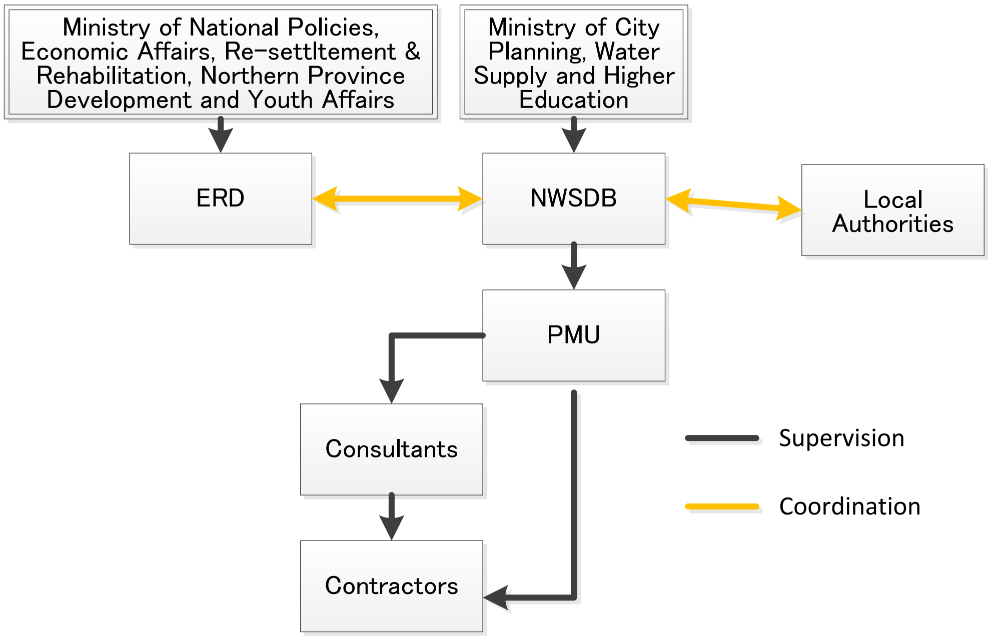
EPZ: Export Processing Zones
BOI: Board of Investment
UDA: Urban Development Authority
NWSDB also manages sewerage projects owned by the Board of Investment (BOI) and Urban Development Authority (UDA).
Source: JET

NWSDB also manages sewerage projects owned by the Board of Investment (BOI) and Urban Development Authority (UDA). According to NWSDB, there is no issue in the performance of implementation of these projects.

6.4 PARTIES INVOLVED IN IMPLEMENTATION OF SEWERAGE PROJECT

6.4.1 Relevant Authorities for Implementation of Sewerage Project

Figure 6.4-1 shows the working relationship among the players involved in the planning, design and construction of the Sri Jayawardenapura Kotte sewerage project.



Source: JET

Figure 6.4-1 Working Relationship in Implementation of Sewerage Project in Sri Jayawardenapura Kotte

NWSDB under the Ministry of City Planning, Water Supply and Higher Education establishes a PMU to supervise the consultants and contractors. NWSDB also coordinates with the Department of External Resources (ERD) under the Ministry of National Policies, Economic Affairs, Re-settlement & Rehabilitation, Northern Province Development and Youth Affairs because Japanese funding is involved.

The roles of the relevant organizations are as follows:

(1) Executing Agency

1) Ministry of City Planning, Water Supply and Higher Education

Ministry of City Planning, Water Supply and Higher Education authorizes the project and exercises the oversight to ensure that the project is implemented properly.

(2) Implementing Agency

1) NWSDB

NWSDB is responsible for planning and design, as well as financial and human resources requirements. It assigns a Project Director and establishes a PMU which operates under its supervision. NWSDB was the executing agency of "Kandy City Wastewater Management Project", but now it is not the executing agency but the implementing agency.

NWSDB approved the project expenditure and defrayed it to the contractors and consultants directly at the Kandy Project, so NWSDB was the executing agency and the implementing agency; however at present Ministry of City Planning, Water Supply and Higher Education approves and defrays the expenditure, so the ministry is the executing agency.

2) PMU

PMU prepares procurement plan, contracts with consultants and contractors and obtains various licenses and permissions, and supervises the consultants and contractors. Even after the STP starts operation, the construction of sewer networks may still be on-going. The PMU stays in operation to complete the sewer networks.

(3) Others

1) Local authorities

Sri Jayawardenapura Kotte MC and relevant local authorities in the project area will work with NWSDB on the acquisition of land for STP and pumping stations and the installation of sewer networks. The Construction Section of the local authorities will implement the roles such as coordinating to the land acquisition for STP site and giving permission for laying sewer pipes along the roads managed by the local authorities. They are responsible for securing and developing human resources for the roles.

2) ERD

The Department of External Resources (ERD) works with donors to identify development assistance strategies and priorities. ERD receives project expenditure from NWSDB through Ministry of City Planning, Water Supply and Higher Education, checks and certifies the payments for these by the Bank of Sri Lanka. ERD participates in the steering committee and monitors project implementation jointly with the donors.

3) Other organization

In the project, permissions and licenses from various organizations are required. STP effluent must meet the standard set by the Central Environment Authority (CEA). The Urban Development Authority (UDA) must approve the selection of sites for the facilities and the Road Development Authority (RDA) must grant the permits for the installation of sewer pipes under major roads.

6.4.2 Roles and Responsibilities of Relevant Organizations in the Project

Table 6.4-1 shows the specific roles and responsibilities of relevant organizations at the planning, design and construction stages.

Table 6.4-1 Roles & Responsibilities of Relevant Organizations

Organization	Stage	Roles and Responsibilities
Ministry of City Planning, Water Supply and Higher Education	Planning	*Project approval *Coordination of land acquisition *Coordination of financing *Supervision of NWSDB
	Design	*Coordination of land acquisition *Coordination of financing *Supervision of NWSDB
	Construction	*Coordination of financing *Supervision of NWSDB

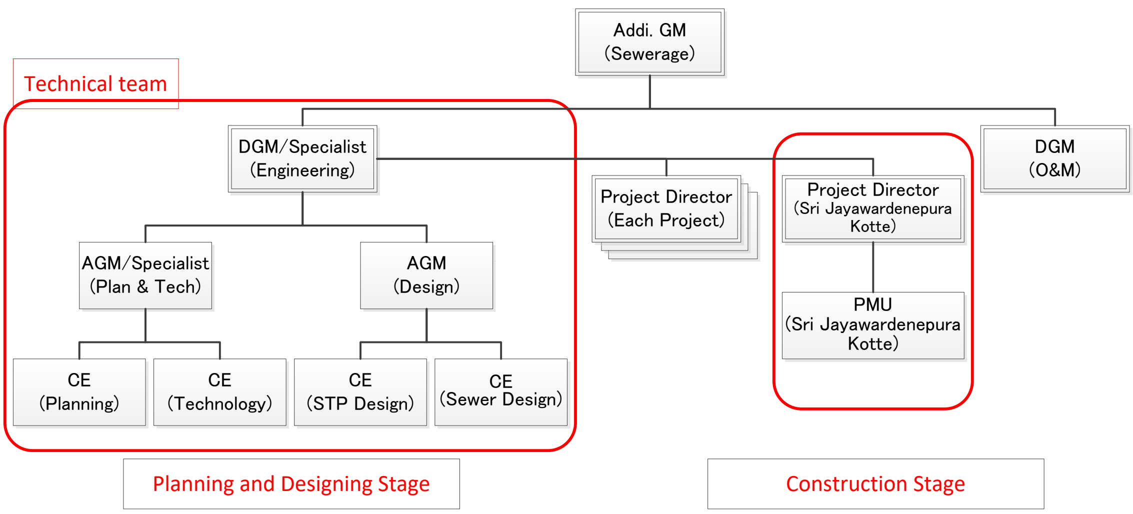
Organization		Stage	Roles and Responsibilities
NWSDB	Sewerage Division	Planning	*Planning works in cooperation with consultants *Coordination of land acquisition
		Design	*Establishment of PMU *Supervision of PMU *Support for design
		Construction	*Supervision of PMU *Support for construction *Consideration of O&M structure and budget *Consideration of appropriate sewerage service charge
	PMU	Planning	-
		Design	*Design works in cooperation with consultants
		Construction	*Supervision of consultants and contractors *Coordination with MC *Obtaining permissions from relevant authorities
Local Authority		Planning	*Coordination of land acquisition
		Design	*Coordination of land acquisition *Coordination of sewer networks design
		Construction	*Coordination of STP and sewer networks construction *Permission for sewer networks construction under local authority roads

Source: JET

The Sewerage Division is involved in all the stages. PMU works closely with the local authorities as shown in the table.

6.4.3 Institutional Adjustments Required for Project Implementation

The tasks of the DGM in charge of sewerage will be split into the DGM/Specialist (Engineering) and the DGM (O&M). The planning and design will be shared between AGM (Planning/Technical) and the AGM (Design).



Source: JET

Figure 6.4-2 Organizational Structure for Planning, Design and Construction

(1) Planning and Design

A technical team will be established to plan and design the project facilities as shown in **Figure 6.4-2**.

(2) Construction

The Project Director of the Sri Jayawardenapura Kotte sewerage project reports to the DGM/Specialist (Engineering) and PMU is established under the director to supervise construction works.

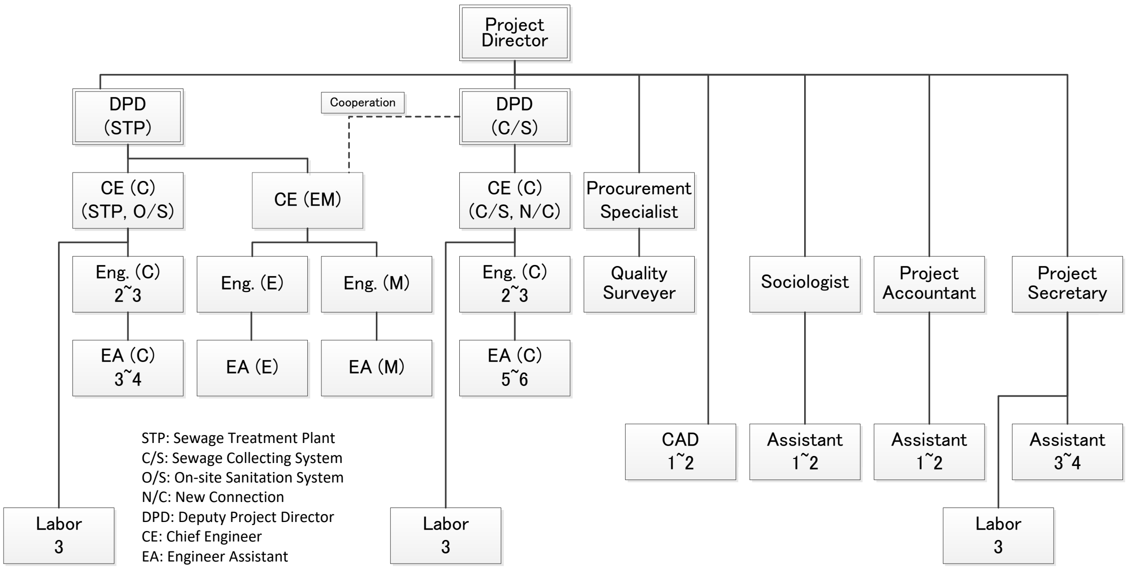
According to the "Recruitment, Remuneration and Management of Project Staff" (Management Service Circular No. 33 (1), 20, Dec. 2007 and "Cadre and Remuneration Management of Projects" (Management Service Circular No. 01/2016 (24, Mar. 2016), the PMU is organized as shown in **Figure 6.4-3**.

Under the Project Director are the Deputy Project Director (DPD) for STP and DPD for sewer networks, plus a number of Chief Engineers, Engineers, and Engineer Assistants.

A Procurement Specialist, Sociologist, Project Accountant and Project Secretary also report to the PD to implement their respective duties including assessing environmental and social considerations, climate change impacts, gender and poverty issues and public outreach.

According to the survey at the existing PMUs, delay in the implementation schedule and staff turnover is the issues in these PMUs.
This project should avoid the delay with better schedule management. Staff turnover is mainly caused by low pay for temporary jobs, so improvement of working conditions for the temporary jobs will be necessary.

Consultants and contractors will deliver lectures and conduct OJT regarding STP design, new sewerage technology to be adopted in the project and construction supervision for PMU staff, as required.



Source: JET

Figure 6.4-3 Organization of PMU for Sri Jayawardenapura Kotte Sewerage Project (tentative)

(3) Committees for Coordination of Sewerage Project

Various committees are established in NWSDB as shown in **Table 6.4-2**. They deal with emerging issues and ensure smooth progression during project implementation.

Table 6.4-2 Committees for Implementation of Sewerage Projects

Title of Committee	Details	
Project Appraisal Committee	Purpose	Determine project viability
	Frequency	Every 1.5 months
	Chairman	Chairman of NWSDB
	Member	GM, Addi. GMs, DGM(P&D), DGM(Commercial), DGM(CP), Chief Chemist, Manager(Ground Water)
Technical Evaluation Committee	Purpose	For bid evaluation
	Frequency	As required
	Chairman	Addi. GM, DGM, AGM, CE
	Member	DGM, AGM, Chief Engineers, Engineers, Accountants
Project Steering Committee	Purpose	Stakeholder meeting
	Frequency	Monthly
	Chairman	Secretary of Ministry of City Planning, Water Supply and Higher Education
	Member	Secretary of relevant ministries
Progress Review Committee	Purpose	Progress monitoring
	Frequency	Monthly
	Chairman	Addi. GM (Sewerage)
	Member	Project Director, DGM (Sewerage), AGM (Sewerage), Chief Engineer (Sewerage)
Taking over & Handing over	Purpose	Taking over and handing over of project
	Frequency	As required
	Chairman	Addi. GM (Sewerage)
	Member	Project Director, DGM (Sewerage), AGM (Sewerage), Chief Engineer (Sewerage)
Variation Committee	Purpose	Approve changes
	Frequency	Monthly
	Chairman	Addi. GM (Sewerage)
	Member	DGM (Costing), DGM (P&D), AGM (Sewerage), AGM (P&D)

Source: JET

A similar set of committees will be overseeing the Sri Jayawardenapura Kotte sewerage project.

(4) Documents Required for Project Implementation

NWSDB will prepare documents required for disbursement, monitoring and procurement, and circulate these to relevant authorities.

(5) Experience in International Bidding and Japanese ODA Loan

Because all of the sewerage developments rely on foreign funds, NWSDB has worked extensively with donor countries and is familiar with the international bidding process. The Kandy City Wastewater Management Project is using Japanese ODA loan, and NWSDB is familiar with the loan procedure. NWSDB has established the Japan Project Unit (JPU) to facilitate smooth coordination with the Japanese donor.

(6) Experience in Obtaining Permissions and Licenses from Domestic Institutions

It is necessary to get permissions and licenses shown in **Table 6.4-3** for implementing the sewerage project. Sewer pipe installation under roadways requires permission from the Road Development Authority (RDA) and acquisition of land for STP and pumping stations requires permission from the Urban Development Authority (UDA). Environmental Protection License must be renewed with the CEA and the Marine Environmental Protection Authority (MEPA) every year. NWSDB has been successful in obtaining these permissions and licenses and should not have any problem with the Sri

Jayawaredanapura Kotte sewerage project requirements.

Table 6.4-3 Permissions and Licenses from Domestic Authorities

Authority	Type	Purpose
MC (Municipal Council)	Permission	Approval for building plan
RDA (Road Development Authority)	permission	Pipe laying under roads
UDA (Urban Development Authority)	Permission	Acquisition of land in urban area
CEA (Central Environmental Authority)	Permission	Approval for IEE and EIA
	License	EPL (Environmental Protection License) (Requires yearly renewal)
MEPA (Marine Environment Protection Authority)	License	Marine environment protection license (Requires yearly renewal)

Source: JET

(7) Performance in Progress of Project

NWSDB has implemented many water supply and sewerage projects nationwide and it has sufficient experience; however long delays in the progress of project especially in procurement and disbursement, sometimes has occurred. According to a JET survey of NWSDB, the main reasons and solutions are as shown in **Table 6.4-4.**

Table 6.4-4 Reasons for Delay in Project Implementation and Potential Solutions

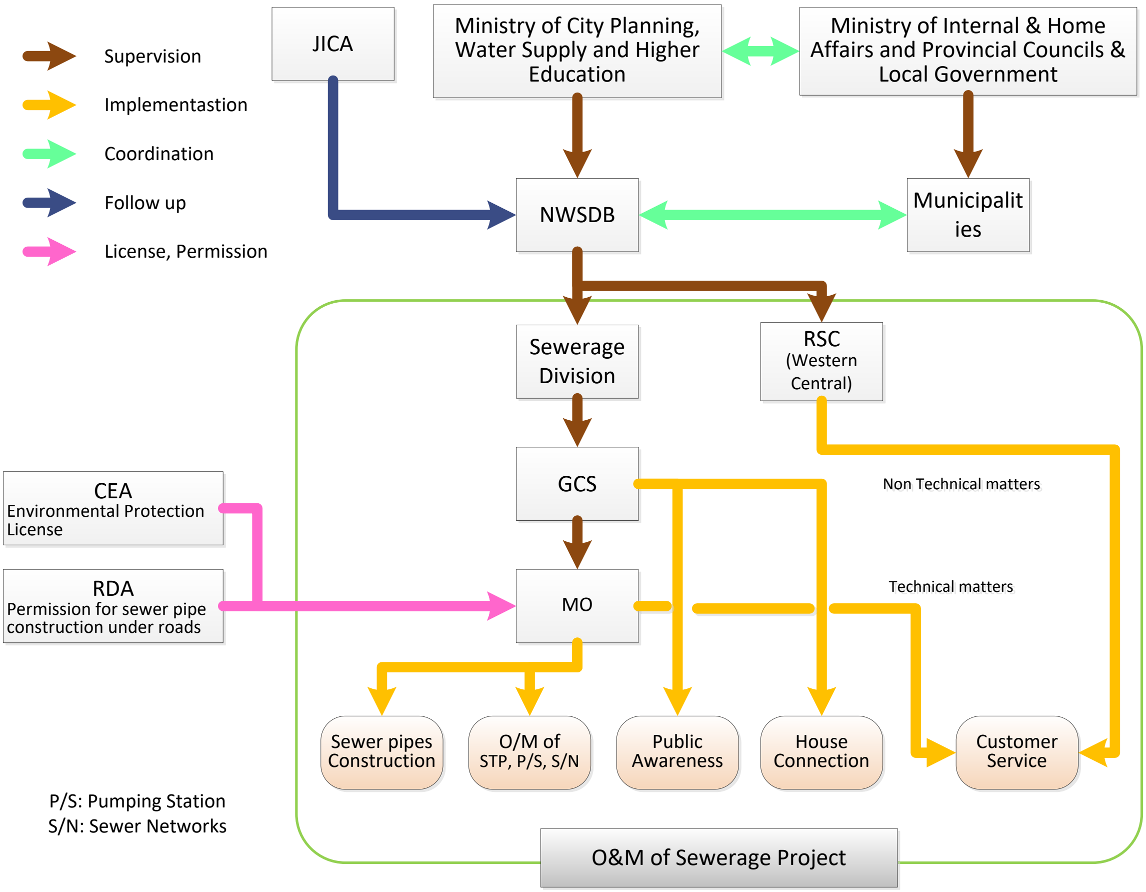
Stage	Reason for Delay	Solution to reduce the delays
Procurement	Technical Evaluation Committee (shown in Table 6.4-2) takes a long time to make determinations in procurement mainly due to; 1. Poor capacity of technical members of the committee ✓ For the technical evaluation, understanding of tender conditions and critical technical requirements is necessary; however, members of the committee sometimes don’t want to study those matters. ✓ Members of the committee sometimes make incorrect determinations due to a lack of knowledge and re-evaluation becomes necessary. 2. Frequent occurrence of petition by bidders at the evaluation stage ✓ There have been instances where competitive bidders send petitions against the determination made by the committee to higher level authorities and/or the funding agencies. ✓ It is common practice that losing bidders send petitions to higher level authorities and/or funding agencies with the intention of disturbing and delaying the process.	1. Selecting competent personnel for the committee will minimize the long delays. 2. At the moment, there is no effective mechanism to handle this situation. NWSDB, relevant ministries and funding agencies must not entertain any petition received during the evaluation. NWSDB, relevant ministries and funding agencies should get together and formulate a mechanism to address this issue.
Disbursement	Although the government tender procedures and guide-lines have already been put in place, some of the technical staff in the PMU is not competent enough to understand them and delay of project including disbursement sometimes has occurred. When the set procedures and guide-lines are not followed properly, and ad-hoc decisions are taken especially with unfair treatment of contractors, there will be conflicts at work sites and the sites may be at a standstill without any work being attended to.	Main staff of the PMU has been assigned based on the seniority system and inappropriate personnel sometimes have been appointed to key positions. Employment of enough competent staff who understands the procedures, standards and guide-lines well will minimize the delay in implementing the projects.

Source: JET

6.5 INSTITUTIONAL ARRANGEMENT FOR OPERATION AND MAINTENANCE

6.5.1 Relevant Organizations and Working Relationships

Figure 6.5-1 shows the functions of relevant authorities in O&M of the sewerage project.



Source: JET

Figure 6.5-1 Responsibilities for O&M

The Sri Jayawardenapura Kotte MO is newly established under the GCS for constructing sewer pipes and implementing O&M of the STP and sewer networks.

(1) Greater Colombo Sewerage (GCS)

GCS supervises and assists the MO on O&M. GCS also conducts public awareness and promotion of house connection.

(2) Sewerage Management Office (MO)

Sri Jayawardenapura Kotte MO conducts not only O&M of STP, pumping stations and sewer networks, but also supervises the construction of small-scale sewer pipes and provide customer services related to technical matters. (PMU will continuously conduct the construction of main sewer networks.)

(3) RSC (Western Central)

RSC (Western Central) is already responsible for administrative functions such as billing and customer service for the water supply of the MC. It will do the same for the sewerage project.

(4) Local Authorities

The Sri Jayawardenapura Kotte MC and relevant local authorities in the project area will cooperate with NWSDB in promotion of public awareness and house connections.

The organizational structure of the local authorities may need to be adjusted if the ownership of the sewerage project is transferred to them in the future. O&M should always remain with NWSDB because of its O&M expertise.

(5) Central Environment Authority (CEA)

CEA issues the Level-1 Environmental Protection License (EPL) required for STP operation. This level represents significant impact to the environment, and the license has to be renewed every year. The MO must apply to the regional office of the CEA to get the license.

(6) Road Development Authority (RDA)

RDA issues the permission for the installation of sewer networks under roadways.

6.5.2 Roles and Responsibilities of Relevant Organizations in O&M

Table 6.5-1 shows the roles and responsibilities of relevant organizations in O&M of the sewerage project.

Table 6.5-1 Specific Tasks of Relevant Organizations in O&M

Organization		Roles and Responsibilities in O&M
Ministry of City Planning, Water Supply and Higher Education		*Supervision of NWSDB in O&M and financial status
NWSDB	Sewerage Division	*Establishment of MO under GCS *Preparation of O&M budget *Consideration of appropriate management *Consideration of outsourcing
	GCS	*Supervision of MO in O&M *Support for customer services (technical matters)
	MO	*Implementation of O&M of STP, pumping stations and sewer networks *Customer services (technical matters) *Obtaining EPL license from CEA every year
	RSC (Western Central)	*Billing *Customer services (non-technical matters) *Promotion of house connections
Local Authorities		*Public awareness *Promotion of house connections

Source: JET

6.5.3 O&M Framework

O&M experience at existing MOs provides guidance on how this can be organized at Sri Jayawardenapura Kotte.

(1) Work Schedule

The work schedule of MO staff is shown in **Table 6.5-2**. Operators in the Sri Jayawardenapura Kotte MO will adopt the same 3 shift schedule.

Table 6.5-2 Work Schedule of MO Staff

Staff	Work Schedule
Operator	3 shifts （8:00～16:00、16:00～0:00、0:00～8:00）
Other staff	8:30～16:50

Source: NWSDB

(2) O&M Conditions and Issues

1) Sewer Networks

Table 6.5-3 shows the number of customer complaints received and resolved in the four MOs managed by the GCS. The Seethawaka MO received no complaints because it deals mainly with industries. 270 to 395 complaints per year were received in the other MOs. Some complaints were not attended to because the maintenance crews were not able to access the blockage located in the premise.

The number of complaints will increase with service area expansion. Adequate maintenance equipment stationed at the right places is important for timely response to complaints and to avoid service backlogs.

Table 6.5-3 Number of Complaints and Those Attended to for Sewer Networks (2015, 2016)

MO	2015		2016	
	Complaints Received	Complaints Attended-To	Complaints Received	Complaints Attended-To
Dehiwala/Mt. Lavinia	320	320	360	360
Jaela/Ekala	270	235	-	-
Seethawaka	0	0	-	-
Jayawadanagama/Kolonnawa	395	393	-	-

Source: JET

Manhole type pump stations have not been used in the existing NWSDB sewerage project. The Sri Jayawardenepura Kotte project will have 43 manhole pump stations at the 1st Stage of the project. The proper preventive maintenance of these pumps has to be considered to keep the pump stations and sewer network functional.

According to the maintenance of Kyoto City, the patrol inspection takes place once a month. An inspector performs simple tasks that include opening the manhole and visually checking the pump condition.

Periodical maintenance/cleaning would take place once a year for proper preventive maintenance of manhole pumps. A maintenance crew would carry out tasks such as replacing grease and calibrating level sensors as well as cleaning pumps, suction pipe and guide rails.

Also, out-sourcing on the maintenance of manhole type pump is one of maintenance management options from the 2nd stage if the increase of operational staffs of NWSDB is not admitted.

2) STP

Table 6.5-4 shows the influent and effluent quality of Moratuwa/Ratmalana STP in Dehiwala/Mt. Lavinia MO, Ekala STP in Jaela/Ekala MO and Seethawaka STP in Seethawaka MO. Treatment efficiency is high and effluent quality is better than the regulatory standard (BOD=30 mg/L). However, it should be noted that influent flowrates at the STPs, other than Seethawaka, are less than 50% of the treatment capacity and when the quantity increases, proper O&M will be critical for achieving high treatment efficiency.

Table 6.5-4 Influent and Effluent Quality of STPs (Annual Average)

Parameter / STP		BOD (mg/L)		COD (mg/L)		SS (mg/L)		T-N (mg/L)		T-P (mg/L)	
		Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.
Moratuwa/Ratmalana	2015	99	3.6	260	42	340	6.3	54	12	2.7	0.71
	2016	199.9	9.7	806.1	66.1	523.7	11.4	55.7	10.0	5.5	1.7
Jaela/Ekala	2015	190	6.7	630	56	530	18	70	12	-	-
	2016	181	-	503	53.1	33.6	19	48.9	14.3	5.22	1.06
Seethawaka	2015	150	28	400	110	150	55	38	22	-	-

Source: NWSDB

3) Laboratory Analysis

Sewage and sludge in STP are analysed routinely. As shown in **Table 6.5-5**, the basic parameters are analysed in the STP laboratory, heavy metals and microbiological analysis is carried out by the Central Laboratory of NWSDB and analysis of heavy metals in sludge is contracted to private laboratories.

According to the survey, the analysis is conducted properly at all the STPs and there is no lack of chemicals and equipment. The laboratory at the Sri Jayawardenapura Kotte STP can follow the same system which is working well at the other STPs.

Table 6.5-5 Sewage and Sludge Analyses: Location, Parameters and Frequency

Laboratory	Analysing Parameter	Analysing Frequency
Laboratory in STP	Temperature, pH, Color, BOD, COD, SS, T-S, V-SS, T-N, NH_4-N, NO_3-N, T-P, Ort-P, Oil & Grease, SV, SVI	1/week
Central Laboratory of NWSDB	Heavy metals in wastewater, Microbiological analysis	1/month
Private Laboratory	Heavy metals in sludge	1/month

Source: NWSDB

4) Issues

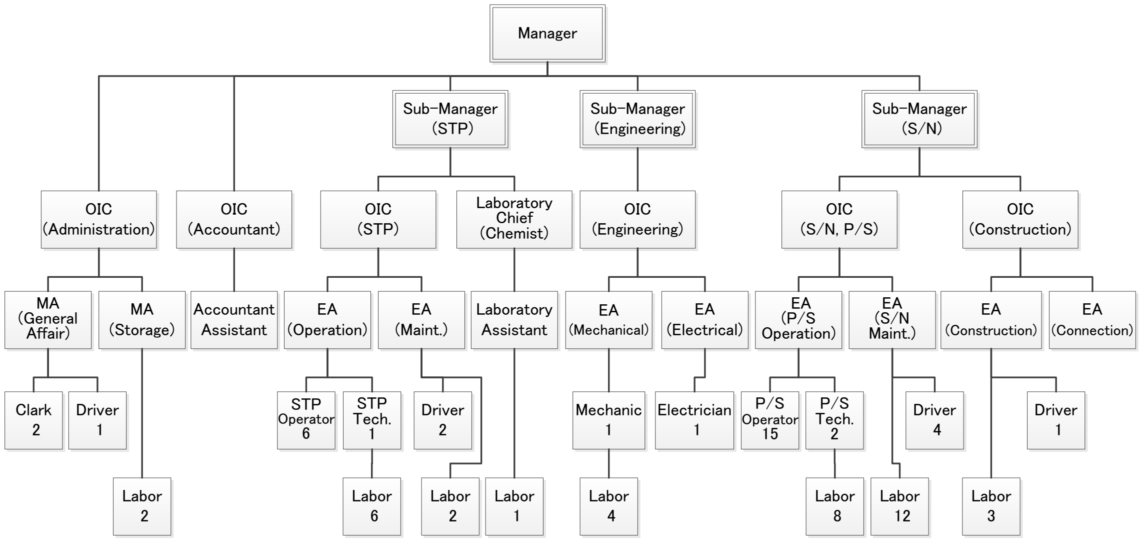
Survey of the existing MOs identified the following O&M issues:

- Shortage of drivers for heavy vehicles
- Shortage of unskilled labor

Maintenance and repairs will continue to increase as service area expands and the facilities age; therefore the need for drivers of heavy vehicles and unskilled labours will also increase. The Sri Jayawardenapura Kotte MO must prepare for similar challenges.

(3) Proposed Organization of Sri Jayawardenapura Kotte MO

The STP site is large enough to accommodate the sewer network office, but has the disadvantage of being far from the city centre. Locating the office at the pumping station site in the centre of the city would be better for more efficient maintenance. After consultation with NWSDB, 2 options for the organization of the MO and required number of staff are proposed as shown in **Figure 6.5-2** and **Figure 6.5-3**.



OIC: Officer in Charge
MA: Management Assistant
EA: Engineer Assistant
S/N: Sewer Networks
P/S: Pumping Station
Maint. Maintenance
Tech.: Technician

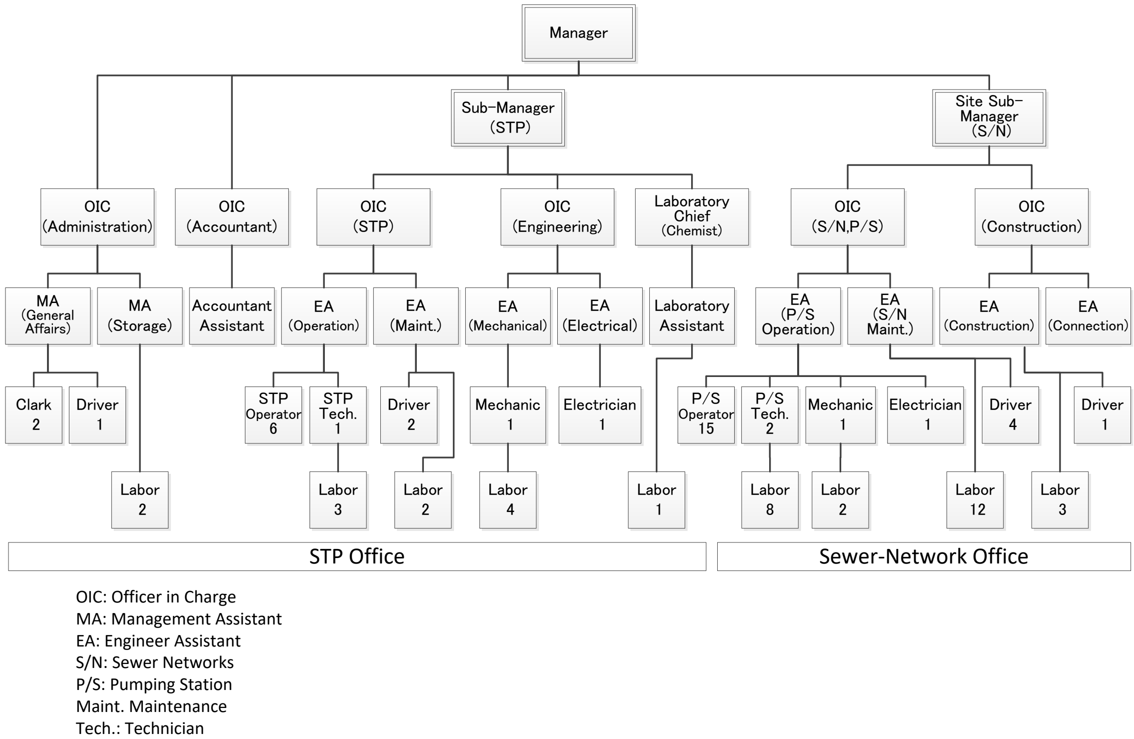
Source: JET

Figure 6.5-2 Organizational Structure of Sri Jayawardenapura Kotte MO for Plan-1 (with O&M of sewer networks at STP site)

In Plan-1 where the sewer network staff office is at the STP site, 3 Sub-Managers would be assigned:

- Sub-Manager (STP) for O&M of the STP and analysis in laboratory,
- Sub-Manager (Engineering) for maintenance of mechanical and electrical equipment in STP, sewer networks and pumping stations,
- Sub-Manager (Sewer Networks) for sewers installation and house connections as well as O&M of sewer networks and pumping stations.

In Plan-2 where the sewer network staff office is at the pumping station, there would be no Sub-Manager (Engineering). Sub-Manager (STP) and Sub-Manager (Sewer Networks) would cover the maintenance of the mechanical and electrical equipment in their respective areas.



Source: JET

Figure 6.5-3 Organizational Structure of Sri Jayawardenapura Kotte MO for Plan-2 (with sewer network office at pumping station site)

In Plan-2, a mechanic and an electrician will be assigned to the Sewer Networks Office as well as the STP Office to maintain mechanical and electrical equipment. Then Plan-2 will need more staff than Plan-1.

More repair and maintenance will be required for sewer networks as the facilities age and deteriorate. Sewer maintenance staff may have their office at the STP at the beginning of the operation. As network maintenance increases, a staff office should be established at a pumping station in the city centre.

Equipment trouble may not occur very often at the beginning of the operation, but will increase as the facilities age. The number of staff required for maintenance of the STP and sewer networks will have to be increased accordingly. At this point, outsourcing should also be considered.

In addition to above two options, NWSDB makes another organization. Since the total number of staffs is more than the member of proposed two options, and the function of each position and division is not clear in the NWSDB's organization structure, this organization structure is attached as a reference in APPENDIX 6.1.

6.5.4 Strengthening of Organizations Capability

(1) Staffing

For establishing the organizational structure of the Sri Jayawardenapura Kotte MO shown in **Figure 6.5-2**, 23 senior engineer assistants and above, 36 O&M workers and drivers and 38 labours are required. The Manager, OICs and Chief of O&M should be experienced staff and transferred from other offices so that the operation can start off smoothly. The Chief of STP and OICs at the Moratuwa/Ratmalana STP plant in Dehiwala/Mt. Lavinia MO were transferred from other STPs, RSC and the water supply sections. The other required staff will be employed by the NWSDB's employment process which has been adopted in other existing water supply and sewerage schemes of NWSDB.

The required staff can be recruited from the many universities, colleges, and technical high schools which have faculty of civil, mechanical, electrical, chemical, and environmental degrees as shown in **Table 6.5-6.**

Table 6.5-6 Faculty of National Universities, Collages and Technical High-Schools

University	Civil	Electrical	Mechanical	Chemical	Environmental
Colombo				✓	
Peradeniya	✓	✓	✓	✓	
Sri Jayewardenepura				✓	
Kelaniya				✓	
Moratuwa	✓	✓	✓	✓	
Jaffna	✓	✓	✓	✓	
Ruhuna	✓	✓	✓	✓	✓
Open University	✓	✓	✓	✓	✓
Eastern				✓	
South Eastern	✓	✓	✓		
Rajarata				✓	✓
Sabaragamuwa					
Wayamba		✓			
Uva Wellassa					
Visual & Performing Arts					
Collage/Technical high-school	Civil	Electrical	Mechanical	Chemical	Environment
Construction Industry Development Authority	✓	✓	✓		
Ceylon-German Technical Training Institute		✓	✓		
National Apprentice & Industrial Training Authority	✓	✓	✓		
National Vocational Training Authority	✓	✓	✓		
Industrial Technical Institute				✓	✓
National Building Research Organization	✓				✓
Institute of Chemistry				✓	✓

Source: JET

(2) Heavy Machinery

Table 6.5-7 shows the number of heavy machines such as gully suckers and high-pressure jet machines for regular and emergency cleaning of sewer pipes in the existing MOs.

According to the survey of the Dehiwala/Mt. Lavinia MO, there are not enough backhoe loaders and crane trucks for sewer maintenance. Shortage of heavy vehicle drivers with specialized experience is also an issue. The MO now is asking the increase of heavy vehicles and drivers. According to the MO, NWSDB head office is now considering the necessity of the increase.

Sri Jayawardenapura Kotte MO will start with the same types and numbers of heavy machines as Dehiwala/Mt. Lavinia MO. More machines will be needed as more sewer pipe maintenance is required and as the served population increases over time.

Table 6.5-7 Heavy Machines Owned by the Existing MOs

Type of Heavy Machine	Dehiwala/Mt. Lavinia	Jayawadanagama/ Kolonnawa	Ja-Ela/Ekala	Seethawaka
Gully/Jetting Combined Machine	-	1 (frequent trouble)	-	-
Gully Bowser	2	1 (frequent trouble)	1	-
Gulley Sucker	2	-	-	-
Portable Jetting Machine	1	1 (frequent trouble)	-	-
Crane Truck	-	1 (frequent trouble)	-	-
High Pressure Jet Machine	2	1	1	-
High Pressure water Spraying Machine	-	1	-	-
Road Breakers	2 (1 is out-of-order)	-	-	-
Water Bowser	1	-	-	-
CCTV machine	1	-	-	-
Boom Truck	-	-	1	-
Generator	3 (1 is out-of-order)	1	-	2

Source: JET

The heavy machines required for the Project in **Table 6.5-8** will be similar to those deployed by existing MOs.

Table 6.5-8 Type and Number of Heavy Machines Proposed in the Project

Machine Type	Purpose	Number
High-Velocity Jetting Machine	Sewer pipe maintenance and cleaning	3
Vacuum Truck		3
Tanker Truck		3
Stop Plug		20
Car with TV Inspection	Sewer pipe maintenance and inspection	1
Patrol Vehicle		6
Backhoe	Construction, sewer pipe maintenance	2
Dump Truck		2
Crane Truck		4
Power Rodding Machine		2
Power Bucket Machine		2
Sludge Transportation Truck	Transportation of sludge generated in STP	3
Mobile Generator	Contingency power in pumping stations	10

Source: JET

(3) O&M Manuals

O&M manuals used in the Dehiwala/Mt. Lavinia MO are shown in **Table 6.5-9**. Manual for O&M of mechanical and electrical equipment was prepared by PURAC AB, the supplier of mechanical and electrical equipment. Some of the machines do not come with the parts described in the manual and required modifications by the MO staff.

MO engineers and Manager prepared the equipment preventive maintenance and sewer networks cleaning schedules.

The Moratuwa/Ratmalana STP in Dehiwala/Mt. Lavinia MO does not have standard operation procedures, risk management and safety manuals. These are necessary to provide consistency in how processes and tasks are performed. The use of these documents significantly improves productivity in terms of training and retraining workers.

Table 6.5-9 O&M Manuals used in Dehiwala/Mt. Lavinia MO

O&M manuals	Prepared by	Issues
O&M Manual for Mechanical & Electrical Equipment	PURAC AB (M&E Supplier)	Some of them do not have assembly details. When the equipment was manufactured with parts from different vendors, there is no manual for the assembled product.
Preventive Maintenance Schedule	Engineer	Some requirements have to be changed considering actual operating conditions.
Cleaning Schedule for Sewer Network	Manager (O&M) , OIC	-

Source: JET

Table 6.5-10 shows the manuals to be prepared by the contractors a year before the start of plant operation.

Table 6.5-10 Manuals to be prepared for the Project

Manuals
O&M
Health/Safety
Maintenance Schedule
Sewage and Sludge Analysis Schedule

Source: JET

(4) Outsourcing

Outsourcing some O&M tasks will become indispensable to improve efficiency and for cost savings.

In Sri Lanka, O&M of some of the small scale STPs owned by BOI and UDA has been outsourced. There is still no private company which can take over O&M of large scale STPs, because the private sector has not yet accumulated sufficient knowledge and technical capabilities. The potential for outsourcing in four stages is proposed as shown in **Table 6.5-11**.

Table 6.5-11 Stepwise Outsourcing Process of O&M Works of STP

Stage	Schedule	Contents of outsourcing
1	At present	No outsourcing, NWSDB implements all the tasks.
2	In a few years	Outsourcing of general labor
3	Within 10 years	Outsourcing of all O&M except supervision
4	Within 15 years	Outsourcing of all O&M including supervision

Source: JET

(5) Public Participation

O&M of sewerage facilities requires sufficient expertise and experience and the tasks involve substantial risk. Chance of public participation for the O&M will be little. Hiring neighbourhoods as the guard of STP might be possible.

6.5.5 Capacity Building

(1) Training

1) NWSDB Training Centre

Only 3 of the 47 technical training programs offered by the Training Centre of NWSDB in 2017 were exclusively on sewerage project, as shown in **Table 6.5-12**. Recognizing the importance of training for staff in sewerage project, the program on “Design of wastewater collection networks and treatment system” was offered for the first time in 2017.

Table 6.5-12 Technical Training on Sewerage Project

Category	Title of the Program	Target Group
General	Wastewater treatment process	Engineers
Design	Design of wastewater collection networks and treatment systems	Engineers
Laboratory	Wastewater treatment process, control & analysis	Chemists Lab. Assistants

Source: NWSDB

NWSDB should increase the training programs as shown in **Table 6.5-13**.

Table 6.5-13 Necessary Training Programs on Sewerage Project

Category		Title of the Program	Target Group
Planning	Planning of sewerage project		Engineer
Design	1	Pipe Jacking method	Engineer
	2	Rehabilitation of pipe networks	Engineer
	3	Mechanical system design in STP	Mechanical Engineer
	4	Electrical system design in STP	Electrical Engineer
O&M	1	Maintenance of sewer system	Maintenance staff
	2	Operation of STP and pumping station	Operator of STP, P/S
	3	Maintenance of mechanical system in STP and pumping station	Mechanical Engineer, Mechanic
	4	Maintenance of electrical system in STP and pumping station	Electrical Engineer, Electrician
	5	Industrial wastewater management	Engineer
Risk Management	On-site risk management		All staff in MO

Source: JET

2) Required Training

Table 6.5-14 shows the training required for the Project.

Before commissioning, overseas training for executive management level and management level of GCS and MO are implemented to improve their understanding in best management practices.

MO staff will get training in sewerage techniques, O&M procedure, administration and financial management. Japanese local governments which have a lot of knowledge and experience in this area are suitable for conducting this training. Training on O&M of STP equipment and pumping stations and health and safety practices are implemented 3 months before commissioning.

Table 6.5-14 Training Required in the Project

<table>
<tr><th colspan="2">Training</th><th>Target</th><th>Purpose</th><th>Number of Trainee, Term</th><th>Execution Stage</th><th>Venue</th><th>Executing Agency</th></tr>
<tr><td colspan="2">Executive Management</td><td>Executive Management Level</td><td rowspan="2">To understand the best management practice</td><td>10 people*
1 time
1 week</td><td>2 year before the start of operation</td><td>Overseas</td><td>Consultants</td></tr>
<tr><td colspan="2">Management</td><td>Management Level of GCS、MO</td><td>7 people*
2 times
2 weeks</td><td>1 year before the start of operation</td><td>Overseas</td><td>Consultants</td></tr>
<tr><td rowspan="4">O & M</td><td>Technical</td><td>Main staff of MO</td><td>To study techniques, administration and finance etc.</td><td>10 days</td><td rowspan="3">3 months before the start of operation</td><td rowspan="3">NWSDB Training Center</td><td>Japanese local governments</td></tr>
<tr><td>Equipment</td><td>O&M staff</td><td>To study O&M procedure of each equipment</td><td>20 days</td><td>Contractors</td></tr>
<tr><td>Safety/ Health</td><td>All staff of MO</td><td>To study safety and health management</td><td>3 days</td><td>Consultants</td></tr>
<tr><td>OJT</td><td>O&M staff</td><td>To study O&M procedure in detail</td><td>2 years</td><td>Commissioning</td><td>On-site</td><td>Contractors</td></tr>
</table>

Source: JET

In this project, some new technologies are used in sewer networks and sewage treatment. The following technical assistances shall be included in the OJT program for capacity building during 2 years.

- Operation of STP with 3-step feed biological nutrient removal
- Cleaning and maintenance of sewer pipes and maintenance equipment
- Maintenance of manhole type pumping stations

During commissioning, contractors conducted OJT for O&M staff over one year at the Moratuwa/Ratmalana STP (Soysapura) in Dehiwala/Mt. Lavinia MO, and PURAC AB implemented OJT for a year as shown in **Table 6.5-15**.

Start-up problems often occur in the first few years after commissioning. One-year OJT will be useful while the staff is likely to encounter real equipment troubles.

Table 6.5-15 OJT during Commissioning of Moratuwa/Ratmalana STP (Soysapura)

Training	Duration	Trainer	Trainee	Problem
O&M of STP	One year	Engineer of PURAC AB	All O&M staff	Treatment process & SCADA training was conducted in English and was difficult for some of the staff to understand.

Source: JET

3) Necessity for Other Technical Assistance

The following technical assistances will be considered for the effective and sustainable implementation of the project.

Table 6.5-16 Other Technical Assistance

No.	Item (Content)	Timing	Implementation		
			Consultant	Contractor	Capacity development project by JICA and/or other donors
1	Asset Management including Register System	With Project		**x**	
2	Build-up for Geographical Information System (GIS)	With Project	**x**		
3	Improvement and Optimization of Fee Collection and System	In Future			**x**
4	Preparation and Improvement of Customer Ledger and Services	In Future			**x**
5	Human Resources Development and Personnel-system Reform	With Project	**x**	**x**	**x**
6	Accounting System Reform for visualization of Financing Standing	In Future			**x**
7	Institutional Design of House Connection	With Project		x	
8	Guideline and Standard for Design and Construction of Sewerage Facilities	In Future			**x**
9	Procurement System for the evaluation of Life Cycle Cost	In Future			**x**
10	Promotion and Edification	With Project	**x**		

Source: JET

Items (3), (4), (6), (7), (8) and (9) are carried after the commissioning of STP. For item No. (7), technical assistance is not required because house connections will be included in the project cost and carried out by NWSDB.

(2) Salary and Benefits

Staff motivation depends strongly on compensation, benefits, and possibility of job advancement. **Table 6.5-17** shows the salary and benefits of engineers, supervisors, and skilled and non-skilled labourers in NWSDB in comparison to a private company in the same business. The salary and benefits at NWSDB are higher than those in the private sector. Therefore, there would not be much migration from NWSDB to the private sector and a good chance for NWSDB to retain experienced staff.

Table 6.5-17 NWSDB and Private Sector Salary and Benefits Comparison

Grade		NWSDB		Private Sector	
		Salary	Benefits	Salary	Benefits
1	Engineer	125,000	39,500	105,000	21,000
2	Supervisor	75,000	30,500	37,500	6,000
3	Skilled Labourer	50,000	28,500	27,500	8,000
4	Un-skilled Labourer	40,000	28,000	19,000	5,000

Source: JET Unit: LKR/month

(3) Promotion System

Table 6.5-18 shows the NWSDB promotion system. Everyone can be promoted after a certain period in a position and it is effective in keeping staff motivated to perform satisfactorily.

There will be more O&M challenges as the facilities age and deteriorate. It is important for NWSDB to maintain staff with sufficient experience by having a fair and equitable promotion system as well as attractive salary and benefits.

Table 6.5-18 Promotion System at NWSDB

Position	NWSDB Grade	Promotion Scheme
1. Engineers		
Position	NWSDB Grade	Promotion Scheme
Engineer	6	BSc Degree in Engineering or equivalent
Senior Engineer	5	Chartered Engineer with 5-year experience in the NWSDB
Chief Engineer	4	Chartered Engineer with 8-year experience in the NWSDB
Assistant general Manager	3	Chartered Engineer with 3-year experience as a Chief Engineer in the NWSDB
Deputy General Manager	2	Chartered Engineer with 4-year experience as an Assistant General Manager in the NWSDB
Additional General Manager	1A	Chartered Engineer with 3-year experience as a Deputy General Manager in the NWSDB
General Manager	1	Chartered Engineer with 15-year experience as an Engineer and 1 year as Addl. GM in the NWSDB
2. Supervisors		
Position	NWSDB Grade	Promotion Scheme
Engineering Assistant Class III	10	NDT/HNDE/NDES/Diploma in Technology of Open University or equivalent
Engineering Assistant Class II	9	Above qualifications and 2-year experience as an Engineering Assistant in Class III
Engineering Assistant Class I	8	Above qualifications and 2-year experience as an Engineering Assistant in Class II
Engineering Assistant - Sp. Class	7	Above qualifications and 12-year experience as an Engineering Assistant out of which 3-year experience
Senior Eng. Assistant - Supra	6	
3. Skilled Labor		
Position	NWSDB Grade	Promotion Scheme
Skilled Labor - Class II	13	GCE(O.L) in 6 subjects with Sinhala/Tamil and Math within 2 sittings and pass in trade test conducted by NWSDB
Skilled Labor - Class I	12	Trade Apprenticeship of NAB or 3-year experience in Class II and pass trade test conducted by NWSDB
Skilled Labor Special Class II	11	5-year experience in Class I and a pass in a trade test conducted by NWSDB
Skilled Labor Special Class I	10	7-year experience in Special Class II and pass trade test conducted by NWSDB
4. Un-skilled Labor		
Position	NWSDB Grade	Promotion Scheme
Un-skilled Labor – Class III	15	5th Standard education and physically and mentally fit
General Labor	14	Above qualifications and 5-year in Labor – Class III or GCE(O.L.) in 6 subjects with 1 year in Class III

NDT: National Diploma in Technology HNDE: Higher National Diploma in Engineering
NDES: National Diploma in Engineering Science NAB: National Apprentice Board, O.L.: Ordinary Level
Source: NWSDB

6.5.6 NWSDB Capability for O&M of the Project

NWSDB is expected to have the capacity necessary to operate and maintain the STP for the following reasons.

(1) Experience in O&M of large scale STP

Since 2013, NWSDB has been operating and maintaining the Moratuwa/Ratmalana STP (Soysapura) constructed with the SIDA assistance. Although the 17,000 m^3/day treatment capacity is about half of that of Sri Jayawardenapura Kotte STP, skills required are similar and NWSDB has gained valuable expertise and experience.

(2) Experience in similar sewage treatment process

The Moratuwa/Ratmalana STP (Soysapura) uses the “Step-Feed Biological Nutrient Removal” process, similar to that proposed for the Sri Jayawardenapura Kotte STP.

(3) Training by contractors

The contractors will implement training for the O&M staff during commissioning of the Sri Jayawardenapura Kotte STP.

(4) NWSDB investment for human resources, materials and budget

NWSDB has invested appropriate number of staff, materials, and budget for the existing water and sewerage projects and is likely to commit to similar investments in the Sri Jayawardenapura Kotte project.

CHAPTER 7 IMPLEMENTATION PROGRAM, COST ESTIMATE, AND PROCUREMENT

7.1 OUTLINE

- The project duration is estimated to be 136 months (including defect liability period for Package 4 of House connections). The 1st stage will be completed by July 2031 at the earliest (if the loan agreement is signed March 2020) (7.4.4).

- Total construction cost is undisclosed.

Table 7.1-1 Project Cost (July, 2019 price level)

Table 7.1-1 is undisclosed.

7.2 BASIC CONDITIONS AND ASSUMPTIONS

7.2.1 Cost Estimation Policy

Project costs were estimated using JICA's cost estimation tool. NWSDB “Rates 2018” were applied for the unit costs of the general construction works and items (civil works and building works excluding micro-tunnelling work), and quotations collected from construction companies and suppliers were used for items (Micro-tunnelling works, Maintenance equipment, Mechanical and Electrical works for all pumping stations and STP) not listed in “Rates 2018”. The some estimated costs based on the price at 2017 are adjusted by the ratio of cost indexes in construction statistics between January 2018 and January 2019.

7.2.2 Cost Saving Principle

The selection of materials and construction methods is based on economic considerations, construction challenges and capability and experience available locally. **Chapter 5** describes the comparative studies carried out for the selection of major facilities and equipment. Cost analysis aiming to achieve high benefits while minimizing investment is guided by the following principles:

- procurement of general items from Sri Lankan markets
- easily available at lower price
- simple construction methods
- moderate price but high quality
- using high efficiency equipment
- minimizing general cost
- easy and low-cost O&M

7.2.3 Procurement and Construction Policy

The selection of materials and construction methods is based on economic considerations, construction challenges and capability and experience available locally.

Most of the construction materials are available in Sri Lanka. Small size water meters, vehicles and computers are imported but can be purchased locally.

The contractor will import ductile iron and polyethylene pipes, fittings and couplings as well as mechanical and electrical equipment such as pumps, motors, valves, larger flow meters, monitoring and control equipment, and plant machinery and equipment.

(1) Procurement Condition in Sri Lanka

The procurement for water supply projects is normally carried out under unit price contract. International competitive bidding (ICB) is used for contracts involving advanced technologies and local competitive bidding (LCB) for other contracts.

Many local contractors have enough experience and capability to carry out the construction of water supply and sewerage projects involving commonly adopted technologies. NWSDB has procured such work valued at 500 million LKR or more from local contractors.

The latest major sewerage construction projects, such as the Kandy City Wastewater Management Project, Ratmalana/Moratuwa and Ja-ela/Ekala area projects, were carried out under the design-build contract. On the other hand, many construction projects for water supply, such as Kalu Ganga Water Supply Project for Phase 1 stage 2 (Water Sector Development Project II), were carried out under unit price contracts.

All construction packages in this project will be procured by unit price contract under the supervision of the consultants selected to deliver the consulting services. The size of the project renders design-build delivery not appropriate because:

- amendment of design criteria and quantification as a result of changing conditions is difficult and may cause delays;
- the contractor in design-build has to cover many responsibilities, and this will increase the contract price and the need for many clarifications in the bidding process.

There are some local consultants engaged in water supply and sewerage construction in Sri Lanka. These engineers have enough technical capability to carry out the detailed design and construction supervision. However, they do not have enough capacity and experience to carry out complicated and integrated design involving the use of advanced treatment technologies. Therefore, the overall project management and adoption of advanced technologies shall be the responsibility of engineers deployed from other countries.

(2) Life Cycle Cost Analysis in Bid Evaluation

Life cycle cost analysis is often used for the evaluation of technical components in submitted bids. In sewerage projects, O&M costs are not significantly affected by improving the individual efficiency of a number of small equipment. O&M costs over the life of the STP are mainly affected by the sewage or sludge treatment system selected. In an unit price contract, sewage and treatment systems are predetermined and cannot be changed by the contractor. Therefore, life cycle cost analysis is usually not carried out in the evaluation of bids for these contracts.

In special cases, such as sludge incineration or deep pumping stations, life cycle cost analysis may be relevant.

(3) Procurement of Consultant

According to the “Guidelines and HANDBOOK for Procurement” for Japanese ODA loan projects, the borrower shall prepare a short list of the consultants who would be invited to submit proposals. The Guidelines suggest the short list to include normally three to five consultants, who must meet the following criteria:

- have satisfactory overseas experience in detailed design and supervision in the relevant sector,
- have experience working in a developing country,

- preferably have experience with Japanese ODA projects.

7.2.4 Exchange Rate

The exchange rate is used the JICA mission rate at July 2019.

- USD 1 ＝ JPY 108
- USD 1 ＝ LKR 175
- LKR 1 ＝ JPY 0.617

7.2.5 Price Escalation

3.50% price escalation in local currency (LC) and 1.72% in foreign currency (FC) will be applied in this cost estimate.

7.2.6 Measures to Reduce Project Costs

The project cost reduction is considered in the design of staging for the entire project. A large number of inefficient manhole type pumping stations in the 2nd stage and the 3rd stage require high operation costs and maintenance costs. However the number of manhole type pumping stations in the 2nd stage and the 3rd stage can be reduced by the development of legal systems for occupation or borrowing of private land. In addition, there are some new road construction plans by RDA and these may reduce the number of manhole type pumping stations in future.

To wait for the above-mentioned conditions, the construction in the service areas covered by manhole type pumping stations is separated from that in other service areas and carried out afterwards. After the development of the necessary legal systems by Sri Lankan government and NWSDB, the planned sewer networks and cost in 2nd stage and 3rd stage service area will be revised by NWSDB with the latest information including road plan to minimize the O&M cost of the project in future.

7.3 PROJECT COMPONENTS AND PACKAGES

Project components and packages are undisclosed.

7.3.1 Construction of Facilities

Construction of facilities is undisclosed.

Table 7.3-1 Content and Bidding Method for Each Construction Package

Table 7.3-1 is undisclosed.

All contracts include a standing dispute board (DB) for each package. Each dispute board of Packages 1, 2 and 3 will be organized by 3 persons because of the larger scale and complex deliverables. Dispute board for Package 4 will be organized by one person.

All contracts include the security deposit. The major item of security deposit is shown in **Table 7.3-2**.

Table 7.3-2 Major Items of Security Deposit for Each Package

	Item	Content
1	Physical Protection Office	Additional Fence for Office, Additional Light
2	Site Monitoring and Security	Additional Security Guard, Metal Detector, Alarm System with Monitoring Camera
3	Traveling Management	Additional Rental Car (4WD) Driver
4	Communication	Additional Mobile Phone Wifi-system

7.3.2 Consulting Services

Consulting services are undisclosed.

(1) Surveys and Investigations

Surveys and investigation are undisclosed.

(2) Detailed Design

Detailed design is undisclosed.

(3) Bidding Assistance

Bidding assistance is undisclosed.

(4) Construction Supervision

Construction supervision includes the following for all construction packages:

- Review construction schedule proposed by the contractor
- Monitor progress and instruct the contractor to update the schedule when required
- Assist NWSDB with progress meetings
- Review shop drawings submitted by the contractor
- Process progress and final payment requisitions and issue progress certificates for NWSDB/JICA approval
- Monitor and advise NWSDB of the financial status as the work progresses
- Advise NWSDB on contract variations and claim issues
- Provide quality assurance during construction through supervision of civil and geotechnical engineering tasks and M&E plant installation
- Check and approve O&M manual and as-built drawings prepared by the contractor
- Capacity building to improve sewerage project management, basic O&M for the new treatment system
- Monitor environmental conditions
- Instruct and monitor the input of information for GIS
- Capacity building for sewerage system management staff
- Public outreach

(5) Capacity Building in Each Stage

Capacity building in each stage is undisclosed.

(6) Required Cost for Consulting Services

Required cost for consulting services is undisclosed.

Table 7.3-3 Required Cost for Consulting Services

Table 7.3-3 is undisclosed.

7.4 IMPLEMENTATION

The implementation schedule can be divided to five stages:

- A: Consultant Selection
- B: Detailed Design
- C: Bidding
- D: Construction
- E: Operation and Maintenance

The time required for each stage is estimated taking into consideration Sri Lankan and JICA approval procedures, Bidding conditions and methods. Each Bidding process requires the approval of the Cabinet Appointed Consultancy Procurement Committee (CACPC) and concurrence of JICA.

An approval by CACPC is necessary before JICA concurrence. These processes will increase the total time for implementation.

7.4.1 Consultant Selection

The required processes for consultant selection is shown in **Table 7.4-1.** According to NWSDB opinion the total period of consultant selection will be estimated 16.5 months. This is a few months longer than the term of JICA standard. The consultant is normally selected by Quality-and Cost-based Selection (QCBS) in Sri Lanka ODA projects. According to the previous Japanese ODA projects for water supply and sewerage in Sri Lanka, the score ratio between Quality and Cost in QCBS is normally 8 and 2. Therefore the same score ratio is recommended in this project.

Table 7.4-1 Required Consultant Selection Processes

Content	
1	**Selection of consultants**
1-1	Preparation and issuance of Expression of Interest (EOI) and prepare short-list
1-2	Preparation of Request for Proposal (RFP) & Short-list and Approval by Cabinet Appointed Consultancy Procurement Committee (CACPC)
1-3	JICA Concurrence for RFP & Short-list
1-4	Issuance of RFP to Short-listed Consultants
1-5	Proposal Submission by Consultants
1-6	Evaluation of Technical Proposal, Approval by CACPC
1-7	JICA Concurrence for Evaluation of Technical Proposal
1-8	Opening Financial Proposals, Evaluation, Approval by CACPC
1-9	JICA Concurrence for Evaluation of Proposals
1-10	Contract Negotiation, Approval by CACPC, Approval by Cabinet
1-11	Signing of Contract
1-12	JICA Concurrence for Signed Contract

Source: JET
Note:* The period is reduced by early preparation of RFP by NWSDB before the loan agreement.

7.4.2 Detailed Design

About 18 months is required for detailed design. This includes 12 months of topographic and geotechnical surveys, plus 6 months for the design of branch and tertiary sewer lines. The survey findings will have more significant impact on the design of gravity sewer lines and pumping stations compared with water supply systems.

7.4.3 Bidding

28 months is normally required for the Japanese tied or the bilateral tied loan of Package 3 and 4 in the two-envelope procedure with pre-qualification (PQ). If PQ term (8.5 months) overlaps with detailed design, Bidding can be shortened to 19.5 months from the completion of detailed design. The bidding period of Package 1 and 2 without PQ will be shortened to 19.5 months.

Table 7.4-2 Required Processes for Bidding under the STEP rule

Content		
3	**Bidding Stage for International Competitive Bidding (ICB)**	Pre-Qualification (PQ) Procedure (8.5 months)
3-1	Preparation of Prequalification (PQ) Documents, and Approval by CACPC	
3-2	JICA Concurrence for PQ Document (above JPY 1,000 million)	
3-3	Issuance of PQ Documents	
3-4	PQ Submission by Contractor	
3-5	Evaluation of PQ, Approval by CACPC	
3-6	JICA Concurrence for PQ Result	
3-7	Preparation of Bidding Documents	Bidding Procedure (19.5 months)
3-8	Approval of Bidding Documents by CACPC	
3-9	JICA Concurrence for Bidding Documents	
3-10	Bidding period	
3-11	Technical Bid Evaluation and Approval by CACPC	
3-12	JICA Concurrence for Technical Bid Evaluation	
3-13	Price Bid Evaluation and Approval by CACPC	
3-14	JICA Concurrence for Price Bid Evaluation	
3-15	Contract Negotiation	
3-16	Approval by Cabinet	
3-17	Signing of Contract	
3-18	JICA Concurrence for Signed Contract	
3-19	Opening of Letter of Credit and Issuance of Letter of Commitment	

Source: JET

7.4.4 Construction

The minimum periods required for the construction of the major facilities are as follows:

- STP (Package 1) : 48 months
- MPS and Trunk sewers (Package 2) : 48 months
- Branch and tertiary sewers (Package 3): 48 months
- House connections (Package 4): 72 months

To expedite plant operation, the trial phase can be carried out when the influent wastewater reaches 20-30% of the design flow.

Construction works of Package 1 for STP can be finished in four years including mechanical and electrical works with trial operation because similar scale of water treatment plants has been constructed during three years.

The minimum period for Construction works of Package 2 for MPS and Trunk sewers is estimated based on the following calculation. The construction period of Package 2 does not include work days of mobilization and clean-up which depend on the number of construction yard and workers.

T2 = 83,186 (m: pipe jacking length) / 6 (m/day/party) / 240 (days/year) / 15 (party) = 3.85 years

The minimum period for Construction works of Package 3 for Branch sewers is estimated based on the following calculation. The period does not include mobilization and clean-up of construction works as well as Package 2.

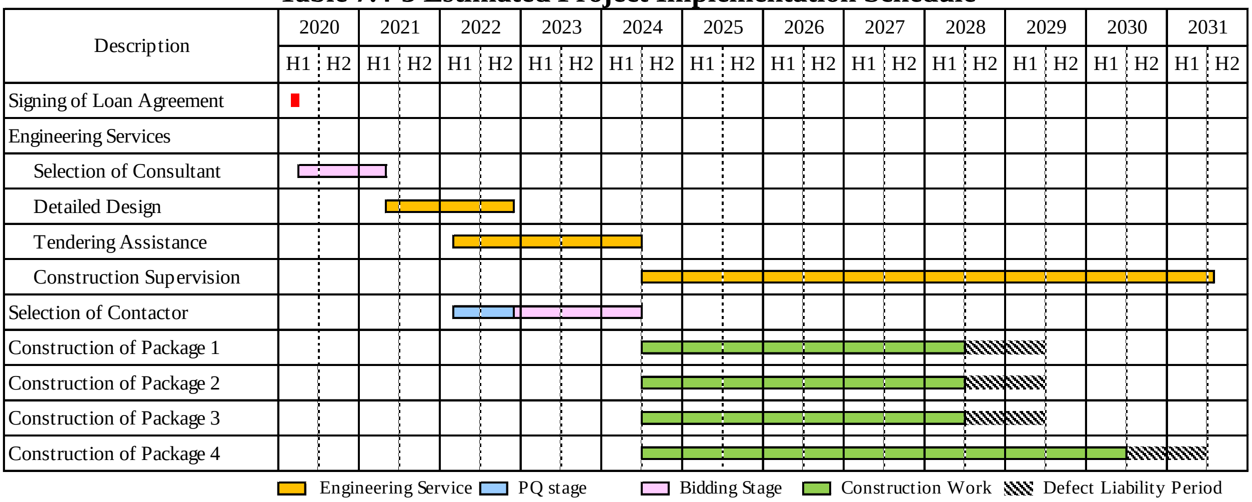
T3 = 219,392 (m: pipe length) / 10 (m/day/party) / 240 (days/year) / 24 (party) = 3.81 years

The minimum period for Construction works of Package 4 for House connection is estimated based on the following calculation. Package 4 includes mobilization and clean-up days because pipe installation in private houses usually includes a site cleaning-up.

T4 = 25,000 (connection) x 3 (day/connection) / 240 (days/year) / 54 (party) = 5.81 years

Total implementation period for the 1st stage is about 12 (136 months) years. The estimated implementation schedule is shown in **Table 7.4-3** and the detailed schedule in **APPENDIX 7-2**.

Table 7.4-3 Estimated Project Implementation Schedule



Source: JET

7.4.5 Action Plan

Many procedures, organizations and agencies are involved in the selection of consultants and contractors, as shown in **Table 7.4-4** and **Table 7.4-5.**

Table 7.4-4 Process for Selection of Consultants and Responsible Organizations

Tasks	Responsible Organization / Section				
	NWSDB	TEC	CACPC	JICA	Cabinet
Preparation of EOI	L	L			
Preparation of RFP & Short-list	L	L			
Approval of RFP & Short-list			C		
JICA Concurrence for RFP & Short-list				C	
Issuance of RFP to Short-listed Consultants	L				
Proposal Submission by Consultants	L	A			
Evaluation of Technical Proposal	L	L			
Approval of Evaluation of Technical Proposal			C		
Concurrence for Evaluation of Technical Proposal				C	
Opening and Evaluation of Financial Proposals	L	L	C		
Concurrence for Evaluation of Proposals				C	
Contract Negotiation	L	L			

Approval of Contract Negotiation by CACPC			C		
Approval of Contract Negotiation by Cabinet					C
Signing of Contract	L				
Concurrence for Signed Contract				C	

Note; "L" means lead or implementing organization, "C" means authority for approval or concurrence, and "A" means advisory agency or organization,
Source: JET

The various organizations involved must carry out their respective responsibilities in a timely fashion if the selection process is to be accomplished smoothly.

Table 7.4-5 Process for Selection of Contractors and Responsible Organizations

Tasks	Responsible Organization / Section					
	NWSDB	TEC	CACPC	JICA	Cabinet	Consultant
Preparation of PQ Documents	L	L				L
Approval of PQ Documents			C			
Concurrence for PQ Document				C		
Issuance of PQ Documents	L					
PQ Submission by Contractor	L	A				A
Evaluation of PQ	L	L				A
Approval of PQ by CACPC			C			
JICA Concurrence for PQ Result				C		
Preparation of Bidding Documents	L	L				L
Approval of Bidding Documents			C			
Concurrence for Bidding Documents				C		
Bidding period	L	A				A
Technical Evaluation	L	L				A
Approval of Technical Evaluation			C			
Concurrence for Technical Evaluation				C		
Price Evaluation	L	L				A
Approval of Price Evaluation			C			
Concurrence for Price Evaluation				C		
Contract Negotiation	L	L	C			A
Approval by Cabinet					C	
Signing of Contract	L					
Concurrence for Signed Contract				C		
Open of letter of credit and issuance of letter of commitment	L	L				

Note; "L" means lead or implementing organization, "C" means authority for approval or concurrence, and "A" means advisory agency or organization,
Source: JET

7.5 COST ESTIMATES

7.5.1 Construction Cost

Construction cost is undisclosed.

Table 7.5-1 Total Construction Cost for Entire Project (for the 1st to 3rd stages)

Table 7.5-1 is undisclosed.

The construction costs for the 1st stage are estimated as shown in **Table 7.5-2**.

Table 7.5-2 Construction Costs for the 1st Stage

Table 7.5-2 is undisclosed.

The construction costs for the 2nd stage are estimated as shown in **Table 7.5-3**.

Table 7.5-3 Construction Costs for the 2nd Stage

Table 7.5-3 is undisclosed.

The construction costs for the 3rd stage are estimated as shown in **Table 7.5-4**.

Table 7.5-4 Construction Costs for the 3rd Stage

Table7.5-4 is undisclosed.

The detailed breakdown of construction costs is shown in **APPENDIX 7-3**.

7.5.2 Operation and Maintenance Costs

The O&M costs for the entire project (at 3rd stage) are estimated based on the required staff complement, electric power consumption, volume of sludge to be disposed, chemicals, repairs and maintenance cost as shown in **Table 7.5-5**. The breakdown of O&M costs is shown in **APPENDIX 7-4.**

Table 7.5-5 Total O&M Costs for Entire Project (at the 3rd stages)

Table 7.5-5 is undisclosed.

The O&M costs at the 1st stage are shown in **Table 7.5-6**.

Table 7.5-6 O&M Costs at the 1st stage

Table7.5-6 is undisclosed.

The O&M costs at the 2nd stage are shown in **Table 7.5-7**.

Table 7.5-7 O&M Costs at the 2nd stage

Table 7.5-7 is undisclosed.

7.6 FUND REQUIREMENT

Fund requirement is undisclosed.

(1) Consulting Services

Consulting serveices are undisclosed.

(2) Land Acquisition

Land acquisition is undislosed.

(3) Import Tax

Import tax is undisclosed.

(4) Value Added Tax (VAT)

Value added tax is undisclosed.

(5) Nation Building Tax (NBT)

Nation building tax is undisclosed.

(6) Physical Contingency

Pysical contingency is undisclosed.

(7) Price Contingency

Price contingency is undisclosed.

(8) Interest rate

Interest rate is undisclosed.

(9) Front-End Fee

Front-End Fee is undisclosed.

Table 7.6-1 Total Project Costs for the 1st stage

Table 7.6-1 is undisclosed.

CHAPTER 8 FINANCIAL AND ECONOMIC ANALYSES

8.1 OUTLINE

- Excluding the O&M contract services which make profits in sewerage sector, NWSDB's sewerage sector has made losses most for the past few years. One of the main causes of deficit in sewerage service is a low sewerage tariff (sewerage tariff revenue is 49% to 61% of the O&M costs) (8.2.4).

- The following cost burden principle for sewerage service is recommended to be applied in Sri Lanka:
  - Central government covers 100% of the construction cost, i.e.100% grant for NWSDB or MC
  - Sewerage tariff is calculated to cover O&M costs, and implemented incrementally
  - Small-scale replacement is covered by NWSDB's or the MC's own budget, but large-scale ones should be funded as projects by the central government (8.4.1).

- Proposed Sewerage tariff is undisclosed.

- EIRR is undisclosed.

8.2 FINANCIAL CONDITIONS OF RELATED ORGANIZATIONS

8.2.1 Financial Situation of the Central Government

Table 8.2-1 shows revenue and expenditures of the Government of Sri Lanka. As shown in "Overall Budget Surplus/Deficit" account, the Government has massive deficits (480 to 830 billion LKR) over the last 6 years. The deficits are funded by foreign and domestic financing. The Government of Sri Lanka relies on foreign financing (24 to 61% of total financing) for capital expenditures, including loans through bilateral aid and international agencies. Accumulated central government debt (Public Debt Outstanding) has become 1.7 times from 2012 to 2017. However, the percentage of debt of GDP was increased and high (68.7% in 2012 and 77.4% in 2017 by "Economic and Social Statistics of Sri Lanka 2018", Central Bank of Sri Lanka).

The annual budget for the "Capital Expenditure", less than 500 billion LKR before 2015, was increased to around 600 billion LKR in 2015 and 2016.

Table 8.2-1 Annual Budget and Expenditures of Central Government

Unit: billion LKR

Item	2012	2013	2014	2015	2016	2017 Provisional
Total Revenue and Grants	**1,067.53**	**1,153.31**	**1,204.62**	**1,460.89**	**1,693.56**	**1,839.56**
Total Revenue	1,051.46	1,137.45	1,195.20	1,454.88	1,686.06	1,831.53
Tax Revenue	908.91	1,005.90	1,050.36	1,355.78	1,463.69	1,670.18
Non Tax Revenue	142.55	131.55	144.84	99.10	222.37	161.35
Grants	16.07	15.86	9.42	6.01	7.50	8.03
Expenditure and Lending Minus Repayments	**1,556.49**	**1,669.39**	**1,795.87**	**2,290.40**	**2,333.88**	**2,573.05**
Current Expenditure	1,131.02	1,205.18	1,322.90	1,701.66	1,757.78	1,927.69
Capital Expenditure	400.08	454.30	459.86	588.18	577.04	638.34
Lending Minus Repayment	25.39	9.91	13.11	0.56	-0.94	7.02
Current Account Surplus (+) / Deficit (-)	**-79.56**	**-67.73**	**-127.70**	**-246.78**	**-71.72**	**-96.16**
Overall Budget Surplus (+) / Deficit (-)	**-488.97**	**-516.09**	**-591.24**	**-829.50**	**-640.33**	**-733.49**
Financing	**488.97**	**516.09**	**591.24**	**829.50**	**640.32**	**733.49**

Unit: billion LKR

Item	2012	2013	2014	2015	2016	2017 Provisional
Foreign Financing (Net)	286.46	123.70	212.52	236.80	391.91	439.24
Domestic Financing	202.51	392.39	378.72	592.70	248.41	294.25
Public Debt Outstanding	**6,000.11**	**6,793.25**	**7,390.90**	**8,503.23**	**9,387.30**	**10,313.05**
Domestic	3,232.81	3,832.83	4,277.78	4,959.20	5,341.50	5,594.43
Foreign	2,767.30	2,960.42	3,113.12	3,544.03	4,045.80	4,718.62

Source: Economic and Social Statistics of Sri Lanka, Central Bank of Sri Lanka

Public investment, which is the sum of Capital Expenditures of Central Government and Lending to Public Enterprises, is shown in **Table A8.1-1**, **APPENDIX 8-1**. As shown in it, the budget amount of "Energy and Water Supply" sectors has decreased since 2014 (also, the share is 8.2% in 2016).

8.2.2 Budget of Ministry of City Planning, Water Supply and Higher Education

(1) General Conditions

Table 8.2-2 shows the annual budget of Ministry of City Planning, Water Supply and Higher Education. Part of the capital expenditure of the Ministry is used (implemented) by itself for community based water supply schemes, which is under the budget item of "Water Sector Community Facilitation" (**Table 8.2-2**). Simple water supply facilities by this scheme are basically operated and maintained by targeted community. Other part of capital expenditure is used (implemented) by NWSDB as a capital transfer for town and urban water supply and sanitation / sewerage schemes.

There was a change of categorization of budget items, that is; before 2015, loan disbursement amount is categorized into scheme-wise, since 2015, loan disbursement is integrated into one category as "For the Loan Disbursement of Ongoing Projects". Therefore, after 2015, expenditure "For the Loan Disbursement of Ongoing Projects" recorded largest at 15 to 25 billion LKR, sharing 67% to 80% of capital expenditure. Regarding the year 2014, largest amount was allocated for "Large Scale Water Supply & Sanitation Schemes" (18 billion LKR). "Emerging Small Townships Water Supply Schemes" was allocated second largest budget (2.7 billion LKR). Budget for "Sewerage Schemes" was third largest (1.9 billion LKR).

Regarding the financing of the budget, the share of foreign funding in total financing is very high at 80.8% on average between 2014 and 2017.

Table 8.2-2 Annual Budget of Ministry of City Planning, Water Supply and Higher Education

Unit: million LKR.

Year	2014	2015	2016 Revised Budget	2017 Estimate
Recurrent Expenditure	**209.99**	**250.71**	**263.72**	**317.69**
Capital Expenditure	**27,039.29**	**30,186.34**	**34,470.38**	**22,528.52**
Rehabilitation and Improvement of Capital Assets	2.57	2.08	7.20	7.08
Acquisition of Capital Assets	3.00	19.16	109.20	5.40
Capital Transfer	22,780.53	28,950.17	28,045.49	17,229.74
Public Institutions	22,780.53	28,950.17	28,045.49	17,229.74
For the Loan Disbursement of Ongoing Projects	0	24,128.02	25,000.00	15,000.00
Water Sector Community Facilitation	50.82	0	0	0
Emerging Small Townships Water Supply Schemes (NWSDB)	2,718.98	1,798.53	1,500.00	1,620.00
Large Scale Water Supply & Sanitation Schemes (NWSDB)	17,979.72	2,918.96	1,129.49	210.00
Tsunami Affected Area Water Supply & Sanitation (NWSDB)	150.70	24.30	0	0

Unit: million LKR.

Year	2014	2015	2016 Revised Budget	2017 Estimate
Sewerage Schemes (NWSDB)	1,880.31	80.36	416.00	399.74
Acquisition of Financial Assets	3,263.62	0	0	0
On-Lending	3,263.62	0	0	0
Large Scale Water Supply & Sanitation Schemes (NWSDB)	3,263.62	0	0	0
Capacity Building	1.23	1.18	1.20	1.30
Other Capital Expenditure	988.34	1,213.75	6,307.29	5,285.00
Infrastructure Development	988.34	1,213.75	6,307.29	5,285.00
Water Sector Community Facilitation	988.34	1,123.81	6,207.29	5,185.00
Improvement of Community Water Supply *[1]	0	89.94	100.00	100.00
Total Expenditure	**27,249.28**	**30,437.05**	**34,734.10**	**22,846.21**
Total Financing	**27,249.28**	**30,437.05**	**34,734.10**	**22,846.21**
Domestic	9,107.96	3,253.52	5,970.61	3,796.21
Foreign	18,141.32	27,183.53	28,763.49	19,050.00

Note: *1; the expenditure is under the account head – 332 Community Water Supply and Sanitation Project（CWSSP）
Source: Budget Estimates - 2016 and 2017, Ministry of Finance, http://www.treasury.gov.lk/web/guest/budget-estimates

(2) Budget Plan of Local Portion of the Proposed Sewerage Project

For water supply and sanitation / sewerage projects, budget for most projects is basically allocated by Ministry of Finance (MOF) to Ministry of City Planning, Water Supply and Higher Education for both of local and foreign portions of the project. Other than community water supply and sanitation schemes, capital expenditure budget for water supply and sewerage is transferred to NWSDB.

Budget preparation process is basically bottom up, that is; drafted by NWSDB and discussed at Ministry of City Planning, Water Supply and Higher Education. Then, the Ministry submits its budget plan to MOF. Finally, a budget plan of all ministries and provinces is approved at Parliament. For this project also, the same manner of budget allocation process shall be applied. Foreign funded project is put higher priority for the government to allocate local portion of the project cost based on the budget proposal made by Ministry of City Planning, Water Supply and Higher Education with NWSDB.

One of the alternative ways of provision of local portion of the project is an issuing of a certain amount of additional Treasury bond by MOF and transferred to NWSDB. In this case, MOF has the obligation of repayment for bond in the future. For NWSDB, bond transfer is the same as usual budget allocation at the point that NWSDB does not need to repay the amount to MOF. However, NWSDB may suffer from a loss by discount from par, depending on the condition of bond market. On the other hand, the advantage of bond transfer is that NWSDB is able to use the amount through the years not in a single year and that it is relatively free from the budget limitation of central government. As of January 2018, it is not clear that the government shall apply Treasury bond transfer for the local portion of this project or usual budget provision.

8.2.3 Financial Situation of Sri Jayawardenapura Kotte Municipal Council

Sri Jayawardenapura Kotte Municipal Council (MC) is not planned to be an O&M responsible organization currently. However, it is the MC where most of the project beneficiaries exist. Therefore, for reference, it is better to briefly check a financial situation of the MC.

Table 8.2-3 shows a summary of "Income & Expenditure Statement" for the Sri Jayawardenapura Kotte MC. Revenue must cover total expenditures as a rule. Any surplus or deficit is rolled over to the next year. Similar to other MCs, Sri Jayawardenapura Kotte MC pays the monthly salaries of central government employees working at the MC and gets reimbursed annually through a central to provincial government budgetary transfer. This is included in the “Revenue, Grant & Reimbursement” account.

In this MC, the amount shown under the “Revenue, Grant & Reimbursement” account is also posted to the “Other Revenue” account. The MC also receives grants to cover part of the project cost, which is posted to the “Capital Receipts and Grants” account.

Largest revenue comes of the MC from Stamp Duty, which is tax on land purchasing. Second largest revenue is sourced by Assessment Rates, which charges some percentages on assessed monthly rental fee of all land and buildings for commercial and household uses.

Table 8.2-3 Summary of Income & Expenditure for Sri Jayawardenapura Kotte MC

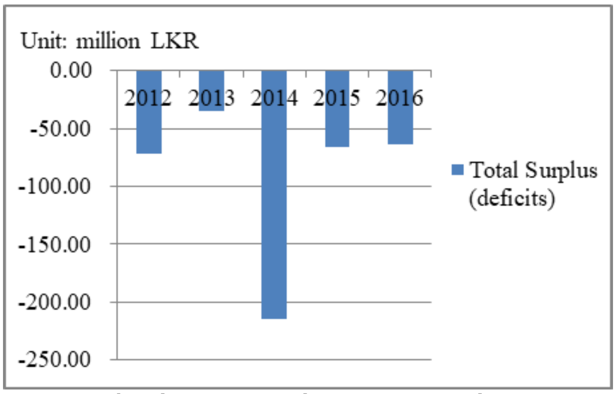
Unit: million LKR

Year	2012	2013	2014	2015	2016
Revenue					
Assessment Rates	166.99	177.34	198.37	226.26	241.76
Rent	24.47	27.64	23.20	25.28	26.05
License Fees	2.70	8.08	5.48	5.86	4.50
Charges for Service	42.27	41.15	59.08	56.29	70.62
Warrant Cost / Fine	12.17	11.51	12.67	3.51	10.99
Stamp duty	86.83	242.95	214.35	425.35	627.53
Court Fines	14.42	1.47	1.14	1.38	0.74
Other Revenue*1	209.62	219.52	258.35	384.99	426.19
Total	**559.46**	**729.65**	**772.64**	**1,128.91**	**1,408.38**
Expenditure					
Personal Emoluments	261.92	292.21	335.25	441.25	459.99
Travelling Expenses	4.82	6.06	5.72	3.25	1.32
Supplies & Equipment	68.39	78.40	107.01	87.76	75.13
Repairs to Capital Assets	7.13	6.30	7.55	9.18	12.13
Transport	129.82	170.00	180.75	157.36	161.70
Interest & Dividends	4.15	6.42	4.39	19.11	21.87
Grants	13.72	16.00	19.01	16.94	9.52
Pension Gratuity	2.91	3.01	2.74	2.90	2.93
Total	**492.85**	**578.41**	**662.42**	**737.75**	**744.59**
Actual revenue over Recurrent Expenditure	**66.61**	**151.24**	**110.22**	**391.16**	**663.79**
Revenue, Grant & Reimbursement	200.34	207.36	247.96	376.19	419.89
Capital Receipts & Grants	11.63	68.15	343.04	272.87	364.71
Capital Expenditure	149.56	254.18	667.51	730.18	1,092.69
Total Surplus (deficits)	**-71.32**	**-34.79**	**-214.24**	**-66.15**	**-64.19**

Note: *1; Other revenue includes "Revenue, Grant & Reimbursement".
Source: Sri Jayawardenapura Kotte MC

Sri Jayawardenapura Kotte MC has recorded an annual budget deficit for the past 5 years, even after including salary reimbursement and capital receipts and grants.

The annual deficit amount was largest in 2014, and has been fluctuating for the past years (**Figure 8.2-1**). In terms of recurrent revenue and expenditure, the MC has made positive increasing balances for the past years (**Figure 8.2-2**). The recurrent revenue includes “Revenue, Grant & Reimbursement”, that is, salary reimbursement from central government.

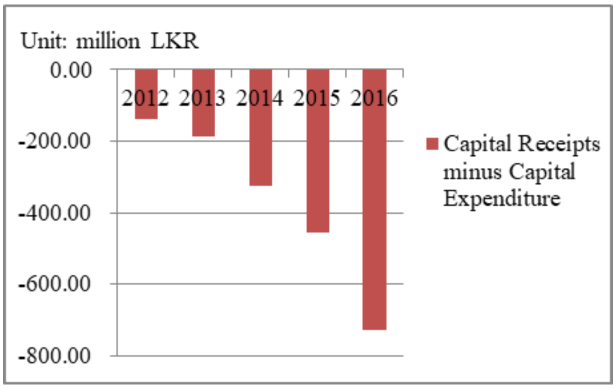


Source: JET, based on Sri Jayawardenapura Kotte MC data

Figure 8.2-1 Trend of Total Surplus (deficits) - Sri Jayawardenapura Kotte MC

Source: JET, based on Sri Jayawardenapura Kotte MC data

Figure 8.2-2 Trend of Actual Revenue minus Recurrent Expenditure - Sri Jayawardenapura Kotte MC



Source: JET, based on Sri Jayawardenapura Kotte MC data

Figure 8.2-3 Trend of Capital Receipts minus Capital Expenditure - Sri Jayawardenapura Kotte MC

The capital account balance (capital receipts minus capital expenditures) has had large deficits (138 million to 728 million LKR) and the deficits have been increasing rapidly (**Figure 8.2-3**). These large deficits were enough to nullify the positive balance in recurrent accounts.

The deficit as a percentage of total revenue was 13%, 5%, 28%, 6%, and 5% in 2012, 2013, 2014, 2015, and 2016. Sri Jayawardenapura Kotte MC's financial condition is slightly weak. Nevertheless, the deficit amount is manageable.

8.2.4 Financial Situation of NWSDB

(1) Financial Statements of NWSDB

Table 8.2-4 to **Table 8.2-6** show the audited financial statements of NWSDB for the past several years. The Auditor General's Department, which audited NWSDB, is an independent and transparent institution appointed by the President, at arms-length from any ministries or government officials.

NWSDB introduced new accounting system in accordance with new Sri Lanka Accounting Standards (SLFRS/LKAS) in the year 2012 from old Sri Lankan Accounting Standard (SLAS). Since then the structures of financial statements were transformed in accordance with the new standard, referred to the International Financial Reporting Standard (IFRS). **Table 8.2-4** Statement of Financial Position corresponds to the usual Balance Sheet. **Table 8.2-5** Statement of Comprehensive Income corresponds to the usual Income Statement. However, they are not exactly the same.

Under the present financial statements of NWSDB, revenues and costs data only for sewerage service are not available and included in those of water supply service. The Sewerage Section, NWSDB, collects and analyses the sewerage revenue and cost data, using number of connections and water consumption volume of sewerage customers. These data, while very useful, are not audited and do not have asset data and depreciation costs for sewerage facilities. For better understanding of the financial situation for sewerage service, it is necessary to establish a separate accounting system or to prepare segment information for sewerage.

Table 8.2-4 Statement of Financial Position, NWSDB

Unit: million LKR.

Year	2014	2015	2016	2017	2018
ASSETS					
Non-Current Assets					
Property, Plant & Equipment-Net	110,021.06	140,105.85	162,279.27	172,557.90	193,056.33
Intangible Assets	52.96	1.62	7.31	6.49	5.67
Capital Work in Progress	148,987.95	149,412.95	158,896.17	194,344.97	247,666.51
Other Financial assets	22.81	16.49	11.02	8.23	3.74
Total Non-Current Assets	**259,084.78**	**289,536.91**	**321,193.77**	**366,917.59**	**440,732.25**
Current Assets					
Non-Operating Assets	154.04	0.00	0.00	0.00	0.00
Inventories*1	5,624.53	6,406.27	6,686.38	7,374.37	8,624.99
Trade & Other Receivables	5,534.64	6,034.67	6,659.80	8,708.95	8,595.13
Deposit & Advances	9,527.45	13,089.00	26,898.95	42,124.65	42,424.89
Investments	244.26	12,844.83	10,265.72	14,619.46	12,421.21
Cash & Cash Equivalent	2,756.52	3,876.92	12,097.67	1,398.20	1,588.51
Total current assets	**23,841.43**	**42,251.69**	**62,608.52**	**74,225.62**	**73,654.73**
TOTAL ASSETS	**282,926.21**	**331,788.60**	**383,802.29**	**441,143.21**	**514,386.98**
EQUITY & LIABILITIES					
Equity					
Assets taken over from Government Dept.	185.48	185.48	185.48	185.48	185.48
Government Equity	0.00	63,736.42	68,810.13	75,254.96	81,053.32
Staff Welfare Fund	15.24	16.51	17.23	22.53	23.46
Retained Earnings	-10,806.21	-11,847.22	-9,462.77	-8,145.45	-8,437.46
Grants-Government Grants*2	88,161.76	90,627.55	92,750.88	94,838.59	98,257.47
Capital Grants*3	151,974.12	165,736.88	181,792.82	192,631.36	218,168.25
Total Equity & Grants	**229,530.39**	**308,455.62**	**334,093.77**	**354,787.47**	**389,250.52**
Non-Current Liabilities					
Loan Payable	37,715.44	9,412.09	35,102.37	64,327.76	94,906.03
Other Deferred Liabilities	2,194.04	4,489.09	4,125.02	4,110.75	4,051.41
Total Non-Current Liabilities	**39,909.48**	**13,901.18**	**39,227.39**	**68,438.50**	**98,957.43**
Current Liabilities					
Trade & Other Payables	6,961.19	9,431.80	9,855.31	13,922.36	17,044.66
Loan Capital Payable	3,440.62	0.00	625.82	2,833.92	5,353.65
Loan Interest Payable	2,912.50	0.00	0.00	1,160.96	3,780.73
Non-Operating Liabilities	71.93	0.00	0.00	0.00	0.00
Total Current Liabilities	**13,386.23**	**9,431.80**	**10,481.13**	**17,917.24**	**26,179.04**
TOTAL EQUITY AND LIABILITIES	**282,826.10**	**331,788.60**	**383,802.29**	**441,143.21**	**514,386.98**

Notes: *1; 'Inventories' doubled to 6.4 billion LKR in 2015 (from 2011) as a result of spare parts provision in foreign funded facility construction projects, and so on.

*2; 'Grants – Government Grants' are burden on the central government for the local portion of the construction project.

*3; NWSDB received grant from the central government for part or all of the construction costs of the water supply and sewerage facilities. These amounts are recorded in the 'Capital Grants' account of the Statement of Financial Position at the time the facilities are transferred to NWSDB.

Source: NWSDB, website

Table 8.2-5 Statement of Comprehensive Income

Unit: million LKR.

Year	2014	2015	2016	2017	2018
Revenue	18,710.05	20,252.45	23,584.73	23,859.76	24,806.46
Cost of Sales	-11,325.83	-12,314.95	-13,485.73	-14,196.35	-15,821.04
Gross Profit	**7,384.22**	**7,937.50**	**10,099.00**	**9,663.41**	**8,985.42**
Other Operating Income and Gains	1,390.07	1,073.73	1,477.54	1,724.46	1,061.97
Administrative Expenses	-5,985.33	-8,505.52	-9,139.29	-9,940.45	-10,957.75
Other Operating Expenses	-334.37	-540.12	-680.66	-714.47	-906.75
Operating Profit / (Loss)	**2,454.59**	**-34.41**	**1,756.59**	**732.95**	**-1,817.12**
Finance Income	213.24	1,186.88	1,236.28	1,157.36	1,574.44
Finance Cost	-1,242.53	-2.87	-3.28	-13.00	-262.73
Profit / (Loss) before Tax	**1,425.29**	**1,149.60**	**2,989.59**	**1,877.32**	**-505.41**
Provision for Income Taxation	-53.11	-53.88	-63.28	-53.88	-63.29
Profit / (Loss) for the Year	**1,372.18**	**1,095.71**	**2,926.31**	**1,823.44**	**-568.70**
Other Comprehensive Income for the Year, Net of Taxes	-	-	53.71	-1,979.65	-541.14
Actuarial Gain / Loss (-) on Defined Benefit Obligation*1	-	-	-	-1,979.65	-541.14
Revaluation surplus	-	-	53.71	-	-
Impairment Loss on Treasury Bond				-79.30	
Total Comprehensive Income for the Year	**1,425.89**	**-883.94**	**2,385.17**	**1,744.13**	**-291.08**

Note: *1; after the introduction of new accounting standard (SLFRS/LKAS), NWSDB sets the rule of evaluation of a defined benefit, or gratuity, for all the staff. NWSDB re-evaluates the benefit once in 3 years. If the total amount of re-evaluated defined benefit of the year is more than that of the previous year, provision for defined benefit is changed to the newly evaluated amount. Then, the increased amount of the provision is recorded as actuarial loss on defined benefit obligation.
Source: NWSDB, website

Table 8.2-6 Statement of Cash Flows

Unit: million LKR.

Year	2014	2015	2016	2017	2018
CASH FLOWS FROM / (Used in) OPERATING ACTIVITIES					
Net Cash Flows from Operating Activities	-964.08	3.66	-10,251.06	-10,117.10	3,699.26
CASH FLOWS FROM / (Used in) INVESTING ACTIVITIES					
Net Cash Flows used in Investing Activities	-31,290.06	-37,410.11	-30,411.88	-54,534.86	-67,738.73
CASH FLOWS FROM /(Used in) FINANCING ACTIVITIES					
Net Cash Flows from Financing Activities	33,130.79	38,526.84	48,883.69	53,957.45	64,229.78
Net Increase in Cash & Cash Equivalents	876.64	1,120.40	8,220.75	-10,694.51	190.32
Cash & Cash Equivalents at the beginning of the year	1,879.88	2,756.52	3,876.92	12,092.71	1,398.20
Cash & Cash Equivalent at the end of the year	**2,756.52**	**3,876.92**	**12,097.67**	**1,398.20**	**1,588.51**

Note: The above is abstract of the Statement of Cash Flows, edited by JET. Original statement is included in **APPENDIX 8-1.**
Source: NWSDB, website

(2) Financial and Management Condition of NWSDB

1) Central Government Subsidy

NWSDB uses a self-supporting financial system. Financial support by central government is provided as a grant for part of the construction costs of water supply and sewerage facilities including construction of pipes. NWSDB had received no other government subsidies up to 2014.

However, the 2014 budget speech stated that the central government's loan (principal and interest) to NWSDB at around 60 billion LKR would be converted to government equity to strengthen NWSDB's financial capacity and NWSDB would arrange self-financing of its projects. As shown in **Table 8.2-4**, 'Loan Capital Payable' and 'Loan Interest Payable' in "Current Liabilities" becomes zero in 2015, and 'Loan Payable' in "Non-Current Liabilities" decreased from 37.7 billion LKR (2014) to 9.4 billion LKR (2015). However, it has increased again to 94.9 billion LKR (2018) through foreign loans (69.9 billion LKR) and local loans (25 billion LKR). On the other hand, 'Government Equity' in "Equity" becomes 81.0 billion LKR in 2018.

2) Profit / Loss

As shown in **Table 8.2-5**, NWSDB reports net loss for the year 2018 for the first in the last 5 years. This was caused by 10% increase of Administrative Expenses through the 14% increase of Staff Cost from 5.2 billion (2017) to 5.9 billion (2018) and the 9% increase of Depreciation from 3.3 billion (2017) to 3.6 billion (2018).

NWSDB recorded increasing annual net profit for the year from 2014 to 2017. In 2016, the net profit for the year is 12.4% of revenue. Excluding the year 2018, return on asset (ROA=Net Profit of the year/Total Asset) is lowest (0.33%) in 2015 and highest (0.76%) in 2016. Return on Equity (ROE=Net Profit of the year/Equity) is lowest (0.36%) in 2015 and highest (0.88%) in 2016 excluding 2018. As a rule, ≥5% ROA indicates good financial condition, 1 to 2% ROA is normal. The ROA of NWSDB, although small, is in the positive territory, excluding the year 2018.

NWSDB recorded loss in "Total Comprehensive Income for the Year" in 2015 caused by minus 1.98 billion LKR for "Actuarial Loss on Defined Benefit Obligation" (refer to Note: *1 of **Table 8.2-5**). Large increase of provision (1.98 billion LKR) for defined benefit is originated by a large salary raise in 2015 and staff number increase for the last 3 years.

3) Loan Capital and Interest

Figure 8.2-4 shows the comparison of loan capital and interest payable (to be paid) of current liabilities, actual paid amount, and unpaid amount of them, all sourced from financial statements (**Table 8.2-4** to **Table 8.2-6**). Loan capital and interest to be paid are more than the actual amounts paid from 2011 to 2014. NWSDB has not been able to repay the full loan amount. More than 96% (2014) of the loan is composed of foreign loans secured through MOF. Therefore, the net profit of NWSDB comes from the central government deferring the recovery of loan repayments. However, in 2015, loan and interest of NWSDB were converted to government equity, therefore, no more loan and interest payable in 2015. Again, in 2016, new loans were borrowed. From 2016 to 2018, loan capital & interest payable has increased rapidly. However, loan & interest paid has increased more rapidly. Therefore, unpaid capital & interest were negative for these years.

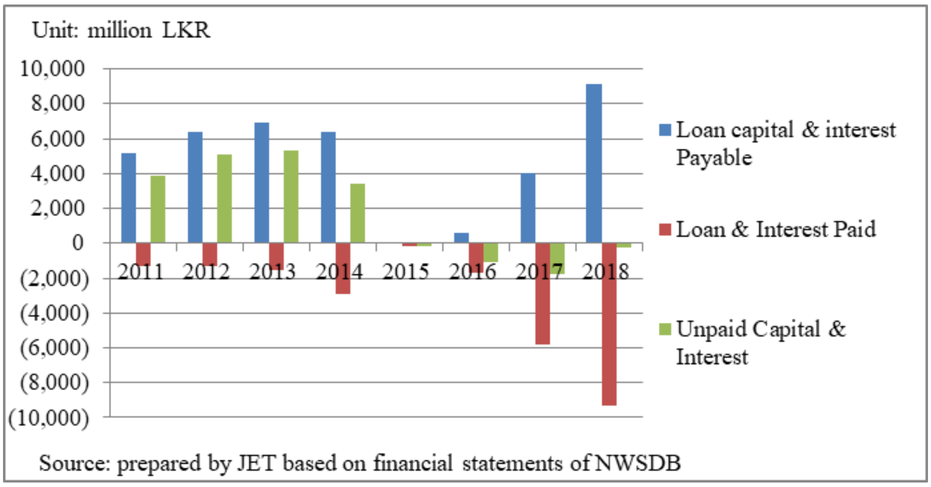


Figure 8.2-4 Unpaid Loan Capital & Interest, NWSDB

4) Budget Policy for Water Supply and Sewerage Projects

The 2014 budget speech stated that NWSDB would arrange self-financing of its projects in addition to conversion of all NWSDB loan (60 billion LKR) to government equity. However, with the change of government, the Ministry of Finance issued the Cabinet Memorandum on 26 January, 2016[4]. The Memorandum states that "NWS&DB will be the primary borrower for all future borrowings. However, if the lender is not willing to lend to NWS&DB directly, the Government of Sri Lanka (GOSL) will consider such borrowings on a case by case basis".

Then, the government grant was re-instated to provide the following percentages of total debt service (capital and interest) for facility construction of urban and rural water supply, and sewerage and wastewater projects funded by local and foreign banks:

Urban water supply project:	50% will be borne by the Treasury, 50% will be borne by the NWSDB
Rural water supply project:	75% will be borne by the Treasury, 25% will be borne by the NWSDB
Sewerage and wastewater project:	100% will be borne by the Treasury

The Memorandum also stated that the Treasury will provide the domestic contribution to the water supply and sewerage projects receiving foreign loans. As of January 2018, the above Cabinet Memorandum on 26 January, 2016 is still effective, according to the NWSDB.

5) Management Information of NWSDB

Table 8.2-7 shows the management information of NWSDB regarding water supply. NWSDB had 1.87 million household customers and total 2.1 million customers including commercial and industrial ones for water supply as of December 2016.

Average household water consumption was about 14.6 to 15.6 m^3/month for 2013-2016 (**Table 8.2-7**). Average household water bill was about 571.4 to 634.2 LKR/month for the same period. Basic data to calculate them are presented in **APPENDIX 8-1**.

Table 8.2-7 Management Information of NWSDB

Table 8.2-7 is undisclosed.

6) Water Supply Tariff

Table 8.2-8 and **Table 8.2-9** show the NWSDB water supply tariff. Water supply tariff was set at progressive volumetric rate with relatively steep progressivity. A lower tariff is levied for Samurdhi (welfare benefit) recipients and for Tenement Garden (low income) households.

Draft tariff revisions for water supply or sewerage are prepared by NWSDB and must be discussed and approved by the National Cabinet.

[4] Title of the Cabinet Memorandum is "Regularizing Foreign Financing Mechanism in Relation to Water Supply and Sewerage projects"

Table 8.2-8 Water Supply Tariff: Domestic

Effective: 1st October 2012

No. of units	Domestic - Samurdhi Recipient		Domestic - Non Samurdhi Tenement Garden		Other than for Samurdhi Recipient and Tenement Garden	
	Usage charge (LKR/Unit)	Monthly Service Charge (LKR)	Usage charge (LKR/Unit)	Monthly Service Charge (LKR)	Usage charge (LKR/Unit)	Monthly Service Charge (LKR)
00 - 05	5	50	8	50	12	50
06 - 10	10	50	11	65	16	65
11 - 15	15	50	20	70	20	70
16 - 20	40	80	40	80	40	80
21 - 25	58	100	58	100	58	100
26 - 30	88	200	88	200	88	200
31 - 40	105	400	105	400	105	400
41 - 50	120	650	120	650	120	650
51 - 75	130	1,000	130	1,000	130	1,000
Over 75	140	1,600	140	1,600	140	1,600

Source: The Gazette of the Democratic Socialist Republic of Sri Lanka, No. 1776/13, Wednesday, September 18, 2012

Table 8.2-9 Water Supply Tariff: Non-Domestic

Effective: 1st October 2012

No. of units	Commercial		Government Hospital		Industries under SME*		Industries other than SME & Government Institution	
	Usage charge (LKR/ Unit)	Monthly Service Charge (LKR)	Usage charge (LKR/ Unit)	Monthly Service Charge (LKR)	Usage charge (LKR/ Unit)	Monthly Service Charge (LKR)	Usage charge (LKR/ Unit)	Monthly Service Charge (LKR)
00 - 25	75	290	53	250	56	265	58	275
26 - 50	75	575	53	500	56	525	58	550
51 - 75	75	1,150	53	1,000	56	1,050	58	1,100
76 - 100	75	1,150	53	1,000	56	1,050	58	1,100
101 - 200	75	1,840	53	1,600	56	1,680	58	1,760
201 - 500	75	2,875	53	2,500	56	2,625	58	2,750
501-1,000	75	4,600	53	4,000	56	4,200	58	4,400
1,001-2,000	75	8,625	53	7,500	56	7,875	58	8,250
2,001-4,000	75	14,375	53	12,500	56	13,125	58	13,750
4,001-10,000	75	28,750	53	25,000	56	26,250	58	27,500
10,001-20,000	75	57,500	53	50,000	56	52,500	58	55,000
Over 20,000	75	115,000	53	100,000	56	105,000	58	110,000

Note: *; Small and Medium Enterprises

Source: The Gazette of the Democratic Socialist Republic of Sri Lanka, No. 1776/13, Wednesday, September 18, 2012

As an example, the water charges for 10 m^3/month and 30 m^3/month for domestic users “Other than Samurdhi Recipients and Tenement Gardens” would be 205 LKR[5] and 1,370 LKR[6] . In this case consumption volume increases 3-fold from 10 to 30 m^3/month, the water charge increases 6.7 times.

(3) Financial and Management Conditions of Sewerage Division of the NWSDB

1) Sewerage tariff

Table 8.2-10 shows a present sewerage tariff of NWSDB. Sewerage tariff is set at progressive volumetric rate with relatively lower progressivity against water consumption volume. Sewerage charges for each 10m^3/month and for 30m^3/month water consumption are 210 LKR/month and 320 LKR/month. If water consumption becomes 3 times from 10 to 30m^3/month, sewerage bill becomes

5 205 LKR = 12LKR x 5m^3 + 16LKR x 5m^3 + 65LKR

6 1,370LKR = 12LKR x 5m^3 + 16LKR x 5m^3 + 20LKR x 5m^3 + 40LKR x 5m^3 + 58LKR x 5m^3 + 88LKR x 5m^3 + 200LKR

only 1.5 times. By the higher progressivity in water tariff, sewerage charge becomes higher than water charge in less water consumption volume. It is necessary to review the sewerage tariff structure to improve this situation.

Table 8.2-10 Tariffs for Sewerage Services

Effective: 1st January 2012

Rate I

Domestic Tariff - applied to sewerage services provided to premises for domestic purposes

Water Consumption (m^3)	Usage Sewerage tariff/m^3 (LKR)	Service Charge (LKR)
0		
1 - 10	1.00	200
1 - 15	1.50	200
1 - 20	2.00	200
1 - 25	2.50	200
1 - 30	4.00	200
1 - 40	6.00	200
1 - 50	8.00	200
> 50	10.00	200

Rate II

Commercial Tariff - applied to sewerage services provided for commercial purposes.

Water Consumption (m^3)	Sewerage tariff/m^3 (LKR)
0	
> 0	40.00

Rate III

Industrial Tariff - applied to sewerage services provided to premises for mass production purposes.

Water Consumption (m^3)	Sewerage tariff/m^3 (LKR)
0	
> 0	65.00

The sewerage charge for the relevant month of billing under Domestic tariff, Commercial tariff and industrial tariff shall be devised on the consumption of water, taking into consideration the utilization of sources of water supply.

Disconnection of Supply to Consumer who default to pay Sewerage Charges

Where the water supply charge and sewerage charge payable by a person in respect of any month is not paid within thirty days from the date of an invoice for payment relating to such charges, water services will be cut off in accordance with Section 88 (1) of the National Water Supply and Drainage Board Law, No.2 of 1974.

Note: The above is applied to consumers connected to the sewerage systems/networks owned, operated and maintained by NWSDB

Source: The Gazette of the Democratic Socialist Republic of Sri Lanka, Extraordinary, No. 1738/7, Wednesday, December 28, 2011

2) Financial and Management Information

Financial management information of sewerage sector is undisclosed.

Table 8.2-11 Financial Management Information of Sewerage Sector, NWSDB

Table 8.2-11 is undisclosed.

3) O&M Contract Service by the NWSDB

Contract service revenue forms a large portion of the P&D/Bowser revenue. Total contract service revenues in 2016 are 125.8 million LKR, or 48% of P&D/Bowser revenue. **Table 8.2-12** shows income minus expenditure for sewerage contract service. There are 7 major contracts in which NWSDB is responsible for O&M of sewerage facilities owned by other organizations. The service fee is calculated to cover staff salary and overtime and not based on metered water consumption volume. As shown in **Table 8.2-12**, all contract services report annual surpluses.

Table 8.2-12 Balance (Income – Expense) from Sewerage Contract Service by NWSDB

Table 8.2-12 is undisclosed.

4) Gully Bowser and Receiving Sludge from Gully Bowser at Pumping Station or STP

Sludge removal from septic tanks is mainly carried out by private contractors, using vacuum trucks called gully bowsers. NWSDB also owns 5 gully bowsers and is offering this service. Sludge removal fee is 4,000 LKR with an extra charge of 35 LKR/km for locations over 10 km[7]. Private contractors charges 3,000 to 5,000 LKR. The service fee charged by NWSDB is comparable to that of private contractors.

NWSDB also receives sludge from other gully bowser operators at pumping stations and STPs managed by NWSDB. NWSDB charges 450 LKR per gully bowser load (3.5 m^3/load).

Costs associated with the service are marginal - some staff salary and electricity and chemical costs at pumping stations and STPs. The charge for each load (3.5 m^3) is 450 LKR, or 129 LKR/m^3, double the sewerage tariff for industrial customers (65 LKR/m^3). Gully bowser unloading is profitable and a good income source (refer to **APPENDIX 8-1**).

5) Sewerage Service for NWSDB's Own Facilities

Table 8.2-13 shows the income and expenditures of sewerage service other than contract service. Huge losses are recorded except for 2014. The surplus for this year corresponds to 3.8% of the income, while the losses are 30.9% (2013), 20.5% (2015), and 1.9% (2016) of the income.

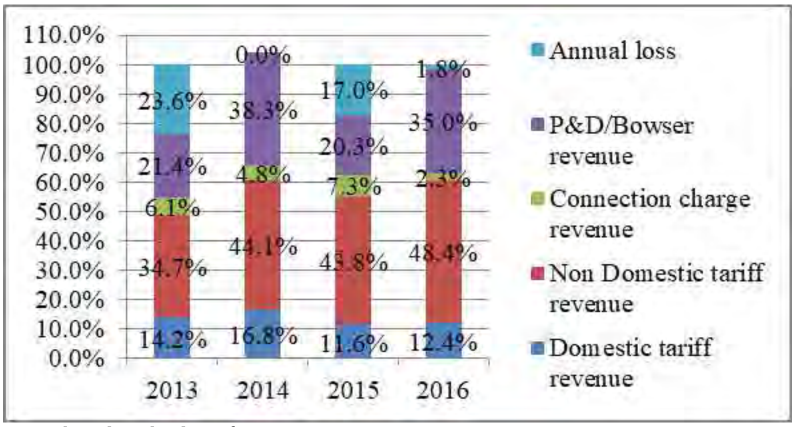
Table 8.2-13 Income & Expenditure Sewerage Service Excluding Contract Service - NWSDB for 2013-2016

Table 8.2-13 is undisclosed.

The surplus in 2014 comes from the 88% increase of "P&D Bowser" income (sludge removal for septic tanks, receiving sludge from gully bowser from private contractors, and planning and design contracts) from the previous year with modest 4.7% increase of total "Operating Expense".

Structural problem of deficit in sewerage service is a low sewerage tariff level, as was shown in **Figure 8.2-5**. Tariff revenues (domestic and non-domestic) are 48.9% (2013), 60.9% (2014), and 55.4% (2015), 60.8% (2016) of total operating expense. Sewerage tariff increase is necessary to generate a surplus.

[7] Based on the "REVISION OF RATES CHARGED BY THE NWSDB FOR HIRING OF GULLY BOWSER ETC. AND UNLOADING OF GULLY BOWSER LOADS AT NWSDB SEWERAGE SCHEMES" issued by NWSDB on 17th June, 2008.

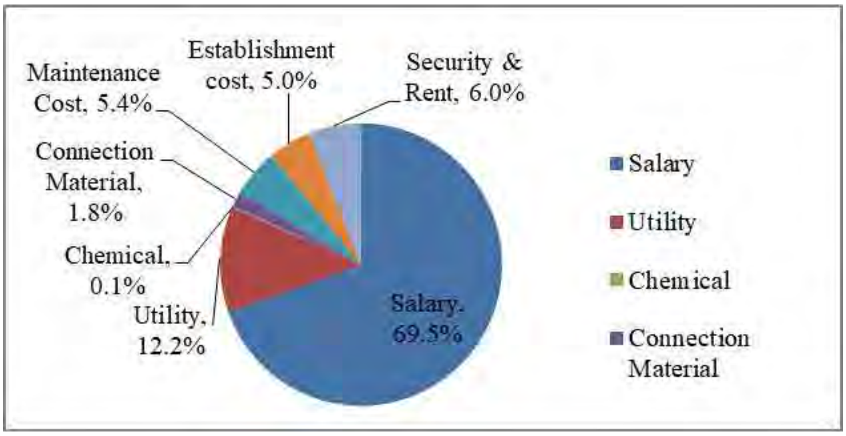


Source: JET, based on the data of NWSDB

Figure 8.2-5 Rates of Each Income Items & Loss against Total Expenses

Total operating expense in this figure excludes operating expenses for contract services, which are fully covered by service fee, but it includes expenses for head office, planning and design, manager's offices of the sewerage section (as described in "Note" of **Table 8.2-13**) which is not expended directly for O&M of sewerage facilities.

Figure 8.2-6 shows the share of each item of operating expense in 2016, based on the data in **Table 8.2-13**. Salary accounts for most of the total expense, followed by utility (electricity) cost. According to the NWSDB, there is no O&M budget shortfalls under the present situation. Maintenance cost shares only 5.4% of operating expense but it is sufficient now. However, with the aging of equipment and facilities, maintenance cost will likely increase in the future.



Source: JET, based on the data of NWSDB

Figure 8.2-6 Share of Operating Expense Items (2016)

8.3 TARIFF ESTIMATION AND FINANCIAL RECOMMENDATIONS OF THE PROPOSED SEWERAGE PROJECT

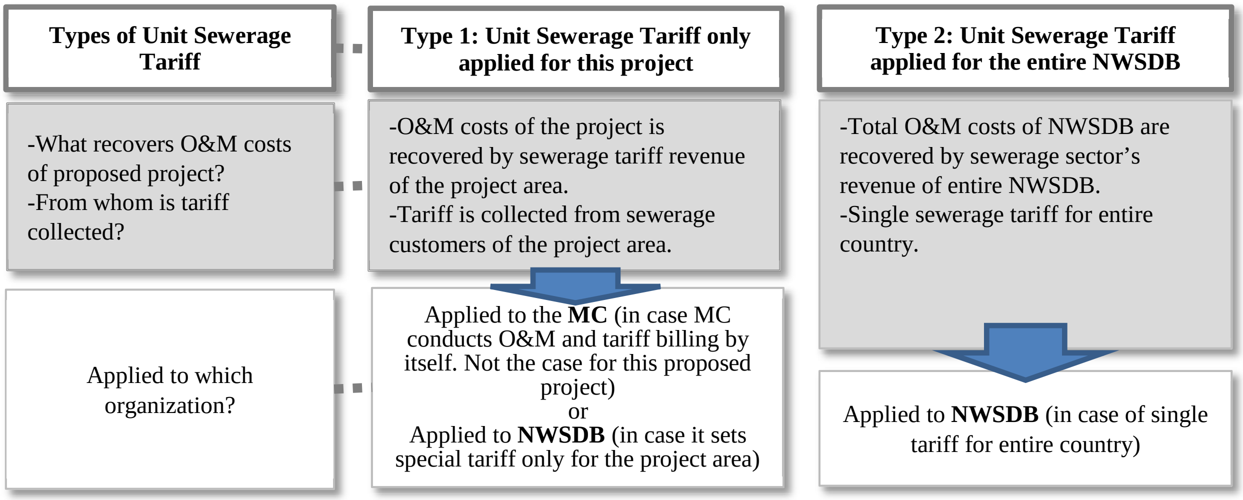
8.3.1 Calculation of Sewerage Tariff to Cover the O&M Costs

Proposed sewerage tariff is calculated in this survey, in order to cover the O&M costs of the constructed facilities. O&M costs include personnel cost, electricity cost, sludge disposal and chemical cost, repair and maintenance cost and so on, excluding depreciation cost, loan repayment and interests.

(1) Two Types of Unit Sewerage Tariff

The final output of this sewerage tariff calculation is the unit sewerage tariff enough to cover the O&M costs of the sewerage facilities for the future.

Two types of unit sewerage tariff are calculated; Type 1 recovers the O&M costs of the project by sewerage tariff revenue in the project area, Type 2 recovers the total O&M costs of the sewerage sector of NWSDB with the proposed project by total revenue of sewerage sector of NWSDB. Type 1 shall be used by; 1) the MC in case that it operates and maintains the constructed facilities, and 2) NWSDB in case that it operates and maintains the constructed facilities and that it applies special tariff limited for the project area. Type 2 shall be used by NWSDB in case that it operates and maintains the constructed facilities and that it applies single tariff for entire country (**Figure 8.3-1**).



Source: JET

Figure 8.3-1 Differences and Target of 2 Types of Unit Sewerage Tariff

(2) Methodology of Sewerage Tariff Calculation

Methodology of sewerage tariff calculation is undisclosed.

(3) Assumptions of Sewerage Tariff Calculation

Assumptions of sewerage tariff calculation is undisclosed.

(4) Relation to Proposed Sewerage Tariff by Strategic Sewerage Master Plan

Relation to proposed sewerage tariff by strategic sewerage master plan is undisclosed.

Figure 8.3-2 is undisclosed.

Figure 8.3-2 Image of Implementation Schedule of Tariff Raise

8.3.2 Result of Unit Sewerage Tariff Calculation

Results of unit sewerage tariff calculation is undisclosed.

Table 8.3-1 Calculation of Unit Sewerage Tariff only applied for this Project

Table 8.3-1 is undisclosed.

Table 8.3-2 Calculation of Unit Sewerage Tariff applied for the entire NWSDB

Table 8.3-2 is undisclosed.

8.3.3 Affordability To Pay, Willingness To Pay, and Proposed Sewerage Tariff

Affordability to pay, willingness to pay, and proposed sewerage tariff are undisclosed.

Figure 8.3-3 is undisclosed.

Figure 8.3-3 Comparison of Future Sewerage tariff and Affordability to Pay (Type 1)

Figure 8.3-4 is undisclosed.

Figure 8.3-4 Comparison of Future Sewerage tariff and Affordability to Pay (Type 2)

8.3.4 Example of Revised Sewerage Tariff Table (Type 2 for NWSDB)

An example of revised sewerage tariff table is undisclosed.

Table 8.3-3 Example of Domestic Sewerage tariff (for 2027)

Table 8.3-3 is undisclosed.

Table 8.3-4 Example of Revised Sewerage tariff: Non-Domestic (in 2027)

Table 8.3-4 is undisclosed.

8.3.5 Affordability of Low Income Households and Example of Sewerage Tariff

Affordability of low income households and an example of sewerage tariff are undisclosed.

Table 8.3-5 Average Monthly Household Income by Income Quintile (national average)

Table 8.3-5 is undisclosed.

8.3.6 A Measure to Realize the Proposed Tariff: Public Awareness Campaign Program

In **Section 8.3.3,** necessity of comprehensive public awareness campaign is confirmed. Following public awareness campaign (**Table 8.3-6**) is planned in order to smoothly implement the project in the coverage area where willingness to pay (WTP) of household is lower than proposed sewerage tariff. On the other hand, for full capacity operation of the project, it is necessary for almost all of households, commercial, governmental entities in coverage area to connect to public sewer. To promote the direct connection through separate sewer system, the project had better carry out a certain activities to obtain citizens' well understanding of the benefit of sewerage system and of the necessary cost burden. Incomplete and short term program is considered to lead unsuccessful results to change the awareness of the people in project coverage area.

Table 8.3-6 Outline of the Public Awareness Campaign

No.	Items	General Contents
1	Purpose:	to let citizens to understand 1) the importance of sewerage system for health and hygienic life of them, 2) to positively connect to the public sewer without using septic tank, 3) to obtain cooperation of sewerage tariff payment, 4) properly use of sewerage system, and so on.
2	Methods:	newspaper, radio, television, consecutive small scale stakeholder meetings, face to face individual talk with community leaders/key persons, hand bills to each houses, and door-to-door visit to talk with families for connection, and so on.
3	By who:	Local contractor, local consultants, local NGOs, university teachers and students, and so on, which has a specialty and experiences in the field of public awareness campaign.
4	Timing:	for the period of detailed design and construction supervision of the project
5	Period:	5 to 7 years
6	Budget items:	personnel, transportation, material, meeting, small souvenir for household, and other costs
7	Necessary staffs:	Sociologist, PR specialist, field supervisor, field activists, and so on.

Source: JET

8.3.7 A Measure to Facilitate the House Connection to Public Sewer

A measure to facilitate the house connection to public sewer is undisclosed.

8.3.8 The Other Financial Matter: Possibilities of Involvement by Private Company, Community, and NGO

In this project, it is considered that private companies shall involve in the implementation as a consultants and contractors for design and construction of the facilities. Plumbers would be asked to smooth connection to public sewer from the premises of each houses and buildings. NWSDB has the list of registered plumbing companies which is able to work for house connection. This is to keep the quality of house connection construction. Therefore, communities and/or NGOs are not expected to work for house connection work of this project.

Community is able to be involved in the project to raise the people's awareness to the sewerage project so as to promote the connection to public sewer and to obtain the understanding for the collection of sewerage charges. NGO is also considered to work for the public awareness campaign and education of the people concerning the connection promotion, understanding to sewerage charge, and the points to be noticed for the usage of sewerage service.

An outsourcing of O&M of the entire facilities, such as; O&M of sewage treatment plant, is possible to be introduced. However, the outsourcing of treatment plant O&M is not observed in Sri Lanka yet. Almost all of the sewage treatment plants are operated and maintained by NWSDB. Private water and/or sewerage companies are not raised in this country yet, which have enough technical capacity for O&M of large sized sewerage facility. It may be introduced in the future, but it is not realistic to be introduced in this project soon. However, an outsourcing of partial simple tasks to any persons or companies is recommended to be introduced for the efficient and economical work of the NWSDB.

8.4 FINANCIAL AND ECONOMIC ANALYSIS OF THE PROPOSED SEWERAGE PROJECT

8.4.1 Financial Analysis

(1) Inadequacy of Calculating FIRR for this Project

Inadequacy of calculating FIRR for this project is undisclosed.

8.4.2 Economic Analysis

(1) Methodology and Assumptions

1) Methodology of Economic Analysis

Methodology of economic analysis is undisclosed.

2) Assumptions for Economic Analysis

Assumptions for economic alalysis are undisclosed.

Table 8.4-1 Major Conditions and Assumptions of Economic Analysis

Table 8.4-1 is undisclosed.

3) Conversion from Financial Value to Economic Value

Conversion from financial value to economic value is undisclosed.

(2) Economic Benefits of the Project

Economic benefits of the project are undisclosed.

Table 8.4-2 Economic Benefits of the Project

Table 8.4-2 is undisclosed.

1) Saving of Cost for Current Sewage Treatment / Excreta Disposal

Saving of cost for current sewage treatment / excreta disposal is undisclosed.

Table 8.4-3 Benefit of Saving of Cost for Current Sewage Treatment / Excreta Disposal

Table 8.4-3 is undisclosed.

2) Reduction of Health Problems by Water Borne Diseases

Reduction of health problems by water borne diseases is undisclosed.

Table 8.4-4 Benefit of Reducing Water Borne Diseases

Table 8.4-4 is undisclosed.

3) Total Benefit of the Project

Total benefit of the project is undisclosed.

Table 8.4-5 Total Benefit of the Project

Table 8.4-5 is undisclosed.

(3) Economic Costs of the Project

Economic costs of the project is undisclosed.

Table 8.4-6 Total Economic Cost of the Project

Table 8.4-6 is undisclosed.

(4) Economic Evaluation

Economic evaluation is undisclosed.

Table 8.4-7 Cost and Benefit Stream of the Project

Table 8.4-7 is undisclosed.

(5) Sensitivity Analysis

Sensitivity analysis is undisclosed.

Table 8.4-8 Sensitivity Analysis of EIRR of the Project (Cost & Benefit Changes)

Table 8.4-8 is undisclosed.

Figure 8.4-1 is undisclosed.

Figure 8.4-1 Sensitivity Analysis of EIRR of the Project (Cost & Benefit Changes)

CHAPTER 9 ENVIRONMENTAL AND SOCIAL CONSIDERATION

9.1 OUTLINE

- Under the JICA Environmental and Social Considerations Guidelines, IEE study was conducted by JET as a Category B project. This report is prepared based on the result of the IEE study (9.4.2).

- Other than IEE study by JET, an EIA study was conducted by NWSDB according to local regulations, based on study outcomes from the JET study. The studies concluded that the Project has many positive social and environmental impacts (9.4.2).

- There are some gaps between the current Sri Lankan Regulations and JICA Guideline, but they are rather minor. In such cases, JICA Guidelines are simply applied (9.4.2).

- Land acquisition is necessary for STP and pumping station sites but no resettlement is necessary (Ch.10).

- Literature and site surveys were carried out on the fauna and flora and any vulnerable, endangered or critically endangered species were not found (9.3.5).

- The construction will be conducted outside of protected areas, but approx.10m away from an ecosystem protection area. The construction is not restricted but care should still be taken to prevent accidental impacts to the animals from the area during construction (9.3.2).

- A group protested the construction of the STP by sending objection letters and conducting a protest demonstration. NWSDB responded and explained the outline and the benefit of the Project in public awareness meetings and others. Under such conditions, many residents became positive about the Project, provided that proper mitigation measures are taken (9.10.1).

9.2 OUTLINE OF COMPONENTS THAT HAVE ENVIRONMENTAL IMPACTS

Since the Project is in a populated area, considerations were taken in the M/P and current stage to reduce any negative impacts from the Project. Components that may have environmental impacts and alternative methods are considered in this section

In sewerage development projects the service area is decided first, followed by appropriate STP location. Subsequently, sewer mains will be routed according to road width and topography of the area. MPSs can be located in limited spots where sewers are gathered along the main sewers. Thus, STP sites may have alternatives but once it is decided, options become limited for main sewers and MPSs.

The Project components that have environmental impacts are shown below.

Table 9.2-1 The Outline of the Project Components

Major Item	Detail or Major Equipment	Scale
Trunk Sewer for Gravity Pipe	φ200-700mm by Open Cut Method	38.4 km
	φ200-1200mm by Micro Tunnelling Method	369.2 km
Trunk Sewer for Force Main Pipe	φ100-500mm by Open Cut Method	10.7 km
	φ300-600mm by Micro Tunnelling Method	13.3 km
Pumping Station	Major Pumping Stations	7
	Manhole Type Pumping Stations	4163
Branch (Secondary) Sewer		17219.4 km
House connection		27,000
STP		39,600 m^3/d

Source: JET

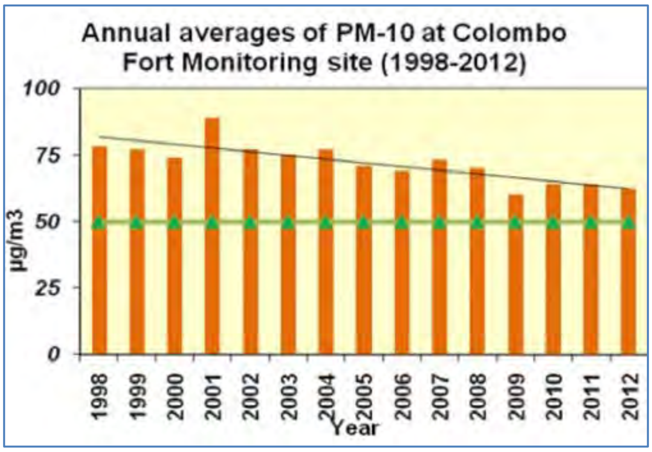
9.3 EXISTING CONDITIONS

9.3.1 Environmental Condition

(1) Air Quality

In Sri Lanka, there has been only one station located at Colombo Fort, since 1997, to monitor ambient air quality on a continuous basis. Annual average of PM_{10} reveals that the pollutant level has relatively been stable within 70-80 μg/m^3 range over the period of 1998 to 2012 (refer to Figure 2.1-8). This was found to be higher level compared to WHO guidelines of 50 μg/m^3.

Major contributors to air quality in Sri Jayawardenapura Kotte Municipal Council area are vehicular and industrial emissions. With the rapid development of the area, heavy traffic and train movements in the Project area lead to elevated levels of air pollutant emissions.

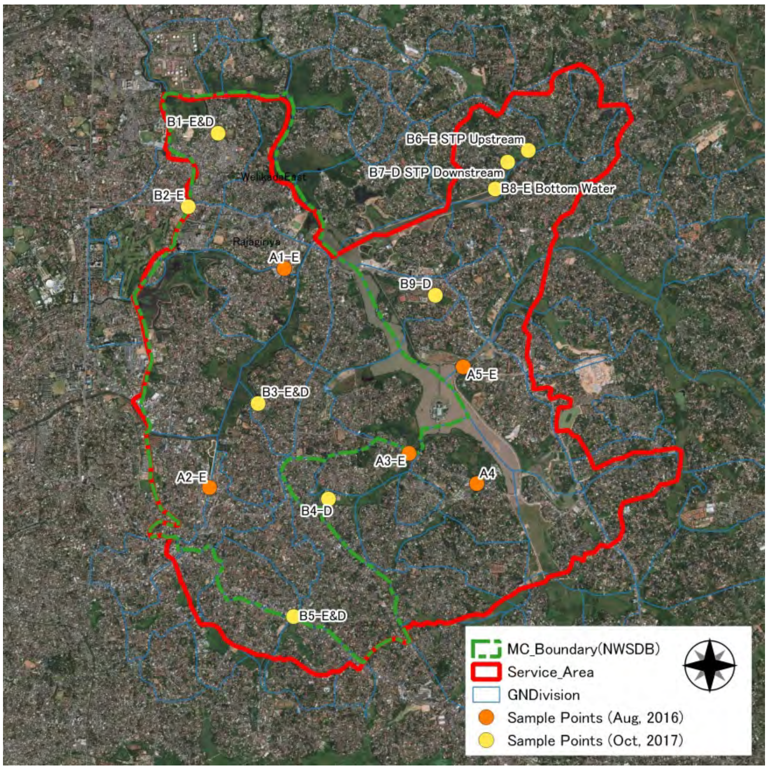


Source: Central Environmental Authority

Figure 9.3-1 PM10 Levels Observed in the Area

(2) Water Quality Results

JET conducted water quality surveys for environmental samples in 2016 and for environmental and discharged water in 2017. The data for each significant parameter and the sampling stations are shown below.

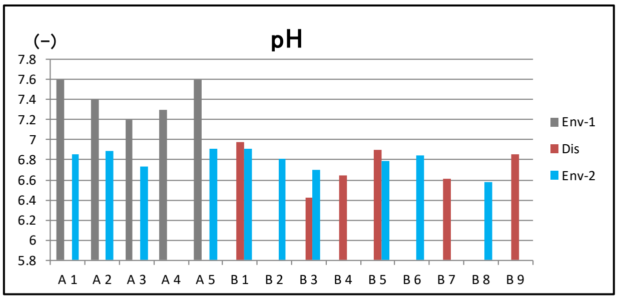


Source: Google Earth/JET

Figure 9.3-2 Sampling station locations

1) pH

pH values are normal for all locations but higher for water bodies. It is assumed that CO_2 was consumed by photosynthetic reaction in the dry season. The water bodies should be monitored because the phytoplankton increase is one of the characteristics of eutrophication.

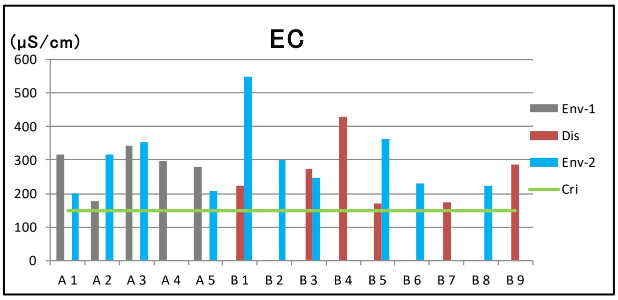


Source: JET

Figure 9.3-3 Water Quality Test Result - pH

2) Electric Conductivity (EC)

EC as an indicator of general contamination is higher than the criteria for general inland water bodies. It is very high at locations B1, B4 and B5.

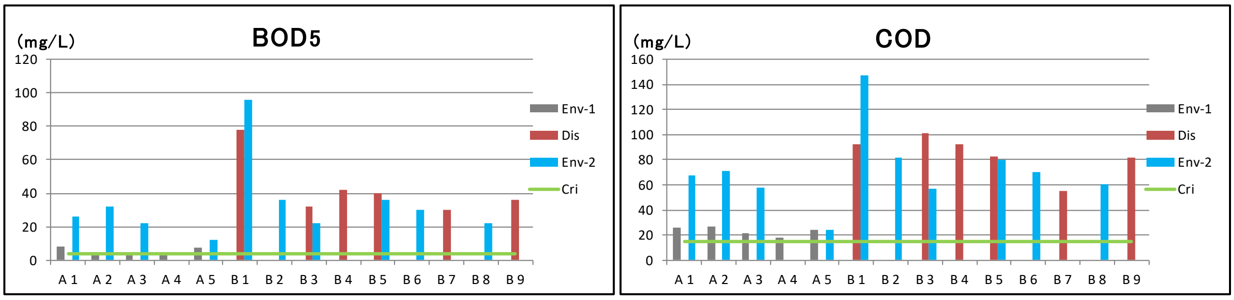


Source: JET

Figure 9.3-4 Water Quality Test Result - EC

3) BOD & COD

Most BOD and COD values are higher than the draft environmental standards and both sets of values show the same pattern, with B1 significantly higher than the other locations. B1 is an area surrounded by low-income residents and septic tanks or other treatment facilities may not be installed in many households. This can cause the increase of BOD and COD.

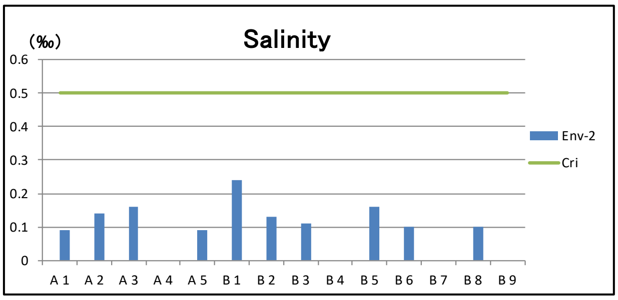


Source: JET

Figure 9.3-5 Water Quality Test Result - BOD&COD

4) Salinity

Salinity is below the lower-limit for general estuarine water, indicating that there is no sea water intrusion.

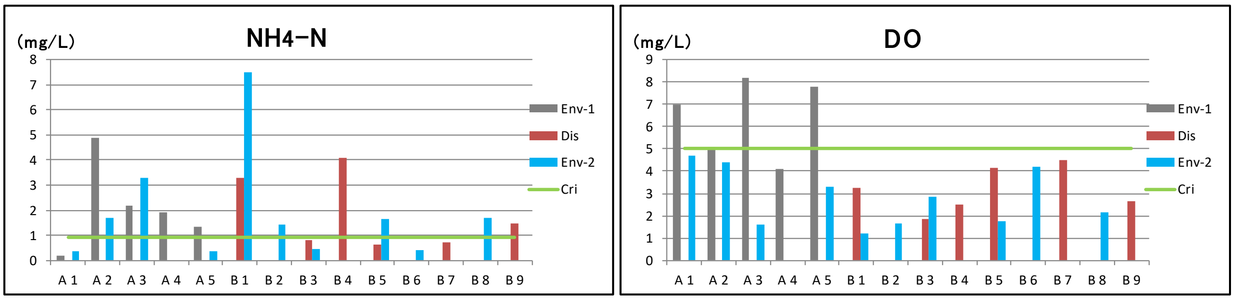


Source: JET

Figure 9.3-6 Water Quality Test Result - Salinity

5) Ammonium nitrogen (NH_4-N) and Dissolved Oxygen (DO)

In many locations, NH_4-N values are higher and DO values are lower than the draft environmental standards. This indicates anaerobic decomposition is taking place due to an over-abundance of nitrogen. B1 is significantly worse.

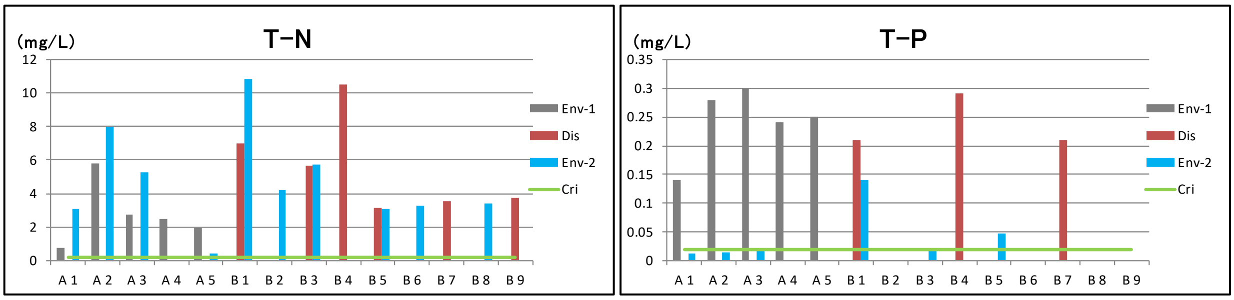


Source: JET

Figure 9.3-7 Water Quality Test Result - NH_4-N&DO

6) Total nitrogen (T-N) and Total phosphorus (T-P)

T-N and T-P exceed the limit for eutrophication at many sampling points. B1 and B4 are worse than others. B1 and B4 are areas surrounded by low-income residents and septic tanks or other treatment facilities may not be installed in many households. This can cause the increase of T-N and T-P.

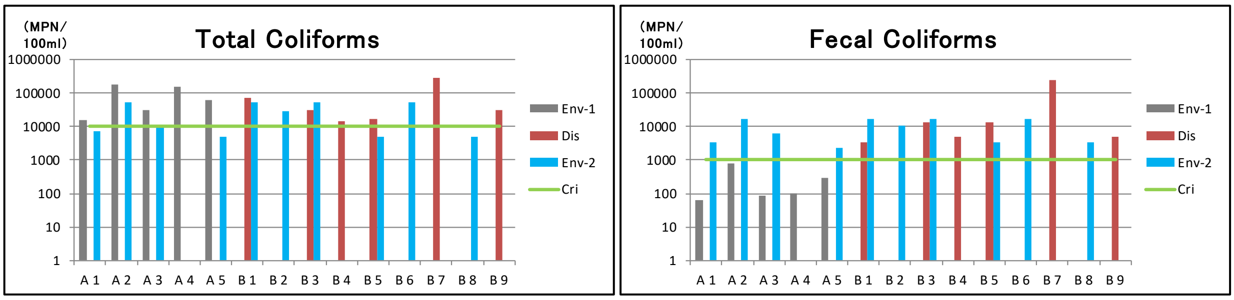


Source: JET

Figure 9.3-8 Water Quality Test Result - T-N&T-P

7) Total coliform and fecal coliform

At many sampling points, both types of coliforms are over the draft environmental standards. This suggests that there is contamination by human waste.



Source: JET

Figure 9.3-9 Water Quality Test Result - Total coliforms & Total fecal coliforms

8) Summary of Water Quality

Poor water quality of the water bodies in the service area is clearly indicated by the abundance of nutrients and organic materials. At some sampling points, the water is anaerobic and/or eutrophic, assumed to be caused mainly by human waste contamination and possibly by industrial discharge. Locations B1 and B4 appear to be the most contaminated areas where low-income households are located. There is no evidence of salt water intrusion.

(3) Noise and Vibration

EIA study found out the current noise condition in the Project area. The measurement was conducted at sites for STP and pumping stations (5-Apr, 2018 / dry weather) in the daytime and the results were as follows.

Table 9.3-1 Noise level in the Project area

Measurement station	Noise level (LAeq/dB(A))	Standard-Daytime (LAeq/dB(A))	
		Sri Lanka	International
STP	47.8	60 (Urban Residential Area)	55 (Residential Area)
MPS-2	55.4		
MPS-3	49.9		
MPS-4	61.9		
MPS-6	73.1		
MPS-7	70.7		
MPS-8	59.1		

Source: EIA draft final report

The noise levels of MPS-4, 6 and 7 locations exceeded permissible noise levels (60 - daytime) stipulated under the “Extraordinaly Gazette No, 924” by CEA, Sri Lanka. Also, by comparison with International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines, The noise levels of MPS-2, 4, 6, 7 and 8 locations exceeded the standard value. It was observed that prevailing traffic and/or construction noise caused the chronic noisy environment at the sites mentioned above.

9.3.2 Protected Area

A land under protected status which is considered as a protected area by JICA Guidelines in the Project area is summarized in the following section. It should be noted that although there is a protected land within the Project area, it is not implicated in any construction activities which will take place on already developed lands, such as along roads or on lots.

(1) Designated Protected Area

A part of the land surrounding Diyawanna Oya is designated as Beddagana Bird Sanctuary (also known as Sri Jayawardenapura Sanctuary) under the Fauna and Flora Protection Ordinance. The sanctuary is home to many endemic birds and other fauna such as butterflies, dragonflies, and mammals native to Sri Lanka and Asian Wetlands. Variety of flora common to inland wetlands comprising endemic categories creates the niches of the habitat. Permission is not required to enter sanctuaries but the following activities are prohibited within the area.

- hunting, killing or removing any wild animal;
- destroying eggs/nests of birds and reptiles;
- disturbing of wild animals; and
- interfering in the breeding of any animal.

The ordinance also prohibits these activities in nearby surrounding areas. The construction will be conducted outside of protected areas, but approx.10m away from the sanctuary. The construction is not restricted but care should be taken to prevent accidental impacts to the animals from the sanctuary during construction.

(2) Other Wetlands

There is no specific legislation governing the conservation of wetlands but Diyawanna Oya Wetlands are generally recognized as important lands to be preserved. Diyawanna Oya is an artificial canal system located on the left bank of the lower valley of Kelani River in the Colombo district, Western province of Sri Lanka. Kolonnawa marsh, Heen-Ela marsh, Kotte marsh and Sri Jayawardenapura marsh function as the main catchment of this system. These areas (400 ha) function as the main drainage system and flood detention zones of the Colombo city. The significance of Diyawanna Oya wetlands is three-fold; (1) they provide good recreational environment, (2) inhabitants in the surrounding areas use it as a source of income from fishing, cattle grazing, collecting reeds, rushes and fuelwood, and (3) the wetland provides important hydrological services and serves as refugium for fauna and flora.

9.3.3 Flood Retention Area

SLLRDC had designated Colombo Flood Detention Areas (Kolonnawa / Heen-Ela / Kotte / Sri Jayawardenapura marshes) under the Flood Protection Ordinance. It is a network of natural and artificial waterbodies serving flood drainage and retention functions scattered across the metropolitan Colombo area. This land category is not designated as protected land under JICA Guidelines.

The STP will be located on land designated by SLLRDC as Flood Detention Area. However, the construction of the STP will not have negative effects on the flood retention capacity of the area since SLLRDC will develop the land to maintain the flood control function through specially considered design. Details of the design are available in **Section 5.3**.

Protected Area and Flood Retention Area in the Project area are summarized in the **Table 9.3-2** and shown in the **Figure 9.3-10**.

Table 9.3-2 Summary of Protected and Flood Retention Areas in the Project Area

Area	Beddagana Bird Sanctuary (Sri Jayawardenapura Sanctuary)	Colombo Flood Detention Areas (Kolonnawa / Heen-Ela / Kotte / Sri Jayawardenapura marshes)
Purpose	Ecosystem protection	Flood Protection
Ordinance	Fauna and Flora Protection Ordinance (1937)	Flood Protection Ordinance (1924)
Administrated by	Department of Wildlife Conservation / Ministry of Agrarian Services and Wildlife	SLLRDC
Species to be protected	39 fauna (such as monkey, squirrel, cat, shrew, bat, crocodile) and 11 flora (such as orchids, Baobab tree) species in Schedule III to VI of the Ordinance	-

Source: JET

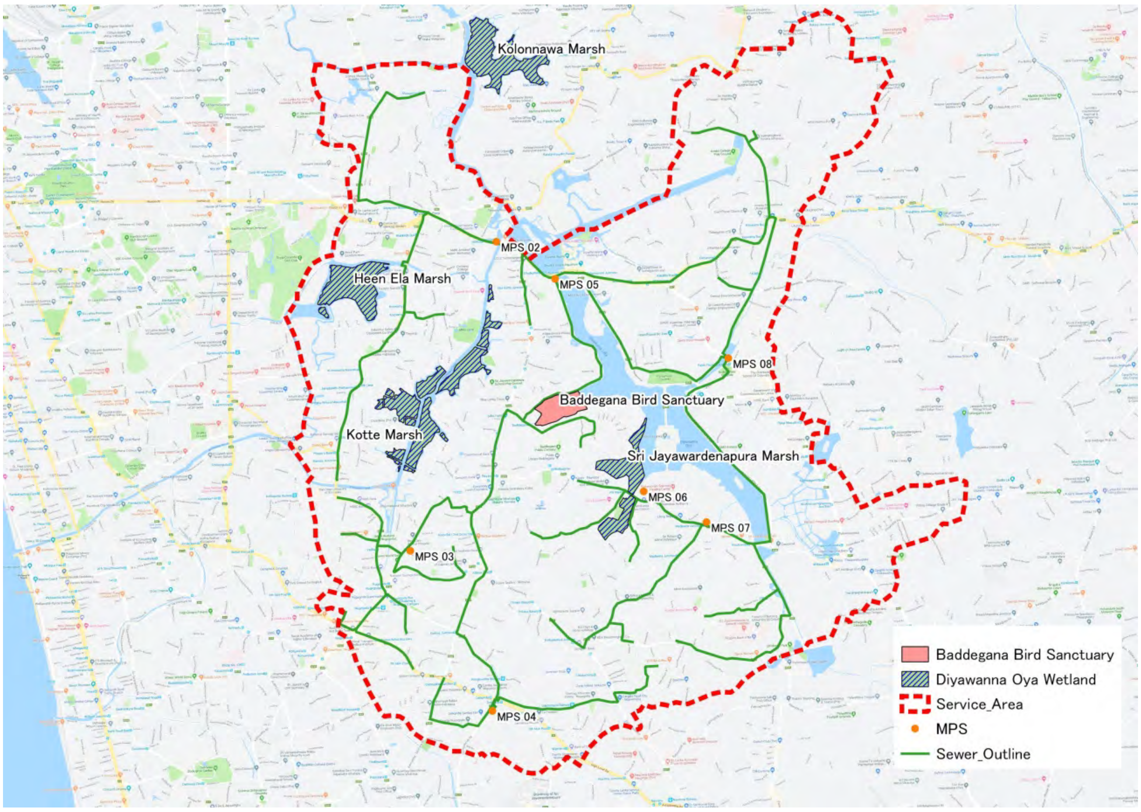


Figure 9.3-10 Protected and Flood Retention Areas in the Project Area

9.3.4 Land Use (STP site)

The land for the STP site was identified and suggested by the Megapolis and Western Development Ministry. According to government records, the land is abandoned paddy land with private and government ownership. The land is controlled by SLLRDC for flood control purposes and is designated as flood prevention land. No part of the land is designated as environmentally or historically protected by the government of Sri Lanka. Thus, from a legal and procedural point of view, the land is available for the STP.

In addition, interviews of residents revealed that cultivation activities have not taken place on the land for several years. Furthermore, Social conditions surveys and EIA surveys performed at the beginning of the Project did not reveal any historical or environmental restrictions to the use of the land for STP construction.

However, later in the Project residents and communities began to express the opinion that the land may have some historical and religious significance. Specifically, some residents claimed that the STP site was once a field for growing “Heenati rice” which was offered to the Buddha Tooth Relic.

In response, additional literature surveys and interviews with experts were carried out to verify this new information. Records of the STP site where Heenati rice was produced could not be found in the literature. Interviews with historians and archaeology experts confirmed that Heenati rice was not grown at the proposed STP site.

Furthermore, Department of Archaeology had issued a letter (18/10/2018) in response to NWSDB's query indicating that there is no historical significance of the STP site.

9.3.5 Fauna and Flora

Literature and site surveys were carried out on the fauna and flora of the general Sri Jayawardenapura Kotte area. The findings are summarized in **Tables 9.3-3** and **Table 9.3-4**. Any vulnerable, endangered or critically endangered species were not found. Examples of the most common weeds are shown in **Figure 9.3-11**.

Table 9.3-3 Survey of Fauna in the Project Area

Class	Type	Taxa		*Significant Species* (common name)	Conservation Status (IUCN 3.1)
		Family			
Birds		Columbidae		*Ducula aenea* (Green imperial pigeon)	LC
				Columba livia (Rock dove)	LC
		Picidae		*Picus chlorolophus* (Lesser yellownape)	LC
		Anhingidae		*Anhinga melanogaster* (Oriental darter)	NT
		Phalacrocoracidae		*Phalaerocorox fuscicollis* (Indian cormorant)	LC
		Rallidae		*Rallus striatus* (Slaty-breated rail)	LC
		Alcedinidae		*Halcyon smyrnensis* (White-throated kingfisher)	LC
				Pelargopsis capensis (Stork-billed kingfisher)	LC
		Ardeidae		*Mesophoyx intermedia* (Intermediate egret)	NA
				Ardeola grayii (Indian pond heron)	LC
				Dupetor flavicollis (Black bittern)	LC
		Accipitridae		*Spilornis cheela* (Crested serpend eagle)	LC
				Haliaeetus leucogaster (White-bellied sea eagle)	LC
		Megalaimidae		*Megalaima zeylanica* (Brownheaded barbet)	LC
				Megalaima flavifrons (Yellow-fronted barbet)	LC
		Cuculidae		*Centropus sinensis* (Greater coucal)	LC
		Psittaculidae		*Psittacula krameri* (Rose-ringed parakeet)	LC
Mammals	Bats	Pteropodidae		*Pteropus giganteus* (Indian flying fox)	LC
		Vespertilionidae		*Kerivoula picta* (Painted bat)	LC
		Herpestidae		*Herpestes brachyurus* (Short-tailed mongoose)	LC
				Herpestes edwardsii (Indian grey mongoose)	LC
	Rodents	Muridae		*Bandicota bengalensis* (Lesser bandicoot rat)	LC
				Bandicota indica (Greater bandicoot rat)	LC
				Rattus rattus (Black rat)	LC
		Sciuridae		*Funambulus palmarum* (Indian palm squirrel)	LC
		Hystricidae		*Hystrix indica* (Indian crested porcupine)	LC
Amphibians		Bufonidae		*Duttaphrynus melanostictus* (Asian toad)	LC
		Dicroglossidae		*Euphlyctis cyanophlyctis* (Indian skipper frog)	LC
				Euphlyctis hexadactylus (Green pond frog)	LC
				Hoplobatrachus crassus (Jerdon's frog)	LC
		Rhacophoridae		*Philautus popularis* (Common shrub frod)	LC
		Microhylidae		*Microhyla rubra* (Marrow-mouthed frog)	LC
		Ranidae		*Hylarana gracilis* (Gravenhorst's frog)	LC
		Rhacophoridae		*Polypedates cruciger* (Sri Lanka whipping frog)	LC
Reptiles		Agamidae		*Calotes calotes* (Common green forest lizard)	NA
				Calotes versicolor (Oriental garden lizard)	NA
		Gekkonidae		*Gehyra mutilata* (Four-clawed gecko)	NA
				Hemidactylus parvimaculatus (Spotted house gecko)	NA
				Hemidactylus frenatus (Common house gecko)	NA
		Varanidae		*Varanus bengalensis* (Bengal monitor lizard)	LC
				Varanus salvator (Asian water monitor)	LC
		Colubridae		*Ptyas mucosa* (oriental ratsnake)	LC
				Oligodon sublineatus (Kukri snake)	LC
				Sibynophis subpunctatus (Black-headed snake)	LC
				Xenochrophis asperrimus (Sri Lankan keelback)	LC

Class	Type	Taxa		*Significant Species* (common name)	Conservation Status (IUCN 3.1)
		Family			
Fish		Osphronemidae		*Trichogaster pectoralis* (Snakeskin gourami)	LC
		Cichlidae		*Oreochromis mossambicus* (Mozambique tilapia)	NT
		Cichlidae		*Etroplus suratensis* (Green chromide)	LC
		Anabantiade		*Anabus testudineus* (Climbing perch)	NA
		Bagridae		*Mystus vittatus* (Striped sward catchfish)	LC
		Heteropneustidae		*Heteropneustes fossilis* (Asian stinging cathish)	LC
		Loricariidae		*Pterygoplichthys multiradiatus* (Sailfish catfish)	NA
		Cobitidae		*Lepidocephalichthys thermalis* (Spiny loach)	LC
		Cyprinidae		*Puntius chola* (Swamp barb)	LC
		Cyprinidae		*Puntius bimaculatus* (Redside barb)	NA

Sources: :
Manamendraarachchi and Adikari (2014)
IUCN Redlist
EIA draft final report
JET

Legend: IUCN 3.1 scale

Dom: Domesticated
Def: Data deficient
NA: Data not available

Table 9.3-4 Survey of Fauna in the Project Area

Taxa		*Significant Species* (common name)	Conservation Status (IUCN 3.1)
Family	Species		
Moraceae		*Ficus religiosa* (Bodhi tree)	LC
Anacardiaceae		*Mangifera indica* (Mango)	None
		Spondias dulcis (Ambarella)	None
		Annona reticulate (Custard apple)	None
		Plumeria rubra (Frangipani)	None
		Phyllanthus myrtifolius (Mousetail plant)	None
		Alstonia macrophylla (Hard milkwood)	LC
		Leucaena leucocephala (white leadtree)	None
		Muntingia calabura (Capulin)	None
		Musa x paradisaca (Plantains)	None
		Tecoma stans (Trumpetbush)	None
		Macaranga indica	None
		Swietenia mahogany	
		Ludwigia decurrens (Willow primrose)	LC
		Lygodium spp. (Climbing fern)	
Salviniaceae		*Salvinia molesta* (Kariba weed)	LC
		Ipomoea aquatic (Kankun)	LC
		Cyclosorus interaptus (Swamp shield-fern)	None
		Eichhornia crassipes (Water hyacinth)	None
		Cerbera odollam (Suicide tree)	None
		Cyperus pilosus	
		Hibiscus tiliaceus (Beach Hibiscus)	LC
		Colocasia esculenta	
		Panicum repens (Torpedograss)	None
		Leersia Hexandra (Southern cutgrass)	LC
		Rhyncospora sp	
		Eleocharis sp	
		Brachiaria sp	
		Bacopa sp	
		Phragmites karka	
		Annona glabra (Swamp apple)	
		Cerbera manghas (Sea mango)	
		Syzygium sp	
		Melastoma sp	
		Lantana camara (Big sage)	
		Ricinus communis	
		Macaranga peltata	
		Colocasia esculenta	

Source:
Egodawatta and Warnasooriya (2014)
Manamendraarachchi and Adikari (2014)
Munashingha et al., (2009)
Dharmasena, (1993)
Wijerathna and Baladurage
IUCN Redlist
EIA draft final report, JET

Legend: IUCN 3.1 scale

Dom: Domesticated
Def: Data deficient
NA: Data not available

Ricinus communis	*Macaranga peltata*	*Colocasia esculenta*

Source: EIA draft final report, JET

Figure 9.3-11 Common Fauna found in the Project sites

9.3.6 History and Culture (Heritage)

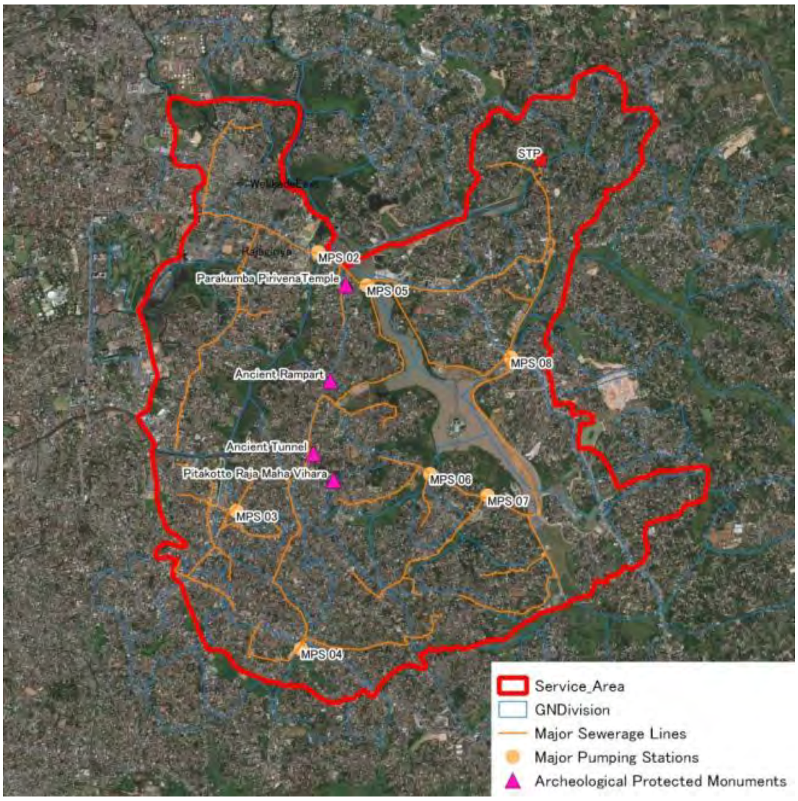
The Department of Archaeology has a list of declared protected monuments in Sri Lanka. The list of Archaeological Protected Monuments in the Project area and distance to closest project component is given in **Table 9.3-5**. Corresponding locations are shown in **Figure 9.3-12.** The project components are not located within or near such protected sites.

The Environmental Management Plan and Environmental Monitoring Plan outline construction methods and other considerations to avoid and/or minimize effects to such sites.

Table 9.3-5 List of Archaeological Protected Monuments in the Project Area

Monument	Declared on	Nearest Project Component	Distance	Influence
Ancient Tunnel at Kotte Ananda Sastralaya	27-Jun-1952	Sewer Main	65 m	minimal
Parakumba Pirivena	14-May-1971	Sewer Main	95 m	minimal
Ancient rampart - Ethul Kotte ruins	23-Feb-2007	Sewer Main	195 m	minimal
Pitakotte Raja Maha Vihara	17-May-2013	Sewer Main	250 m	minimal

Source: JET



Source: JET

Figure 9.3-12 Archaeological Protected Monuments in the Project Area

9.3.7 Religion/Ethnicity

Most of the population in the Colombo District is Buddhist. (Note: Since there are no data on Sri Jayawardenapura Kotte MC, the data of Colombo District are used as representative data for the service area.)

Table 9.3-6 Population by Religion

Buddhist	Hindu	Islam	Roman Catholic	Other Christian	Other	Colombo District Total
1,631,659	185,944	274,267	162,701	67,405	2,324	2,324,300
70.2%	8.0%	11.8%	7.0%	2.9%	0.1%	100%

Source: Economic and Social Statistics of Sri Lanka -2014, Central Bank of Sri Lanka, April 2014

Ethnicities of the population are summarized in the table below. The majority is Sinhala. The indigenous people of Sri Lanka (Vedda) are not found in the Colombo District.

Table 9.3-7 Population by Ethnicity

Sinhala	SL Tamil	Indian Tamil	SL Moor	Other	Colombo District Total
1,778,090	234,754	23,243	248,700	37,189	2,324,300
76.5%	10.1%	1.0%	10.7%	1.6%	100%

Source: Economic and Social Statistics of Sri Lanka -2014, Central Bank of Sri Lanka, April 2014

9.4 EXISTING ENVIRONMENTAL FRAMEWORK

9.4.1 Laws and Regulations

The Central Environment Agency (CEA) is the main governing body in charge of setting and enforcing environmental quality standards to mitigate environmental pollution, including in sanitation related activities. It provides overall environmental protection legislation, including environmental licensing and project approval procedures.

Several laws and environmental standards on environmental and social considerations are applicable to the current Project. They are listed in **Table 9.4-1** and **Table 9.4-2**.

Table 9.4-1 Laws in Sri Lanka Relevant to the Project

Laws	Relevant Information
National Water Supply and Drainage Board Law No. 2 of 1974 as amended by the National Water Supply and Drainage Board (Amendment) Act No. 13 of 1992	This Act established the NWSDB as a public authority. The NWSDB has the authority to plan, develop, operate and control water and sanitation works, and take over such activities from any local authority.
The Urban Development Authority Law No. 41 of 1978	The Urban Development Authority Law and Urban Development Authority (Amendment) Act and the Urban Development Authority Planning and Building Regulations include regulations and ordinances related to the construction of and connection to sewers.
National Environmental Act No: 47 of 1980 as amended by the National Environmental Act (Amendment) No: 56 of 1988 and the National Environmental (Protection & Quality) Regulations No. 1 of 2008	Sri Lanka enacted the National Environmental Act No: 47 in 1980. This Act established the Central Environmental Authority and allows it to provide overall environmental regulation legislation such as licensing procedures, environmental standards, and project approval procedures, including IEE/EIA procedures. The IEE/EIA Framework outlined by the CEA is outlined in the following sections.
National Environmental (noise control) Regulations Gazette No. 924/12 dated May 23, 1996	Noise standards in four areas (daytime and night-time) and for construction activities.

Source: JET

Table 9.4-2 Standards in Sri Lanka Relevant to the Project

(1) Discharged Water Quality

Parameter	Unit	Sri Lankan Standards	International Standards*1	Standards for the Project
pH	-	6.0-8.5	6.0-9.0	6.0-8.5
TSS	mg/L	50	50	15*2
COD	mg/L	250	125	75*2
Oil	mg/L	10	10	10
Fecal Coliform	MPN/100 mL	40	400	40

*1: International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines
*2: Treatment levels stricter than the national standards by CEA

(2) Air Quality

Parameter	Unit	Sri Lankan Standards	International Standards*	Standards for the Project
PM_{10}	$\mu g/m^3$	100 (24hr)	50 (24hr) *1	50 (24hr)
$PM_{2.5}$	$\mu g/m^3$	50 (24hr)	25 (24hr) *1	25 (24hr)
NO_2	$\mu g/m^3$	100 (24hr)	100 (24hr) *1	100 (24hr)
SO_2	$\mu g/m^3$	80 (24hr)	20 (24hr) *1	20 (24hr)
O_3	$\mu g/m^3$	200 (1hr)	100 (8hr) *1	100 (8hr)
CO	$\mu g/m^3$	10,000 (8hr)	10,000 (8hr) *2	10,000 (8hr)

*1: International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines
*2: WHO Guidelines for Indoor Air Quality

(3) Noise and Vibration

Parameter	Unit	Sri Lankan Standards	International Standards*	Standards for the Project
Equivalent continuous A sound level (Laeq, 10) and vibration level (Lv10)	dB(A)	55-70 (depending on location) (6:00-18:00)	55-70 (depending on location) (7:00-22:00)	55-70
		45-60 (18:00-6:00)	45-70 (22:00-7:00)	N/A (Night time construction is not planned)

*International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines
Source: JET

9.4.2 Administrative Framework for Environmental and Social Considerations

(1) IEE/EIA Framework

The provision relating to Initial Environmental Evaluations (IEE) and Environmental Impact Assessment (EIA) is included in the National Environmental Act and its amendments. According to the procedure, approval of development projects requires submission of the reports based on the characteristics of the project. Development activities described below require approval under the EIA regulations.

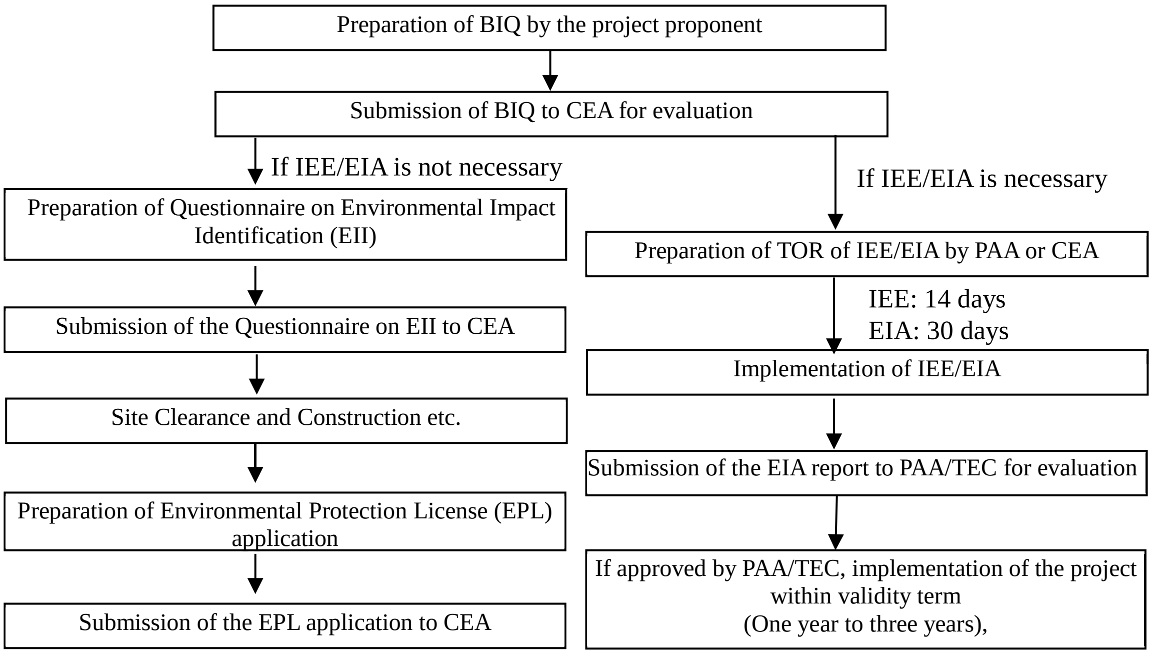
- Reclamation of land, wetland area exceeding 4 hectares
- Conversion of forest area exceeding 1 hectare to non-forest uses
- Involuntary resettlement exceeding 100 families other than resettlement under emergency situations.
- Construction of pipeline (excluding water) exceeding 1 kilometer in length.

Furthermore, if such project or undertaking irrespective of its magnitude, if located partly or wholly within an Environmental Sensitive Area whether or not such areas are wholly or partly within the coastal zone as defined in the Coast Conservation Act No. 57 (1981), will require approval under the EIA regulations.

The requirement for EIA and the level of study required are determined by CEA after submission of a Basic Information Questionnaire (BIQ) and supporting information by the project proponent. There are two possible outcomes:

1) Categorical exclusion: The activity is not on the list of prescribed projects in the EIA regulations, is not in or near a sensitive area, has not been the subject of public protest, and it is clear from the BIQ and supporting information that the project will have no significant environmental impacts. Environmental clearance is granted (with or without conditions) and the project may proceed; and
2) All other projects require environmental assessment, and the CEA (or the relevant Project Approving Agency; PAA) establishes a scoping committee to decide on the level of study (EIA or IEE) and prepare terms of reference (TOR). A technical review committee reviews the completed EIA or IEE report and recommends whether environmental clearance shall be granted; the final decision is made by CEA/PAA.

The steps of the EIA process shown schematically in **Figure 9.4-1**.



Source: JET

Figure 9.4-1 Procedure for Evaluation and Approval of EIA Report

(2) Necessity of IEE/EIA

Under the JICA Environmental and Social Considerations Guidelines, the current project has been categorized as a Category B project. According to the same guidelines, Category B projects require IEE level studies to be performed at early stages of the project.

On the other hand, according to the environmental laws and regulations of Sri Lanka, laying of gas and liquid pipelines exceeding 1 kilometre in length requires submission of EIA. This definition is commonly interpreted to include wastewater. Under this provision, the current project requires EIA submission and approval.

It should be further mentioned that due to the proximity of project components to the Diyawanna Oya Wetland, installation of the STP has been approved by CEA subject to treatment levels stricter than the national standards (Refer to: **APPENDIX 4-3**).

IEE study was conducted by JICA Expert Team (JET) according to JICA Guidelines. This report is prepared based on the result of the IEE study.

Other than IEE study by JET, an EIA study was conducted by NWSDB according to local regulations, based on study outcomes from the JET study.

(3) Approvals Required for Implementation of Sewerage Projects

Approvals required for implementation of the Project are summarized below.

Table 9.4-3 Approvals required for implementation of the Project

Subject	Type	Authority	Obtained by	Stage
Approval for building plan	Approval	MC (Municipal Council)	NWSDB	DD-Before construction
Pipe laying under roads	Approval	RDA (Road Development Authority)	NWSDB	DD-Before construction
Acquisition of land in urban area	Approval	UDA (Urban Development Authority)	NWSDB	DD-Before construction

Subject	Type	Authority	Obtained by	Stage
Approval for IEE and EIA	Approval	CEA (Central Environmental Authority)	NWSDB / EIA Consultant	Before L/A
EPL (Environmental Protection License) (Requires yearly renewal)	License		NWSDB	DD-Before construction
Treated Effluent Quality	Approval / Restriction		NWSDB	March, 2017
Abbreviated Resettlement Action Plan	Approval	Grama Niladhari (GN) / Divisional Secretary (DS) / Ministry of Lands	NWSDB	DD-Before construction
Income Restoration Program	Approval		NWSDB	DD-Before construction

Source: JET

The proposed Project and each of its subprojects will be in full concurrence with legal requirements of the relevant government ministries and agencies.

Central Environmental Authority (CEA)
Under EIA regulations, approval from the CEA s is required for the implementation of any “Prescribed Project” and valid Environmental Protection License (EPL) is required to discharge effluents into the environment.

Coast Conservation and Coastal Resources Management Department (CC&CRMD - Commonly known as CCD)
Approval of the Director General of CC&CRMD is required for any development activity to be carried out within the Coastal Zone as defined under Coast Conservation Act.

Local Authority (LA) (Municipal Councils, Urban Councils or Pradeshiya Sabha)
To carry out construction activities of any project, the approval of relevant local authority must be obtained.

Mahaweli Authority of Sri Lanka (MASL)
As the responsible agency for Mahaweli River, the MASL has been vested with the authority of granting permission for development works in the Mahaweli River and its reservation. Moreover, MASL is also a Project Approving Agency Gazette under the NEA.

Road Development Authority (RDA), Provincial Road Development Authority (PRDA)
If the project activities require laying pipelines along provincial or national roads, the approval of PRDA or RDA is required.

Department of Archaeology
The Department of Archaeology is the state agency responsible for conservation of archaeological artefacts and structures of historical interest. Any development on such land requires permission from the Director General of Archaeology.

The Forest Department
The Forest Department acts as the statutory custodian of state forests. Development activities on any land specified in the Forest Ordinance requires permission from the Forest Department.

The Department of Wild Life Conservation
The Department of Wild Life Conservation requires that development projects located within, or within a 1-mile radius of National Reserves declared under the Fauna and Flora Protection Ordinance carry out EIA.

Department of Agrarian Development
Filling of any paddy land requires approval of the Department of Agrarian Development.

Urban Development Authority (UDA)
If the development activities of the proposed project are within an area declared under UDA law, approval of UDA is required.

(4) Comparison with JICA Guidelines

There are some gaps between the current Sri Lankan Regulations and JICA Guideline, but they are rather minor. For example, although JICA Guidelines suggest that "examinations must be endeavoured to include an analysis of environmental and social costs and benefits", it is not an obligation under the Sri Lanka's legislation. In such cases, JICA Guidelines are simply applied. When Sri Lanka's decision requires some study such as an EIA while JICA Guidelines do not, Sri Lanka's decision will be followed. "Guidance for Implementation of the Environmental Impact Assessment Process" has been published by the CEA. Requirements for EIA is provided under the NEA and the process is monitored by CEA. Thus, this "Guidance" is also referenced. The detail of the comparison is shown in **Table 9.4-4**.

Table 9.4-4 Comparison of JICA Guidelines and Sri Lankan Policies

JICA Guideline	Sri Lankan Law	Gap between JICA Guidelines and Laws of Sri Lanka/Action to be taken
Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.	A project proponent of any proposed prescribed project shall as early as possible submit to the PAA preliminary information on the project requested by the appropriate PAA. (Regulations and guidelines under National Environmental Act (NEA) No. 47, 1988)	No Gap
Environmental assessment reports must be written in the official language of the country or a language that is widely used in the country where the project is taking place. In addition, for informing the public, documents should be written in a language and style that can be understood by local people.	IEE/EIA may be in English, Sinhala, or Tamil, but…it may become necessary for the document to be made available to the public in Sinhala and Tamil at the public inspection. (Regulations and guidelines under NEA, Guidance for implementing the EIA process)	In SL law, multiple languages are not obligation. So, JICA guidelines will be applied and EIA will be published and made available in English, Sinhala and Tamil.
The environmental assessment report should be publicized in the country where the project is implemented so that stakeholders such as local residents can view it at any time and copying is to be permitted.	The PAA (Project Approving Agency) should establish procedures for making EIA readily available to the public for reading…in the district or division in which the project is proposed. PAA should establish an efficient process to allow copies of EIA to be made for the public upon request and…full payment. (Regulations and guidelines under NEA, Guidance for implementing the EIA process)	No Gap
For projects with a potentially large environmental impact, enough consultations with local stakeholders, such as residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such	During scoping sessions, conducted by the environmental and social study teams, local people are consulted. Information is disclosed to the people during the 1-month public commenting period of the EIA. EIA reports are	No Gap

JICA Guideline	Sri Lankan Law	Gap between JICA Guidelines and Laws of Sri Lanka/Action to be taken
consultations must be incorporated into the contents of project plans.	published on the CEA web site and available at relevant government agencies. (Regulations and guidelines under NEA)	
Although consultations with stakeholders should be conducted as needed throughout the project preparation and implementation period, it is also desirable that consultations be conducted especially during the selection of assessment items and preparation of the draft assessment report.	Public hearings may be held at the discretion of the PAA when…it would be in the public interest to do so. (Regulations and guidelines under NEA, Guidance for implementing the EIA process)	In SL law, hearings are not obligation. So, JICA Guidelines will be applied as much as possible. Public comments will be gathered before the preparation of the final EIA report.
The impacts to be assessed about environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children s rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.	Local and regional level environmental and social impacts are assessed through the prevailing laws of Sri Lanka. (Regulations and guidelines under NEA, Flora and fauna Protection Ordinance, Forest Ordinance, Marine Pollution Prevention Act etc.) Trans-boundary or global scale impacts are covered under relevant international treaties, protocols, conventions etc. ratified by the Sri Lankan Government. (United Nations Framework Convention on Climate Change, Kyoto Protocol, Montreal Protocol, Vienna Convention, Ramsar Convention, Basel Convention, etc.)	JICA Guidelines are more specific and will be applied
In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.	This aspect is covered under the EIA process and monitoring mechanism. (Regulations and guidelines under NEA)	No Gap
Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.	Upon receipt of the report, the PAA shall submit a copy thereof to the CEA and by prompt notice published in the Gazette and in one national newspaper published daily in the Sinhala, Tamil and English languages invite the public to make written comments within thirty days from the date of the first appearance of the notice. People also have access to monitoring results through the recently passed Right to Information Act.	No Gap
When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on enough	Although not mentioned in the regulations, generally this is practiced during implementation of projects. (Common practice)	No Gap. Local practices will be followed unless

JICA Guideline	Sri Lankan Law	Gap between JICA Guidelines and Laws of Sri Lanka/Action to be taken
information disclosure, including stakeholder participation in relevant projects. Project proponents etc. should make efforts to reach an agreement on procedures to be adopted with a view to resolving problems.		insufficient. Then, JICA guidelines will be followed.
Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.	Critical natural habitats and critical forests are declared as reserves and protected areas under Forest Ordinance and Flora and Fauna Protect Ordinance respectively. No development projects are allowed within these areas.	No Gap
Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses.	There is no direct reference to indigenous people in the environmental laws, regulations and guidelines.	JICA Guidelines applied

Source: JICA Guidelines, relevant Sri Lankan Laws and Regulations

(5) International Commitments

A list of environment-related international conventions, protocols, and treaties which the Government of Sri Lanka has agreed to is given in the table below.

Table 9.4-5 List of Environment related International Conventions, Protocols, and Treaties

No	Environment-Related International Conventions, Protocols, and Treaties
1	International Plant Protection Convention (Rome, 1951)
2	Plant Protection Agreement for the South East Asia and Pacific Region (Rome, 1956)
3	Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971)
4	Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972)
5	Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, 1973)
6	Convention on Conservation of Migratory Species (Bonn, 1979)
7	Vienna Convention for the Protection of the Ozone Layer (Vienna, 1985)
8	Montreal Protocol on Substances that Deplete the ozone Layer (Montreal 1987)
9	United Nations Framework Convention on Climate Change (New York, 1992)
10	Convention on Biological Diversity (Rio De Janeiro, 1992)
11	International Convention to Combat Desertification (Paris 1994)
12	United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (Paris, 1994)
13	Kyoto protocol to the United Nations Framework Convention on Climate Change (Kyoto, 1997)
14	Cartagena protocol on Biosafety to the Convention on Biological Diversity (Cartagena, 2003)

Source: JET

9.5 ALTERNATIVES OF THE PROJECT COMPONENTS

IEE study was conducted by JET according to JICA Guidelines. The results are described in this and the following sections.

For the Project, alternatives were considered for STP sites, but main sewer routes were determined by roads and topography, and MPSs sites were fixed as recommended by authorities and resulted in the only proximate lands without alternatives.

9.5.1 With/without Project

As mentioned previously in this and other reports, Sri Jayawardenapura Kotte and the surrounding areas are growing rapidly. The need for managing wastewater treatment associated with such growth has been recognized and goals for sewerage system (pipe-borne system with sewage treatment plants) development set at the national level, with prioritization to high population and growth centres. Currently, sewerage coverage in Sri Jayawardenapura Kotte is limited to a handful of major government buildings. The area suffers from two types of wastewater pollution: 1) wastewater discharged directly into nearby drains and water bodies, and 2) wastewater that migrates into nearby ground and surface waters with inadequate treatment by on-site facilities. These waters eventually end up in larger streams and ultimately collect in the Diyawanna Oya Wetland, located in the middle of Sri Jayawardenapura Kotte.

As a result of the above, the Project is highly necessity for the promotion of sustainable economic development of the area while providing improved living environment by developing a sewerage system in Sri Jayawardenapura Kotte MC and its surrounding areas.

9.5.2 STP Location

The technical aspects of treatment process selection were outlined in **Section 5.4**. Adequate treatment levels, facility area, construction and operating costs were taken into consideration and Step-Feed BNR process was selected.

Several locations for the STP were considered throughout the Project in consultation with local authorities (Megapolis, UDA, SLLRDC, and NWSDB). Due to the high population and commercial densities of the area, finding large plots of land with no environmental or social effects was difficult. Any other lands selected would require land acquisition and resettlement. Lands with low possibility of these issues are selected and compared.

Table 9.5-1 Alternative STP Sites

Item		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Land	Location	Thalawathugoda West	Udahamulla Bus Depot	Ambatale	Wapola
	Area	3.6 hectares	2.0 hectares	3.0 hectares	3.0 hectares
	Use	Urban Farming Program	Bus Parking, Repairing and Storage Garage	Open Land	Flood retention land
	Conservation	Not protected land	Not protected land	Not protected land	Not protected land
	Owner	Urban Development Authority	Sri Lanka Transport Board	Private Owners	SLLRDC Private Owners
	Availability	Difficult to negotiate (The land is currently used for other purpose.)	Difficult to negotiate (The land is currently used for other purpose.)	Difficult to negotiate (The discharge point is close to an existing WTP intake.)	Negotiable Suggested by Megapolis and Western Development Ministry
Tech	Treatment method	- Step-Feed Biological Nutrient Removal method and UV disinfection for sewage treatment, - Mechanical sludge treatment and solar sludge drying bed with odour control facility	- Step-Feed Biological Nutrient Removal method with Membrane Bio-Reactor (MBR) and UV disinfection for sewage treatment, - Mechanical sludge treatment and solar sludge drying bed with odour control facility	- Step-Feed Biological Nutrient Removal method and UV disinfection for sewage treatment, - Mechanical sludge treatment and solar sludge drying bed with odour control facility	- Step-Feed Biological Nutrient Removal method and UV disinfection for sewage treatment, - Mechanical sludge treatment and solar sludge drying bed with odour control facility
	Construction	- Normal construction. - Administration building built on top of plant, - Double protection of odour emission by covering the tank and enclosing it in a room.	- Due to limited land (2.0 hectares) area, special treatment method and complex facility with multi-story is necessary to keep the footprint of the STP small. - Double protection of odour emission by covering the tank and enclosing it in a room.	- Normal construction. - Administration building built on top of plant, - Double protection of odour emission by covering the tank and enclosing it in a room. - Additional pipeline is required due to location which is far, over additional 3 km away (to avoid hills etc),	- Normal construction. - Administration building built on top of plant, - Double protection of odour emission by covering the tank and enclosing it in a room.

Item		Alternative 1	Alternative 2	Alternative 3	Alternative 4
	Other	Relocation of power line is necessary.	High O&M skills are required by complex facilities with MBR (advanced technology)	Due to discharge of treated water near the intake of Ambatale WTP, more large number of water quality items for treated water shall be checked and controlled in STP.	
	Cost	- Average construction cost - Average O&M cost	- High construction cost - High O&M cost by MBR (additional equipment)	- High construction cost by transmission pipe - High O&M cost by pumping up to STP	- Average construction cost - Average O&M cost
ESC	Social (resettlement/relocation)	No resettlement / Small scale of relocation / No residences in the immediate proximity.	No resettlement / Relocation of depot, jobs / Houses on property border	No resettlement / No relocation /	No resettlement / No relocation /
	Environmental	Medium residential area. / Already cultivated land without trees / Little impact to natural environment	High residential density/ Already developed land without trees / Little impact to natural environment	Medium residential area / Already cultivated land without trees / Little impact to natural environment	Medium residential area / Already cultivated land without trees / Little impact to natural environment
Conclusion		Not recommended due to the following reasons: Relocation of power line is necessary. The land is currently used for other purpose.	Not recommended due to the following reasons: Advanced technology (MBR) and multi-story construction would be required to accommodate the small land area. This would increase construction and operation costs. The compact construction would make maintenance works difficult. Bus depot relocation is necessary. Residential units are located very close to the site, with units built up to the land boundary.	Not recommended due to the following reasons: The STP would discharge into the Kelani River close to the Ambatale WTP intake. This is not desirable for the WTP. The STP site is far from the planned service area. Long pumping distances would make operation expensive. Land for pumping stations would be necessary, causing more land issues. And surrounding populations would also need to be included, dramatically changing the service area and population.	Recommended due to the following reasons: Land acquisition is negotiable Land is big enough to construct STP. Roads, waterways and hills provide buffer zones for nearby houses. There is little impact to natural environment because the land without trees is already cultivated The land was recommended by Megapolis and Western Development Ministry, so it is available for development.

SLTB: Sri Lanka Transport Board (public bus operator)
Source: JET

After careful consideration as described above, the land chosen in Alternative 4 is recommended for the STP site. Initially, this did not receive support from nearby residents who were not adequately informed of the Project, its goals and benefits. To correct the situation, NWSDB supported by JET, vigorously conducted public awareness consultations. More and more residents are gaining a better understanding of the Project and are becoming positive towards its implementation. (see **Section 9.8** for details).

9.5.3 Pumping Stations

Several pumping stations are required to relay sewerage to the STP. Technical details of pumping station design are available in **Section 4.4**. To reduce impacts to the surroundings, manhole-type pumping stations have been selected where possible. However, several larger pumping stations (major pumping stations: MPSs) were necessary. After a comparison of alternative options, the number and locations of the MPSs were selected in consultation with local authorities (Megapolis, UDA, SLLRDC, NWSDB), as shown in the table below. Impact comparison and consideration of alternate designs resulted in the reduction of MPSs from 8 to 7.

Table 9.5-2 Alternative MPS Locations

MPS	Alternative 1	Alternative 2
Number of MPS	8	7 (MPS-01 is omitted by alternative design)
Owner	SLLRDC, UDA, NWSDB, Private	SLLRDC, UDA, NWSDB, Private
Land type	Abandoned paddy, open lot,	Abandoned paddy, open lot
Social	Impacts to a parking lot and illegal dwelling	-
Environmental	Little impacts due to no primitive trees	Little impacts due to no primitive trees
Comment	Illegal housing (4) units should be displaced.	Due to design change and consideration of supply areas, one MPS was eliminated. This also prevents displacement of households.
Recommendation	Not recommended	Recommend

Source: JET

For all sites of major pumping stations UDA recommended land that would not require the resettlement of residents. Four sites (MPS-04, MPS-05, MPS-06, and MPS-07) are government land (UDA, SLLRDC, and NWSDB). Three sites (MPS-02, MPS-03, and MPS-08) are private land.

From a design perspective, MPSs should be located as close to the pipeline as possible. Accordingly, candidate sites were empty land along main roads where sewerage mains will be installed. However, land along such roads is in high demand and open land is difficult to find. All vacant land near MPS No.8 were visited and availability checked. Only one negotiable area was found for MPS08 (shown as MPS08 in **Figure 9.5-1**).

Source: Google Earth / JET

Figure 9.5-1 MPS candidate site confirmation (MPS No.8)

9.6 SCOPING AND TOR FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Scoping is defined as the process of identifying the content and extent of potential environmental and social impacts of the project. The proposed STP construction site, main pumping station sites, other construction sites such as pipe laying and manhole pumps, and other Project components are included in the Scoping and TOR.

Scoping for the project components and the reasons for the evaluation are shown in **Table 9.6-1** below.

Table 9.6-1 Scoping

Item	Evaluation		Reason
Pollution Control			
1 Air pollution	P/C	B-	Dust and exhaust gases are generated during construction.
	O	D	No impacts are expected during operation. No exhaust gases. Odours are considered in #7.
2 Water pollution	P/C	B-	Excavation and runoff will cause turbidity during construction.
	O	B+	Collection and treatment of sewage and greywater will reduce water pollution in the project area. Effluent from STP will not contain heavy metals.
3 Waste	P/C	B-	Construction waste will be generated.
	O	B-	Sludge will be generated during wastewater treatment.
4 Soil pollution	P/C	B-	Construction activities may contribute to soil pollution.
	O	B-	Disposal of sludge from STP at land fill site may have environmental impacts.
5 Noise and vibrations	P/C	B-	Noise and vibrations will be generated during construction.
	O	B-	Noise and vibrations will be generated during operation.
6. Ground subsidence	P/C	C	Impacts are unknown and require investigation.
	O	C	Impacts are unknown and require investigation.
7. Offensive odours	P/C	D	No impacts are expected during construction because wastewater is not yet entering the area.
	O	B-/B+	B-: Odour will be generated at the STP during operation. B+: Improved sewerage collection and environmental conditions will reduce offensive odours in the project area.
8 Bottom sediment	P/C	C	Impacts are unknown and require investigation.
	O	B+	No adverse impacts are expected during operation because operation of the STP will not increase bottom sediments and will help reduce waste runoff into water bodies.
Natural Environment			
9 Protected lands	P/C	C	There are protected lands in the project area, these impacts are unknown and require investigation.
	O	C	
10 Biota and ecosystems	P/C	C	Impacts are unknown and require investigation.
	O	B+/C	B+: Ecosystems will benefit from improved water quality. C: Negative impacts of construction are unknown and require investigation.
11 Hydrology	P/C	C	Impacts are unknown and require investigation.
	O	C	Impacts are unknown and require investigation.
12 Geographical features	P/C	C	Impacts are unknown and require investigation.
	O	D	No impacts are expected during operation.
Social Environment			
13 Land acquisition / resettlement	P/C	B-	Land for treatment plant, pumping stations, and sewerage lines will be required.
	O	D	No impacts are expected during operation because operation of the STP does not consume additional land and expansion is not expected.
14 Low income households	P/C	D	Construction impacts will be the same for all income levels.
	O	C	Impacts are unknown and require investigation.
15 Indigenous and ethnic populations	P/C	C	Impacts are unknown and require investigation.
	O	C	Impacts are unknown and require investigation.
16 Local economies	P/C	C	Construction activities may increase local employment and economic activities. Construction activities may inconvenience local businesses.
	O	C	Improved water environment will have positive impact on aquaculture and businesses (tourism etc.)
17 Land use	P/C	C	Land use patterns may change as a result of acquisition, resettlement, and construction of facilities.
	O	D	No additional impact caused by operation is expected.

Item	Evaluation		Reason
Pollution Control			
18 Water usage	P/C	C	Impacts are unknown and require investigation.
	O	C	Water usage downstream of Project has not been investigated. Thus, impacts are unknown and require investigation.
19 Existing social infrastructures and services	P/C	B-	Construction activities may cause traffic problems.
	O	C	Impacts are unknown and require investigation.
20 Social institutions	P/C	D	No adverse impacts are expected.
	O	D	
21 Inappropriate distribution of benefits and damages	P/C	C	Impacts are unknown and require investigation.
	O	C	Impacts are unknown and require investigation.
22 Local conflicts of interest	P/C	C	Impacts are unknown and require investigation.
	O	C	Impacts are unknown and require investigation.
23 Cultural heritage	P/C	C	Construction activities may impact heritage sites.
	O	C	Impacts are unknown and require investigation.
24 Landscapes	P/C	B-	Construction activities will have impact on the landscape.
	O	B-	New facilities will have impact on landscape.
25 Gender	P/C	C	Women may receive unequal economic opportunities during construction.
	O	C	Women, who suffer disproportionately from water borne diseases, will benefit from improved water environment.
26 Children's rights	P/C	C	Child labour may be used during construction.
	O	C	Children, who suffer disproportionately from water borne diseases, will benefit from improved water environment.
27 Infectious diseases such as HIV/AIDS	P/C	B-	Influx of construction workers will increase risk of infectious diseases.
	O	D	Incidences of infectious diseases are not expected to increase as a result of the Project.
28 Working conditions (including occupational safety)	P/C	B-	Working conditions should be closely monitored during construction.
	O	B-	Working conditions should be closely monitored during operation.
Other			
26 Accidents	P/C	B-	Construction activities and disruption to traffic will increase risk of accidents.
	O	B-	Accidents may occur in treatment facilities during operation.
30 Global warming	P/C	D	No impacts are expected because the greenhouse gas emissions from this scale of construction activities will be negligible.
	O	D	

【Evaluation】
A: Significant impact is expected
B: Some impact is expected
C: Extent of impact is unknown
D: No impact is expected
+ : Impact is Positive
- : Impact is Negative
P/C: Preconstruction/Construction Period
O: Operation Period
Source: JET

The TOR outlines study methods for contents identified in the scoping step. In principle, items that received an A, B or C in the scoping table (**Table 9.6-1**) should be studies and evaluated. Other items that are identified as the survey proceeds should also be included. TOR for the Project, including study methods, is given in **Table 9.6-2**.

Table 9.6-2 TOR for Impact Study

Item	Study
Pollution Control	
1 Air pollution	Study: Air pollution standards, construction vehicles and construction methods. Method: Site survey, literature review.
2 Water pollution	Study: Water pollution standards, construction methods, water quality. Method: Site survey, literature review.
3 Waste	Study: Waste management procedures, collection and disposal methods, disposal site conditions, Method: Site surveys, interview concerned parties, expected treatment level of planned STP.
4 Soil pollution	Study: Soil pollution standards, construction methods, construction equipment. Method: Site survey, literature review, construction methods confirmation.
5 Noise and vibrations	Study: Noise regulations, current condition, construction methods. Method: Site surveys, interview concerned parties, noise measurement surveys.
6. Ground subsidence	Study: Design / construction methods study. Method: Design / construction methods confirmation.

Item	Study
7. Offensive odours	Study: Current odour conditions, treatment method. Method: Site surveys, literature review, interview concerned parties.
8 Bottom sediment	Study: Design / construction methods study. Method: Design / construction methods confirmation.
Natural Environment	
9 Protected lands	Study: Environmental related laws / regulation study, Design / construction methods study. Method: Site surveys, literature review, design / construction methods confirmation.
10 Biota and ecosystems	Study: Inventory of flora and fauna in the construction area. Method: Site survey, literature review.
11 Hydrology	Study: Current condition study of the target area, Design / construction methods study. Method: Site surveys, literature review, design / construction methods confirmation.
12 Geographical features	Study: Geographic condition study, Design / construction methods study. Method: Site survey, design / construction methods confirmation.
Social Environment	
13 Land acquisition	Study: Land requirements, acquisition procedures, compliance to JICA guidelines. Method: Site surveys, literature review, interview concerned parties.
14 Low income households	Study: Census/demographic data, economic status, and land use patterns of affected peoples. Method: Interview concerned parties, site survey, relevant laws and regulations.
15 Indigenous and ethnic populations	Study: Census/demographic data, economic status, and land use patterns of affected peoples. Method: Social condition survey, interview concerned parties, site survey.
16 Local economies	Study: Local economic environment, industries, markets, design / construction methods study. Method: Site surveys, interview concerned parties, design / construction methods confirmation.
17 Land use	Study: Land use practices of local communities, design / construction methods study. Method: Site surveys, interview concerned parties, design / construction methods confirmation.
18 Water usage	Study: Water use practices of local communities, impacts of sewerage treatment on water usage. Method: Site surveys, interview concerned parties.
19 Existing social infrastructures and services	Study: Local economic environment, industries, markets, design / construction methods study. Method: Site surveys, interview concerned parties, design / construction methods confirmation.
20 Social institutions	Not applicable
21 Misdistribution of benefits and damages	Study: Census/demographic data, social and economic conditions economic status, and land use patterns of affected peoples. Method: interview concerned parties, site survey, public consultation.
22 Local conflicts of interest	Study: Risks and prevalence of conflicts of interest. Method: Social condition survey, interview concerned parties, public consultation.
23 Cultural heritage	Study: Location of cultural heritage sites. Method: Site survey, location of registered heritage/historical sites, interview concerned parties.
24 Landscapes	Study: Location of significant cultural, religious, and tourism sites, construction locations and methods. Method: Site survey, interview concerned parties.
25 Gender	Study: Working conditions/statistics of women, gender equality policies. Method: Social condition survey, interview concerned parties, relevant laws and regulations.
26 Children’s rights	Study: Working conditions/statistics of youngsters. Method: Social condition survey, interview concerned parties, relevant laws and regulations.
27 Infectious diseases such as HIV/AIDS	Study & Method: Employment conditions, prevalence of AIDS/HIV and other infectious diseases, current prevention programs.
28 Working conditions (including occupational safety)	Study: Working conditions, construction/industrial safety regulations, traffic safety/accident prevention methods. Method: Site surveys, literature review, interview concerned parties.
29 Accidents	Study: Construction/industrial safety regulations, traffic safety/accident prevention methods. Method: Site surveys, literature review, interview concerned parties.
30Global warming	Not applicable

【Evaluation】
A: Significant impact is expected
B: Some impact is expected
C: Extent of impact is unknown
D: No impact is expected

+ : Impact is Positive
- : Impact is Negative

P/C: Preconstruction/Construction Period
O: Operation Period

Source: JET

9.7 FINDINGS OF THE IMPACT STUDY

The findings of the survey outlined in the TOR are given in the table below.

Table 9.7-1 Findings of the Impact Study

Item	Results
Pollution Control	
1 Air pollution	The PM10 level at the nearest observation station (Colombo Fort) was in the range of 70-80 µg/m^3 from 1998 to 2012, higher than WHO guideline level of 50 µg/m^3. <P/C> Dust and exhaust gas emissions from construction activities such as excavation and transfer may affect air quality in the immediate vicinity. <O> No significant air pollution is expected during STP operation with electricity as the power source.
2 Water pollution	Water quality surveys in the project area found presence of fecal coliform (5 to 17 times the allowable limits) indicating contamination by human waste. <P/C> Soil runoff may contribute to water pollution during construction activities such as excavation and soil storage. <O> The target effluent quality is set lower than required by the regulatory standard to ensure that there will be no negative impact on the environment. Also, the effluent will not contain heavy metals because the target is domestic wastewater and industry discharge will not be received if without pre-treated.
3 Waste	<P/C> Construction waste (damaged pavement: approx.8,000m^3) and soil from excavation (approx.67,000m^3) will be generated during construction and stored in a 3-ha vacant land of NWSDB. The soil will basically be used for backfilling and levelling in this or other construction. For storage and use of soil in NWSDB-owned land, no approval is needed from other authorities. <O> Sludge from treatment plant operation could be composted for use as soil conditioner by private companies. The amount of waste will be approx.10.9m^3/day. For the time being, it is estimated that all sludge from planned STP can be treated by private companies because the demand is over the supply. In case exceeding sludge is generated, an official compost production facility at Kerawalapitiya will accept it.
4 Soil pollution	<P/C> No national soil pollution data or standards are available Chosen construction methods are commonly used and are not expected to pose any pollution problems. However, care will still be taken to avoid any leakage of oil from machineries. In case of leakage, TPH concentration can be referred. US-EPA classified TPH (total petroleum hydrocarbons) as a priority pollutant (max. 10,000 µg/g. by U.S. Department of Health and Human Services) <O> Sludge from treatment plant operation could be composted and is not expected to cause soil pollution.
5 Noise and vibrations	<P/C> Noise will be produced by construction vehicles and construction activities such as pilling by excavator (113db(A)), excavation by backhoe (107db(A)) and clearance by bulldozer (104db(A)) . Noise levels can be reduced by proper maintenance of equipment, erection of barriers, isolation and enclosures. For example, barrier fence can reduce the above mentioned noise level as followings (113 to 75 db(A) / 107 to 72 db(A) / 104 to 68 db(A)). The shortest distance between construction sites and households is approx.6 m (MPS-8). 75 db(A) will be decayed to 30 db(A) or less by the distance (calculated by Distance Attenuation Formula). This value is half of the standard (60 db(A)). <O> Pumps and equipment in the STP and pumping stations can also produce noise but simply be undetectable level by covering and isolation at the border of the sites. Site surveys show that these noise and vibration are comparable to levels associated with urban, industrial, commercial, and public institutions (The current noise levels of MPS-4, 6 and 7 locations exceed permissible noise levels stipulated under the "Extraordinaly Gazette No, 924" by CEA.
6. Ground subsidence	<P/C> <O> As a result of soil quality survey around STPsite, the depth of the bearing layer is approximate 10 ~ 17 m consisting mostly of stiff clay with N values between 10 and 40 (very hard). Proper design and construction practice will ensure that ground subsidence will not occur during construction of the STP, and when the plant is in planned operation.

7. Offensive odours	<P/C> Rotting food and untreated wastewater in canals and roadside drains causes foul odours, especially during dry weather. Having the facility to collect and treat wastewater and greywater will reduce odours in the general environment. <O> Any offensive odours generated by STP operation can be dealt with by well-established odour control measures. The design uses three levels of odour protection 1) The odour producing areas such as receiving chamber and sludge (from septic tanks) receiving facility will be covered by corrosion resistant cover so odours don’t escape into the atmosphere. 2) In addition, the whole wastewater treatment plant itself can be enclosed by roof and wall to further prevent escape of odours. 3) All odourous air is captured and treated by a biological filter and an activated carbon absorption system. The biological filter will remove main part of odourous substance by bacterial decomposition. The activated carbon will adsorb all remaining odourous substances. Nearby residents should be informed of preventive and control measures that will be used to reduce concerns. It was found that residents in surrounding areas of STP concerned about odours emanation and enough awareness about prevention measures should be needed.
8 Bottom sediment	<P/C> No special chemicals will be used in the construction of the flood retention area by SLLRDC. Water turbidity may increase during construction, but bottom sediments downstream would not be affected by any extraneous materials such as chemicals. <O> Bottom sediment will be reduced because of treatment.
Natural Environment	
9 Protected lands	<P/C> Beddagana Bird Sanctuary is in the project service area but is not part of the component. The construction of sewer pipe laying will be conducted approx.10m away from the sanctuary. The construction is not restricted but care should still be taken to prevent accidental impacts to the animals from the sanctuary during construction. JET design will have construction activities take place along roads and other developed lands. <O> Ecosystems in the region will benefit from improved environmental conditions.
10 Biota and ecosystems	EIA study found no endangered species habitats in the project area. <P/C> The project components will be in urbanized areas and no virgin land will be disturbed. Impacts on biota and ecosystems during construction will be minimal. <O> Collection and treatment of wastewater will improve the water environment and benefit the biota and ecosystems.
11 Hydrology	<P/C> SLLRDC will implement drainage plan to prevent flooding of the STP area by construction drainage canals around the entire land. The flood control function/capacity of the field will not be affected, and the occurrence and severity of flood events will not be affected. <O> The discharge of 0.41 m^3/sec from the STP is very small compared to floods that regularly take place. Thus, no hydrological impacts are expected.
12 Geographical features	<P/C> The construction of the flood retention area by SLLRDC will change the geographical feature of the land. <O> The change for flood retention is a positive impact.
Social Environment	
13 Land acquisition / resettlement	<P/C> Even with careful consideration, the JET design still cannot avoid making land acquisition for STP (4.43 ha / 21 land owners / 230MLKR) and 7 pumping stations (0.29 ha in total / 8 land owners / 26MLKR). No resettlement is necessary for any site. Sri Lankan land acquisition laws and regulations are applicable to international projects. <O> No additional land acquisition will be necessary during operation.
14 Poor (low income households)	< P/C > Increase of employment opportunity may benefit the poor. <O> JET sets the priority to benefit low income households and will use Samurdhi[*)] and other social assistance programs to lower tariff for those below the poverty line. [*)] National program with the main goal of reducing poverty in Sri Lanka. In the long term, improved wastewater management will lead to better living conditions and livelihoods.
15 Indigenous and ethnic populations	< P/C >< O> Social conditions survey and site surveys show no habitation of indigenous people in the project area. Deferent ethnic groups inhabit in the area but differences in population distribution or cultural patterns are not seen. Opposition group appealed indigenous population of the STP area as a reason of opposition. In response, Kaduwela DS investigated and issued a letter to confirm no persons or communities matching World Bank definition of “indigenous person/community” are residing in the area.

16 Local economies	< P/C > Local businesses along roadways may be affected by pipe laying and other construction activities. Traffic congestion or obstruction of access can be bad for business. On the other hand, the influx of workers can increase sales. < O> In the long term, improved wastewater management will lead to better living conditions and livelihoods.
17 Land use	< P/C >STP and pumping stations will be located on abandoned land. The site for the STP will maintain the function of flood retention and paddy field (if needed). Opposition group appealed the expected damage to the land by the construction of the STP. In response, the followings were explained in public awareness meetings where majority agreed. - Only one part of the area will be developed for the STP. The remaining, majority of the area will be developed by SLLRDC for flood control (and possibly recreational) use. - EIA studies are implemented and show no detrimental effects to the environment or wildlife. - The objective of the project is to stop the environmental damages caused by contamination. The project will improve the local natural environment. - Construction of the STP will improve the local natural environment and contribute to protecting the natural environment and natural species. < O> No additional impact caused by operation is expected.
18 Water usage	< P/C >< O> No water use conflicts (such as fisheries, irrigation) are expected downstream of STP site.
19 Existing social infrastructures and services	< P/C > Traffic congestion and disturbance will occur during pipe laying and other construction activities. < O> In the long term, improved wastewater management will lead to better living conditions and livelihoods. Nearby residents should be informed of the plant's commitment to proper O&M and they will become less concerned about any perceived impacts from plant operations.
20 Social institutions	< P/C >< O> No negative impacts on social institutions are expected.
21 Inappropriate distribution of benefits and damages	< P/C >Land acquisition procedures are in place and concerned parties will be adequately compensated to avoid any negative impacts to livelihoods. Nearby residents are concerned that property value may decline with the construction of the STP. Public outreach and consultations should be planned to address this concern. < O> JET sets the priority to benefit low income households and will use Samurdhi and other social assistance programs to reduce tariff for those below the poverty line.
22 Local conflicts of interest	< P/C >< O> No local conflicts of interest in the project area have been found other than the concern about decline in property value stated above. Small scale public consultations were held. In this series of meetings, greater rate of attendants showed strong interests and came to have positive opinions appealing the necessity and urgency. NWSDB continues with public outreach until most nearby residents are well informed of the project activities and treatment plant operation and are supportive of the initiative.
23 Cultural heritage	< P/C >There are 4 cultural heritage sites (Table 9.1-3) in the project area and the closest distance from Project component is 65m away. Construction of the project components will not negatively affect or destroy any of the protected sites < O> No negative impacts on cultural heritage are expected.
24 Landscapes	< P/C > Construction activities will alter landscapes temporarily < O> Nearby residents are concerned that the new STP may negatively affect the landscape. The new STP will alter landscapes.
25 Gender	< P/C > The Project will pay attention to and avoid any violation of women's rights in labour employment. < O> Social conditions survey revealed no gender discrimination in the project area.
26 Children's rights	< P/C > The Project will pay attention to and avoid any violation of children's rights in labour employment. Children below the age of 14 cannot be hired and ones below the age of 18 cannot do hard labour work in Sri Lanka. The Project will also comply with the regulation. < O> In the long term, improved wastewater management will lead to better living conditions, livelihoods, and health outcomes for children.
27 Infectious diseases such as HIV/AIDS	< P/C > Influx of workers and construction activities can lead to spread of infectious diseases and increased incidence of injuries. Disease prevention education and proper treatment of injuries will reduce these impacts. < O> No negative impacts are expected during operation.
28 Working conditions (including occupational safety)	< P/C >< O> Working conditions may deteriorate and accidents may occur during construction and plant operation.

29 Accidents	< P/C > Traffic congestion and even accidents may occur during construction. Micro tunnelling (as opposed to open-cut methods) can reduce disruption to traffic flow. < O> Accidents may also occur during plant operation.
30 Global warming	The Project will not contribute to global warming considerably.

【Evaluation】

A: Significant impact is expected + : Impact is Positive P/C: Preconstruction/Construction Period
B: Some impact is expected - : Impact is Negative O: Operation Period
C: Extent of impact is unknown
D: No impact is expected
Source: JET

9.8 ASSESSMENT OF ENVIRONMENTAL IMPACTS

Based upon the findings of the impact study, impacts of the Project on social and environmental conditions in the Project area were reassessed. The final assessment results are given in **Table 9.8-1**.

Table 9.8-1 Final Assessment of Project Impacts

Title	At time of Scoping		Final Assessment	Reason
Pollution Control				
1 Air pollution	P/C	B-	B-	Dust and exhaust gas emissions may affect air quality in the immediate vicinity during construction but there will not be significant deterioration to the current situation.
	O	D	D	No impacts are expected during operation.
2 Water pollution	P/C	B-	B-	Soil runoff may increase turbidity downstream of STP site during construction but no pollution by chemical materials is expected.
	O	B+	B+	Collection and treatment of sewage and greywater will reduce water pollution in the project area.
3 Waste	P/C	B-	B-	Construction waste and soil from excavation will be treated adequately and removed to NWSDB-owned disposal site.
	O	B-	B-	Sludge from operation of the STP will be generated but composted and sold. If not, it will be accepted by an official disposal site.
4 Soil pollution	P/C	B-	B-	Appropriate care will be taken to avoid leakage of oil from machineries.
	O	B-	D	Sludge from operation of the STP will be composted and sold. The possibility that the sludge will be disposed of at landfill and cause soil pollution is minimal.
5 Noise and vibrations	P/C	B-	B-	Noise produced by construction vehicles and construction activities can be minimized by proper maintenance of equipment and erection of barriers.
	O	B-	B-	Noise by pumps and other equipment in the STP and pumping stations can be reduced to or below allowable levels by installing these underground or within enclosures.
6. Ground subsidence	P/C	C	D	The bearing layer is of STP site is shallow and very hard. No ground subsidence is expected.
	O	C	D	The construction design takes special care in avoiding any effects on ground subsidence.
7. Offensive odours	P/C	D	B-	No impacts are expected during construction. Nearby residents concerned about odours from the STP will be informed of preventative measures and should be well aware of the countermeasures.
	O	B-/B+	B-/B+	B-: Offensive odours may be generated during STP operation. These odours will be removed by well-established control technologies. B+: Collection and treatment of wastewater and greywater will reduce odours in the general environment.
8 Bottom sediment	P/C	C	D	Water turbidity may increase during construction but no extraneous materials such as chemicals will be deposited in bottom sediment downstream.
	O	B+	B+	Collection and treatment of sewage and greywater will reduce adverse impacts to bottom sediment in the project area.
Natural Environment				

Title	At time of Scoping		Final Assessment	Reason
9 Protected lands	P/C	C	B-	Construction activities will take place on roads and developed land. Construction will not disturb native protected lands. However, care should be taken to prevent accidental impacts to the animals from the sanctuary during construction.
	O	C	B+	Ecosystems will benefit from improved environmental conditions.
10 Biota and ecosystems	P/C	C	B-	STP and related facilities will be in urban areas and no virgin land will be disturbed by the Project. Therefore, impacts on biota and ecosystems during construction are considered minimal. However, care should be taken to prevent accidental impacts to the animals from the sanctuary during construction.
	O	B+/C	B+	Ecosystems will benefit from improved environmental conditions.
11 Hydrology	P/C	C	B-	By SLLRDC's drainage plan, The flood control function/capacity of the field will not be affected, and the occurrence and severity of flood events will not be affected. However, in order to prevent misunderstandings, residents should be well aware of the plan.
	O	C	D	The STP discharge is very small compared to floods that regularly take place. No hydrological impacts are expected.
12 Geographical features	P/C	C	D	Flood retention measures will not have any negative impacts.
	O	D	B+	Improvement of flood retention is a positive impact.
Social Environment				
13 Land acquisition / resettlement	P/C	B-	B-	Land acquisition is required for STP and pumping stations. This will follow the legal process and land owners' rights will be respected.
	O	D	D	No additional land acquisition is planned after the plant goes into operation.
14 Low income households	P/C	D	B+	The impacts of construction activities will be the same for all income levels. Increase of employment opportunity may benefit the poor.
	O	C	B+	Improved wastewater management will lead to better living conditions and livelihoods during STP operation. Samurdhi and other social aid programs will be used to reduce tariff for low income households.
15 Indigenous and ethnic populations	P/C	C	D	There is no habitation of indigenous people in the project area. Deferent ethnic groups inhabit in the area but differences in population distribution or cultural patterns are not seen. Thus, no adverse impacts are expected.
	O	C	D	
16 Local economies	P/C	C	B+/B-	B+: Influx of workers may increase the volume of local businesses. B-: Traffic disturbances and obstruction of access may affect local businesses during STP construction and pipe laying.
	O	C	B+	Improved wastewater management will lead to better living conditions and livelihoods.
17 Land use	P/C	C	B+/B-	STP and pumping stations will be located on abandoned land. Flood retention measures still be in place and paddy fields will be maintained if necessary. Opposition group appealed the expected damage to the land by the construction of the STP. So adequate explanation is necessary. Improvement of flood retention is a positive impact.
	O	D	D	No additional impact caused by operation is expected.
18 Water usage	P/C	C	D	No water-use related conflicts (such as fisheries and irrigation) are expected downstream of STP site.
	O	C	D	
19 Existing social infrastructures and services	P/C	B-	B-	Traffic congestion and disruptions are expected during pipe laying and other construction activities. These will be temporary and localized.
	O	C	B-/B+	B- Nearby residents are being informed of preventive measures and best practices in O&M. They are becoming more assured of the efforts taken to avoid operational mishaps and the safety and security in their living environment. B+: Improved wastewater management will lead to better living conditions, livelihoods, and health outcomes.
20 Social institutions	P/C	D	D	This project is for improvement of the water environment, and no impacts are expected on social capital or local decision-making bodies.
	O	D	D	
21 Inappropriate distribution of benefits and damages	P/C	C	B-	Land acquisition/relocation will affect livelihoods but land acquisition procedures are in place and concerned parties will be adequately compensated.
	O	C	B-	No impacts to the poor are expected. (Samurdhi and other social aid programs will reduce tariff for low income households.)

Title	At time of Scoping		Final Assessment	Reason
				Nearby residents were concerned about the decline of property value. A series of public awareness activities should be conducted. (The residents became more supportive as they learned more about the Project and its benefits.)
22 Local conflicts of interest	P/C	C	B-	Nearby residents were concerned about the decline of property value. A series of public awareness activities should be conducted. (The residents became more supportive as they learned more about the Project and its benefits.) NWSDB continues with public outreach until most nearby residents are well informed of the project activities and treatment plant operation and are supportive of the initiative.
	O	C	B-	
23 Cultural heritage	P/C	C	D	No impacts on cultural heritage are expected.
	O	C	D	
24 Landscapes	P/C	B-	B-	Construction activities will alter landscapes temporarily.
	O	B-	B-	The new facilities will change the landscape. The planting of trees and other vegetation around the facilities and the buffer zone will improve the visual environment. Nearby residents were informed of the limited footprint (only 25% of the whole area) of the STP and are accepting that the change will not be drastic.
25 Gender	P/C	C	D	No gender discrimination was found, and equal working opportunity can be suggested for construction.
	O	C	D	No gender discrimination was found in the project area.
26 Children's rights	P/C	C	B-	Violation of children's rights may occur. Hiring practice will comply with age restriction stated in the relevant laws
	O	C	B+	Improved wastewater management will lead to better living conditions, livelihoods, and health outcomes.
27 Infectious diseases such as HIV/AIDS	P/C	B-	B-	Influx of workers and construction activities may increase incidence of infectious diseases and injuries during the construction period. This will be addressed with health education, safety precautions and proper treatment of injuries.
	O	D	D	Incidences of infectious diseases are not expected to increase as a result of the Project.
28 Working conditions (including occupational safety)	P/C	B-	B-	Accidents can occur during construction and operation. Working conditions will be monitored and safety measures taken during construction and operation.
	O	B-	B-	
29 Accidents	P/C	B-	B-	Traffic congestion and related accidents may occur during construction and mitigation measures will be considered carefully. Micro-tunnelling can reduce disruption to traffic flow.
	O	B-	B-	Accidents may also occur during plant operation. Safety precautions will be taken to minimize accidents during operation. Nuisance to public from malfunctioning of system, accumulation of sewage on site or at pump houses / WWTP, odour, etc.
30 Global warming	P/C	D	D	Greenhouse gas emissions during construction / operation will be negligible.
	O	D	D	

【Evaluation】
A: Significant impact is expected
B: Some impact is expected
C: Extent of impact is unknown
D: No impact is expected

+ : Impact is Positive
- : Impact is Negative

P/C: Preconstruction/Construction Period
O: Operation Period

Source: JET

9.9 MITIGATION MEASURES

The Environmental Management Plan (EMP) identifies mitigation measures for any potential negative environmental impacts and will be implemented through the Environmental Monitoring Plan (EMoP). The latter identifies steps to be taken as well as the relevant authorities that will ensure the effective implementation of mitigation measures. Requirements for executing the plans, monitoring frequency, responsible organizations, necessary capacity building in the organizations and required budget are outlined in these documents. Draft versions of the EMP and EMoP are presented in the following sections.

9.9.1 Objective of the Environmental Monitoring Plan

In order to fulfil the following objectives, an appropriate Environmental Monitoring Plan (EMoP) will be carried out to

- monitor the implementation of mitigation measures to ensure that they conform with the requirements
- ensure that the impacts do not exceed legal standards
- provide timely warning of potential environmental damages

The EMoP characterizes the proposed mitigation and monitoring actions as a set of tasks. The EMoP assigns responsibility of implementation to the project proponent, contractor(s), and regulatory agencies.

9.9.2 Outline of the Environmental Monitoring Plan

Environmental Monitoring activities shall take place during Design, Construction and Operation stages of the Project. Regular site inspections are required to assess whether the various mitigation measures are properly implemented and if they are effective in achieving the objectives. Outline of the Environmental Monitoring Plan is presented in this section.

One important aspect of monitoring is to assess the effectiveness of the mitigation measures. Where they are found to be lacking, appropriate new actions should be undertaken. This requires measurement of selected environmental parameters at identified locations and a proposed measurement schedule is given in the table below.

Table 9.9-1 Draft Environmental Management Plan

Impacts	Mitigation Measures	Implementing Organization	Responsible Organization	Cost
Before / During Construction				
Air Pollution	Dust: Cover excavated soil with tarp, watering of excavated soil, other dust reduction measures. Exhaust gases: Ensure vehicles and equipment are in proper working condition.	Contractor	MC/NWSDB	Included in the construction cost
Water Pollution	Ensure vehicles, equipment, and infrastructures are properly maintained and in good working condition to prevent spills of fuels and chemicals. Use proper containment for chemicals to prevent spills. Soil erosion control such as silt fences for staked hay bales should be installed to prevent soil runoff into waterways.	Contractor	MC/NWSDB	Included in the construction cost
Waste	Wastes generated during construction should be collected onsite and disposed of properly in the city's waste disposal facilities.	Contractor	MC/NWSDB	Included in the construction cost
Soil Pollution	Ensure vehicles, equipment, and infrastructures are properly maintained and in good working condition to prevent spills of oil, fuels and chemicals. Use proper containment for chemicals to prevent spills.	Contractor	MC/NWSDB	Included in the construction cost
Noise and Vibrations	Select machineries with low noise and vibration. Ensure they are in proper working order. Drive slowly and operate machinery at reasonable levels. Use enclosures to block noise. Schedule work to minimize impact to the surroundings. Noise generating activities close to residential and public areas should be carried out between 7 am and 6 pm. Limit maximum noise level at residential and public areas to 75 dB during the day time. Special consideration should be given to the noise sensitive sites such as schools and hospitals whenever using noisy equipment. With sufficient justification by the contractor, and subjective to the location, if any activity is permitted to be carried out during night time, the noise level should be maintained below 50 dB. Personnel Protective Equipment to be provided to labor force involved in high noise activities.	Contractor	MC/NWSDB	Included in the construction cost
Offensive odours	In order to reach a consensus with nearby residents of STP before construction, NWSDB should continue with public outreach on odour prevention measures until most of the nearby residents are assured that potential problems can be addressed effectively. During construction, well-established control technologies will be applied. The design uses three levels of odour protection 1) The odour producing areas will be covered by corrosion resistant cover so odours don't escape into the atmosphere. 2) In addition, the whole wastewater treatment plant itself can be enclosed by roof and wall to further prevent escape of odours. 3) All odourous air is captured and treated by a biological filter and an activated carbon absorption system.	NWSDB	NWSDB	Covered by NWSDB's budget
Protected lands Biota and ecosystems	Care should be taken to prevent accidental impacts to the animals from the sanctuary during construction.	Contractor	MC/NWSDB	Included in the construction cost
Hydrology	By SLLRDC's drainage plan, any adverse impacts by floods are expected. However, in order to prevent misunderstandings, residents should be well aware of the plan. SLLRDC will implement drainage plan to prevent flooding of the STP area by construction drainage canals around the entire land. The flood control	NWSDB	NWSDB	Covered by NWSDB's budget

Impacts	Mitigation Measures	Implementing Organization	Responsible Organization	Cost
	function/capacity of the field will not be affected, and the occurrence and severity of flood events will not be affected.			
Land acquisition / resettlement	Follow land acquisition procedures (Land Acquisition Act / National Involuntary Resettlement Policy) and consult with concerned parties. Compensate in accordance with the Abbreviated Resettlement Action Plan which was prepared based on Sri Lankan laws and the JICA Guideline	NWSDB	MOCPWS	Will be calculated through LA process.
Local economies	Implement a traffic management plan including hazard communication (signs), rerouting and employing traffic control personnel. Manage construction times to avoid causing traffic congestion. Proper road barriers should be used by the roadsides.	Contractor	MC/NWSDB	Included in the construction cost
Existing social infrastructures and services	NWSDB should continue with public outreach until most nearby residents are assured that proper maintenance measures will be taken and that no undue concern remains in terms of safety and security to their living environment. A separate space (temporary access) should be demarcated for the pedestrians and this pathway should be cleared from construction waste. Work zones should be clearly demarcated with warning signs, transition and buffer area should be provided to reduce any risks to road users. Restricting the movement of heavy vehicles during the peak hours. Operation of heavy construction vehicles/equipment should be stopped during the peak hours, where the construction site is located within 150 m of a major road or a road junction. Making those who are in the impact zone aware, early, about the duration of accessibility issues. Providing alternative parking areas within a reasonable proximity. Obtaining information/plans on utility networks laid in the project area from the respective utility companies and preparation of an inventory of utilities at proposed site. Liaise with utility companies on necessary shifting arrangements or demarcation of pipeline trace. Making the machine operators aware of the existing utility lines and providing ample instructions to be cautious during the machine operations. Informing the service providers promptly on any accidental damage to utilities, and with them for immediate repairing of damages.	NWSDB	NWSDB	Covered by NWSDB's budget
Inappropriate distribution of benefits and damages	Refer to "Land acquisition / resettlement" for Land Acquisition.	-	-	-
	NWSDB should continue with public outreach until most nearby residents are well informed and are supportive of STP construction and operation.	NWSDB	NWSDB	Covered by NWSDB's budget
Local conflicts of interest	NWSDB should continue with public outreach until most nearby residents are well informed of the project activities and treatment plant operation and are supportive of the initiative.	NWSDB	NWSDB	Covered by NWSDB's budget
Landscapes	NWSDB should continue with public outreach until most nearby residents understand the restricted footprint of the STP and are no longer concerned with the presence of the facilities nearby.	NWSDB	NWSDB	Covered by NWSDB's budget
	Use barricades and enclosures around construction sites.	Contractor	MC/NWSDB	Included in the construction cost
Children's rights	Comply with Sri Lankan General Labour Laws. (Children below the age of 14 cannot be hired and ones below the age of 18 cannot do hard labour work)	Contractor	MC/NWSDB	-
Infectious diseases	Conduct awareness and training programs with workers. Provide proper medical	Contractor	MC/NWSDB	Included in the

Impacts	Mitigation Measures	Implementing Organization	Responsible Organization	Cost
such as HIV/AIDS	equipment and care.			construction cost
Working conditions (including occupational safety)	Comply with Sri Lankan General Labour Laws. Distribute and display safety manuals and educate workers. Monitor working conditions periodically.	Contractor	MC/NWSDB	Included in the construction cost
Accidents	Refer to “Local economies” to avoid external accidents. Refer to “Working conditions” to avoid internal accidents.	-	-	-
During Operation				
Water Pollution (Water Quality improvement indicator)	Sampling and testing for water quality parameters. Monitoring the flow rate at the point of effluent discharge	NWSDB	MOCPWS	Included in the O&M cost
Waste	Dry sludge generated from STP will be composted and used as fertilizer. Dried sludge to be covered while transporting to disposal site.	NWSDB / Private or Public Treatment Plant	MOCPWS	Included in the O&M cost
Noise and vibration	Minimize noise and vibration through proper facility design and selection of equipment, including the use of enclosures. Noise from the pump house / WWTP (at the boundary) should not exceed the noise limits gazetted by the CEA.	NWSDB	MOCPWS	Included in the O&M cost
Offensive odours	Odour reduction systems are included in the facility designs.	NWSDB	MOCPWS	Included in the O&M cost
Existing social infrastructures and services	Nearby residents should be informed of preventive measures and best practices in O&M. (They should be more assured of the efforts taken to avoid operational mishaps and the safety and security in their living environment.)	NWSDB	MOCPWS	Included in the O&M cost
Inappropriate distribution of benefits and damages	Nearby residents were concerned about the decline of property value. A series of public awareness activities should be conducted.	NWSDB	MOCPWS	Included in the O&M cost
Local conflicts of interest	Nearby residents were concerned about the decline of property value. A series of public awareness activities should be conducted. NWSDB continues with public outreach until most nearby residents are well informed of the project activities and treatment plant operation and are supportive of the initiative.	NWSDB	MOCPWS	Included in the O&M cost
Landscapes	Reduce impacts to landscapes by construction of barricades and planting of trees.	NWSDB	MOCPWS	Included in the O&M cost
Working conditions (including occupational safety) / Accidents	Comply with Sri Lankan General Labour Laws. Distribute and display safety manuals and educate workers. Monitor working conditions periodically.	NWSDB	MOCPWS	Included in the O&M cost
Accidents	Nuisance to public from malfunctioning of system, accumulation of sewage on site or at pump houses / WWTP, odour, etc.	NWSDB	MOCPWS	Included in the O&M cost

Source: JET

Table 9.9-2 Environmental Monitoring Plan (1. Pre-construction)

Aspect	Parameter	Method	Frequency	Execution Agency / Responsibility	Location	Cost
Air Pollution						
Air quality / Odour	SO_x, NO_x, O_3, PM_{10}, $PM_{2.5}$, TSPM, VOCs, Ammonia, H_2S	Spectrometric method; High volume sampling and Gravimetric analysis	Once (Prior to any construction activities on site)	Contractor / External Monitoring Committee / NWSDB	At least 2 locations at the boundary of WWTP site (upwind and downwind) and at 1 location each at the boundary of the major pump stations	Approx. Rs. 200,000
Water Pollution						
Water Quality (surface)	pH, EC, TSS, BOD, COD, DO, NH_4-N, Kjeldahl-N, NO_3-N, Dissolved-P, T-N, E-coli, Total Coliform Bacteria as set in EIA report. Further, all parameters in the National Environmental Act – Tolerance limit for the Discharge of Industrial Waste in to Inland Surface Waters (refer relevant gazette) should be obtained as baseline water quality data	Portable water quality meter, Spectrometric method, and as defined in measurement methods designated by the gazette.	Once (Prior to any construction activities on site)	Contractor / External Monitoring Committee / NWSDB	At least 3 locations (one upstream of treated effluent discharge point and 2 downstream)	Approx. Rs. 250,000
Water Quality (ground)	All parameters in the Sri Lanka Specification for Potable Water (First Revision) SLS 614:2013 (39 parameters and pesticides)	ditto	Once (Prior to any construction activities on site)	Contractor / External Monitoring Committee / NWSDB	At least 3 locations surrounding WWTP (wells in the vicinity can be used) At least one location (well) at each main pump house location	Approx. Rs. 400,000
Flow rate						
Flow rate	Flow rate of the receiving water body	Electromagnetic flowmeter or equivalent	Daily for one year	NWSDB	At the points of effluent discharge	Rs. 5,000,000
Noise and Vibrations						
Noise level	Equivalent A weighted sound pressure level (LAeq)	Portable noise meter (range 0-120 dB(A))	Once (Prior to any construction activities on site)	Contractor / External Monitoring Committee / NWSDB	Houses surrounding WWTP and pump houses	Approx. Rs. 100,000
Vibration	Peak Particle Velocity with reference to vibration frequencies applicable for different categories of structures	Seismographs or equivalent	Once (Prior to any construction activities on site)	Contractor / External Monitoring Committee / NWSDB	Houses surrounding WWTP and pump houses	Approx. Rs. 100,000
Land acquisition / resettlement – Inappropriate distribution of benefits and damages (refer to CHAPTER 10 ABBREVIATED RESETTLEMENT ACTION PLAN)						
Public awareness programs for Offensive odours / Hydrology / Existing social infrastructures and services / Inappropriate distribution of benefits and damages / Local conflicts of interest / Landscapes (refer to 9.8 Public Awareness)						
-	-	-	-	-	Grand Total (Approx. Rs.)	6,050,000

Source: EIA report (Sri Jayawardenapura Kotte Wastewater Collection, Treatment, and Disposal Project Environmental Impact Assessment Final Report, July 2019)

Table 9.9-3 Environmental Monitoring Plan (2. Construction)

Aspect	Parameter	Method	Frequency	Execution Agency / Responsibility	Location	Cost
Air Pollution						
Air quality / Odour	SO_x, NO_x, O_3, PM_{10}, $PM_{2.5}$, TSPM, VOCs, Ammonia, H_2S	Spectrometric method; High volume sampling and Gravimetric analysis	Quarterly	Contractor / External Monitoring Committee / NWSDB	At least 2 locations at the boundary of WWTP site (upwind and downwind) and at 1 location each at the boundary of the major pump stations	Approx. Rs. 2,400,000
Dust, Noise and Vibrations						
Dust / Noise / Vibrations	-Noise -Dust levels at construction site -Emission certificates of motor vehicles -Method of transport of construction material -Wetting frequency of dust generating surfaces -Number of public complaints -Regulating / minimizing construction activities during peak hours and at night.	Check whether the action proposed is implemented properly for dust, noise and vibrations arising from construction sites	Every week Emission certificates of construction vehicles to be checked and verified prior to use.	Contractor / External Monitoring Committee / NWSDB	At all sites where project interventions are carried out	Included in the construction cost
Water Pollution						
Water Quality	EC, TSS, DO, BOD, COD, pH, Oil and grease, E-coli	Portable water quality meter, Spectrometric method	Quarterly	Contractor / External Monitoring Committee / NWSDB	At least 3 locations (one upstream of treated effluent discharge point and 2 downstream)	Approx. Rs. 3,000,000
Waste						
Visual inspection of construction sites / Public complaints	Proper disposal of solid, liquid and construction waste	Check whether the action proposed is implemented properly with respect to disposal of solid, liquid and construction related waste	Every week	Environmental Officer and the Environmental Specialist, Sociologist	At all sites where project interventions are carried out	Included in the construction cost
Soil Pollution						
Leakage	Situation	Recording	In each case	Contractor / MC&NWSDB	Construction sites	Included in the construction cost
Noise and Vibrations						
Noise level	Equivalent A weighted sound pressure level (LAeq)	Portable noise meter (range 0-120 dB(A))	Quarterly	Contractor / External Monitoring Committee / NWSDB	Houses surrounding WWTP and pump houses	Approx. Rs. 1,200,000

Aspect	Parameter	Method	Frequency	Execution Agency / Responsibility	Location	Cost
Local economies - Existing social infrastructures and services						
Mitigation of nuisance to general public due to hindrance in accessibility	-Work zone management practices – if the approved work zone plan is maintained, required barricades, danger tape, signs etc. are installed, presence of traffic controller where required. -Condition of the temporary walkways and traffic lanes. -Public complaints	Check whether the action proposed is implemented properly to reduce public nuisance	Every week	Environmental Officer and the Environmental Specialist, Sociologist	At all sites where pipe laying activities take place	Included in the construction cost
Reinstatement of roads after trenching	Condition of road surface, road edges and checking with standards of relevant authority (RDA/PRDA, etc.).	Check whether the action proposed is implemented properly and standards are met and acceptable to RDA/ PRDA.	Throughout rehabilitation and on completion	Engineer in charge liaising with RDA/PRDA	Along all roads in the project after pipe laying activities have been completed and rehabilitation work is in progress and directly after completion	Included in the construction cost
Protected lands / Biota and ecosystems						
Observation	Care should still be taken to prevent accidental impacts to the animals from Beddagana Bird Sanctuary during construction nearby.	Recording	Anytime during construction nearby.	Contractor / MC&NWSDB	Construction sites	-
Landscapes						
Barricades	Setting condition	Recording	Everyday	Contractor / MC&NWSDB	Construction sites	Included in the construction cost
Children's rights						
Employment	Age	Identification	When hiring	Contractor / MC&NWSDB	Adequate venue	-
Infectious diseases such as HIV/AIDS						
Awareness program	Education	Recording	When hiring	Contractor / MC&NWSDB	Adequate venue	Included in the construction cost
Working conditions (including occupational safety)						
Working conditions	Safety conditions, working hours, termination, wages, holiday, etc.	Recording	Everyday	Contractor / MC&NWSDB	Construction sites	Included in the construction cost
Accidents (refer to "Local economies" for external accidents and to "Working conditions" for internal accidents						
-	-	-	-	-	Grand Total (Approx. Rs.)	6,600,000

Construction period set at 3 years for calculation purposes
Source: EIA report with modification by JET

Table 9.9-4 Environmental Monitoring Plan (3. Operation)

Aspect	Parameter	Method	Frequency	Execution Agency / Responsibility	Location	Cost
Water Pollution						
Water Quality (Water Quality improvement indicator)	pH, EC, TSS, BOD, COD, DO, NH_4-N, Kjeldahl-N, NO_3-N, Dissolved-P, T-N, E-coli, Total Coliform Bacteria as set in EIA report. Further, all parameters in the National Environmental Act – Tolerance limit for the Discharge of Industrial Waste in to Inland Surface Waters (refer relevant gazette) should be obtained as baseline water quality data	Portable water quality meter, Spectrometric method, and as defined in measurement methods designated by the gazette. (measured by Competent Laboratory)	Monthly during first year Annually	Contractor / NWSDB	Immediate downstream of discharge point	Cost to be included in operational budget
	pH, EC, TSS, BOD, COD, DO, NH_4-N, Kjeldahl-N, NO_3-N, Dissolved-P, T-N, E-coli, Total Coliform Bacteria as set in EIA report.	Portable water quality meter, Spectrometric method, and as defined in measurement methods designated by the gazette.	Intermittently during the dry season	Contractor / External Monitoring Committee / NWSDB	At two locations. One upstream to the point of discharge, and the other at the downstream location	Rs. 750,000 per year
Waste						
Waste	Amount of Sludge, date	Recording	In each case of transport	NWSDB / NWSDB	STP	Included in the operation cost
Noise and Vibrations						
Noise level	Equivalent A weighted sound pressure level (LAeq)	Portable noise meter (range 0-120 dB(A))	Annually or as decided on receiving complaints from public	Contractor / NWSDB	During night or as required per complaint received at the boundary of WWTP / pump house and /or nearest house making complaint.	Approx. Rs. 50,000/= per set of readings on noise and vibration
Vibration	PPV with reference to vibration frequencies applicable for different categories of structures	Seismographs or equivalent				
Offensive odours						
Offensive odours	Monitoring of hydrogen sulfide, VOCs (would be necessary on receiving complaints)	Spectrometric method	Case by case on receiving public complaints in addition to annual testing of air quality	Competent Laboratory / service provider to be employed / NWSDB	Routine inspection and on receiving complaints	Approx. Rs. 50,000/= to 100,000/= for total set of air quality readings
Landscapes						
Landscapes (planting)		Observation	Everyday	NWSDB / NWSDB	STP	-
Working conditions (including occupational safety) / Accidents						
Working conditions	Safety conditions	Recording	Everyday	NWSDB / NWSDB	STP and pumping stations	Included in the operation cost
Accidents						
Malfunctio	Number and magnitude of occurrences.	Emergency Response	Annually or on	NWSDB /	Routine inspection and on	Inspection cost

Aspect	Parameter	Method	Frequency	Execution Agency / Responsibility	Location	Cost
ning	Deployment of Emergency Response Team	Team deployment from NWS&DB. Establishment of sanitation safety plan	event basis	NWSDB	receiving complaints or on occurrence of breakdowns.	
Public awareness programs for Existing social infrastructures and services / Inappropriate distribution of benefits and damages / Local conflicts of interest (refer to 9.8 Public Awareness)						
-	-	-	-	-	Grand Total (Approx. Rs.)	800,000 or more

Source: JET

Draft Environmental Monitoring Form (Pre-construction Period)

1. Response/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from government agencies (such as CEA etc.)	

2. Pollution

2.1 Air Quality

Parameter	Unit	Measured Value (average)	Measured Value (Max.)	Sri Lankan Standards	International Standards	Standards for Contract	Measurement Point *2	Time&Date
TSPM				-	-	-	(Specify here)	From (AM/PM) ___:___ To (AM/PM) ___:___ ___/___/ 20___ (Frequency: 1 time/point)
PM_{10}				100 (24hr)	50 (24hr) *1	100 (24hr)		
$PM_{2.5}$				50 (24hr)	25 (24hr) *1	50 (24hr)		
NO_X as NO_2				100 (24hr)	100 (24hr) *1	100 (24hr)		
SO_X as SO_2	µg/m³			80 (24hr)	20 (24hr) *1	80 (24hr)		
O_3				200 (1hr)	100 (8hr) *1	200 (1hr)		
Total VOCs				-	-	-		
Ammonia				-	-	-		
H_2S				-	-	-		

*1: International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines
*2: At least 2 locations at the boundary of WWTP site (upwind and downwind) and at 1 location each at the boundary of the major pump stations

2.2 Water Quality

Parameter	Unit	Measures Value (average)	Measures Value (Max.)	Sri Lankan Standards	International Standards	Standards for Contract	Measurement Point *5	Time&Date
pH	-			6.0-8.5	6-9*1	6.0-8.5	(Specify here)	
EC				-	-	-		
TSS	mg/L			50	25*1	15*4		
BOD	mg/L			30	25*2	15*4		
COD	mg/L			250	125*2	75*4		
DO	mg/L			-	-	-		
NH_4-N	mg/L			50	-	2.5*4		
Kjeldahl-N	mg/L			150	-	2.5*4		
NO_3-N	mg/L			10	-	10*4		(AM/PM) ___:___
Dissolved-P	mg/L			5	-	2*4		
T-P	mg/L			10	2*3	3*4		___/___/ 20___
E-coli	MPN/100mL			-	-	-		
Total Coliform	MPN/100mL			-	400*3	400*3		(Frequency: 1 time/point)

*1:EPA Environmental Quality Standards for Conservation of the Living Environment
*2:EU (Urban Waste Water Directive, Council Directive 91/271/EEC concerning urban waste-water treatment)

*3: International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines
*4: Treatment levels stricter than the national standards by CEA
*5: At least 3 locations (one upstream of treated effluent discharge point and 2 downstream)

2.3 Noise and Vibration and Solid Waste

Parameter	Unit	Measures Value (average)	Measures Value (Max.)	Sri Lankan Standards	International Standards*1	Standards for Contract	Measurement Point*2	Frequency
Equivalent continuous A sound level (Laeq, 10) and vibration level (Lv10)	dB(A)			55-70 (depending on location)	55-70	55-70	(Specify here)	From (AM/PM) ___:___ To (AM/PM) ___:___ ___/___/ 20___ (Frequency: 1 time/point)

*1:International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines
*2: Houses surrounding WWTP and pump houses

Draft Environmental Monitoring Form (Construction Period)

1. Response/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from government agencies (such as CEA etc.)	

2. Pollution
2.1 Air Quality

Parameter	Unit	Measured Value (average)	Measured Value (Max.)	Sri Lankan Standards	International Standards	Standards for Contract	Measurement Point *2	Time&Date
TSPM	μg/m^3			-	-	-	(Specify here)	From (AM/PM) ___:___ To (AM/PM) ___:___ ___/___/ 20___ (Frequency: Quarterly)
PM_{10}				100 (24hr)	50 (24hr) *1	100 (24hr)		
$PM_{2.5}$				50 (24hr)	25 (24hr) *1	50 (24hr)		
NO_X as NO_2				100 (24hr)	100 (24hr) *1	100 (24hr)		
SO_X as SO_2				80 (24hr)	20 (24hr) *1	80 (24hr)		
O_3				200 (1hr)	100 (8hr) *1	200 (1hr)		
Total VOCs				-	-	-		
Ammonia				-	-	-		
H_2S				-	-	-		

*1: International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines
*2: At least 2 locations at the boundary of WWTP site (upwind and downwind) and at 1 location each at the boundary of the major pump stations

2.2 Water Quality

Parameter	Unit	Measures Value (average)	Measures Value (Max.)	Sri Lankan Standards	International Standards	Standards for Contract	Measurement Point *4	Time&Date
pH	-			6.0-8.5	6-9*1	6.0-8.5	(Specify here)	(AM/PM) ___:___ ___/___/ 20___ (Frequency: Quarterly)
EC				-	-	-		
TSS	mg/L			50	25*1	15*3		
BOD	mg/L			30	25*2	15*3		
COD	mg/L			250	125*2	75*3		
DO	mg/L			-	-	-		
Oil & grease	mg/L			10	10	10		
E-coli	MPN/100mL			-	-	-		

*1:EPA Environmental Quality Standards for Conservation of the Living Environment
*2:EU (Urban Waste Water Directive, Council Directive 91/271/EEC concerning urban waste-water treatment)
*3:Treatment levels stricter than the national standards by CEA
*4:At least 3 locations (one upstream of treated effluent discharge point and 2 downstream)

2.3 Noise and Vibration and Solid Waste

Parameter	Unit	Measures Value (average)	Measures Value (Max.)	Sri Lankan Standards	International Standards*1	Standards for Contract	Measurement Point*2	Frequency
Equivalent continuous A sound level (Laeq, 10) and vibration level (Lv10)	dB(A)			55-70 (depending on location)	55-70	55-70	(Specify here)	From (AM/PM) ___:___ To (AM/PM) ___:___ ___/___/ 20___ (Frequency: Every week)

*1:International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines
*2: At all sites where project interventions are carried out

3. Social Environment

Monitoring Item	Monitoring Results during Report Period	Measures to be Taken
Traffic disruption	Traffic congestion number and time (minutes)/day	1) Arranging specific person for control the flow of traffic, 2) Completing the construction works at the sections with high traffic flow as short time period.

Draft Environmental Monitoring Form (Operation Period)

1. Response/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from government agencies (such as CEA etc.)	

2. Pollution

2.1 Water Quality

Parameter	Unit	Measures Value (average)	Measures Value (Max.)	Sri Lankan Standards	International Standards	Standards for Contract	Measurement Point*5	Time&Date
pH	-			6.0-8.5	6-9*1	6.0-8.5	(Specify here)	(AM/PM) ___: / ___ / 20 (Frequency: Annually)
EC				-	-	-		
TSS	mg/L			50	25*1	15*4		
BOD	mg/L			30	25*2	15*4		
COD	mg/L			250	125*2	75*4		
DO	mg/L			-	-	-		
NH_4-N	mg/L			50	-	2.5*4		
Kjeldahl-N	mg/L			150	-	2.5*4		
NO_3-N	mg/L			10	-	10*4		
Dissolved-P	mg/L			5	-	2*4		
T-P	mg/L			10	2*3	3*4		
E-coli	MPN/100mL			-	-	-		
Total Coliform	MPN/100mL			-	400*3	400*3		

*1:EPA Environmental Quality Standards for Conservation of the Living Environment
*2:EU (Urban Waste Water Directive, Council Directive 91/271/EEC concerning urban waste-water treatment)
*3: International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines
*4: Treatment levels stricter than the national standards by CEA
*5: Immediate downstream of discharge point

2.2 Solid Waste

Parameter	Unit	Measures Value (average)	Measures Value (Max.)	Sri Lankan Standards	International Standards	Standards for Contract	Measurement Point	Time&Date
Volume of sludge	mg/m^3			-	1000	-	(Specify here)	(AM/PM) ___: / ___ / 20 (Frequency: 1 time/6 months)

*EU Council Directive 86/278/EEC

9.10 PUBLIC AWARENESS - STAKEHOLDER CONSULTATION

9.10.1 Initial Awareness Meetings

Stakeholder meetings are typically held at the early stages of a project once basic information such as location, technology to be used, and impacts are determined in enough detail to inform residents and other stakeholders of the effect of the project. In the current project, while discussions with government Ministries (Megapolis and Western Development, UDA, SLLRDC, NWSDB etc.) were ongoing for site selection, residents came to know about the project through surveys related to the project such as Social Conditions Survey which was a series of interviews to obtain basic conditions of residents in the Project area, and Environmental and Social Considerations Survey. Although these surveys were performed throughout the whole project area, residents living near the candidate STP sites may have been especially sensitive to the information. In addition, two representatives from a farmers group were invited to one of the initial Ministry level discussions. The Megapolis and Western Development Ministry requested their participation as their opinions and inputs would be important to the discussion, and their comments were taken during the meeting in which candidate locations for the STP were discussed.

In this way, residents of the Heenatikumbura area came to know about the Project through comparatively narrow contexts and this may have raised unease. This was exacerbated when construction of a condominium unrelated to the project started in the area. Residents misunderstood this as construction of the STP, further increasing their concerns.

Subsequently, a group called the Heenatikumbura Field Preservation Society (HFPS) protested the construction of the STP by sending objection letters and conducting a protest demonstration.

NWSDB responded to the protest activities and held the first public awareness meeting at a temple near the planned STP site on 2018/3/25. Approximately 400 people attended. NWSDB, EIA consultant and local staff of JET explained the outline and the benefit of the Project. Head Priest of the temple made a speech opposing the Project. HFPS members demonstrated strong opposition and disrupted the meeting, often using misleading facts and uncivil language, which made fruitful discussion difficult. They also promised to disrupt future meetings to prevent the construction of STP.

Due to the difficulties imposed by HFPS, NWSDS and JET decided to hold small scale meetings with relevant politicians, officials, and residents to ensure that voices of all people could be heard and taken into further planning. Activities for politicians/officials and for residents are described in the following sections.

The outline of the initial activities by NWSDB is summarized below.

Table 9.10-1 Initial Awareness Meetings and the Related Activities

Date	Activity	Remark
2017/9/21	Meeting for STP site selection at Megapolis and Western Development Ministry	Participants: NWSDB, Megapolis and Western Development Ministry, Ministry of Agriculture, Rural Economic Affairs, Livestock Development, Irrigation and Fisheries & Aquatic Resources Development (w/ 2 farmers), UDA, SLLRDC, JET
2017/12/18~	Questionnaire Survey*	EIA consultant explained the Project, questionnaire survey and collected opinions. (Most of the residents became more informed about the Project.)
2018/1/3	Gazette for reserving the STP candidate site	Section 2 of Urban Development Project (Special Provisions) Act, No. 2 of 1980 (by SLLRDC)
2018/2/19	Objection Letter	To: JICA, NWSDB and CEA From: HFPS with petition signed by 468 residents, some of them were interviewed in the Questionnaire Survey
2018/3/14	Objection Letter	HFPS to JICA, NWSDB, CEA, Requesting JICA not to fund the Project

Date	Activity	Remark
2018/3/14	Meeting with Kaduwela DS	NWSDB & EIA consultant explained the Project and consulted on the "Awareness Presentation" to be held on 3/25
2018/3/15	Meeting with Divisional Coordination Committee	Participants: NWSDB, CEA, UDA, Irrigation Department, Electricity Board, RDA, Western Province Waste Management Authority, Development Officers, GND officers, residents. Reasons for the protest were gathered from residents (odour, environmental impacts, flooding). NWSDB gave introduction of the Project.
2018/3/22	Meeting with Chief Priest	Participants: Chief Priest of Heenatigala Temple, NWSDB, JET Reason for protest was gathered from the Chief Priest (Religious significance of the STP site)
2018/3/25	Awareness Meeting (for STP site)	Participants: Chief Priest of Heenatigala Temple, local government officers, SLLRDC, UDA, Kaduwela DS, 400 residents at Heenatigala Temple. NWSDB (with EIA consultant) presented the outline of the Project, EIA study results, the final drawings and monitoring after construction. In addition, they explained mitigation measures that will address the objections stated in the letter. Reasons for the protest were gathered from residents. (odour, environmental impacts, flooding, pollution).
2018/3/26	JICA Response Letter to Chairman of HFPS	JICA's response to letters received on Feb. 19th and Mar 14th outlining the need and history of the Project and highlighting the JICA policies for social and environmental protection and sustainable development. Also emphasizing JICA continued commitment to work together with relevant authorities to ensure JICA guidelines for environmental and social considerations are followed. CC: Director General ERD, Secretary MCPWS, Secretary MMWD, General Manager NWSDB
2018/3/26	JICA Response Letter to General Manager NWSDB	Letter stating receipt of letters from protest groups. JICA stressed the importance of consideration of social and environmental impacts of any JICA project, including public awareness and understanding of the current Project. The need for NWSDB to consult with stakeholders and gather their understanding for the realization of the Project was emphasized. CC: Director General ERD, Secretary MCPWS, Addl. GM Sewerage NWSDB, AGM Japanese Project Unit NWSDB

*) Questionnaire Survey:
Introduction of surveyor / objective of the survey / Project introduction (incl. STP candidate site) / explanation of sewerage system (collection method, treatment process, environmental impact reduction) / benefits by connection were presented in advance.
Questionnaire surveys were conducted targeting 110 households around STP site / 5-6 households around each MPS. The questions were about water use / discharging wastewater / surrounding environmental problem / expected impacts by the Project / against and for / opinion collection.
Source: JET

9.10.2 Activities for Politicians and Religious Leaders

NWSDB and JET approached relevant politicians and administrative officials to verify the acceptability of the project with national policies and strategies. The outline of the Project with the latest findings from EIA study, environmental and social consideration including alternative consideration, concerns from the residents and the answers by scientific/technical explanation, and other necessary information were shared. Most were supportive of the project as the STP project is in line with national and local development strategies.

Many community or religious leaders stated their enthusiasm to support for the Project and requested not to be hindered by HFPS's strong opposition. Visits to existing STPs were conducted along with the meetings. Visitors were impressed by treatment technologies and nonsignificant odours, and then became more supportive.

9.10.3 Small-Scale Workshops

To ensure that the opinions and concerns of all residents could be heard without interruption or coercion, a series of Small-scale workshops were held to explain the project and gather opinions and concerns. JICA deployed an expert to the site in July, 2018 to assist with public awareness campaign activities directed at local residents and communities. Workshops and site visits were held in a focused manner to provide accurate information to residents, communities, and protest groups. At the same time, reasons for protests and concerns regarding the project were gathered. From the information gathered, mitigation measures were formulated to fully respond to each concern and communicated to the affected groups.

Through consultation with relevant Divisional Secretary (DS) and Grama Nihladaris (GN), groups of up to twenty people were invited from relevant neighbourhoods, farmers groups, or PTAs. Initially, uninvited HFPS members disrupted the meetings with its strong opposition. To make the situation more tenable, it was agreed with HFPS that they would be allowed one representative to observe all meetings if they did not disrupt the meetings, with the meetings supervised by GN and/or DS. With is agreement in place, a series of small-scale Public Awareness Workshops were held.

Small-scale workshops were comprised of introductory presentation of Project and question/answer session. Some workshops also included visit to a current STP plant operated by NWSDB. The main concern gathered from residents during the workshops was odours generated by the STP. After learning that the project team had carefully considered this impact and the techniques available to mitigate odours, such as covering of odour producing areas, enclosing the entire STP to prevent odours, and two-step biological/activated carbon odour removal system, most residents were satisfied with the measures. In fact, the current water pollution and diseases caused by the lack of proper wastewater treatment was a major concern for many residents. Many residents welcomed any effort to collect and treat wastewater before discharge into the environment, and became strongly supportive of the Project when they learned that odour issues could be solved.

The major concerns and responses provided are summarized in **Table 9.10-2**.

Table 9.10-2 Summary of Resident Concerns and NWSDB/JET responses

No.	Protestor Concern	Response by JET
01	Unpleasant odour from the STP will negatively affect houses, business, schools and life in general	The design uses three levels of odour protection 1) The odour producing areas will be covered by corrosion resistant cover so odours don't escape into the atmosphere. 2) In addition, the whole wastewater treatment plant itself can be enclosed by roof and wall to further prevent escape of odours. 3) All odourous air is captured and treated by a biological filter and an activated carbon absorption system. The biological filter will remove main part of odourous substance by bacterial decomposition. The activated carbon will adsorb all remaining odourous substances. *IN SUM:* The possibility of odour issues is very minimal.
02	The flood control capacity of the field will be reduced, leading to increased flooding in the area	SLLRDC will implement drainage plan to prevent flooding of the area by construction drainage canals around the entire land. *IN SUM:* The flood control function/capacity of the field will not be affected, and may be improved. The occurrence and severity of flood events will not be affected, and may be improved

No.	Protestor Concern	Response by JET
03	Effluent from the STP will contribute to pollution of the local water bodies. Dilution rate is insufficient.	CEA has approved the discharge of treated water with treatment levels much stricter than the national standard (ie: water from this STP will be much cleaner than other STPs and discharge points). To achieve the higher criteria of treated water, advanced treatment method of "Step-Feed Biological Nutrient Removal method" developed in Japan is used in this STP. Hydraulic modelling shows that enough water is available in the water body to achieve 1:8 dilution. Currently, septic tanks are insufficient at treating sewage resulting in pollution the local environment and contamination of groundwater such as streams, drains, and wells. The project will collect all unclean waters, treat it, and return clean water to the environment. *IN SUM:* Overall reduction of pollution and contamination of the community and environment will improve living and health conditions.
04	Being associated with STP will lower the social status of residents	1) The STP can be covered and designed so it will look like a normal building or factory. It can be surrounded by attractive landscaping to improve the looks of the facility and also the community. 2) The STP will be a modern facility using the latest technology to protect and improve the water environment similar to systems in every developed country and which should not lower the social status of residents. 3) Parks and recreational areas (similar to Bellanwila Park) can be constructed to improve the local environment and increase the desirability and living conditions of the area. 4) Access roads walkways can be incorporated into the design to increase convenience for the residents and local community 5) In other parts of Colombo and SJK, dirty polluted rivers and streams are the cause of smell, disease, and lower social status. The STP will prevent this from happening to Heenathikumbura. *IN SUM:* Improvement of the community and its environment with latest modern technologies of developed countries should contribute to positive image of the area.
05	Construction activities will damage the natural environment and threaten rare species	1) Only one part of the area will be developed for the STP. The remaining, majority of the area will be developed by SLLRDC for flood control (and possibly recreational) use. 2) The noise and vibration of STP construction works can be minimized by the works of improved construction machine and selecting of construction methods. 3) EIA studies are implemented and show no detrimental effects to the environment or wildlife. 4) The objective of the project is to stop the environmental damages caused by contamination. The project will improve the local natural environment. *IN SUM:* Construction of the STP will improve the local natural environment and contribute to protecting the natural environment and natural species.
06	The site has historical significance as place where rice for offering to the Tooth Relic was harvested	1) Current observations and past satellite imagery shows that the field has not been cultivated since around 2010. 2) Interviews with historical experts and archaeologists found no direct account of rice grown at the STP site being offered to the Tooth Relic. However, if the site has religious or social significance to the community, measures to preserve and celebrate the history can be implemented through the project. Currently the area is not a well-known area and many are not familiar with the history or community. With the above improvements, the area can re-emerge and become a special place for all members of SJK and Colombo. To realize this improvement, we need to work closely together to correctly develop the area. *IN SUM:* Historical significance can be preserved and celebrated.

No.	Protestor Concern	Response by JET
07	Current rice production activities will be affected.	Current observations and past satellite imagery shows that the field has not been cultivated since around 2010. The STP requires only one section of the field. The remaining land can be developed for rice cultivation or any other use the residents choose. *IN SUM:* Rice production activities will not be affected.
08a	Japanese technology may be sufficient, but NWSDB will not have the ability to operated it effectively in the long term	1) Current STP technology requires very little maintenance. 2) SCADA systems reduce manual labor and human error. 3) Technical assistance and capacity development for operation, maintenance, and management will be implemented by Japanese cooperation. *IN SUM:* Operation and management capacity of NWSDB will be greatly improved by Japanese support.
08b	Lack of maintenance of Soysapura STP proves the above point	The existing STP at Soysapura is functioning adequately and there is not significant smell. NWSDB has allocated budget and is implementing further improvements to the plant. People are very positive about the Project after visits to existing STPs. *IN SUM:* NWSDB has allocated budget to make improvements. NWSDB is capable of maintaining and improving STP.
09	The area is a highly residential zone and the STP will negatively affect residents	As mentioned above 1) Odours will be eliminated by two levels of odour protection and deodourizer mechanism. 2) The STP will improve the environment overall. Reduced smells, less contamination of surface and ground water, less diseases etc. can be expected. 3) The STP will be designed to look like a normal building or factory. It can be surrounded by attractive landscaping to improve the looks of the facility and the community 4) Parks, memorials, access roads, and other conveniences will have a positive impact on the community. *IN SUM:* The STP and related improvement projects will not negatively affect residents and will improve the lives of residents
10	Fear of negative health effects	In general, collection and proper treatment (much stricter than the national standard) of sewage will improve the overall environment and reduce risks of diseases, especially during times of flooding or due to groundwater (well water) contamination. *IN SUM:* The project will improve water quality and reduce pollution and contamination. Therefore, positive health effects are expected.
11	The negative effects of the STP will reduce land and home values of the area	1) As mentioned above, many improvements are planned with the project 2) Surrounding water quality will be improved, reducing contamination, waterborne diseases, and odours coming from drains 3) Flood control capacity will be developed by SLLRD *IN SUM:* Effects on property values are expected to be minimal and may be positive.

Source: JET

Still, some concerns remained regarding the ability of government agencies such NWSDB to properly operate and maintain such large projects. Although beyond the scope of the current Project, JICA has available a wide range of capacity development and technical assistance programs that could be applied to ensure sustainable operation of the STP in the future.

9.10.4 Public Relations/Awareness by NWSDB

NWSDB worked closely with JET during the small-scale workshops and became able to initiate these activities on their own. Since the end of 2018, they have been implementing workshops and other public relations activities to promote understanding and support for the Project.

Table 9.10-3 Secondary Activities (for politicians and religious leaders / Small-scale workshop)

Date	Activity	Remark
2018/3/28	Meeting with Deputy Minister of National Policies and Economic Affairs	Participants: Deputy Minister of National Policies and Economic Affairs, NWSDB, JICA, JET Project outline explained to Deputy Minister
2018/4/2	Meeting with Kaduwela DS	Participants: Kaduwela DS, NWSDB, JET, D/S
2018/4	Telephone survey of protestors	Objection Letter (2/16) signatories were contacted directly to understand the reasons for objection. Reasons for protest were gathered. (environmental impact, flooding, odour, pollution)
2018/4/6	Meeting at Megapolis and Western Development Ministry	Participants: Minister of Megapolis and Western Development, NWSDB, JET
2018/4/18		Kaduwela D/S and GNDs
2018/05	Gazette for reserving the MPS candidate site	Section 92 of NWSDB Law (not yet published) (by NWSDB)
2018/6/1	Awareness Meeting with community leaders/officials	Participants: Kaduwela DS, NWSDB, JET, residents Top political officials, local officials, protest groups and residents discuss the Project and reasons for protest. Gather reasons for protest (Environmental impact, flooding, odour, pollution, historical significance)
2018/7/9	JICA letter to NWSDB AGM (Sewerage)	Letter inquiring about the progress of the awareness works according to the Time Bound Action Plan of NWSDB
2018/7/24	Meeting at SJK Mayor's Office	Participants: Mayor of SJK, JET Discussed current protest situation and strategies for progress. Set meeting with Municipal Councillors to be held on July 31st at Mayor's Office.
2018/7/28	Meeting at Kaduwela D/S Office	Participants: Kaduwela D/S, JET Discussed current protest situation and strategies for moving forward. Set meeting with relevant GNs to be held on August 8th at Kaduwela D/S Office.
2018/7/31	Meeting at SJK Mayor's Office	Participants: Mayor of SJK, Municipal Councillors, NWSDB, JET Presented details of the Project to raise awareness for the councillors, discussed current protest situation, and strategies for progress. Made agreements with relevant councillors to further plan strategies (youth councillor, etc)
2018/7/31	Project Progress meeting at Prime Minister's Office	Participants: NWSDB, SLLRDC, JET Reported on current progress of the Project including survey, land acquisition and protest. Made instruction to Deputy Minister's Office to resolve the protest situation.
2018/8/2	Meeting at Deputy Ministers Office	Participants: Deputy Minister, Coordinators, NWSDB, JET Reported on current protest situation and measures tried by the Project team to resolve them. Deputy Minister suggested relocating the STP within SJK. Arranged visit to candidate sites. At the same time, the Office will try to coordinate with Superior Priests to try to convince Heenathikumbura Priest to support the Project.
2018/8/4	Site visit to Baddegana Field	Participants: Deputy Minister, UDA, SJK councillors, NWSDB, JET Site visit to Baddegana Field to determine if it was big enough for the STP due to limited land area and proximity to environmentally protected land. Other candidates were given by UDA for consideration.
2018/8/7	Meeting at Parliament Office	Participants: Deputy Minister, Minister of City Planning, Water Supply and Higher Education, NWSDB, JET Searching for new location is an option, but the delay will cause the Project to miss the current loan cycle. So, efforts to resolve the current protest will continue. DEADLINE for results will be August 24th.

Date	Activity	Remark
2018/8/8	Meeting at Kaduwela D/S	Participants: Kaduwela D/S, GN from Walpola, Karupaluwala, Thalangama North A, Area Agricultural Officer, JET. Project was explained to the G/Ns and Agriculture officer. Many misconceptions were clarified. They agreed to setup Public Awareness Meetings with residents to explain the Project. The meetings were set for August 10^{th} and 12^{th}.
2018/8/9	Meeting at Sri Mahaviharava Sri Dhammaloka Temple	Participants: High Priest of SJK area Ven. Itthapana Dhammalankara Mahanayaka, Coordinator to the Deputy Minister, JET The Coordinator to the Deputy Minister and JET explained to High Priest the planned project, its importance and the community resistance which was supported by the local Priest of the Heenathikumbura Temple. The High Priest agreed that there was no need for resistance and agreed to speak with the local priest to reconsider his resistance to the Project.
2018/8/10	Public Awareness Workshop (refer to Table 9.8-2)	
2018/8/12	Public Awareness Workshop (refer to Table 9.8-2)	
2018/8/13	Meeting at Kaduwela Mayor’s Office	Participants: Mayor, Deputy Mayor, Municipal Commissioner, JET Some more details of the Project were explained to the Mayor’s office. Their concerns were recorded. Set meeting to explain the Project to Municipal Councilors on August 20^{th}.
2018/8/16	Meeting at Sri Mahaviharava Sri Dhammaloka Temple	Participants: High Priest of SJK area Ven. Itthepana Dhammalankara Mahanayaka, Priest of Heenathikumbura Temple Ven. Ananda, MCPWS, NWSDB, JET, HFPS. In the presence of the High Priest and Local Priest, MCPWS, NWSDB, and JET explained the Project. Although the High Priest agreed with the Project and attempted to persuade the local priest, the local priest continued to resist the Project.
2018/8/17	Meeting at MCPWS	Participants: Minister, Secretary, Additional Secretary, NWSDB, JET Outcome of the meeting with the priests was reported, along with the current protest situation and outlook. The Minister will set up a meeting with top political officials to discuss how to resolve the matter.
2018/8/20	Public Awareness Workshop (refer to Table 9.8-2)	
2018/8/26	Newspaper Article	Newspaper article describing current water pollution issues and lack of action by government agencies published. Comments from protestors also included.
2018/8/27	Letter to JICA	Letter from HFPS to JICA. The Project should be Category A project due to indigenous population of the area.
2018/9/3	Letter to NWSDB	Letter from HFPS to NWSDB notifying that a letter was sent to JICA office.
2018/9/5	TV documentary	ITN Channel 7:00 ~ 7:30 TV Documentary program by MCPWS highlighting current pollution issues and promoting sewerage development programs.
2018/9/6	Public Awareness Workshop (refer to Table 9.8-2)	
2018/9/8	Public Awareness Workshop (refer to Table 9.8-2)	
2018/9/9	Public Awareness Workshop (refer to Table 9.8-2)	
2018/9/14	Letter from Kaduwela DS	Letter to confirm no persons or communities matching World Bank definition of “indigenous person/community” are residing in the Heenathikumbura area.
2018/9/15	Public Awareness Workshop (refer to Table 9.8-2)	
2018/9/16	Public Awareness Workshop (refer to Table 9.8-2)	
2018/9/21	Public Awareness Workshop (refer to Table 9.8-2)	
2018/9/25	Site Visit: Kurunegala STP	Participants: Media, MCPWS, NWSDB, JET MCPWS and NWSDB arranged to take members of media to newly constructed Kurunegala STP. Presentations and tour were conducted to raise awareness of STP projects. (minutes available)
2018/9/30	Public Awareness Workshop (refer to Table 9.8-2)	
2018/10/11	Site Visit: Ja-Ela STP	Participants: Residents, CBOs, Welfare Society Leaders, Government Officials and retirees from Pita-Kotte, Ethul Kotte, and Epitamulla area, NWSDB, JET Raise awareness and disseminate knowledge about the proposed Sri Jayawardenapura-Kotte Sewerage Treatment Plant aimed to be established in Heenatikumbura. (minutes available)
2018/10/14	Site Visit: Soysapura STP	Participants: Residents, CBOs, Welfare Society Leaders, Government Officers and retirees from Obeysekarapura and Welikanda areas, NWSDB, JET Raise awareness and disseminate knowledge about the proposed Sri Jayawardenapura-Kotte Sewerage Treatment Plant aimed to be established in Heenatikumbura. (minutes available)

Date	Activity	Remark
2018/11/4	Site Visit: Soysapura STP	Participants: Residents, CBOs, Welfare Society Leaders, Government Officers and retirees from Nawala Mosque Land and Rajagiriya Polwatte areas, NWSDB, JET Raise awareness and disseminate knowledge about the proposed Sri Jayawardenapura-Kotte Sewerage Treatment Plant aimed to be established in Heenatikumbura. (minutes available)
2018/11/11	Site Visit: Soysapura STP	Participants: Residents, CBOs, Welfare Society Leaders, Government Officers and retirees from UE Perera Road in Rajagiriya, NWSDB, JET Raise awareness and disseminate knowledge about the proposed Sri Jayawardenapura-Kotte Sewerage Treatment Plant aimed to be established in Heenatikumbura. (minutes available)
2018/11/17 and later	Public Awareness Workshop (refer to Table 9.8-2) 69 meetings were held	

Source: JET

Table 9.10-4 Summary of Public Awareness Campaign Activities

S/N	Date	DSD	Covered GNDs	Place of Meeting/ Discussion	Type of Awareness Program				Aimed Group	No. of Participants	Observations and Conclusions (positive / negative / other remark)
					Religious Leaders	CBOs	Public	Field Visit			
1	10.08. 2018	**Kaduwela**	Thalangama North and South, Walpola, Himbutana, Ruvanpura, Kalapaluvawa	DS Office Kaduwela			Yes		Farmers and Paddyland Owners	15	Attended by a number of (uninvited) HFPS members and political representatives; Strong opposition against STP by HFPS hindering the proceedings and inviting dissatisfaction of farmers.
2	10.08. 2018	**Kaduwela**	Thalangama North and South, Walpola, Himbutana, Ruvanpura, Kalapaluvawa	DS Office Kaduwela		Yes			Heenatikumbura Paddyfield Preservation Society (HFPS) Members	19	Attended by HFPS members and officials including its President and VP. Various points strongly stressed against the implementation of the STP. Demanded for HFPS to be present at all proceedings. Meeting disrupted due to above strong opposition.
3	12.08. 2018	**Kaduwela**	Thalangama North and South Walpola, Himbutana,Ruvanpura, Kalapaluvawa	DS Office Kaduwela			Yes		Residents of Sumedha Mawatha and Aggona areas	16	Attended by uninvited HFPS members; disrupted proceedings by rallying crowds to meeting location. Opinions given by individual residents and attempts at round-table discussions by JET resulted in HFPS taking a more cooperative approach. Decisions made to hold small-scale meetings supervised by GNs and HFPS; agreed that only one HFPS official would be present in exchange of no future disruptions by members. Meeting ended on cordial note between JET and HFPS.
4	12.08. 2018	**Kaduwela**	Thalangama North and South, Walpola, Himbutana, Ruvanpura, Kalapaluvawa	DS Office Kaduwela			Yes		Paddyfield Farmers from Kurunduwatte and Vijithapura areas	4	Out of 20 invited farmers, only 02 attended; 02 HFPS members present. Attended by Electrical Engineer residing in UK who questioned technical aspects of project. Further points raised by HFPS opposing STP, but meeting ended on cordial note.
5	12.08. 2018	**Kaduwela**	Thalangama North and South, Walpola, Himbutana, Ruvanpura, Kalapaluvawa	DS Office Kaduwela			Yes		Residents of Sumedha Mawatha	11	Attended by members of the HFPS and Urban Council member. Positive comments in favour of project by member of Urban Council and residents. HFPS reinstated points against implementation of STP, but meeting ended on a cordial note.
6	12.08. 2018	**Kaduwela**	Thalangama North and South, Walpola, Himbutana, Ruvanpura, Kalapaluvawa	DS Office Kaduwela			Yes		Residents of Sumedha Mawatha	4	Only 04 participants attended out of invited 20, including members of HFPS. Resident and HFPS raised questions regarding proposed project, session carried out in terms of a positive discussion.
7	20.08. 2018	**Kaduwela**	Entirety of Kaduwela area	MC Kaduwela	Political Leaders and Members				Municipal Council Members and Officials	30	30 political leaders and council members attended out of invited 50. Points and questions regarding project raised by Municipal Council members; addressed and answered by JET. Main point of discussions was on EIA for STP project; meeting concluded with decision for further discussions following perusal of EIA.
8	06.09. 2018	**Kaduwela & SJK**	Hinatikumbura, Thalangama South, Ethul Kotte.	NWSDB Office Battaramulla		Yes	Yes		Residents and Paddyland Owners	10	Attended by area residents and CBO members of Walpola Farmer's Association. Participants seemed in favour of STP; however stated lack of knowledge among general community regarding actual project and adverse influence by HFPS. Suggestions made by residents and request for more awareness programs in areas.
9	08.09. 2018	**SJK**	Obesekarapura West	Reading Hall Obesekarapura		Yes	Yes		Residents of Obeysekarapura West, Rajagiriya	35	Attended by 35 area residents, out of invited 20. Members of CBO and residents engaged in discussions with JET and NWSDB. Questions and concerns pointed out regarding STP; addressed by JET. Residents enthusiastic and in support of STP.
10	09.09. 2018	**SJK**	Welikada, Obesekarapura East	Reading Hall Obesekarapura		Yes	Yes		Residents of Obeysekarapura East, Rajagiriya	45	Attended by 45 residents, out of 20 invited by GN. Comments and questions raised by residents and members of CBO, addressed and clarified by NWSDB. Participants in favour of STP implementation, request for more awareness programs.
11	15.09. 2018	**SJK**	Arunodayapura, Welikada	Reading Hall Obeysekarapura		Yes	Yes		Residents of Obeysekarapura	15	Attended by area residents, including former Additional Secretary of the Ministry of Transport and Civil Aviation. Concerns and questions raised by residents, addressed by NWSDB. Request by participants for more awareness and suggestion to work closely with the communities. Majority view of support for the Project.
12	15.09. 2018	**SJK**	Gangodawila, Pita-Kotte	Ananda Balika Girls School		Yes	Yes		Residents of Gangodawila North, Pita-Kotte	27	27 participants attended out of invited 20. Comments and views by residents and Kotte Municipal Councilor addressed by JET and NWSDB. Suggestions for more large-scale meetings and mass awareness programs. In favour of STP project.
13	16.09. 2018	**SJK**	Welikada, Obesekarapura, Arunodayapura	Reading Hall Nawala		Yes	Yes		Residents of Gangodawila North, Pita-Kotte	9	Attended by 09 community residents and 02 Kotte Municipal Councilors. Residents in favour of project; requested large-scale programs instead of small group meetings. Councilors suggested increased awareness for general public; agreed by JET.
14	16.09. 2018	**SJK**	Welikada, Obesekarapura, Arunodayapura	Bodhigara Viharaya Obeysekarapura		Yes	Yes		Residents of Welikeda area	11	Residents discussed views and concerns with JET and NWSDB. Suggestion to conduct awareness campaigns through media for larger impact. Municipal Councilor suggested residents wish for largescale counter-protests against Heenatikumbura protestors. Support STP; but need for good rapport between NWSDB and public.
15	21.09. 2018	**Kaduwela**	Walpola, Thalangama South, Hinatikumbura	NWSDB Office Battaramulla		Yes			Paddyland Owners of Heenatikumbura, through Walpola Farmer's Association	6	Paddyland owners and farmers of Heenatikumbura with Walpola Farmers' Assocation, expressed views. Mostly in favour of STP but strongly opposed by HFPS. Concerns of residents against HFPS discussed. Requested meeting for landowners with Minister to discuss matters of land acquisition and compensation.
16	25.09. 2018		All Island	Kurunegala Sewerage Treatment Plant	National Media				Newspapers, TV media and Social Media Journalists	26	Representatives from print, electronic and social media were impressed by STP during plant visit. Interviewed public who had experienced modern sewerage system. Planned to write articles in order to raise awareness among general public.
17	30.09. 2018	**Kolonnawa**	Udumulla, Himbutana East & West, Walpola	Abhinavarama Temple		Yes	Yes		Residents of Himbutana West	13	Residents and community members in favourable view of project, positive discussions. However, meeting disrupted halfway by 08 members of HFPS and local politicians with their strong opposition. UK Engineer brought by HFPS alleged points against STP, addressed by JET. Meeting adjourned. Next sessions cancelled.
18	11.10. 2018	**SJK**	Ethulkotte, Pitakotte, Pagoda	Ja-Ela Sewerage Treatment Plant		Yes	Yes	Yes	Residents of Pita-Kotte, Ethul-Kotte and Epitamulla	15	Community members taken on field visit to Ja-Ela STP. Strong enthusiasm and interest in practical and technical demonstrations of STP; noted lack of strong odours. Stressed need for more awareness, particularly through religious leaders. Residents ready to organize awareness meetings, petition to Japanese government.
19	14.10. 2018	**SJK**	Welikada, Obesekarapura East	Ja-Ela Sewerage Treatment Plant		Yes	Yes	Yes	Residents of Obeysekarapura and	11	Community members taken on field visit to Ja-Ela STP. Strong enthusiasm and interest in practical and technical demonstrations of STP; noted lack of strong odours. Residents ready to organize door-to-door camapigns, stage mass rally to demonstrate

S/N	Date	DSD	Covered GNDs	Place of Meeting/ Discussion	Type of Awareness Program				Aimed Group	No. of Participants	Observations and Conclusions (positive / negative / other remark)
					Religious Leaders	CBOs	Public	Field Visit			
									Welikeda		support, organize signed petition to JICA. Keen interest.
20	04.11. 2018	**SJK**	Nawala, Bandaranayakapura, Polwatte	Soyzapura Sewage Treatment Plant		Yes	Yes	Yes	Residents of Nawala and Rajagiriya	26	Unexpectedly large turnout of interested residents, although only 15 invited. Strong interest and wish to participate. Noteworthy point of young mothers with infants participating. Impressed with STP process, requests for larger-scale awareness and field visits for schoolchildren. Positive outcomes seen of visit to Soyzapura STP.
21	11.11. 2018	**SJK**	Moragasmulla, UE Pereramawatha, Obeysekarapura	Soyzapura Sewage Treatment Plant		Yes	Yes	Yes	Residents of Rajagiriya and CBOs	19	Communities in favour of project; support strengthened after visit to Soyzapura. JET stressed reason for field visit being for general public to experience the actual situation. Residents expressed wish to demonstrate mass protest in front of Japanese embassy. Participating students requested school awareness programs, NWSDB replied in affirmative.
22	17.11. 2018	**SJK**	Rajagiriya	Sri Gnanawasa Tripitaka Temple	Yes				Buddhist Religious Leaders	2	Positive discussions with Monks of temple; in support of the Project as one that is essential and beneficial for the communties. Requested if benefits from STP could be incorporated agriculture sector as well. Assured support through local community.
23	17.11. 2018	**SJK**	Rajagiriya	Sacred Heart Church	Yes				Catholic Religious Leaders	1	Priest of church aware of project and current status of protests, described project as essential as even church is facing sewerage problems. Assured support through educating and enlisting support of local church community.
24	17.11. 2018	**SJK**	Nawala	Main Mosque Nawala	Yes				Islamic Religious Leaders	4	Moulavi(Mawlawi)s of mosque described support for project in local Muslim community; as area faced with a lot of water pollution and sewerage problems. Ensured enlisting support of local community through mosque committee.
25	18.11. 2018	**SJK**	Welikada	Sri Vijayaramaya Temple	Yes				Buddhist Religious Leaders	1	Monk of temple expressed support of STP project; however, mentioned need for sustainability and proper management by local officials. Requested officials to be mobilized for awareness programs, and assured support through temple donors.
26	18.11. 2018	**SJK**	Obeysekarapura	St. Stephen's Church	Yes		Yes		Catholic Religious Leaders	5	Priest of church stated strong awareness of status of STP project; stressed that government should proceed despite politically motivated protests. Church also faced with lack of water supply, issue common to area. Expressed support and willingness to aid in future awareness raising campaigns, through church.
27	23.11. 2018	**SJK**	All SJK DS area GNDs	DS Office Kotte		Yes			Senior Community Leaders of Kotte area	33	33 senior citizens of SJK attended in meeting aimed at CBOs such as Senior Citizens' Federation etc. Keen interest and enthusiasm in project, and requested speedy progress in future. SCF organization had prepared letter addressed to President, reviewed by Kotte DS, stressing need for project- community taking action in support of STP project.
28	24.11. 2018	**SJK**	Bandaranayakapura, Polwatte	Sri Sakyaraja Viharaya		Yes	Yes		Residents of Polwatte and Bandaranayakapra	45	Large public meeting organized with support of CBOs in areas. Community residents of areas engaged in discussions with JET and NWSDB; majority in favour of project despite questions. Meeting became unorganized due to contending arguments by residents, mediated by JET. Request to organize Plant visits for schoolchildren; residents and CBOs promised support for endeavours.
29	25.11. 2018	**SJK**	Arunodayapura, Welikada	Bodhigara Viharaya		Yes	Yes		Residents of Arunodhayapura Welikada and Kolonnawa	46	Large public meeting organized with support of CBOs. Residents in support of project and requesting implementation of STP. Community prepared to rally and visit Heenatikumbura to speak to opposition; idea discouraged by JET. Strong support for approach towards religious leaders in raising awareness.
30	04.12. 2018	**Kadu wela**	Subhuthipura	Jumma Masjid Mosque	Yes				Islamic Religious Leaders	2	Moulavi of mosque stated mild awareness of project, no in-depth knowledge so far. However, described project as essential as Kotte is becoming rapidly developing and highly urbanized capital city. Promised to support through mosque committee and aid campaign activities of JET/NWSDB in local community.
31	04.12. 2018	**SJK**	Battaramulla	Sri Vidya Ganapathi Kovil	Yes				Hindu Religious Leaders	1	Swami (Yogi) of temple expressed enthusiasm for project as important for highly-congested area. Mentioned knowledge of technical aspects due to having been a structural engineer in past. Stated sewerage problems in kovil as well. Wished to organize large-scale awareness program in Kovil following discussions with head Swami.
32	04.12. 2018	**Kadu wela**	Battaramulla	Sri Sudharmarama Temple	Yes				Buddhist Religious Leaders	1	Monk of temple expressed support and mentioned temple as being central to all GNDs; hence could be ideal to hold large-scale awareness campaigns for proposed STP project. Agreed to inform Head Monk and discuss possible future activities.
33	04.12. 2018	**Kadu wela**	Thalangama	Our Lady of Fateema Church	Yes				Catholic Religious Leaders	1	Priest of church previously unaware of STP project; interested to know details. Need to study project and examine reasons for opposition from Heenatikumbura. Willing to organize community meeting for public with JET/NWSDB, at church.
34	06.12. 2018	**SJK**	Nawala	Nuraniya Mosque	Yes				Islamic Religious Leaders	1	Moulavi of mosque stated awareness of project through Main Mosque in Nawala. Explicated difficulties and problems of sewerage in area; thus in strong approval of the Project. Requested further community awareness programs, with Tamil speaker if possible.
35	12.12. 2018	**SJK**	Rajagiriya	Sri Jayasekararamaya	Yes				Buddhist Religious Leaders	1	Monk of temple expressed opinion that such projects should have been impemented much earlier, as communities strongly in need of proper sewerage systems. Recommended increased awareness activities in Heenatikumbura; and assured temple's support in organizing community campaigns for project.
36	12.12. 2018	**Kadu wela**	Thalangama	St. Matthew's Church	Yes				Catholic Religious Leaders	1	Priest stated previously unaware that their area came under proposed SJK project. Expressed need for such modern projects to be established in a developing country. Emphasized need for development over political protests, and pledged support.
37	13.12. 2018	**SJK**	Nawala	Sri Sidaththarama Maha Viharaya	Yes				Buddhist Religious Leaders	2	Expressed importance and timeliness of project. Monk of temple also has foreign experience; witnessed sewerage systems abroad. Assured spread of awareness to community through temple and donors, as well as through Education and Postal Service departments, where he was an advisor. Recommended that it would be good if Japanese JICA officials could address crowd during mass campaigns.
38	13.12. 2018	**SJK**	Nawala	Sri Saddharmarajika Viharaya	Yes				Buddhist Religious Leaders	1	Monk of temple wished to know process of constructing STP for project; explained in detail by JET and NWSDB. Head Monk of temple currently indisposed and no donor committee for temple, but would distribute leaflets to people's organizations.
39	15.12. 2018	**SJK**	Ethul Kotte	Mahindarama Temple	Yes				Buddhist Religious Leaders	1	Monk stated awareness of project due to TV and print media publicity; expressed opinion that government should deal with political protestors attempting to disrupt important national projects. Stressed need for government officials to fulfil duties to sustain project; assured assistance for any future JET/NWSDB campagns or activities.
40	15.12. 2018	**SJK**	Nugegoda	Wimala Viharaya	Yes				Buddhist Religious Leaders	1	Buddhist monk mentioned need for sewerage project of high-technology to be implemented in area. Described problems of sewerage; and stressed importance of approach to religious leaders in raising awareness in communities. Agreed to organize awareness meetings; wished JET/NWSDB to explain technicalities at these.
41	19.12.	**SJK**	Obesekarapura	Siri Amara	Yes				Buddhist Religious	1	Monk stated awareness of both project and protests from party in Heenatikumbura; stating clear political agendas at the root.

S/N	Date	DSD	Covered GNDs	Place of Meeting/ Discussion	Type of Awareness Program				Aimed Group	No. of Participants	Observations and Conclusions (positive / negative / other remark)
					Religious Leaders	CBOs	Public	Field Visit			
	2018			Viharaya					Leaders		Expressed knowledge of technical aspects of project due to having been an electrical and motor expert prior to ordination. Suggested organizing of mass counter-protest in Heenatikumbura, willing to take lead.
42	19.12. 2018	**Nugegoda**	Nugegoda	Wikramasinharamaya Temple	Yes				Buddhist Religious Leaders	1	Monk of temple stated knowledge of similar project implemented in Narahenpita, though small-scale, and expressed need for one in area as well. Expressed willingness to support as national project needed for the people.
43	20.12. 2018	**SJK**	Pitakotte	Naga Viharaya	Yes				Buddhist Religious Leaders	1	Monk stated that the Project was good; nevertheless needed to examine and address reasons behind Ven. Ananda's opposition. Recommended to conduct increased JET/NWSDB awareness campaigns in Heenatikumbura area.
44	20.12. 2018	**SJK**	Pitakotte	Rajamaha Viharaya Kotte	Yes				Buddhist Religious Leaders	2	Monks of temple aware of project and current status due to media coverage and publicity. Stressed need to increase awareness among protesting groups as a means of overcoming opposition. Emphasized project as national necessity; pledged to aid.
45	21.12. 2018	**Kaduwela**	Udumulla, Subhuthipura, Rajamalwatte	Poorwaramaya Temple Battaramulla	Yes		Yes		Residents of Subhutipura, Thalangama and Battaramulla	51	Largescale public meeting, attended by 51 participants. Request from residents to hold meetings on weekends and holidays. Postitive discussions between community and JET/NWSDB. Suggestions by Buddhist religious leader to increase awareness and move forward with STP. Majority support for project and positive outcome.
46	27.12. 2018	**SJK**	Ethulkotte	Nippon Viharaya Temple Ethul-Kotte	Yes				Buddhist Religious Leaders	1	Head Monk of temple well aware of project. Temple has strong ties with Japan and Kyoto Municipal Council; monk has visited and STP in Kyoto and its adjacent Kyoto Lake. Proposed to organize a major conference inviting all monks in the area including Ven. Ananda, JET/NWSDB and media; creating open forum to discuss STP issues and causes for oppostion etc. Recommended taking protestors on site/field visits to STPs in order to counter opposition through experience.
47	27.12. 2018	**SJK**	Ethulkotte	Siri Parakumba Pirivena Ethul-Kotte	Yes				Buddhist Religious Leaders	2	Expressed that SJK project was extremely timely and essential, requested JET/ NWSDB to keep temple and monks updated on future proceedings and activities.
48	28.12. 2018	**SJK**	Nugegoda	Dhammadinnaramaya Temple	Yes				Buddhist Religious Leaders	1	Bhikkuni (Nun) of temple expressed opinion that project is essential and valuable, and stated willingness to support where possible However, means of action limited as the temple is a Bhikkuni Aramaya and exclusively for female monks.
49	28.12. 2018	**SJK**	Obeysekarapura	Pattana Viharaya Obeysekarapura	Yes				Buddhist Religious Leaders	1	Monk of temple skeptical about practicality of project; questioned whether could be implemented in such areas with low-income families, without causing damage to small homes and adjacent roads. Expressed displeasure at lack of water supply by NWSDB to area, and recommended fixing these problems prior to large projects.
50	03.01. 2019	**Kaduwela**	Udumulla	Sri Poorwaramaya Temple	Yes				Buddhist Religious Leaders	1	Monk of temple stated reasons for public doubt being lack of faith in government officials, hence recommended this as main gap to be filled. Expressed willingness to support for this endeavour; and aid in support of SJK project where required.
51	03.01. 2019	**SJK**	Nugegoda	St. Thomas' Church Kotte	Yes				Catholic Religious Leaders	1	Priest of church interested and agreed to provide support for the STP project.
52	06.01. 2019	**Kaduwela**	Subhuthipura, Rajamalwatte	Buddist Hall, Subuthipura		Yes	Yes		CBO Leaders in Areas adjoining Heenatikumbura	47	Attended by CBO leaders who had gained experience of foreign STP and sewerage projects; requested from JET/NWSDB to address the participants. Elaborated on the benefits of STP project with their foreign experience, to the public. Stated that CBOs had previously worked on a JICA social work project; appreciated the work ethics of the organization. Requested to help JET to organize more awareness campaigns within their CBO network.
53	07.01. 2019	**Kaduwela**	Udumulla, Battaramulla	Purvaramaya Temple, Udumulla		Yes	Yes		CBO Leaders in Areas adjoining Heenatikumbura	18	Majority in favor of the Project, request for greater number of community awareness campaigns to be conducted per area, through local authorities such as GN, MC and PC. Requested from JET/NWSDB to hold meetings on weekends and holidays.
54	09.01. 2019	**SJK**	Pitakotte	Sri Nandaramaya Temple	Yes				Buddhist Religious Leaders	1	Monk of temple stated pressing need for project to be implemented due to increasing population rise; agreed to provide needed support to aid implementation.
55	09.01. 2019	**SJK**	Pitakotte	Sudarshanramaya Sadaham Viharaya	Yes				Buddhist Religious Leaders	3	Monks aware of project; Head Monk emphasized need for sewerage project as expressed to him by people of community and area.
56	11.01. 2019	**SJK**	Pitakotte	Maliban Aranya Temple	Yes				Buddhist Religious Leaders	1	Monk in support of the SJK project; recommended that further awareness campaigns be conducted aimed at the areas where opposition was arising, chiefly Heenatikumbura. Agreed to support project through temple where required.
57	11.01. 2019	**SJK**	Pitakotte	Veherakanda Temple	Yes				Buddhist Religious Leaders	1	Monk of temple expressed support for project; and stressed that projects should be implemented as soon as possible as both cost and problems will be much higher when postponed further. Recommended more awareness programs to be conducted in various areas.
58	12.01. 2019	**SJK**	Madiwela	Community Hall Madiwela		Yes	Yes		Residents of Madiwela, Thalapathpitiya	33	Large public awareness meeting held with participation of 33 residents of area. Resident inquired as to why awareness and knowledge dissemination was not conducted through political authorities/institutions; JET explained that this had been the first approach but grassroots community awareness was more effective. Residents in support of STP project; however have poor faith in NWSDB for future management. Sewerage and water issues. Inquired why other location apart from Heenatikumbura had not been chosen for STP; again explained by JET/NWSDB.
59	12.01. 2019	**SJK**	Kaduwela	Shaalarukkharamaya, Battaramulla	Yes				Buddhist Religious Leaders	1	Monk in support of the SJK project; also aware of opposition from Heenatikumbura headed by Venerable Ananda and displeased at protests employing a Bhikkuni at forefront. Trust in the Japanese government to implement good initiatives; wish for continued awareness activities and speedy implementation.
70	16.01. 2019	**SJK**	Madiwela	Sri Shangamiththaramaya Madiwela	Yes				Buddhist Religious Leaders	2	Bhikkuni of temple expressed support of project and favourable impression of Japanese projects due to their reputation as ethical and a Buddhist nation. Requested JET/NWSD to carry out further awareness programs, particularly aimed at opposition in Heenatikumbura.
71	16.01. 2019	**SJK**	Madiwela	Kethumathi Viharaya, Obawatte	Yes				Buddhist Religious Leaders	1	Monk of the view that project is extremely good initiative and should be implemented as soon as possible for the area; advised to not be deterred by opposition protests and to commence the STP project as soon as possible.
72	17.01. 2019	**Kaduwela**	Battaramulla	Sri Wijayasumanaramaya	Yes				Buddhist Religious Leaders	1	Monk in support of SJK proejct as extremely vital for developing area; however, has poor opinion of NWSDB and its activities, particularly in terms of maintenance during breakdowns. Strongly recommended increased efficiency and fulfilling duties by NWSDB officials if project were to become a success in any way.

S/ N	Date	DSD	Covered GNDs	Place of Meeting/ Discussion	Type of Awareness Program				Aimed Group	No. of Partici pants	Observations and Conclusions (positive / negative / other remark)
					Religious Leaders	CBOs	Public	Field Visit			
73	17.01. 2019	**Kadu wela**	Pelawatte	Sri Sudarshanarama Purana Viharaya	Yes				Buddhist Religious Leaders	1	Monk acknowledged importance of project, but very poor faith in government officials and authorities in charge to carry out duties accordingly. Expressed faith in Japanese as a country and people, to implement projects with good ethics and best technology; however, noted legitimate reasons why people mistrusted NWSDB.
74	17.01. 2019	**SJK**	Nawala	Sri Bodhirajaramaya, Nawala	Yes				Buddhist Religious Leaders	1	Monk mentioned favour of project as essential for developing urban areas and recommended implementaion in other urban areas as well. Expressed his view of lack of proper grounds for opposition to project, and promised support from temple.
75	18.01. 2019	**Kadu wela**	Wikramasinghapura	Sri Subodharamaya	Yes				Buddhist Religious Leaders	1	Monk expressed support for SJK project as he had seen such large STP projects in developed countries which were essential. However pointed out irresponsibility and lack of accountability on side of authorities, noting inefficient maintenance by NWSDB and bad state of Wickramasinhapura STP, explaining possible reasons for people's opposition. Recommended attitudinal change and reworking of structure.
76	22.01. 2019	**SJK**	Madiwela	Gangathilaka Viharaya	Yes				Buddhist Religious Leaders	1	Monk in support of project, expressed pleasure that such an initiative was being implemented in the area and that it was being spearheaded by the Japanese. Agreed to provide support for any activities where needed.
77	22.01. 2019	**SJK**	Madiwela	Silumini Viharaya	Yes				Buddhist Religious Leaders	1	Monk in support of project, expressed need for proper sewerage management in the area as issue was severely affecting temple as well. Pledged support and advised to continue conducting awareness campaigns for Heenatikumbura opposition.
78	23.01. 2019	**SJK**	Madiwela	Sri Gunananada Buddhist Centre	Yes				Buddhist Religious Leaders	1	Monk expressed support for SJK project; but pointed out that spreading awareness through Grama Niladharis and political authorities might be a better approach than religious leaders. JET explained that such measures have already been taken.
79	23.01. 2019	**SJK**	Madiwela	Sambudhaloka Viharaya	Yes				Buddhist Religious Leaders	2	Monk expressed support for SJK project; but pointed out that spreading awareness through CBOs and community societies might be a better approach as could reach a larger audience. Promised to give list of Sanasa and other community organizations together with the contact numbers to JET/NWSDB for organizing purposes.
80	24.01. 2019	**SJK**	Nawala	Sri Bodhirajaramaya	Yes				Buddhist Religious Leaders	1	Monk in support of project, but stated that most projects in Sri Lanka commenced with strong initiative, but not executed accordingly and ultimately fail due to lack of proper maintenance and management. Recommended strongly to fix this for SJK.
81	24.01. 2019	**Kadu wela**	Thalangama	Sri Lumbini Viveka Senasanaya	Yes				Buddhist Religious Leaders	1	Monk in support of project; described that issue of sewerage was pressing and needed resolution. Also inquired as to control of insect-breeding in drainage systems; asserted by JET/NWSDB as an important objective of SJK STP project.
82	25.01. 2019	**SJK**	Gangodawila	Sri Wijayawardhanara may	Yes				Buddhist Religious Leaders	2	In support of the Project; monk requested that they pay no heed to opposition groups that are trying to hinder project, explaining that there is always opposition to development. Cited Wetlands Park project and stressed the great advantages now being reaped by residents since its completion.
83	25.01. 2019	**SJK**	Nugegoda	Dharmadutha Centre	Yes				Buddhist Religious Leaders	1	Monk in support of the Project as sewerage issue being a pressing problem in the area for the temple as well. Suggested organizing mass awareness campaign through Samurdhi Authority which could be liaised with through temple.
84	29.01. 2019	**SJK**	Ramphert Road	Sri Parakumba Dharmasrama Viharaya	Yes				Buddhist Religious Leaders	2	Monks in strong support of project and requiring speedy implementation; liased two members of Donor Committee with JET/NWSDB in order to conduct further awareness campaigns or activities in support of SJK STP project.
85	29.01. 2019	**Maha ragam a**	Delkanda	Sri Bodhimalu Viharaya	Yes				Buddhist Religious Leaders	2	Monks in support of SJK project implemented for the area; inquired whether drainage system pollution would also be addressed through this means- replied in affirmative by JET. Requested to visit temple again in future for meeting with Head Monk.
86	30.01. 2019	**SJK, Kaduw ela & Mahar agama**	33 GNDs	Auditorium DS Office Kotte		Yes			CBO Leaders in Areas adjoining Heenatikumbura	37	Officers of Samurdhi CBOs in all the areas expressed strong support for project as essential to all their communities. However, expressed lack of satisfaction with NWSDB efficiency and hence lack of trust by general public. Suggestion to JET/NWSDB to organize field visit to STPs for members of 60 CBOs in their zone.
87	31.01. 2019	**SJK, Kaduw ela, Mahar agama**	31 GNDs	Auditorium DS Office Kotte		Yes			CBO Leaders in Areas adjoining Heenatikumbura	35	Bank Managers of Samurdhi CBOs in several surrounding areas in strong support of project implementation as area devastated by sewerage issue. Suggestion for project office to be moved to Battaramulla and for field visit to be organized to STP. CBO leaders voiced displeasure against NWSDB for lack of efficieny in maintenance; however, desire the Project to be implemented.
88	02.02. 2019	**Western Province**	Western Province	Governor's Office, Rajagiriya	Political Leaders and Members				Meeting with Hon. Governor of Western Province and 02 Secretaries	5	Governor of Western Province briefed in detail regarding SJK STP project, current progress of project implementation, background of opposition arising from HFPS and Heenatikumbura area, and status of Land Acquisition. Governor in strong approval of project and requested to go ahead without heeding protests by HFPS.
89	02.02. 2019	**Kadu wela**	Jayawadanagama	Maithree Dharmayathanaya		Yes	Yes		CBO members and Community around Jayawadanagama area	33	Large scale meeting for CBO members and community with 33 participants. Residents highly enthusiastic expressed interest in helping to organize mass public awareness program. However, noted deficiencies in Jayawadanagama STP and queries of possible similar scenarios. Expressed faith in Japanese technology but lack of same in NWSDB due to inefficiency. Emphasized problem of low water supply to area over 10 years. Nevertheless in support of proposed STP project.
90	03.02. 2019	**SJK**	Arunodayapura, Welikada	Reading Hall, Moragasmulla		Yes			CBO Members	67	Very large awareness meeting for CBO members of Sri Punyawardhana Welfare Society with 67 participants. Strong enthusiasm and support for the proposed STP project. However, stated lack of faith in NWSDB due to present inefficiency. Request to provide the sewerage service free of charge; using savings in other sectors through implementation of project to reduce fee for general public. Unanimous support for the Project and wished to be implemented soon.

Source: JET

9.10.5 Summary of Public Awareness Activities

Dissemination of information to the public related to the Project was hindered in the initial stages by disruptive actions of HFPS. Due to strong opposition, providing accurate information to the public and getting honest feedback was difficult. However, NWSDB, JET and HFPS were able to come to a consensus on how to proceed with small-scale workshops without disruption.

The small-scale workshops allowed residents to express their concerns and ask questions specific to themselves and their communities in a non-hostile, familiar environment. This was also beneficial to JET as they were able to spend more time with each individual to understand their concerns, and discuss the risks and benefits of the Project. Under such conditions, many residents became satisfied with the benefits of the Project, provided that proper mitigation measures are taken.

Still, some concerns remained regarding the ability of government agencies such NWSDB to properly operate and maintain such large projects. Although beyond the scope of the current Project, JICA has available a wide range of capacity development and technical assistance programs that could be applied to ensure sustainable operation of the STP in the future.

9.10.6 Stakeholder Meeting

After the series of public awareness activities mentioned above, the final Stakeholder Meeting was organized by NWSDB with the assistance of JET. It was a large-scale awareness meeting for Government and Non-Government stakeholders, donors, media, members of Community Based Organizations, land owners, residents, etc. to be impacted by the Project.

A total number of 83 participants (including NWSDB and JET representatives / 25% of them were female) representing Central and Local Government, various institutions and community members from areas such as Obeysekarapura, Heenatikumbura, Rajagiriya, Welikada, Bandaranayakapura, Maharagama, Dehiwela Ethul-Kotte and Arunodhayapura areas attended the meeting out of the total of 110 that were invited.

Objectives of the Stakeholder Meeting are as follows.

- Present the outline, justification, final outcomes and findings of the Preparatory Survey for the Project to be implemented in the area, to the representatives of government and non-government organizations, beneficiaries, community members and other stakeholders to be impacted by the project and ensure that all stakeholders are up to-date with the latest results.
- Present the Environmental and Social Consideration results including alternative study and impact evaluation such as scoping, assessment and mitigation.
- Allow a platform for discussion for the stakeholders of the project regarding any further queries or clarifications that they might have regarding the Project procedures.
- Address the issues or concerns raised by residents by providing clarifications about the project, backed by the findings from the Preparatory Survey and the EIA Study.
- Inform the stakeholders on ways that they may access the findings and reports in physical copies and online.

The outline of the meeting is outlined in the following tables.

Table 9.10-5 Outline of the Stakeholder Meeting

Event	Stakeholder Meeting for Sri Jayawardenapura Kotte Wastewater Management Project
Date/Time	From 9.30 am to 1.30 pm on September 17th, 2019.
Place	Raffles Residencies, Jubilee Post, Kotte Road, Kotte.
Organized by	NWSDB/JET

Source: JET

Table 9.10-6 Attendant list of the Stakeholder Meeting

Organization / Affiliation	No. of Attendants	Organization / Affiliation	No. of Attendants
Invitees from Institutions & Organizations		Members of NWSDB and JET	
NPD	1	NWSDB	9
SLLRDC	1	JET	10
CEA	1	Media	
Survey Dept.	1	Newspaper writer	5
ADB	1	Total	83
DS Maharagama	1		
Dehiwela- Mt. Lavinia MC	1		
CECB	2		
Landowner	14		
HFPS	5		
WHUWS	1		
Business Leader	2		
Engineer	1		
NGO Leader	3		
CBO Leader	10		
CBO Member (Resident)	9		
Bank Society	1		
Kotte Heritage Foundation	1		
MOHNIM, Kotte MC	1		
NWSDB (other section)	2		
Sub total	59		

Source: JET

Invitations to the official groups were hand delivered and the invitees'/recipients' signatures were obtained as documentary evidence. Others were invited for the meeting by sending invitations via courier service. The presidents of all related CBOs including 3 CBOs in Heenatikumbura area had been invited with message that anyone even without invitation can attend the meeting.

In the meeting, there was no disagreement about the Project execution but the demands to change the proposed location of STP were stated by residents of the surrounding areas.

To collect every opinion of the stakeholders, opinion sheets were handed to all attendants. Majority of the opinions were supportive about the Project. On the other hand, there were some objections about the STP location and distrust of O&M activities by NWSDB.

The discussion made in Q&A section is summarised in the Table below. Some answers could not be stated because of subsequent comments made before answering. Thus, the correspondences were clarified in this Table.

The detail of the meeting is given in **APPENDIX 9-2**.

Table 9.10-7 Summary of Discussion in the Stakeholder Meeting

#	Opinion / Question / Comment	Answer by panellist	Clarification / Correspondence
1	Soyzapura STP was known to be a failure, not a success like being stated.[*1]	NWSDB stated that they had a letter of thanks by the residents of Soyzapura addressed to the NWSDB expressing their pleasure at the solutions to the issue of odour from the STP.	-
2	No schools in the Heenatikumbura area were informed or targeted to receive any awareness programs. [*1]	(No time to reply given)	Only students above grade 10 can get involved in the learning session and the particular school does not qualify for that.
3	The specific names of the 3 supposed Professors from the Department of Archaeology at Sri Jayawardenapura University.[*1]	Names mentioned.	-
4	The NWSDB/JET team were purposefully depicting a different portrait to the JICA than an actual picture of the true situation. [*1]	(No time to reply given)	NWSDB and JET technically prepared the designs based on scientific data and did not depict a different portrait.
5	The people were being portrayed an inaccurate picture with regard to the STPs in order to gain their support for the project. [*1]	(No time to reply given)	
6	The EIA report is inaccurate and inconclusive. [*1]	(No time to reply given)	EIA report is evaluated by CEA, NWSDB and JET. Then NWSDB and JET do not recognize such facts.
7	That the method of choosing the STP location was wrong; while the most suitable location was situated in a land in close proximity to the Parliament. [*1]	There was an increased chance of flood retention and that also the SLLRDC had affirmed that this land was already allocated for a different developmental project.	-
8	There was an increased chance of flood retention and that also the SLLRDC had affirmed that this land was already allocated for a different developmental project. [*1]	There was an increased chance of flood retention and that also the SLLRDC had affirmed that this land was already allocated for a different developmental project.	-
9	None of the societies had been invited from the Heenatikumbura area. [*1]	The presidents of all 3 CBOs in Heenatikumbura area had been invited, and that there was documented evidence that these had been couriered to all areas.	-
10	A landowner of PS No. 08 is currently facing issues with the compensation for the land and is in urgent need of the money. [*2]	This was being delayed due to some further opposition in this regard, but assured that the matter of compensation will be looked into soon.	-
11	<<Comment>> A representative of residents stated that they were taken by NWSDB and JET to visit the Ja-Ela and Soyzapura STP sites and had overall had a very positive experience with no indication of the terrible odour issue that was being much discussed. They were taken on an entire guided tour of the STP process, and he himself touched the treated water and the water was clear and had no odour. He stressed that the Project would be essential. [*3]		
12	HFPS had never been invited to any STP field visits. [*1]	Even though HFPS representatives had been invited for the STP field visits several times, they had adamantly refused to take part.	-
13	There are no media persons present at meeting today. [*1]	Media personnel present at the meeting today.	-
14	<<Comment>> This project is essential as Maharagama itself has 16 GN divisions, all of which are affected by the present sewerage problem and therefore included in the Project. A couple of other individuals too tried to give their comments, but the HFPS group continued to act aggressively and overpower the attempted comments by other residents with their collective loud remarks. [*3]		
15	The location of discharging points of proposed STP being unclear and not being named clearly. [*4]	Clearly mentioned in the EIA report now available for public reference.	-

#	Opinion / Question / Comment	Answer by panellist	Clarification / Correspondence
16	A previous speaker mentioned that the treated wastewater would supposedly be at drinking water level. *4	(No time to reply given)	Discharged water is not necessary at drinking water level because it will not be used for drinking purpose.
17	Indicate a strong lack of faith in NWSDB to conduct proper maintenance of STP. *4	NWSDB's proper ability of O&M is one of the most important conditions of the loan. It has to be guaranteed in advance to be funded.	-
18	HFPS inquired whether they could have tours and field visits organized to visit these supposedly successful STP sites. *1	NWSDB can definitely organize such field visits once the participation and dates were confirmed.	-

*1: HFPS, *2: Landowner, *3: Representative of residents, *4: An engineer
Source: JET

9.11 SUMMARY OF THE EIA STUDY

An EIA study for the Project was carried out by Central Engineering Consultancy Bureau supervised by NWSDB.

In the study, the physical, ecological, and social environment of the Project area of the proposed Sri Jayawardenapura Kotte wastewater collection, treatment, and disposal project were studied and the impacts of the Project activities during both construction and operational stages were analysed. The findings and the conclusion of the study are as follows.

Use of septic tanks is the present mode of wastewater disposal in the Project area. The area is densely populated. The commuter population who visit this administrative capital of the country for employment or for the services offered by thousands of existing and proposed public and private sector institutions and businesses have doubled this population density during the day time. Therefore, the septic tank option is no longer feasible for the limited space available in this project area.

Shallow groundwater table, and frequent flooding in the Project area, have worsened the situation with septic tanks overflowing and leaking. Studies performed for this EIA indicate that both groundwater and surface water bodies have been contaminated with fecal coliform bacteria. Therefore, the necessity of a central wastewater collection, treatment, and disposal system can be justified.

The study indicates that the proposed project imposes both positive and negative impacts on the environment. Almost all significant negative environmental impacts can be mitigated with implementation of proposed mitigation measures, a comprehensive construction management plan, traffic management plan, environmental management plan, and an environmental monitoring plan.

Publicly expressed protest of the residents in Heenatikumbura, against the construction of proposed STP within their neighbourhood can be identified as the most critical negative impact. The residents including protesters joined several meetings and awareness programs which explained the necessity of the Project for their area to control further deterioration of their environment. Subsequently, many of them came to have supportive attitude while some of them still kept negative attitudes. Following activities for public awareness by NWSDB and the results are shown in " 9.8 PUBLIC AWARENESS - STAKEHOLDER CONSULTATION".

The site selected for the construction of STP is presently a flood retention area of the Metro Colombo basin. To compensate the loss of retention capacity of this marsh land, flood control interventions are to be implemented by SLLRDC.

The project area is not home for any endemic or threatened species, and the vegetation at these sites is dominated by cultivated species. Still, the site selected for the construction of STP is an abandoned paddy field and is home to common wetland habitats. 16 acres of adjacent land is to be reserved as a flood retention area and it is expected to maintain the bio diversity at this land compensating the impact on flora and fauna. Therefore, the overall conclusion is that the proposed project will not have a negative impact on the ecology of the Project area.

The water quality model analysis performed for understanding the impacts on water quality in the target water environment, indicates that implementation of this proposed project significantly improve the surface and ground water quality of the Project area in the long term.

Adhering to the proposed mitigation measures, during design, construction and operational phases of the Project is essential to minimize possible negative impacts. The study recommends implementing the Project along with the strict execution of the contingency management plan, the environmental management plan, and the environmental monitoring plan.

9.12 ENVIRONMENTAL CHECKLIST

The Environmental Checklist for the Project is given in **APPENDIX 9-1**.

CHAPTER 10 ABBREVIATED RESETTLEMENT ACTION PLAN

10.1 OUTLINE

- Approximately 8.37 ha and 0.225 ha land will be acquired for construction of STP and Major Pumping Station (10.3).
- No resettlement will be required for the Project. However, a total of 30 land owners (including 4 public owners) will be affected by the Project (10.3.1).
- NWSDB will provided prompt and effective compensation at full replacement cost for losses of assets attributable directly to the Project based on JICA Guidelines and World Bank PO 4.12 (10.4.1).
- The cut-off date for entitlements for titleholders has been disclosed by the government publishing Section 2 notice under the Land Acquisition Act (LAA) (10.3.4).
- Grievance redress mechanism has been established (10.4.3).
- The Total cost required for acquiring necessary lands is estimated to be approximately 456 million LKR (10.5).
- Consultation with landowners has been conducted by NWSDB in collaboration with JET (10.8).

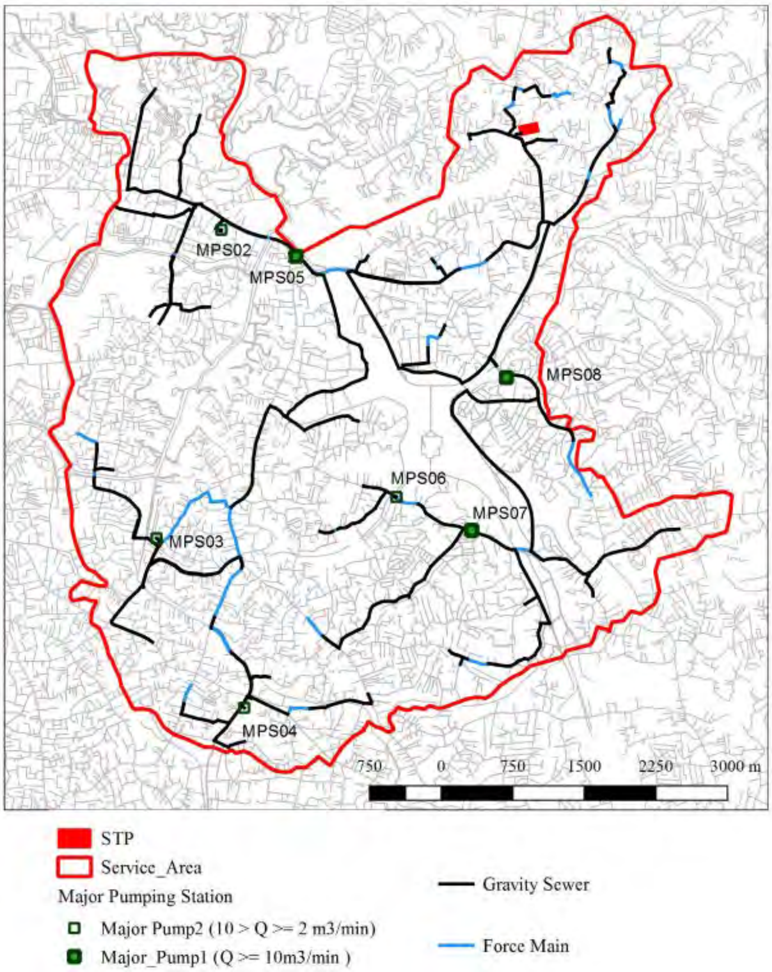
10.2 NEED FOR LAND ACQUISITION AND RESETTLEMENT

It is a policy of GOSL to acquire public land for project components requiring construction. Similarly, JICA Guidelines and World Bank Operational Policy include policies for the minimization of private land acquisition and involuntary resettlement. As such, efforts of minimize impacts of land acquisition and resettlement were taken through consideration of aspects of location, land use, conservation, land owner, availability, technical requirement, cost, resettlement, relocation and surrounding environment. They are presented in **Section 9.3**. As a result, no resettlement will be required for the Project. However, due to the nature of sewerage collection systems and large number of project components, acquisition of private land is required. Procedures set forth in the Land Acquisition Act of Sri Lanka will be followed by NWSDB for the lawful acquisition of the required lands.

Table 10.2-1 Summary of Lands Required for the Project

No.	Facility	Remarks
01	Sewerage Treatment Plant (STP) and Flood Retention Area	Public land (SLLRDC) and private land
02	STP access road and canal	Private land
03	Major Pumping Stations	Land acquisition for MPS at 6 of 7 locations. Mix of public and private lands.

Source: JET



Source: JET

Figure 10.2-1 The location of the Project Components

10.3 EXISTING LEGAL FRAMEWORK

10.3.1 Key Sri Lankan Laws and Regulations

Land Acquisition Act (LAA) of 1950 and subsequent amendments form the basis for land acquisition and resettlement policies in Sri Lanka. This has been supplemented by several other regulations to fill in gaps in the policy. The key regulations are summarized in the table below. Details of the applicable laws for acquiring land and resettling project affected persons are given in the following subsections.

Table 10.3-1 LAA and the Related Regulations

Law	Key points
Land Acquisition Act of 1950 (and subsequent amendments)	Defines procedures for inspection, valuation, consultation, compensation, and acquisition. Ensures that no person shall lose access to their land without first going through the procedure. (Does not address other key issues, such as social impacts. Non-titleholders and other dependents on land are not assisted)
National Involuntary Resettlement Policy (NIRP)	Addresses key resettlement issues missing in the LAA such as i) exploration of alternative options that avoid or minimize impacts on people, ii) compensation for those that do not own the land, but benefit from it in other ways, iii) consultation with project affected persons and communities on resettlement options, iv) integration of the displaced in the host communities, and v) full social and economic rehabilitation of the displaced persons. The plans are also required to be publicly available.

Law	Key points
The National Environmental Act	Requires the formulation of a RAP to address for involuntary resettlement of 100 or more households. The NEA further requires an assessment of project impacts on relocating households and other community groups in sufficient. The requirements are compatible with that of involuntary resettlement safeguard requirements of the ADB.

Source: JET

As of January 2018, location of the STP has been agreed to by all concerned parties (NWSDB, UDA, and SLLRDC) and necessary gazette notification to reserve the land has been issued.

(1) Land Acquisition Act of 1950

The LAA makes “Provision for the acquisition of lands and servitudes for public services”. Detailed procedures for inspection, valuation, consultation, compensation, and acquisition are defined in the Act. It ensures that no person shall lose access to their land without first going through the procedure. The LAA of 1950 has several amendments, the latest being the version of 1986 and the Revised Land Acquisition Regulations of 2008 gazetted as No. 1585/7 Tuesday, 20th of January 2009. Land acquisition procedure stipulated by LAA which the project proponent and the related officials follow is summarised below.

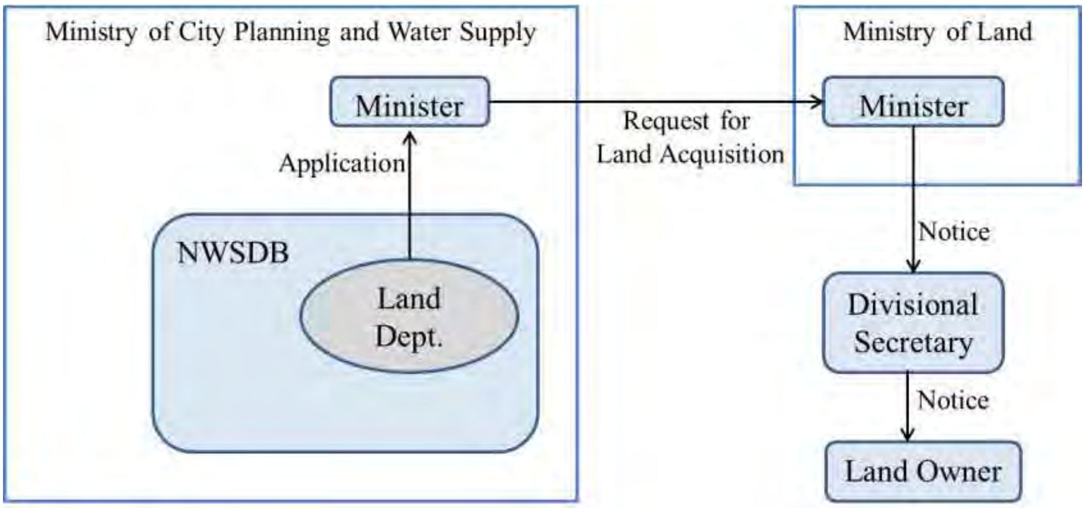
Table 10.3-2 Land Acquisition Procedure by LAA

Step Under	Action	Action by
	Submission of application by the respective Ministry to the Ministry of Land	Applicant ministry
Section 2 of LAA	Section 2 Direction by Ministry of Lands - Grants the authority to enter the land and the decision of Hon. Minister that the particular land is needed for a public purpose;	Ministry of Lands
	Section 2 Notice by Divisional Secretary - Publish the notice in the surrounding area;	Divisional Secretary
	Preparation of Advance Tracing	Superintendent of Survey (Survey Department)
Section 4 of LAA	Section 4 Direction by Ministry of Lands - Inviting objections from the land owners and decision of the Hon. Minister for investigation; Notification by Sinhala, Tamil & English newspapers (inviting any objections from the land owners)	Divisional Secretary / Acquiring Officer
	Section 4 Notice - Publish the notice inviting objections;	by Divisional Secretary
	Inquiring the objections	Applicant Ministry
Section 5 of LAA	Section 5 Declaration by Ministry of Lands - Decision of the Hon. Minister of Lands that the land is to be acquired;	Ministry of Lands
	Section 5 Notice by Divisional Secretary/Government Printer - Publish a gazette notice that Hon. Minister of Land decided that the land is to be acquired;	Divisional Secretary / Government Printer
	Preparation of Final plan	Superintendent of Survey (Survey Department)
Section 7 of LAA	Section 7 notice – Invitation notice to investigate the title of the land - Publish a gazette notice and newspapers on date and place of compensation inquiry	Divisional Secretary / Government Printer
	Decision on actual people to be compensated	Divisional Secretary / Acquiring Officer
Section 9 of LAA	Investigating title (Inquiry into claims for compensation)	Divisional Secretary / Acquiring Officer
Section 10 of LAA	Determine the title - Decision of the Divisional Secretary to the claimant	Divisional Secretary / Acquiring Officer
	Preparation of valuation report	Valuation Department
Section 17 of LAA	Awarding compensation - Payment of compensation and interest to the claimant	Divisional Secretary / Acquiring Officer
	Allocation financial provisions from the Ministry of Lands or the relevant Institution and make payments to the land owner	Divisional Secretary / Acquiring Officer

Section 38 of LAA	Gazetting 38 Order - Take over the land's possession to the Government	Ministry of Lands
	Taking over possession of the land and handing over to the applicant ministry	Divisional Secretary / Acquiring Officer
Section 44 of LAA	Vesting certificate / registration of state ownership (Issue vesting certificate (Transferring of the deed) to the applicant ministry after payment of compensation to the land owners)	Divisional Secretary / Registrar General

Source: JET

The framework of land acquisition is shown below. The NWSDB (Project Proponent) files an application to its line ministry (Ministry of City Planning and Water Supply) through the Land Department. The Minister of City Planning and Water Supply officially requests the Minister of Land to start the land acquisition procedure. The Ministry of Land then processes the request according to the relevant laws and regulations.



Source: JET

Figure 10.3-1 The Framework of Land Acquisition

(2) National Involuntary Resettlement Policy (NIRP)

The Land Acquisition Act provides compensation for land, structures, and crops only. Provisions are not available to address other key resettlement issues, or to mitigate negative impacts on people resulting from land acquisition. In addition, non-titleholders and other dependents on land cannot be assisted under the LAA.

To address the gaps in the LAA, the Government of Sri Lanka adopted the National Policy on Involuntary Resettlement (NIRP) on 24th May, 2001. The NIRP assigns responsibility of implementing resettlement plans and addresses key resettlement issues such as i) exploration of alternative options that avoid or minimize impacts on people, ii) compensation for those that do not own the land, but benefit from it in other ways, iii) consultation with project affected persons and communities on resettlement options, iv) integration of the displaced in the host communities, and v) full social and economic rehabilitation of the displaced persons. The CEA is tasked to review and approve Resettlement Plans (RPs) prepared by project executing agencies. The plans are also required to be publicly available.

The objectives of the NIRP are as follows:

- Avoid, minimize and mitigate negative impacts of involuntary resettlement by facilitating the reestablishment of the APs on a productive and self-sustaining basis. The policy should also facilitate the development of the APs and the project;

- Ensure that APs are fully and promptly compensated and satisfactorily resettled. The livelihoods of all displaced persons should be re-established and their standard of living improved;
- Ensure that no impoverishment of people shall result as a consequence of compulsory land acquisition for development purposes by the state;
- Assist APs in dealing with the psychological, cultural, social and other stresses caused by land acquisition;
- Make all APs aware of processes available for redress of grievances; and
- Have in place a consultative, transparent and accountable involuntary resettlement process with a time frame agreed to by the project executing agency and APs.

Key principles of the policy are as follows:

- Involuntary resettlement should be avoided or reduced as much as possible by reviewing the projects as well as alternatives within the project.
- Where involuntary resettlement is unavoidable, displaced persons should be assisted to re-establish them and improve their quality of life.
- Gender equality and equity should be ensured and adhered to throughout the policy.
- Displaced persons should be fully involved in the selections of relocation sites, livelihood compensation and development options at the earliest opportunity.
- Replacement land should be an option for compensation in the case of loss of land; in the absence of replacement land cash compensation should be an option for all displaced persons
- Compensation for loss of land, structures, other assets and income should be based on full replacement cost and should be paid promptly. This should include transaction costs.
- Resettlement should be planned and implemented with full participation of the provincial and local authorities.
- To assist those displaced to be economically and socially integrated in to the host communities; participatory measures should be designed and implemented.
- Common property resources and community and public services should be provided to Displaced persons.
- Resettlement should be planned as a development activity for the Displaced persons.
- Displaced persons who do not have documented title to land should receive fair and just treatment.
- Vulnerable groups should be identified and given appropriate assistance to substantially improve their living standards
- PIAs should bear the full costs of compensation and resettlement.

The Policy applies to:

- All development-induced land acquisition or recovery of possession by the state.
- A comprehensive resettlement plan will be required where 20 or more families are displaced.
- If less than 20 families are displaced the policy still applies but a plan can be prepared to a lesser level of detail.
- The policy will apply to all projects regardless of source of funding.
- The policy will apply to all projects in the planning phase on the date this policy comes in to effect, and all future projects
- National Policy for Payment of Compensation
- The National Policy on Payment of Compensation (NPPC) came into effect on November 2008 after Cabinet approval. The Policy aims to establish a uniform system of compensation and payment of compensation necessary due to land acquisition and resettlement. The policy is based on the LAA, NIRP, and other laws related to land acquisition and resettlement.

(3) National Environmental Act No 47 of 1980 (NEA)

The National Environmental Act (NEA), No.47 of 1980, amended by Act No.56 of 1988, and its regulations are applicable to involuntary resettlement. The Gazette notification No.859/14 of 23 February 1995 determined the projects and undertakings for which CEA approval is needed in terms of Part IV – C of the NEA. Item 12 in the Schedule requires the formulation of a RAP to address involuntary resettlement of 100 or more households.

The NEA further requires an assessment of project impacts on relocating households and other community groups in sufficient detail. This assessment should identify anticipated social problems, proposed mitigation measures, estimated cost involved, and an entitlements package. This assessment should be based on information collected from Project Affected Persons (PAPs), census and survey data, and on interviews with community leaders and site visit or field surveys. The assessment will demonstrate that every possible action has been taken to avoid the relocation of households and businesses. Where relocation is found to be unavoidable, the following issues are to be addressed with an action plan. These requirements are compatible with that of involuntary resettlement safeguard requirements of the SPS of ADB.

10.3.2 Key Principles of JICA Policies on Land Acquisition and Involuntary Resettlement

The key principles of JICA policies on involuntary resettlement are as follows:

- Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
- When population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
- People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.
- Compensation must be based on the full replacement cost as much as possible.
- Compensation and other kinds of assistance must be provided prior to displacement.
- For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan includes elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.
- In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.
- When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
- Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
- Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by World Bank OP 4.12, as it is stated in the JICA Guideline that “JICA confirms that projects do not deviate significantly from the World Bank’s Safeguard Policies”. Additional key principles based on World Bank OP 4.12 are as follows.

- Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.

- Eligibility of Benefits include, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.
- Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.
- Provide support for the transition period (between displacement and livelihood restoration).
- Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.
- For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.

In addition to the above core principles of the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

10.3.3 Comparison of JICA Guidelines and Sri Lankan Policies

A comparison of LAA and NIRP against the JICA Guidelines was made and the results are shown in the table below. The NIRP is a set of policies governing land acquisition in Sri Lanka while the LAA is the law describing the acquisition procedure. Therefore, much of the following discussion focuses on the NIRP. When gaps are found, JICA guidelines will be prioritized.

Table 10.3-3 Comparison of JICA and Sri Lankan Policies on Involuntary Resettlement

No.	JICA Policies	Sri Lankan Laws and Policies	Key Gaps of JICA GL and Sri Lankan Laws	Resettlement Policies for the Project
1	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	Involuntary resettlement should be avoided or reduced as much as possible by reviewing the projects as well as alternatives within the project (NIRP) Discourages unnecessary acquisition and requires that the land should be used for the purpose for which it is acquired (LAA)	No key gaps	NWSDB will follow NIRP and JICA GL to select STP site by analyzing alternatives
2	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	Where involuntary resettlement is unavoidable, displaces persons should be assisted to re-establish them and improve their quality of life (NIRP)	No key gaps	NWSDB will compensate for losses.
3	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	Where involuntary resettlement is unavoidable, displaced persons should be assisted to re-establish them and improve their quality of life (NIRP) Same as NIRP (LAA)	No key gaps	NWSDB will follow NIRP and JICA Gl and prepare detailed income restoration program to keep PAPs' standard of living improved.
4	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	Compensation for loss of land, structures, other assets, and income should be based on full replacement costs and should be paid promptly. This should include transaction	No key gaps	Compensation will be based on the full replacement cost.

No.	JICA Policies	Sri Lankan Laws and Policies	Key Gaps of JICA GL and Sri Lankan Laws	Resettlement Policies for the Project
		costs (NIRP)		
5	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	Compensation for loss of land, structures, other assets, and income should be based on full replacement costs and should be paid promptly. This should include transaction costs (NIRP) No clear regulation to ensure compensation prior to displacement, even there are measures to prompt payment of compensation (NIRP)	There is a slight gap in description of payment time.	NIRP and JICA GL will be followed. NWSDB will prepare budge for full replacement costs and conduct full payment prior to land acquisition and displacement.
6	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)	A comprehensive resettlement plan will be required where 20 or more families are displaced. If less than 20 families are displaced the policy still applies but a plan can be prepared to a lesser level of detail (NIRP) However, no required under LAA.	The number of for preparing Abbreviated Resettlement Action Plan (ARAP) is different, but no key gaps.	No households are expected to be displaced in the Project. ARAP will be prepared and updated by following NIRP and JICA GL.
7	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	Displaces persons should be fully involved in the selections of relocation sites, livelihood compensation and development options at the earliest opportunity. Resettlement should be planned and implemented with full participation of the provincial and local authorities (NIRP) Consultation with affected population is not required (LAA)	No key gaps	Consultations will be conducted by using local language and information (such as alternatives, compensation policy and income restoration) will be provided in advance.
8	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	No specific policy regarding communication method	Policy regarding communication method is not specified	Consultations will be conducted by using local language.
9	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	Displaced persons should be fully involved in the selection of relocation sites, livelihood compensation, and development options at the earliest opportunity. Resettlement should be planned and implemented with full participation of the provincial and local authorities (NIRP)	No key gaps	Participation of PAPs will be considered.
10	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	A system of internal monitoring should be established by project execution agencies to monitor implementation of resettlement plans including budget, schedule, and delivery of entitlements, consultation, grievances, and benefits (NIRP)	No key gaps	NWSDB will follow NIRP and JICA GL. A Grievance Redress Committee (GRC) will be established at the local level and grievance procedures will be proposed.
11	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey	The notice referred to in subsection 7(1) shall direct every person interested in the land which is to be acquired to appear before the	Minor gaps on timing of survey.	JICA guidelines and WB OP4.12 will be followed.

No.	JICA Policies	Sri Lankan Laws and Policies	Key Gaps of JICA GL and Sri Lankan Laws	Resettlement Policies for the Project
	(including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	acquiring officer on a date and at a time and place specified in the notice (such date not being earlier than the twenty-first day after the date on which the notice is to be exhibited for the first time) and at least seven days before the date specified in the notice to notify the particulars of his claim for compensation, the amount of compensation, and the details of the computation of such amount (LAA, Section 7(2)-c)		
12	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	Displaced persons who do not have documented title to land should receive fair and just treatment (NIRP)	No key gaps	NWSDB will follow NIRP and JICA GL. NWSDB will also provide resettlement assistance to the PAPs who have no recognizable legal right to the land they are occupying.
13	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	Replacement land should be an option for compensation in the case of loss of land. In the absence of replacement land, cash compensation should be an option for all displaced persons (NIRP)	No key gaps	No households are expected to be displaced in the Project. Replacement land or cash compensation will be proposed.
14	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	Where involuntary resettlement is unavoidable, displaced persons should be assisted to reestablish them and improve their quality of life (NIRP)	No key gaps	NWSDB will follow NIRP and JICA GL to provide support for the transition period.
15	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	Vulnerable groups should be identified and given appropriate assistance to substantially improve their living standards (NIRP)	No key gaps	To conduct a census survey to identify the vulnerable groups and to pay particular attention on them by following NIRP and JICA GL.
16	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	A comprehensive resettlement plan will be required where 20 or more families are displaced. If less than 20 families are displaced the policy still applies but a plan can be prepared to a lesser level of detail (NIRP)	The number for preparing ARAP is different, but no key gaps.	No households are expected to be displaced in the Project. ARAP will be prepared and NIRP will be followed because NIRP's policy is more strict than JICA GL.

Source: JICA Guidelines for Environmental and Social Considerations (Apr. 2010), World Bank Operational Policy 4.12, NIRP and LAA.

10.4 SCOPE OF LAND ACQUISITION AND RESETTLEMENT

No resettlement will be required for the Project through the efforts of alternative study. However, due to the nature of sewerage collection systems and large number of project components, acquisition of private land is required. Lands to be acquired are outlined in the tables below. Census and asset surveys related to the acquisition are treated in the sections that follow.

Table 10.4-1 Land Acquisition for STP Site

Facility	Land Area of Needed	Current Use	Owner	Land Acquisition Necessity	Resettlement Required	Remarks
Flood Retention Area	3.74 ha	Flood control	Private (12)	Necessary (3.74 ha)	0	Including road, canal and abandoned paddy land.
STP	4.43 ha	Flood control	Private (9)	Necessary (4.43 ha)	0	Including road, canal and abandoned paddy land.
Access Road and Canal	0.2 ha	Car repair shop, Maga Industry	Private (2)	Necessary (0.2 ha)	0	Including existing structures.
Total	**8.37 ha**	**-**	**23**	**8.37 ha**	0	

Source: JET

Table 10.4-2 Land Acquisition for Major Pumping Stations (MPSs)

Facility	Land Area of Needed	Current Use	Owner	Land Acquisition Necessity	Resettlement Required	Remarks
MPS-2	0.03 ha	Open Land	Private (1)	Necessary (0.03 ha)	0	
MPS-3	0.025 ha	Open Land	Private (1)	Necessary (0.025 ha)	0	
MPS-4	0.03 ha	Construction equipment storage	SLLRDC (Public, 1)	Necessary (0.03)	0	Transfer the land only
MPS-5	0.065 ha	Sewerage pumping station, equipment storage	NWSDB (1)	0	0	Land acquisition is not required.
MPS-6	0.035 ha	Open Land	UDA (Public, 1)	Necessary (0.035)	0	Transfer the land only
MPS-7	0.042 ha	Open Land	UDA (Public, 1)	Necessary (0.042 ha)	0	Transfer the land only
MPS-8	0.063 ha	Open Land	Private (1)	Necessary (0.068 ha)	0	
Total	**0.29 ha**	**-**	**7**	**0.225 ha**	**0**	

Source: JET

10.4.1 Population Census Survey

Table 10.4-3 presents the results of census survey on project affected population. The number of project affected units (PAUs) and project affected persons (PAPs) is summarized in **Table 10.4-4**.

Table 10.4-3 The Results of Population Census Survey

No.	Affected Land Owner	Land Category	Legal/Illegal Residence	Structure	Vulnerable* Owner
1	Person 1	Private	Legal	No	No
2	Person 2	Private	Legal	No	No
3	Person 3	Private	Legal	No	No
4	Person 4	Private	Legal	No	No
5	Person 5	Private	Legal	No	No
6	Person 6	Private	Legal	No	No
7	Person 7	Private	Legal	No	No
8	Person 8	Private	Legal	No	No
9	Person 9	Private	Legal	No	No
10	Person 10	Private	Legal	No	No
11	Person 11	Private	Legal	No	No
12	Person 12	Private	Legal	No	No

No.	Affected Land Owner	Land Category	Legal/Illegal Residence	Structure	Vulnerable* Owner
13	Person 13	Private	Legal	No	No
14	Person 14	Private	Legal	No	No
15	Person 15	Private	Legal	No	No
16	Person 16	Private	Legal	No	No
17	Person 17	Private	Legal	No	No
18	Person 18	Private	Legal	No	No
19	Person 19	Private	Legal	No	No
20	Person 20	Private	Legal	No	No
21	Person 21	Private	Legal	No	No
22	Person 22	Private	Legal	Temporary (1 F)	No
23	Person 23	Private	Legal	Temporary (1 F)	No
24	Person 24	Private	Legal	No	No
25	Person 25	Private	Legal	No	No
26	SLLRDC	Public	Legal	No	No
27	NWSDB	Public	Legal	No	No
28	UDA	Public	Legal	No	No
29	UDA	Private	Legal	No	No
30	Person 26	Private	Legal	No	No

*: Vulnerable means the poor, those without legal title to land, ethnic minorities, women, children, elderly and disabled.
Source: JET

Table 10.4-4 Summary of PAUs and PAPs

Type of Loss	No of PAUs			No of PAPs		
	Legal	Illegal	Total	Legal	Illegal	Total
Required for displacement						
1) HH (structure on private land)	0	0	0	0	0	0
2) HH Tenants	0	0	0	0	0	0
3) CBE (structure on private land)	0	0	0	0	0	0
4) CBE tenants	0	0	0	0	0	0
Not required for displacement						
5) Land only	4	0	4	24	0	24
6) Land with structure	0	0	0	2	0	2
Total (1~6)	4	0	4	26	0	26

HH: House Hold, CBEs: Commercial and Business Enterprises
Source: JET

10.4.2 Land Type and Asset Survey

Private lands and assets affected by the Project are summarized in the tables and photos below.

Table 10.4-5 Summary of Land Type and Market Price Survey

No.	Facility	Location (District/Division)	Land Type	Affected Area (ha)	Estimated Unit Price (MLKR/ha)	Estimated Land Price (MLKR)	Remarks
1	Flood Retention Area	Village: Kalapaluwawa DS Division: Kadawela District: Colombo Province: Western Province	Abandoned paddy land	0.1914	19.8	3.79	
2			Road	0.0285	395.4	11.27	
3			Canal	0.0973	19.8	1.93	
4			Abandoned paddy land	1.6953	19.8	33.57	
5			Road	0.0387	395.4	15.30	
6			Abandoned paddy land	0.1989	19.8	3.94	
7			Canal	0.0164	19.8	0.32	
8			Abandoned paddy land	0.2328	19.8	4.61	
9			Canal	0.0153	19.8	0.30	
10			Canal	0.0791	19.8	1.57	
11			Abandoned paddy land	1.0329	19.8	20.45	
12			Canal	0.1093	19.8	2.16	
13	STP	Village: Kalapaluwawa DS Division: Kadawela District: Colombo Province: Western Province	Road	0.0214	395.4	8.46	
14			Canal	0.0583	19.8	1.15	
15			Abandoned paddy land	1.9701	19.8	39.01	
16			Canal	0.0834	19.8	1.65	
17			Abandoned paddy land	2.1691	19.8	42.95	
18			Canal	0.0365	19.8	0.72	
19			Shrub	0.0138	395.4	5.46	
20			Shrub	0.0198	395.4	7.83	
21			Road	0.0562	395.4	22.22	
22	Access Road and Canal	Village: Kalapaluwawa DS Division: Kadawela District: Colombo Province: Western Province	Car repair shop	0.03	1,977	59.31	Commercial
23			Maga Industry	0.17	395.4	67.22	
24	MPS-2	GN Division: 521/B Rajagiriya District: Colombo Province: Western Province	Open Land	0.030	395.4	11.86	
25	MPS-3	GN Division: 519- Nugegoda DS Division: Kotte District: Colombo Province: Western Province	Open Land	0.025	395.4	9.89	
26	MPS-4	GN Division: 526/B, Gangodawila DS Division: Maharagama District: Colombo Province: Western Province	Construction equipment storage (public)	0.030	-	-	Transfer the land only
27	MPS-5	GN Division: 521 Ethul Kotte DS Division: Kotte District: Colombo Province: Western Province	Sewerage pumping station (public)	0.065	-	-	NWSDB's land
28	MPS-6	GN Division: 524 Madiwela DS Division: Maharagama District: Colombo Province: Western Province	Open Land (public)	0.035	-	-	Transfer the land only

No.	Facility	Location (District/Division)	Land Type	Affected Area (ha)	Estimated Unit Price (MLKR/ha)	Estimated Land Price (MLKR)	Remarks
29	MPS-7	GN Division: 524 Madiwela DS Division: Maharagama District: Colombo Province: Western Province	Open Land (public)	0.042	-	-	Transfer the land only
30	MPS-8	GN Division: 479/A Pahalawela DS Division: Kaduwela District: Colombo Province: Western Province	Open Land	0.063	395.4	24.91	
Total				**8.6545**	-	**401.85**	

Note: The costs of crops and trees on the land, and costs of administrative procedures for land acquisition have been included into the land price.
Source: JET

Table 10.4-6 Summary of Asset Type Survey

No.	Facility	Location (District/Division)	Asset Type	No.	Estimated Unit Price (LKR)	Estimated Asset Price (LKR)	Remarks
1	Flood Retention Area	Village: Kalapaluwawa DS Division: Kadawela District: Colombo Province: Western Province	Abandoned paddy land	0	0	0	Not cultivated for the last 15 years.
2			Road	0	0	0	No asset loss.
3			Canal	0	0	0	No asset loss.
4			Abandoned paddy land	0	0	0	Not cultivated for the last 15 years.
5			Road	0	0	0	No asset loss.
6			Abandoned paddy land	0	0	0	Not cultivated for the last 10 years.
7			Canal	0	0	0	No asset loss.
8			Abandoned paddy land	0	0	0	Not cultivated for the last 15 years.
9			Canal	0	0	0	No asset loss.
10			Canal	0	0	0	No asset loss.
11			Abandoned paddy land	0	0	0	Not cultivated for the last 15 years.
12			Canal	0	0	0	No asset loss.
13	STP	Village: Kalapaluwawa DS Division: Kadawela District: Colombo Province: Western Province	Road	0	0	0	No asset loss.
14			Canal	0	0	0	No asset loss.
15			Abandoned paddy land	0	0	0	Not cultivated for the last 15 years.
16			Canal	0	0	0	No asset loss.
17			Abandoned paddy land	0	0	0	Not cultivated for the last 15 years.
18			Canal	0	0	0	No asset loss.
19			Shrub	0	0	0	No asset loss.
20			Shrub	0	0	0	No asset loss.
21			Road	0	0	0	No asset loss.
22	Access Road and Canal	Village: Kalapaluwawa DS Division: Kadawela District: Colombo Province: Western Province	1) Temporary structure (1 F)	300 m^2	25,000/m^2	$7.5*10^6$	Tin sheet roof, tin & brick wall
23			1) Temporary structure (1 F)	400 m^2	25,000/m^2	$10*10^6$	Tin sheet roof, tin & iron railings
24	MPS-2	GN Division: 521/B Rajagiriya District: Colombo Province: Western Province	Open land	0	0	0	No asset loss.

No.	Facility	Location (District/Division)	Asset Type	No.	Estimated Unit Price (LKR)	Estimated Asset Price (LKR)	Remarks
25	MPS-3	GN Division: 519-Nugegoda DS Division: Kotte District: Colombo Province: Western Province	Open land	0	0	0	No asset loss.
26	MPS-4	GN Division: 526/B, Gangodawila DS Division: Maharagama District: Colombo Province: Western Province	Construction equipment storage (public)	0	0	0	Public land and no asset loss.
27	MPS-5	GN Division: 521 Ethul Kotte DS Division: Kotte District: Colombo Province: Western Province	Open land (public)	0	0	0	NWSDB's land
28	MPS-6	GN Division: 524 Madiwela DS Division: Maharagama District: Colombo Province: Western Province	Open Land (public)	0	0	0	Public land and no asset loss.
29	MPS-7	GN Division: 524 Madiwela DS Division: Maharagama District: Colombo Province: Western Province	Open Land (public)	0	0	0	Public land and no asset loss.
30	MPS-8	GN Division: 479/A Pahalawela DS Division: Kaduwela District: Colombo Province: Western Province	Coconut tree	6	25,000	150,000	Based on average annual production in 10-year and market unit price.
			King Coconut tree	2	30,000	60,000	
			Mongo tree	1	40,000	40,000	
			Banana tree	8	20,000	160,000	
			Orange tree	1	50,000	50,000	
			Teak	2	15,000	30,000	Market price
			Kottamba tree	9	10,000	90,000	Market price
Total						**18,080,000**	

Source: JET

Site of Proposed Sewerage Treatment Plant (STP) and Flood Retention Area (No. 1 to No.21)

Site of the access road to the STP (only left side will be acquired. No. 22)

Site of the canal for Flood Retention Area (only right side will be acquired. No. 23)

Site for construction of MPS-2 (private land, No. 24)

Site for construction of MPS-3 (private land, No. 25)

Site for construction of MPS-4 (public land, No. 26)

Site for construction of MPS-5 (NWSDB's land, No. 27)

Site for construction of MPS-6 (public land, No. 28)

Site for construction of MPS-7 (public land, No. 29)

Site for construction of MPS-8 (private land, No. 30)

10.4.3 Household Economy Survey of PAPs

A survey on livelihoods of the PAPs was performed and the results excluding project affected units (PAUs) are summarized in **Table 10.4-7**.

Table 10.4-7 Summary of Household Economy Survey of PAPs

Monthly Income Level (LKR/month)	Number of PAPs	%	Number of PAPs Earning Income from the Affected Land	Estimated Percent of Productive Assets Lost
<30,000	0	0%	0	0
30,000-49,999	15	58%	1 (Fruit tree)	<2%
50,000-99,999	6	23%	0	0
100,000-200,000	1	4%	0	0
>200,000	4	15%	1 (Car repair shop)	Unknown
Total	26	100%	2	

Source: JET; Living Standard: Low/Middle / High

As a conclusion, the income from the land to be acquired by the project is less than 2% of the income of land owners except one car repair shop. There are no poor people (below the official poverty line for 2016, 4,166 LKR per person per month) who will be affected by the project.

10.4.4 Cut-off Date

According to the LAA, the cut-off date for entitlements for titleholders have been disclosed by the government publishing Section 2 notice under the LAA on or after 08 October 2018. Persons who encroach on the area after the cut-off date are not entitled to claim compensation or any resettlement assistance. Contents of the Section 2 notice were disclose to PAPs by the following means: 1) post, 2) public consultation, 3) stakeholder meeting, 4) individual visit. In order to prevent invasion, fence or wall have been constructed in some area (such as No. 22, 23, 25, 27 to 30). However, measures for preventing invasion at No. 1 to 21, 24 and 26 have not been taken. Therefore, it is recommended for NWSDB to take some measures at these areas to prevent invasion.

10.5 COMPENSATION

10.5.1 Compensation Methods

All losses of properties will be compensated for on a replacement cost basis, as stipulated in the various Sri Lankan regulations, World Bank Operational Policies, and JICA Guidelines. Government Valuation Department officials will calculate the Statutory Compensation (SC) using existing government procedures. Where this SC is determined to be insufficient for full replacement at market value, an additional Ex-Gratia Payment (EG) will be negotiated by the parties involved. Thus the formula for calculating the total Replacement Cost (RC) will be: "RC = SC + EG".

All compensation must be paid to all PAPs before being dispossessed of their affected assets. The entitlement matrix is shown in the table below.

Table 10.5-1 Entitlement Matrix

Item No.	Type of Loss	Entitled Persons (Beneficiaries)	Entitlement (Compensation Package)	Responsible Organization
1.	Lands	Legal owners of lands	a) Replacement cost of land (including statutory compensation and additional negotiated ex-gratia payment to cover the market value of land as well as all other related losses. b) Refund of stamp duty & registration cost incurred for replacement land purchase at the replacement value. c) Contingency arrangements will be prepared by NWSDB to deal with unexpected issues.	NWSDB
2.	Trees etc.	a) Person with legal ownership of the land b) Socially recognized owner	a) Cash compensation (including market rates and transaction costs etc.) determined for different types of trees using the price agreed between owners and NWSDB. b) Compensation at full replacement cost.	NWSDB
3.	Structures	Legal and/or non-eligible owners of the structures	a) Cash compensation (including full replacement based on market rates and transaction costs etc.) of structures which are built before cut-off date decided by NWSDB. b) Compensation for loss of business income (see No. 5)	NWSDB
4.	Livelihood	All project households (PAHs)	a) When a PAH's livelihood and standards are found to going worse after land transformation, assistance and supports (such as providing employment opportunities to them during construction period and operation period) will be provided. b) Special assistance: No. 22 (such as during operation period of the STP, to give priority to the car repair shop for equipment and car repair of the STP) and No. 30 (providing employment opportunities to the owner during construction period and operation period)	NWSDB, District Secretariats, Divisional Secretariats
5.	Loss of business income of car repair shop	Legal tenants/lease holders	a) At least three months advance notice for relocation. b) Allowance for alternative rental accommodation of equivalent standard as determined by NWSDB. c) Supporting the owner to construct a two-storey building to provide same service as before. d) Compensation for loss of business income (3 million LKR) during construction of new building. e) Transportation supporting（100,000 LKR）	

Source: JET

10.5.2 Income Restoration

According to JICA guidelines, host countries must make efforts to enable people affected by projects and to improve their standard of living, income opportunities, and production levels, or at least to restore these to pre-project levels. The results of census survey and livelihood survey indicate that the project will likely affect two land owners who are earning income from the land to be acquired as shown in **Table 10.4-7**. The following supports are considered to restore and improve their livelihood.

1) Providing employment opportunities to them during construction period and operation period, except to provide cash-based compensation.

2) Supporting the owner of car repair shop (No. 22) to construct a two-storey building to provide same service as pre-project.

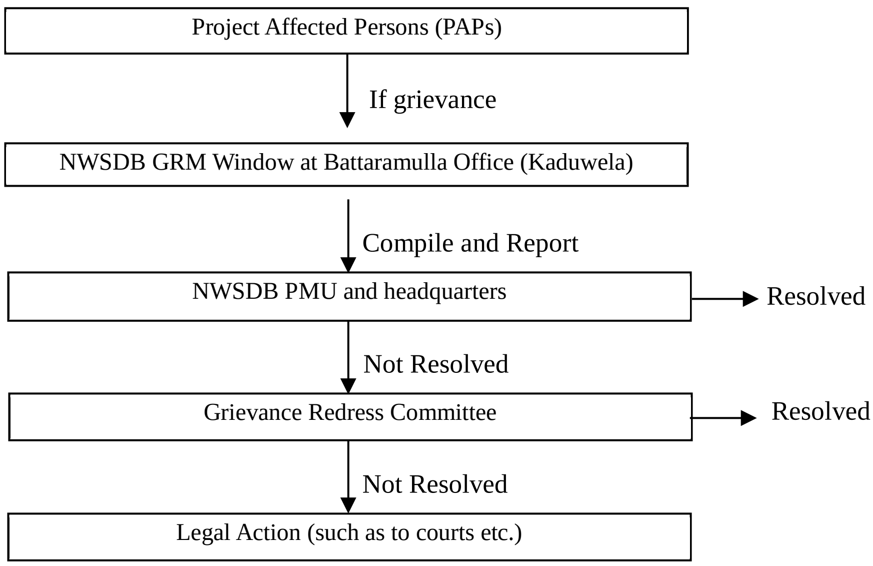
3) During operation period of the STP, to give priority to the car repair shop (No. 22) for repairing the vehicle of the STP.

4) Developing an detailed income restoration program (IRP) during the implementation stage.

10.5.3 Grievance Redress Mechanism

Grievance Redress Mechanism (GRM) was established (May, 2018) to support PAP in their pursuit for fair and adequate reparations for land acquired and to resolve any disputes through mutual understanding and consensus building among all relevant parties. This is in addition to the available legal institutions available for resolving claims brought about by public against disagreeable decisions.

A Grievance Redress Committee (GRC) was established (May, 2018), chaired by the relevant Divisional Secretaries with the participation of officer of Grama Niladhari (GN) Divisional in each project affected land area, the staff of the NWSDB, and community leaders or representatives of PAPs. GRC should be drawn from a diverse field of PAPs and beneficiaries reflect the social diversity of the community. Grievance procedures for land acquisition are summarized in **Figure 10.5-1** Grievance Procedures for Land Acquisition. The PAP with grievance can contact NWSDB GRM Window at Battaramulla Office (Kaduwela) by direct visits or phone call so they can make complaints. A NWSDB sociologist in charge will compile and report the contents to NWSDB PMU and headquarters so they can consider the countermeasures to solve them. If not, they submit the complaints to GRC.



Source: JET

Figure 10.5-1 Grievance Procedures for Land Acquisition

10.5.4 Implementation Structure

Implementation of the land acquisition, compensation, support and monitoring will involve various organizations. At national level, Project Management Unit (PMU) of NWSDB is core organization for coordinating other relevant organizations, especially to coordinate with the officers of the Land Section under NWSDB and land officers of each Divisional Secretariat (DS) to implement the ARAP. At project level, consultants and RAP experts will provide necessary supports to PMU, Land Section of NWSDB and DS.

Implementation institute arrangements and implementation system including organizations and their responsibilities for land acquisition are shown in **Figure 10.5-2** and **Table 10.5-2**.

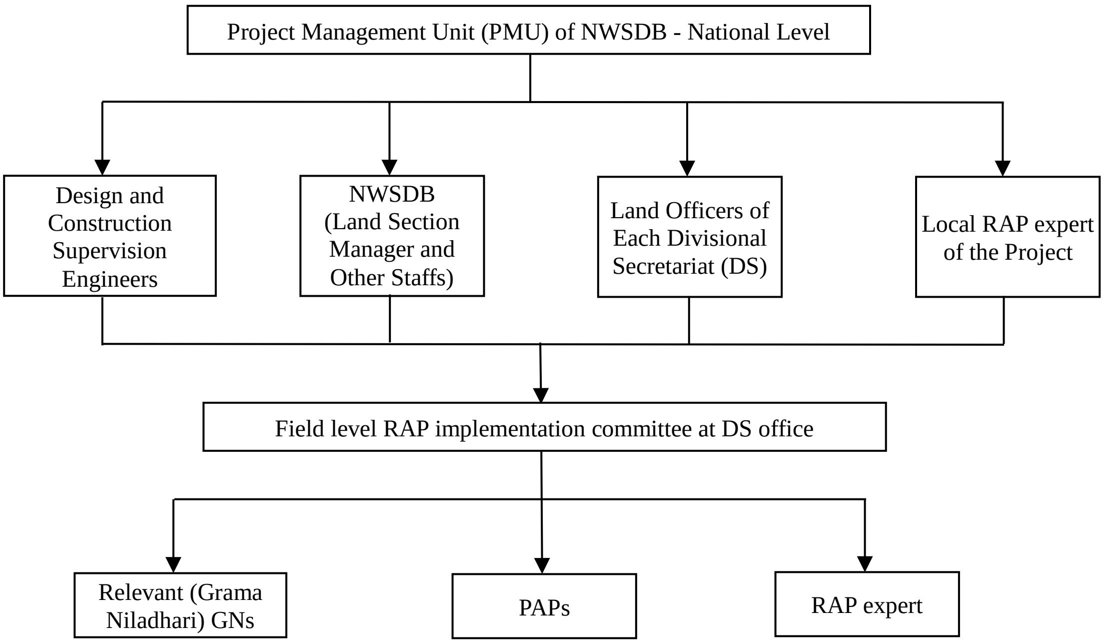


Figure 10.5-2 ARAP Implementation Institutional Arrangement

. Source: JET

Table 10.5-2 Implementation System

No.	Organizations	Responsibility	Remarks
1	Ministry City Planning, Water Supply and Higher Education	Supervision implementation of the ARAP	
2	National Water Supply and Drainage Board (NWSDB)	Implementing the ARAP, arranging funds and coordinating with the relevant DSs	Following NIRP, LAA, World Bank OP 4.12 and JICA Guidelines.
3	Valuation Department	Determination of the statutory component of compensation	
4	PMU	Carrying out all land acquisition and resettlement related activities Reporting to JICA	Disbursing compensation to PAPs, providing assistance, looking into grievance redress, briefing and cooperating with the External Monitoring and Evaluation Consultant
5	Consultants	Supporting and monitoring implementation of the ARAP, and reporting to JICA Sri Lanka Office periodically	
6	Land Officers (LO) of the Division Secretariats (DS)	Carrying out the legally mandated activities related to land acquisition	Coordinating with relevant GNs.
7	Local RAP expert	Supporting NWSDB to carry out land acquisition and consulting with PAPs	

Source: JET

10.6 COST, BUDGET AND SCHEDULE

The total cost required for acquiring necessary lands is estimated to be approximately 456 million LKR as shown in **Table 10.6-1** and budget will be prepared by NWSDB.

Table 10.6-1 Land Acquisition Cost Estimation

No.	Item	Quantity	Unit Price	Total Cost (LKR)	Remarks
1	Attending Inquiries under Sec. 9 of LAA	26	10,000	260,000	
2	Compensation for lands	1 set	401,850,000	401,850,000	Table10.4-5
3	Compensation for structures	1 set	17,500,000	17,500,000	Table10.4-6
4	Compensation for trees etc.	1 set	580,000	580,000	Table10.4-6
5	Loss of income	1 set	3,000,000	3,000,000	
6	Transportation supporting	1 set	100,000	100,000	Car repair shop
7	Operation (monitoring etc.)	10MM	300,000	3,000,000	
8	**Sub-total**			**426,290,000**	
9	Income restoration program	1		8,525,800	2% of sub-total
10	Contingency	1		21,314,500	5% of sub-total
11	**Total**			**456,130,300**	

Source: JET

Schedule for implementing the ARAP is proposed in **Figure 10.6-1**.

Item	2020				2021				2022				2023	2024	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		H1	H2
Consultations with PAPs															
Approval of ARAP															
Approval of IRP															
Approval of entitlements															
Payment of compensation															
Reconstruction of structures															
Titling of land to NWSDB															
Detailed Design															
Monitoring															
Grievance redress															
Start of construction of Package 1, 2, 3, 4															

Source: JET

Figure 10.6-1 ARAP Implementation Schedule Arrangement

10.7 MONITORING

Administrative monitoring of land acquisition procedures is necessary to ensure implementation is on schedule and problems are solved quickly. The progress of land acquisition will be monitored through the following forms. As proposed as **Figure 10.5-2,** monitoring will be undertaken by the local consultant and PMU of NWSDB, and PMU will submit bimonthly monitoring report to JICA. Public consultations will be held as required by NWSDB. Related monitoring forms are shown in the tables below.

Table 10.7-1 Public Consultations Monitoring Form

No	Date / Time	Organizer	Venue	Participants	Consulted Issues / Comments / Response
1		NWSDB			
2		NWSDB			
3		NWSDB			

Public Consultations are held as needed
Source: JET

Table 10.7-2 Land Acquisition (LA)/ARAP Monitoring Form

Activity	Q'ty	Unit	Progress (figure / %)						Completed as of	Responsibility
			1-qtr	2-qtr	3-qtr	4-qtr	5-qtr	6-qtr		
Consultant procurement		MM								
Census survey (incl. Household Economic Survey)										
ARAP approval			Approved as of:							
LA progress		ha								NWSDB/local RAP expert
Lot-1		ha								
Lot-2		ha								
Lot-3		ha								
Lot-4		ha								
…		ha								
Lot-30		ha								
Compensation progress		HH								NWSDB/local RAP expert
Lot-1		HH								
Lot-2		HH								
Lot-3		HH								
Lot-4		HH								
…		HH								
Lot-30		HH								

HH: Household
Source: JET

Table 10.7-3 Summary of Income Restoration

No	Item	Contents	Result/Evaluation
1	Auto Service Centre		
2	Maga Industry		
3	MPS-8		

Source: JET

Table 10.7-4 Grievance Redress Monitoring Form

No	Receiving Date	Category	Contents	Mitigation / Result
1				
2				
3				

Grievances are addressed as they are received. There is no set periodic schedule.
Source: JET

10.8 CONSULTATION WITH PAPS

The objectives of the consultation with the Project Affected Persons (PAPs) are:

- To introduce the outline of the Project;
- To explain the results of alternatives analysis of STP and Major Pump Station sites;
- To introduce potentially affected population and properties;

- To introduce compensation policies of Sri Lanka and JICA, as well as cut-off-date;
- To explain the income restoration program (IRP), and
- To get requirements and comments on compensation policies and IRP etc.

10.8.1 Preparation of Consultation Meeting

A taskforce is established by NWSDB in collaboration with the JET for preparing the consultation with PAPs. The preparation activities are summarized in **Table 10.8-1.**

Table 10.8-1 Preparations for Consultation Meeting

No	Item	Actions
1	Organizations arrangement	Staffs of Sewerage Department and Land Section of NWSDB, JET
2	Date and place	Discuss and determine the appropriate time and place (NWSDB Headquarters or its Area Engineers Office) considering access of participants.
3	Consultation method	Meeting in the form of individual or group considering the convenience of the participants
4	Materials for discussion and presentation	Prepare presentation materials in English and Sinhala.
5	Notification method	1) Individual visit 2) Telephone notification
6	Others	Arrange and prepare meeting room (including setting up A/V equipment etc.).

Source: JET

10.8.2 Meeting Time, Place and Method

The time, place and method of the meetings shown in **Table 10.8-2** were determined in consultation with NWSDB and participants.

Table 10.8-2 Time, Place and Method of the Meetings

No	Time	Place	Method
1st Meeting	10:00 – 12:00, 7th July 2019 (Sun.)	NWSDB Area Engineers Office, Battaramulla	Group
2nd Meeting	10:00 – 11:00, 10th July 2019 (Wed.)	JET office, Borupona	Individual
3rd Meeting	10:00 – 11:30, 15th July 2019 (Mon.)	NWSDB Area Engineers Office, Battaramulla	Group
4th Meeting	15:00 – 16:00, 18th July 2019 (Thu.)	Ditto	Individual
5th Meeting	15:00 – 16:00, 24th July 2019 (Wed.)	Thibirigasyaya (House of the land owner)	Individual

Source: JET

10.8.3 Meeting Participants

The number and affiliation of the participants are summarized in **Table 10.8-3**. In addition, individual consultation on five (5) landowners was conducted by telephone. NWSDB will continuously conduct consultation with remaining landowners based on both Sri Lanka regulations and JICA Guidelines.

Table 10.8-3 Participants of the Meetings

No	Number of Participants (PAPs)	Affiliation	Number of Participants (NWSDB & JET)
1st Meeting	7	PAPs of STP and Flood Retention Area	5
2nd Meeting	1	PAPs of STP	4
3rd Meeting	4	PAPs of MPS	4
4th Meeting	1	PAPs of STP	4
5th Meeting	3	PAPs of MPS	3

Source: JET

10.8.4 Consultations Contents

Major contents of consultation area shown in the followings:

- Alternatives analysis of the STP site;
- Operation and maintenance of the STP and Main Pumping Stations (MPSs);
- Odour control the STP and Main Pumping Stations (MPSs);
- Compensation methods, and
- Income Restoration Program (IRP).

10.8.5 Main Topics Discussed at the Consultation Meetings

The main comments and responses at the consultation meetings are summarized in **Table 10.8-4**.

Table 10.8-4 Main Comments and Responses

No	Main Comments from PAPs	Responses
1	All participants asked what measures were taken to ensure the normal operation and maintenance (O/M) of STP.	NWSDB and JET answered that following measures will be considered : ➢ Proper O/M will be conducted by operators by following SOP (standard operation procedures) prepared by Japanese contractor. ➢ Operators will received proper training activities from Japanese contractor during testing operation period. ➢ In addition, one year follow-up operation by Japanese contractor for training NWSDB's staff will be implemented. ➢ NWSDB has a plan to request Japanese local government for dispatch of long-term experts after one year follow-up operation in order to train operators of the STP.
2	All participants showed their concerns on odour form the STP and MPS when Japanese contractor leaves.	NWSDB and JET answered that various countermeasures on odour issue have been considered. Detailed measures include: ➢ Japanese contractor will prepare proper O/M manuals to reduce the risk of odour. ➢ Deodourization facility will be introduced according to planning. ➢ In case of the deodourization facility breakdown, odour counteractant will be applied as an additional measures.
3	All participants pointed out that land prices are rising, therefore, a reasonable market price for their lands in future valuation should be considered.	NWSDB explained that ➢ Both Sri Lanka and JICA compensation policies will be followed for land acquisition in this Project. ➢ Compensation will be at full replacement cost (including refund of stamp duty & registration cost incurred for replacement land purchase at the replacement value) following World Bank and JICA policies. ➢ NWSDB will make a further consultation with PAPs to reach consensus. ➢ A Grievance Redress Committee (GRC) was established. If land owners have any grievances, they can use Grievance Redress Mechanism to resolve any disputes.
4	The owner of Auto Service Centre requested NWSDB to consider the compensation of income loss during reconstruction period except compensation for the land and structure.	NWSDB would undertake to calculate his income loss during reconstruction of his Auto Service Centre as well as future opportunities for improving his business, such as: ➢ Providing compensation for loss of business income during construction of new building. ➢ Supporting the owner to construct a two-storey building to provide same service as before. ➢ During operation period of the STP, to give priority to the car repair shop for equipment and car repair of the STP etc.

5	Land owner of Main Pumping Station No. 8 requested to shift an existing drainage canal that runs next to her land to proposed land.	NWSDB will confirm the situation and then make decision because at this moment the project is still in the feasibility study stage. Detailed methods for removal of the existing drainage canal will be studied in next detailed design stage.
6	Some participants asked why individual consultations were conducted instead of plenary sessions.	NWSDB and JET explained that individual consultation method is applied by considering the convenience of the participants. In addition, some land owners are not in Colombo even not in Sri Lanka.

Source: JET

Based on the results of these consultation meetings, it can be concluded that most of PAPs agree with the project. However, a reasonable compensation should be made for land, structures and assets as well as livelihood lost. In addition, a few land owners seem to be unwilling to sell their lands to NWSDB for the project. Therefore, it is recommended that NWSDB should have more propaganda meetings to improve public awareness on sewerage project, and at the same time NWSDB should continue its efforts to conduct consultation with landowners based on both Sri Lanka regulations and JICA Guidelines.

10.9 GENDER ACTION PLAN

The overall objective of the Gender Action Plan (GAP) is to promote and facilitate the equal participation of women and men as stakeholders and beneficiaries of the project. The GAP is based on the analysis that women are often times disadvantaged in terms of accessing water resources, decision making, and economic opportunities as most of them are occupied with household work, or have lower standing in terms of social influence. Therefore, a GAP is prepared to encourage and support increased participation of women in the implementation of project activities to ensure that women benefit equally from the project outcomes and are not unfairly overburdened with the costs. The Gender Action Plan is shown in **Table 10.9-1**.

Table 10.9-1 Gender Action Plan

Activities	Sub activities	Indicators/ Targets	Responsibility	Time
Output 1: Establishment of Baseline Data of Gender Related Issues				
1.1 Collect basic social, economic, health, and occupational data for women and vulnerable groups in the Project area	(a) Collect age and sex segregated data on socio, economic, health, and occupational profiles. (b) Identify female specific roles in the area related to wastewater and its effects on the above. (c) Identify households headed by women, and poor/vulnerable households.	Age and sex segregated data collected in all subject areas. Vulnerable groups in the Project area and their profiles.	Project Management Unit (PMU), NWSDB, Women Development Officer (WDO)	Within six months
1.2 List women's and vulnerable group advocacy groups in the Project area.	(a) Identify and list potential women's and vulnerable group advocacy groups. (b) Assign tasks related to promotion and education of the new sanitation services. (c) Report findings.	Advocacy groups are engaged to promote and propagate sanitation services and its benefits	NWSDB, PMU, WDO, NGOs, Advocacy Groups, Local Governments	Within one year
1.3 Consult women, vulnerable groups, and other members of society, and advocacy groups that support them	(a) Conduct regular meetings with local population (b) Report findings	More than 50% women participation in awareness & training programmes	NWSDB, PMU, WDO, women's societies, District Women Federation	Within 6 months after providing the water supply
Output 2: Methods to ensure/increase inclusion in Project implementation				
2.1 Increase participation of women in the Project construction and operation works	(a) Identify potential women headed households & vulnerable groups for labour hiring (b) Match potential households with positions available in the Project (c) Provide training for needed positions	At least 15% of the works for construction and operation involves women and benefits them	NWSDB, PMU	Throughout the construction and operation period
2.2 Provide financial and infrastructure support for women and vulnerable people in the Project area	(a) Identify poor groups with certification from Grama Niladhari and Samurdhi Officer (b) Provide financial assistance to vulnerable households for service connections, toilet installation etc. (c) Reduce costs for service connections for more vulnerable households (d) Provide service connections and other needed facilities for the most vulnerable/poor households	Sewerage service connections on par with water connections. Samurdhi benefits are expanded to include sewerage services.	NWSDB, PMU NWSDB, PMU	At the time of issuing connections At the time of issuing connections
Output 3: Methods to ensure/increase inclusion in Project planning				
3.1 Appoint women engineers under this project	(a) Encourage women engineers to apply (b) Give preference in recruitment for those who have fulfilled the requirements for the position	30% of increase Number of women engineers appointed	NWSDB, PMU	
3.2 Provide trainings on gender sensitive project planning and implementation to relevant stakeholders	(a) Identify key stakeholders (b) Conduct training programmes on gender sensitive project planning and implementation for NWSDB, relevant District Secretaries, and Divisional Secretaries, relevant officers of Divisional Secretariats, Grama Niladharies, Municipal Councils, Urban Councils and Pradeshiya Sabhas.	30% of increase in number of water and sanitation related projects/ activities designed and implemented with a gender sensitivity after conducting training programmes	NWSDB, PMU, Academically qualified gender experts (from universities), NGOs	

Activities	Sub activities	Indicators/ Targets	Responsibility	Time
3.3 Mobilize advocacy groups to undertake awareness and training programs related to water and sanitation with the support of NGOs	(a) Conduct training programmes on water and sanitation for the women societies at Divisional level and Women's Federations at District level	30% women's societies and 100 % of District Women's Federations mobilized	NWSDB, PMU, District Secretariats, Divisional Secretariats, WDO, District Coordinator-NGOs	
Output 4: Establishment of a Monitoring and Evaluation mechanism				
4.1 Establish monitoring and evaluation mechanism	(a) Local community members (men, women, and youth groups) in the area are given trainings on relevant technical matters and response to relevant emergencies (b) Identify and recognize of community volunteers for reporting safety, traffic, leakages, etc. during construction and operation phases.	30% individuals selected from CBOs, Women's and Youth societies trained on relevant technical matters and responding to relevant emergencies	NWSDB, PMU, CBOs, Divisional Secretaries, Grama Niladharies, WDO	Starting two weeks prior to constructions until project completion

Source: JET

CHAPTER 11 MEASURES FOR ANTICIPATED EFFECT OF THE PROJECT

11.1 OUTLINE

- Four effect indicators (volume of sewage treated, population served, sewerage system served rate, and quality of treated effluent) are proposed for the monitoring and evaluation of progress in achieving the intended benefits of the project (11.2).

- The project is expected to achieve its intended targets of each indicator by the year 2031. The indicators should be periodically monitored and summarized to check the effects of the project (11.3 and 11.4).

11.2 EFFECT INDICATORS

Effect indicators are recommended to monitor and evaluate progress in achieving the intended benefits of the Project.

The following indicators are proposed for the project:

- volume of sewage treated: measured at the outlet of UV disinfector by a flow meter.
- population served: calculated by multiplying the of number of house connections by the average family size.
- sewerage system service rate: calculated by dividing the area population by population served.
- quality of treated effluent: analyzed in the laboratory at the STP

11.3 ANTICIPATED TARGET

Targets for the proposed indicators are determined according to the nature of the project and should generally be achieved 2 years after the project becomes operational. The project is expected to achieve its intended targets by the year 2032. Indicators and proposed targets are shown in **Table 11.3-1**.

Table 11.3-1 Indicators and Targets

Indicator	Present (year 2019)	Target (year 2032)
Volume of Sewage Treated (m^3/d)	0	23,970
Population Served (Persons)	0	136,100
Percentage of the Population Served in the Service Area (%)	0	About 62
Quality of Treated Effluent	BOD_5: – COD: – SS: – NH_4^+-N: – NO_3-N: – Org-N: – TP:	BOD_5 < 10 mg/l COD < 100 mg/l SS < 15 mg/l NH_4^+-N < 1.0 mg/l NO_3-N < 10 mg/l Org-N < 1.0mg/l T-P < 1.0 mg/l

Source: JET

11.4 MEASUREMENT PROCEDURE FOR INDICATOR

The volume of sewage treated will be measured automatically at the disinfection facility of the STP. Served population would be estimated from the recorded number of house connections, and percentage of population served would be calculated from the official population data. Quality of treated effluent would be monitored for compliance by the treatment plant operator as required by the discharge permit.

Although water quality improvement would be observed at discharge points of the STPs, this is not a direct measurement of an actual reduction in pollution of the receiving waters. It is recommended that NWSDB periodically monitor water quality in waterbodies, as indicated in **Table 11.4-1**. Accumulated data before commissioning of the sewerage system will also be needed to demonstrate any improvements resulting from the project.

Table 11.4-1 Recommended Monitoring Method for Water Quality of Rivers

River/Stream Water Quality	Monitoring Locations	Effluent Discharge Points for a STP and 9 points (Location A1, A2, A3, A5, B1, B2,B3, B5, and B8 in **Figure 3.2-4**)
	Parameters for Analysis	pH, Turbidity, Temperature, DO, SS, COD, BOD_5, T-N, T-P. Total Coliform, Heavy metal
	Sampling Frequency	4 times/month except for heavy metals (1 time/3 month)

Source: JET

Regarding the monitoring system of those indicators, the following system is proposed to NWSDB. All indicators are reported to NWSDB Sewerage Section by PMU once every three months for monitoring the progress and effects of the project (**Table 11.4-2**). Data for calculated indicators are collected by Sri Jayawardenapura Kotte Management Office, except for served population and the percentage of served population, which is collected by Greater Colombo Sewerage.

Table 11.4-2 Proposed Monitoring System

Monitoring contents	Monitoring Management Section	Way to monitor
Volume of Sewage Treated (m^3/d), Quality of Treated Effluent	PMU	Sri Jayawardenapura Kotte Management Office collects and summarizes data from STP O&M section and reports to PMU once a month.
Population Served (Persons), Percentage of the Population Served in the Service Area (%)	PMU	Greater Colombo Sewerage collects and summarizes the number of house connection in the service area and reports to PMU once a month. PMU calculates served population and percentage of served population based on number of house connection.
River/Stream Water quality	PMU	Sri Jayawardenapura Kotte Management Office collects and summarizes data from laboratory section and report to PMU once a month.

Source: JET

CHAPTER 12 CONCLUSIONS AND RECOMMENDATIONS

12.1 OUTLINE

- The Project will reduce pollution of public water bodies, improve sanitation, public health conditions, and subsequently bring about further sustainable economic development. The Project satisfies national priorities for this area and has many positive environmental and social impacts (12.2).

- Some risks related to cost increases and delay in the project implementation are anticipated. Therefore, three recommendations on geotechnical investigation, public awareness, and information sharing with relevant agencies are made for project implantation (12.5).

- It is recommended that sludge from septic tanks be treated in the STP to bring the benefit of the project to people without sewerage services (12.5).

12.2 CONCLUSION

This Project will reduce pollution of public water bodies and improve sanitation/public health conditions and subsequently bring about further sustainable economic development. The Project satisfies national priorities for this area and has many positive environmental/social impacts.

12.3 SUSTAINABILITY

Project benefits can be sustained through: (i) the use of innovative technology appropriate for local conditions; (ii) commitment to capacity building for O&M; and (iii) an appropriate tariff structure. The lessons learned during project design and implementation will be useful for other projects, thereby enhancing the sustainability of the broader initiatives in NWSDB.

12.4 RISKS AND MITIGATION MEASURES

Risks to the successful implementation of the project are identified in **Table 12.4-1**(see **APPENDIX 12-1**).

Table 12.4-1 Risks and Mitigation Measures

Risks	Mitigation Measures
1 Cost Increases For building foundations, pipe trenching, and micro tunnelling. For building road crossings, under-river crossings of sewers and micro tunnelling.	Analysis of probability and impact
	Sewerage facilities are spread out over the entire project area in the Highland Complex, where there are different soil conditions. Government buildings in the area have different security levels. The construction methods and schedule may have to be adjusted based on the requirement of the implicated agencies.
	Mitigation measures:
	Soil tests should be carried out at proper sampling points to confirm the conditions. The scope of work and costs should be discussed with authorities with jurisdictional responsibility. Provisional sums should be included in the cost estimates.
2 To Project & Donor Delay in Project implementation: if the identified land is not acquired before the commencement of the project. Delay in Project implementation: if the drainage channels to be built by	Analysis of probability and impact
	The sewage treatment plant, an access road and three pumping stations are to be built on private land. Construction of the access road requires the land acquisition. Land acquisition may take time. After land acquisition and the building of the access road, SLLRDC has to design and construct drainage channels around the STP site for flood prevention. This should be finished before the construction of STP.
	Mitigation measures:

Risks	Mitigation Measures
SLLRDC at the STP site is not finished before the commencement of project.	PMU, NWSDB, UDA, Ministry of Lands and Parliamentary Reforms, and other relevant agencies must have project sites ready. The budget for land acquisition should be allocated to NWSDB. Awareness meetings for residents surrounding sites should be held for enhancing their understandings of the project to promptly conduct land acquisition and construction. Budget for the drainage channels should be allocated to SLLRDC. SLLRDC and Megapolis and Western Development Ministry must design and build the channels before the start of the STP construction.
3 Delivery Quality Low inflow: at the treatment plant, if sewer construction and house connections are delayed. Poor treated water quality: as a result of equipment and process malfunction because staff do not have adequate training.	Analysis of probability and impact
	It may take time to get permission for the construction of sewers under busy streets and in high security areas. Delays in sewer construction and wastewater collection may mean targeted treatment operation would not be achieved according to schedule. Insufficient skilled operators may hinder the smooth operation of the treatment plant.
	Mitigation measures:
	Allocate enough time for meetings to explain to relevant agencies in advance, the construction methods (such as micro tunnelling), time required for the work and where sewer lines have to be routed. This would minimize potential delays. Implement capacity building program for O&M staff including technical assistance during construction and at commissioning. Sewerage tariff should be raised to adequately cover the costs of maintenance and equipment replacement.

Source: JET

12.5 RECOMMENDATIONS

The following actions should be undertaken during the design and implementation periods:

(1) Detailed geotechnical investigations should be carried out during the design stage for:
- STP and pumping station sites to confirm the structural requirements for the foundations.
- Sewer routes to confirm the proper micro Tunnelling methods.
- Pipe trenches to prepare appropriate temporary works and pipe bedding, and to select economical and safe construction methods.
- The tender documents shall specify that the successful bidder is responsible for carrying out an independent investigation of soil conditions.

(2) NWSDB should conduct public awareness campaigns on the importance of sewage treatment and hold frequent meetings to share information on the Project during the detailed design and construction stages.

(3) NWSDB should share information and coordinate with relevant agencies to avoid potential delays. In particular, it is important for SLLRDC and the Megapolis and Western Development Ministry to understand the STP construction schedule to ensure that the drainage channels are built before STP construction starts.

(4) NWSDB should accept sludge from septic tanks and treat them in the STP to bring the benefit of the project to people without sewerage services.

APPENDICES

APPENDIX 2-1 Laws and Regulations on Environmental Protection (2.2.3)

National Environment (Protection and Quality) Regulation No.1, SLS 776:1987, SLS 721:1985, and SLS 775:1987, regulates effluent according to the discharge locations, such as inland surface water, fields for irrigation, or the ocean. The sewage system is designed following the National Water Drainage Board Design Manual D7, 2012, to meet the relevant effluent regulations. Septic Tanks are designed for SLS745 Part1 and Part2.

The Environment Impact Assessment (EIA) is required for sewerage projects. The legal framework for EIA regulations in Sri Lanka were enacted by the National Environmental (Amendment) Act, No. 56 of 1988 and National Environmental (Amendment) Act, No. 53 of 2000. The guidelines for the EIA process are published in Gazette Notifications. The Central Environmental Authority (CEA) oversees the EIA process and designates state agencies as Project Approving Agencies (PAA).

The first level in the EIA process is the Initial Environmental Examination (IEE). Environmental Impact Assessment at the next level is a more comprehensive exercise where alternatives to the project and mitigation measures are identified.

National Institute of Occupational Safety and Health regulates the safety and health aspects in the construction of any infrastructure project. In the absence of construction safety regulations in the country, contractors follow the SLS OHSAS 18001 Safety System Standards and the Certification Scheme in managing workplace safety.

Table A2.1-1 Laws and Regulations on Environmental Protection

Laws/Regulations	Parameters Regulated
Wastewater	
General Standards for Discharge of Effluents into Inland Surface Waters 1. National Environmental (Protection and Quality) Regulations, No. 1 of 2008	Temperature, pH, BOD, SS, oil and grease, toxic matters and heavy metals
Tolerance Limits for Industrial Effluents discharged on Land for Irrigation Purposes 1. SLS 776: 1987	pH, BOD, SS, oil and grease, Cl^-, SAR, toxic matters and heavy metals
Tolerance Limits for Industrial and Domestic Effluents discharged into Marine Coastal Areas 1. SLS 721: 1985 Tolerance Limits for Marine Coastal Waters liable to pollution 2. SLS 775: 1987	Temperature, pH, BOD, COD, SS, NH_3-N, oil and grease, toxic matters and heavy metals
National Water Drainage Board Design Manual D7 Wastewater Collection, Treatment, Disposal & Re-use 1. March 1989 2. February 2012	Sewerage system planning and design such as design period, wastewater flow estimation, sewer design, treatment facility design etc.
Sri Lanka Standards for Septic Tank 1. SLS 745 Part1:2004 for small system 2. SLS 745 Part2:2009 for large system	Septic tank design and maintenance such as flow estimation, design, materials and construction, inspection, commissioning, maintenance
Waste and Wastewater Pollution	
Guidelines for licensing procedure and requirements are listed in No 924/13 dated 23rd May 1996	
General Environmental Protection – Acts and Regulations	
1. National Environmental Act No. 47 of 1980 2. National Environmental (Amendment) Act, No. 56 of 1988 3. National Environmental (Amendment) Act, No. 53	Authority, function and obligation of CEA; Policy, management and protection of the environment

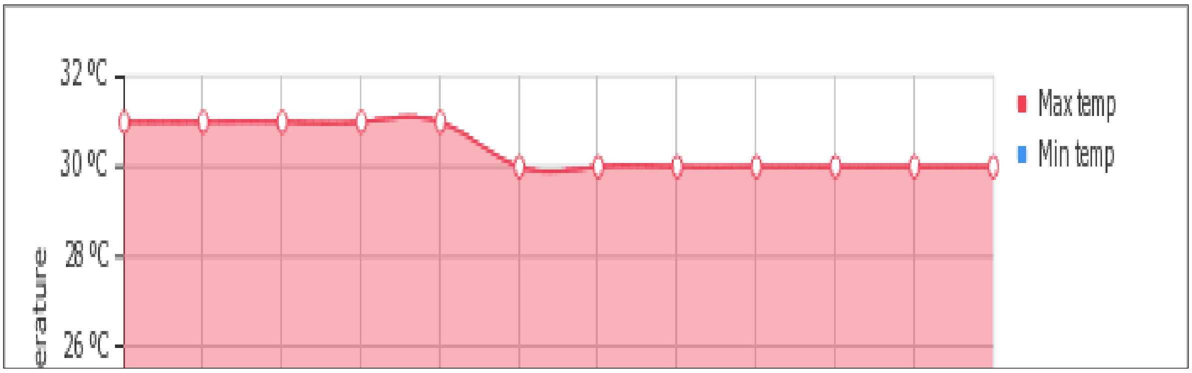
of 2000	
Guidelines for Implementing the EIA Process 1. No. 772/22 dated 24th June 1993 2. No. 850/4 dated 20th Dec. 1994 3. No. 859/14 dated 23rd Feb. 1995 4. No. 1104/22 dated 5th Nov. 1999 5. No. 1108/1 dated 29th Nov. 1999 6. No. 1373/6 dated 29th Dec. 2004 7. No. 1533/16 dated 25th Jan. 2008 8. No. 1534/18 dated 1st Feb. 2008	"Prescribed Projects" for which EIA are necessary, Project Approving Agencies (PAA) and their responsibilities, procedures for compliance with regulations and EIA content and format etc.
1. Coast Conservation Act No. 57 of 1981 2. Coast Conservation (Amendment) Act, No. 49 of 2011	Coastal zone management, permit procedures etc.
Air Pollution	
National Environmental (Ambient Air Quality) Regulations 1. No. 1295/11 dated 30th June 2003 2. No. 1309/20 dated 10th Oct. 2003 3. No. 1557/14 dated 9th July 2008 4. No. 1562/22 dated 15th Aug. 2008 5. No. 1887/20 dated 5th Nov. 2014 6. No. 1895/43 dated 2nd Jan. 2015	sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO) and Particulate Matter (PM_{10}) etc.
Noise Pollution	
National Environmental (Noise Control) Regulations 1. No. 924/12 dated 23rd May 1996 2. No. 973/7 dated 30th April 1997 3. No. 1738/37 dated 29th Dec. 2011	Noise standards in residential, business and industrial areas
Construction	
Occupational Health and Safety Act 1. Health and Safety Policy – Health and Safety at Work Act 1974 2. Occupational Health and Safety at Work, Act 2007 3. National Institute of Occupational Safety and Health Act, No. 38 of 2009 4. Safety System Standards – SLS OHSAS 18001 – Certification Scheme	Occupational Health and Safety Executive to enforce Occupational Health and Safety at Work Act. Occupational Health Safety Management System to Implement Health and Safety at Works as per the Occupational and Safety Policy.
Drinking Water Quality	
Sri Lanka Standards for Drinking Water 1. SLS 614: 1983 2. 1st Revision – SLS 614: 2013	Bacteriological and chemicals of health significance (inorganic constituents, organic constituents) and substances and parameters that may give rise to complaints from consumers.
Tolerance Limits for Inland Surface Waters used as Raw Water for Public Water Supply 1. SLS 722: 1985	Water Quality Standards of Raw Water for Water Supply
National Water Supply and Drainage Board Act 1. NWSDB Law, No. 2 of 1974 2. NWSDB (Amendment) Act, No. 13 of 1992	Regulations on the plan, development activities and management of water supply, sewage and drainage systems etc.

Source: JET

APPENDIX 3-1 Climate of The Service Area(3.2.2)

(1) Temperature

The Sri Jayawardenapura Kotte Municipal Council area and its surroundings receive the lowest rainfall in the western province with a mean annual rainfall of over 1,700 mm, with a relatively dry period from December to mid-March. The significant amount of rain falls during the month of May, which averages 392 mm. Monthly precipitations are summarized in **Figure A3.1-1**.

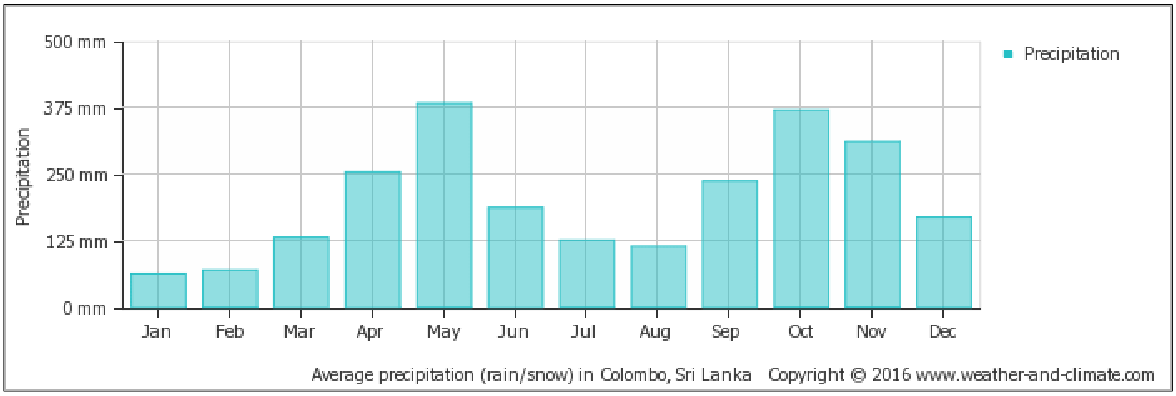


Source: JET, using Department of Meteorology data

Figure A3.1-1 Average Monthly Minimum and Maximum Temperatures

(2) Precipitation

Sri Jayawardenapura Kotte gets a significant amount of rain during the year, receiving the most precipitation in May and October. As much as 377 mm can be recorded in May. Average monthly precipitation is summarized in **Figure A3.1-2**.

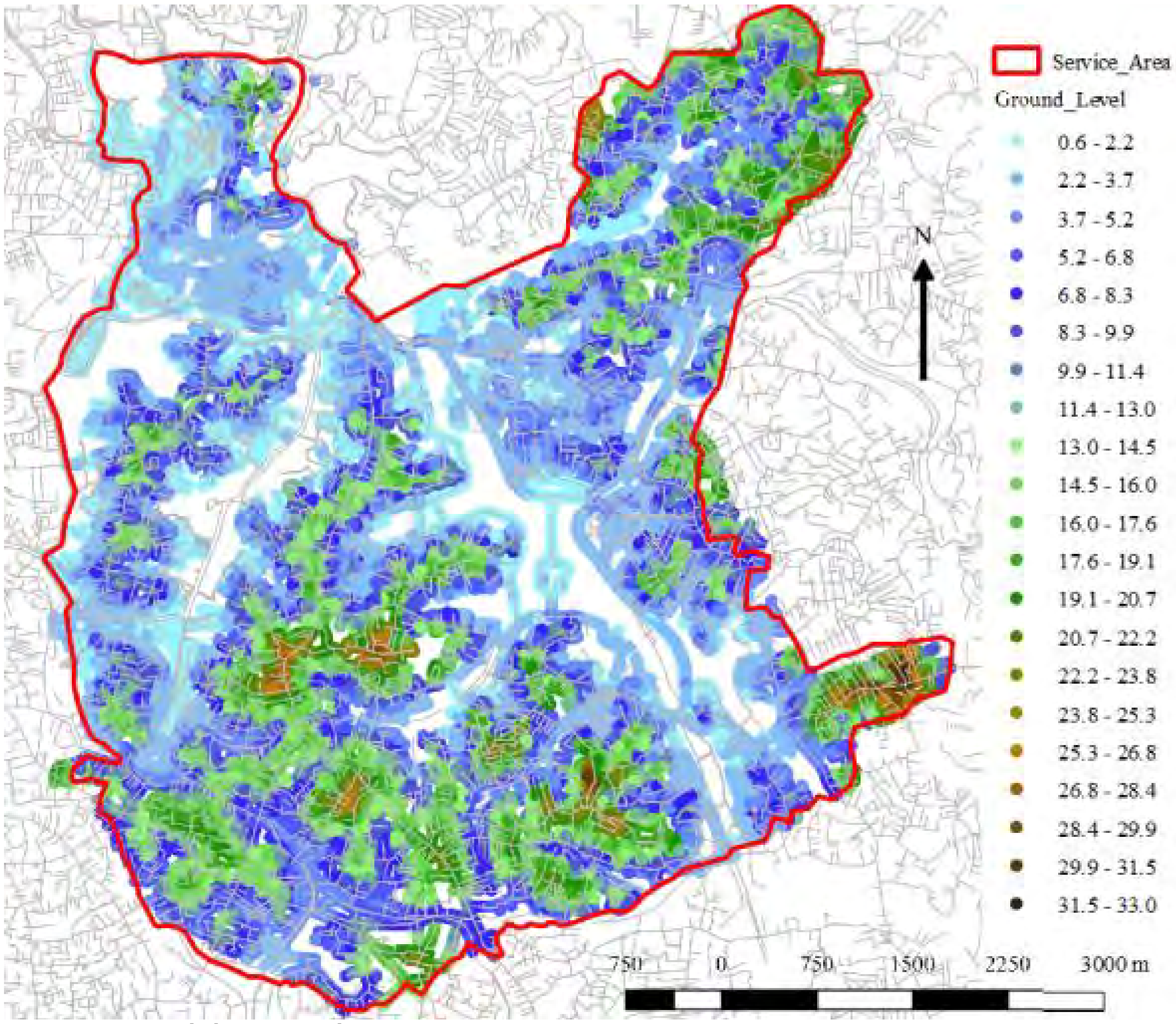


Source: JET, using Department of Meteorology data

Figure A3.1-2 Average Monthly Precipitation

(3) Topography

The area consists mainly of scattered hills between 1 and 35 meters above sea level, as shown in **Figure A3.1-3**.



Source: JET, using Digital Elevation Map data

Figure A3.1-3 Elevation around Service Area

(4) Geographical Features

Geographically, the Sri Jayawardenapura Kotte MC area has a mix of land and water bodies. The extent of marshlands is summarized in **TableA3.1-1**.

Table A3.1-1 Percentage of Marshlands in Sri Jayawardenapura Kotte MC area

Ward Name	Total Area (ha)	Marshlands (ha)	% of Marshland
Rajagiriya West	122	32	26.2
Rajagiriya East	120	25	20.8
Welikada	206	79	38.3
Nawala	321	58	18.1
Ethul Kotte	165	53	32.1
Pita Kotte	270	86	31.8
Pagoda	142	21	14.8
Nugegoda North	69	7	10.0
Nugegoda South	76	0	0
Gangodawila	213	0	0
Total	**1704**	**361**	**21.2**

Source: Survey Department of Sri Lanka

Only Nugegoda South and Gangodawila do not have any marshlands. These marshlands retain water during heavy rainfalls. They are productive environments that are cradles of biodiversity. The area is underlain by crystalline metamorphic rocks of ortho-gneisses, comprising of amphibolite-grade migmatitic granitic and granodioritic gneisses, generally 5-15 m deep. Laterite and lateritic soils are found in the lower flat terrain close to the west coast. A belt of beach sands are present along the coastline. Alluvial deposits are associated with river flood plains.

The soil consists of loose to medium dense soft clayey sand up to an average depth of 2 - 5 m, on top of 2 - 6 m of medium dense to dense gravelly sandy clay with weathered laterite particles. The soil in marshy areas also consists of peat. Completely weathered rock had been encountered 12 - 15 m from the surface.

APPENDIX 3-2 Water Quality Survey Results (3.2.4)

Water Quality Survey (Discharged & Environmental Water Quality Survey / Literature Survey / Interview Survey)

Sri Jayawardenapura Kotte Sewerage Construction Project

Final Report

February 2018

(1) Authority Interview Survey

Officers from related authorities were interviewed on discharged and environmental water quality. All these key informants are given valuable ideas on the status of the water quality of the proposed project area and there are key stakeholders that they are directly involved in activities related to water quality. A summary of key matters discussed and highlighted in the discussion is given in **Table A3.2-1** below.

Table A3.2-1 Summary Points of the Discussion Held with Key Informants

Name	Matter/Issue/Suggestion
Ms. Wasanthi Wijesinghe Director (Lab services) Central Environmental Authority	▪ Under the Ministry of Mahaweli Development & Environment, CEA is the main responsible organization to control the water quality including the surface water bodies by implementing under the provisions of National Environmental Act 1980 and its amendments. ▪ CEA has not conducted water quality measurements to cover the SJK area previously but has conducted programs to monitor water quality in number of rivers including Kelani River. ▪ The CEA's laboratory division has initiated a water quality monitoring program very recently for the Diyawanna Oya and 8 sampling locations have been identified for the program. CEA's Environmental Pollution Control Division has requested this program after some observation on deteriorated water quality in Diyawanna oya causing some incidents of unusual deaths of some aquatic species (fish kill incidents). The selected sampling locations are; 1. Madiwela 2. Kimbulwala Bridge 3. Apegama 4. Diyatha Uyana 5. KFC Bridge 6. Kotuwegoda Bridge 7. Kalapaluwawa 8. Ariyasinhala Mawatha ▪ The parameters monitored includes Temperature, pH, EC, DO, Turbidity, BOD, COD, Oil and Grease, Heavy metals (Lead, Cr, Zn, Cd, Fe) and Fecal and Total Coliforms etc. ▪ The monitoring program was started in Apr-2017 and the reports are not available for the moment. ▪ None of the organizations but SLLRDC has collected water quality data in and around the SJK area previously from 2004.

Name	Matter/Issue/Suggestion
	▪ Discharge water quality is normally not measured and not available. ▪ Accepted that there are many health and sanitation issues due to lack of proper sewerage system in the area.
Ms. Himali Karunaweera Asst Director (Environmental Pollution Control) Central Environmental Authority	▪ The Environmental Pollution Control (EPC) Division has drafted revised standards for standards limits for discharge of effluents in to waters and in the process of finalizing ambient water quality standards for Sri Lanka. ▪ Accepted that there are many health and sanitation issues due to lack of proper sewerage system in the area. ▪ Discharge water quality data for domestic and commercial institutes is normally not available but under the Environmental Protection License (EPL) system, EPC Division has discharge water quality records for all the industries located within the SJK area. Some of the industries are come under the Board of Investment (BoI) and those reports are available at BoI head office. ▪ Environmental Pollution Control Division has requested to conduct a water quality monitoring program for Diyawanna Oya after some observation on deteriorated water quality causing some incidents of unusual deaths of some aquatic species (fish kill incidents) in recent past. ▪ SLLRDC has collected water quality data to cover the Colombo area including SJK. That is the most comprehensive study which has been conducted in the recent past.
Ms. Lalika De Zoysa Former AGM (Research & Development) Consultant, Wetland Management Division Sri Lanka Land Reclamation and Development Corporation (SLLRDC) Ms. Isuri Dharmasoma Environmental Officer. Wetland Management Division SLLRDC	▪ The SLLRDC launched the Greater Colombo Flood Control and Environment Improvement Project (GCFC & EIP) in 1993. This project included massive exercise of canal clearing, widening, canal lining and other activities, including relocation of shanty communities living along canals. ▪ Water quality monitoring program was a part of the project and monthly measurements were taken at 10 locations on the Colombo Canal System, starting from1997. ▪ By 2004, the number of locations was increased to 20, with 13 of them lying within the Greater Colombo Area. ▪ Out of the 20 sampling locations, 7 locations are located within SJK area. ▪ The parameters monitored include, 1. pH 2. Conductivity 3. Turbidity 4. Temperature 5. Dissolved Oxygen 6. Ammonia (As NH3) 7. Nitrate (As N) 8. Phosphate (As PO4) 9. Chemical Oxygen Demand(COD) 10. Biological Oxygen Demand (BOD5) 11. Salinity ▪ Water quality data from 2004 to 2014 were provided on request. ▪ Discharge water quality is normally not measured and not available.

Source: JET

(2) Water Quality Survey

1) Sampling Methodology & Parameters tested for the study

The objective of the Survey is to grasp the water quality condition of Sri Jayawardenapura Kotte MC and it was conducted as part of Preparatory Survey on Preparatory Survey on Preparatory Survey on Sri Jayawardenapura Kotte Sewerage Construction Project. The survey consists of two parts namely Discharge Water Quality and Environmental Water Quality. Sampling points were selected to satisfy study objectives. The sampling locations were identified considering the importance of the water bodies, level of pollution, flow rates, flow directions and accessibility etc. Locations were selected after discussions with the relevant parties and site visits in a way that to represent the entire proposed project area. For Discharged Water Quality Survey, 6 sample locations (domestic and commercial samples in SJKMC) were selected. The parameters are; Temp, pH, SS, BOD, COD, T-N, T-P, Fecal coliform, Coliform, Flow rate. For Environmental Water Quality Survey, 10 sample locations within SJKMC were selected. The parameters are; Temp, pH, SS, BOD, COD, T-N, T-P, Fecal coliform, Coliform, Odour, DO, NH_4-N, Salinity. Maps of Sampling Stations are given in Figure 2-1.

Samples were manually collected at each location. The samples were stored in appropriate temperature conditions and brought to the laboratory for analysis. While conducting the sampling, following field measurements such as pH. Dissolved Oxygen, Conductivity, Temperature etc. were measured. Site photographs were taken and site observations such as climatic condition were recorded. Rainfall records from nearest meteorological stations (Colombo and for September and October months were collected and given in Annex III.

In order to maintain the representativeness of samples for Discharge Water Quality, sampling was made in different 2 times (e.g. AM & PM) and mixes them together as composite sample. Composite samples were made in accordance with the flow rate. For the flow measurements, conventional bucket-stopwatch method and float method were used depending on the drain location and the flow rate etc. In float method, constant cross sectional length of the discharge canal/ditch was selected and the time taken for a floating object to pass a known distance was measured. Average width of the canal/ditch and the average water level at the time was measured. Same method was repeated for AM and PM measurements. The AM & PM samples were mixed together to prepare the composite sample proportionately to the flow rate. The method is; in case of AM: flow rate x l/min, PM: flow rate y l/min; flow rate proportion was taken as x: y (or 1: y/x); Then samples were mixed as x mL (AM) and y mL (PM) of each samples to prepare composite sample.

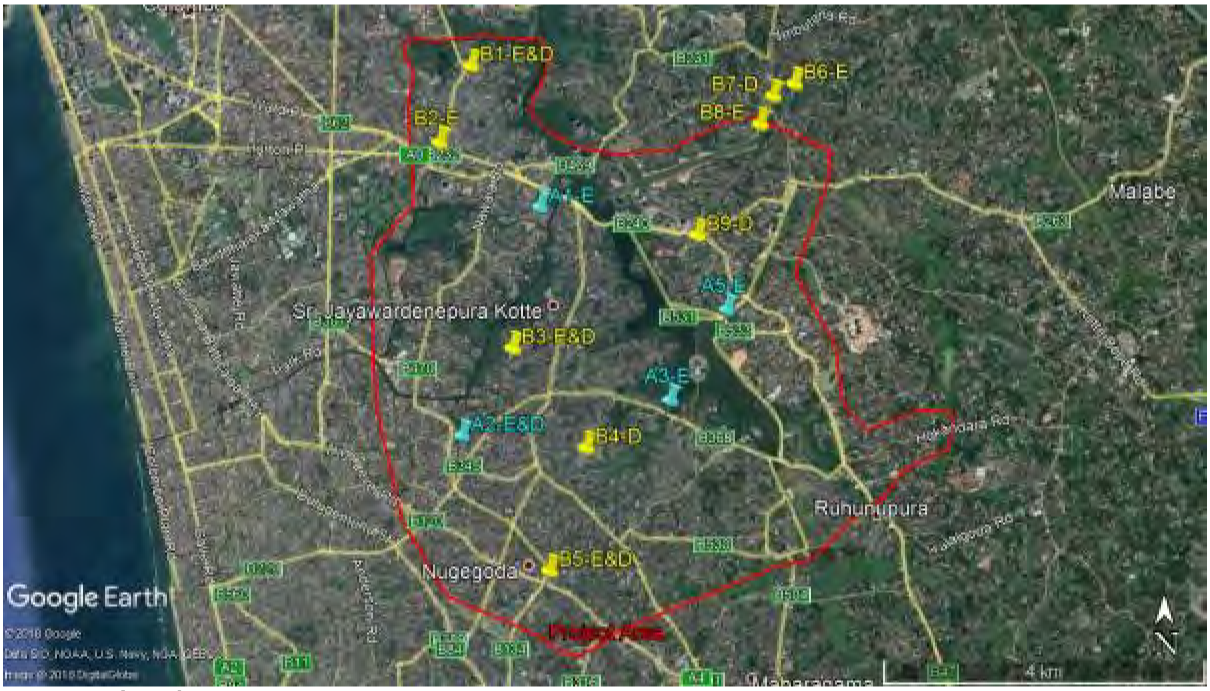
The analysis was performed in accordance to Standard Methods (**Table A3.1-2**) for Examination of Water and Wastewater (2005).

Table A3.2-2 Standard Methods for Examination of water and wastewater

Parameter	Methodology
Temperature	Standard Methods for Examination of Water and Wastewater (2005) 2550 B Temperature probe
pH	Standard Methods for Examination of Water and Wastewater (2005) 4500 H pH Water Quality Meter
Salinity	Standard Methods for Examination of Water and Wastewater (2005) Water Quality Meter
Conductivity	Standard Methods for Examination of Water and Wastewater (2005) 2510B Conductivity meter (Hach)
Dissolved Oxygen	Standard Methods for Examination of Water and Wastewater (2005) 4500 O Water Quality Meter
BOD	Standard Methods for Examination of Water and Wastewater (2005) 4500 O BOD5 Azide Modification
COD	Standard Methods for Examination of Water and Wastewater (2005) 4500 O Open reflux method
Total Suspended Solids	Standard Methods for Examination of Water and Wastewater (2005) 2540D Filtration, Dried at 103^{0}C
Total Dissolved Solids	Standard Methods for Examination of Water and Wastewater (2005) 2540 C Water Quality Meter
Ammonia	Standard Methods for Examination of Water and Wastewater (2005) 4500 Water Quality Meter
Total Nitrogen	Standard Methods for Examination of Water and Wastewater (2005) 4500 – Persulfate digestion IC
Total Phosphates	Standard Methods for Examination of Water and Wastewater (2005) 4500 – Persulfate digestion IC
Total coliforms/ Fecal coliforms	Standard Methods for Examination of Water and Wastewater (2005) 9221 B Multiple Tube Fermentation Technique

Source: JET

2) Sampling Locations and Schedule



Source: Google Earth/JET

Figure A3.2-1 Sampling station location

Table A3.2-3 Discharge Water Quality (Sampling date: 9.10.2017)

Location Ref. No.	Sample Type	Location	Coordinates	Sample Name	Sampling Time (hrs)	Parameters	Flow rate (l/min)
B1	Discharge	Arunalu Uyana, Obesekarapura (Drain; Flow can be measured at Hume pipe)	6°55'9.56"N 79°53'33.62"E	B1-D-AM	1140	Temp, pH, SS, BOD, COD, T-N, T-P, Fecal coliform, Coliform, Flow rate	114.285
				B1-D-PM	1445	,,	146.670
B3	Discharge	Ananda Balika (Hume pipe discharge)	6°53'15.53"N 79°53'50.60"E	B3-D-AM	1055	,,	1900
				B3-D-PM	1510	,,	2400
B4	Discharge	Senadilankaragama (Discharge to canal)	6°52'35.25"N 79°54'20.47"E	B4-D-AM	0955	,,	75.84
				B4-D-PM	1530	,,	107.14
B5	Discharge	Delkanda Junction (Left bank hume pipe)	6°51'45.66"N 79°54'5.67"E	B5-D-AM	0905		64.28
				B5-D-PM	1550	,,	71.05
B7	Discharge	STP Downstream, Thalangama N (Left bank –service station side- drain / pipe)	6°54'57.38"N 79°55'36.52"E	B7-D-AM	1120	,,	189
				B7-D-PM	1420	,,	252
B9	Discharge	Rajamalwatta Rd (Roadside drain near marshy area	6°54'1.21"N 79°55'5.83"E	B9-D-AM	1025	,,	22.968
				B9-D-PM	1400	,,	25.520

Source: JET

Table A3.2-4 Environmental Water Quality (Sampling date: 12.10.2017)

Location Ref. No.	Sample Type	Location	Coordinates	Sample Name	Sampling Time (hrs)	Parameters
A1	Environmental	Nawala Koswatta - Rajagiriya shortcut (Canal near Gateway side)	6°54'12.49"N 79°54'1.70"E	A1-E	1000	Temp, pH, SS, BOD, COD, T-N, T-P, Fecal coliform, Coliform, Odour, DO, NH_4-N, Salinity
A2	Environmental	Welipara (Canal - park side)	6°52'40.88"N 79°53'30.52"E	A2-E	1300	,,
A3	Environmental	Thalawatugoda Rd, Culvert 2/1 (Canal - downstream side)	6°52'54.50"N 79°54'54.67"E	A3-E	1235	,,
A5	Environmental	Japan-SL Friendship Rd, Diyawanna Oya (Near the bridge)	6°53'31.01"N 79°55'17.68"E	A5-E	1215	,,
B1	Environmental	Arunalu Uyana Obesekarapura (Lake)	6°55'11.22"N 79°53'32.74"E	B1-E	1030	,,
B2	Environmental	Rajagiriya (Canal near Golden Key Hospital)	6°54'38.58"N 79°53'20.94"E	B2-E	1015	,,
B3	Environmental	Ananda Balika (Stagnated lake - water body)	6°53'15.53"N 79°53'50.60"E	B3-E	0940	,,
B5	Environmental	Delkanda Junction (Main canal)	6°51'45.66"N 79°54'5.67"E	B5-E	0910	
B6	Environmental	STP Upstream, Thalangama N (Canal - Inside abandoned paddy field)	6°55'2.33"N 79°55'45.29"E	B6-E	1125	,,
B8	Environmental	Diyawanna Oya **Bottom Water** (Thalangama N, Near Indoor Cricket)	6°54'46.07"N 79°55'31.30"E	B8-E	1115	,,

Source: JET

Table A3.2-5 Discharge water quality (Sampling date: 9.10.2017)

Sample	Location	Temp (°C)	pH	Conductivity (μS/cm)	BOD^{20}_5 mg/l	COD mg/l	NH^+_4 as N mg/l	DO mg/l	Total N mg/l	Total P mg/l	Total Coliforms MPN/100ml	Faecal coliforms MPN/100ml	TSS mg/l	TDS mg/l	Flow rate proportion
B1Mix-D	Arunalu Uyana, Obesekarapura	29.2	6.98	223.5	78	92	3.28	3.24	7.015	0.209	70,000	3,300	46	94.42	01:01.3
B3Mix-D	Ananda Balika	28.5	6.42	272.6	32	101.2	0.82	1.84	5.657	<0.005	30,000	13,000	32	154.25	01:01.3
B4Mix-D	Senadilankaragama	28.8	6.64	428.6	42	92	4.07	2.51	10.474	0.291	14,000	5,000	42	256.254	01:01.4
B5Mix-D	Delkanda Junction	28.8	6.9	170.4	40	82.8	0.65	4.13	3.131	<0.005	17,000	13,000	22.2	195.17	01:01.1
B7Mix-D	STP Downstream	29.2	6.61	173.1	30	55.2	0.72	4.5	3.572	0.209	280,000	240,000	9.2	110.28	01:01.3
B9Mix-D	Rajamalwatta Rd	29.4	6.86	285.6	36	82	1.48	2.64	3.737	<0.005	30,000	5,000	36	181.42	01:01.1
Criteria		-	-	150	4	15	0.94	5	0.2	0.02	10,000	1,000	40	-	-
		-	-	General criteria for inland water	Draft Environmental Standard				Limits for eutrophication (general values)		Draft Environmental Standard			-	-

Shadowed values: Over the criteria

Source: JET

Table A3.2-6 Environmental water quality (Sampling date: 12.10.2017)

Sample	Location	Temp (°C)	pH	EC μS/cm	Salinity per mil (0/00)	BOD^{20}_{5} mg/l	COD mg/l	NH^{+}_{4} as N mg/l	DO mg/l	Total N ppm	Total P ppm	Total Coliforms MPN/100ml	Faecal coliforms MPN/100ml	TSS mg/l	TDS mg/l	Odour
A 1	Nawala Koswatta - Rajagiriya shortcut	28.8	6.86	199.3	0.09	26	67.2	0.39	4.68	3.046	0.013	7,000	3,300	13.6	120.85	Objectionable
A 2	Welipara	28.7	6.89	318	0.14	32	71.1	1.71	4.38	7.961	0.015	54,000	17, 000	20	193	Objectionable
A 3	Thalawatugoda Rd, Culvert 2/1	28.2	6.73	353.4	0.16	22	57.8	3.27	1.6	5.235	0.018	11,000	6,300	12	330.9	Objectionable
A 5	Japan-SL Friendship Rd, Diyawanna Oya	27.8	6.91	208.4	0.09	12	24	0.39	3.29	0.452	<0.005	4,900	2,300	4	129	Unobjectionable
B 1	Arunalu Uyana Obesekarapura	28.9	6.91	550	0.24	96	146.8	7.51	1.23	10.818	0.14	54,000	17,000	41.2	332.72	Objectionable
B 2	Rajagiriya	28.3	6.81	301	0.13	36	81.8	1.44	1.64	4.187	<0.005	28,000	11,000	16	184.16	Objectionable
B 3	Ananda Balika	28.2	6.7	247.4	0.11	22	56.7	0.48	2.88	5.746	0.018	54,000	17,000	14	151	Objectionable
B 5	Delkanda Junction	28	6.79	363.2	0.16	36	79.6	1.65	1.76	3.071	0.047	4,900	3,300	26	223	Objectionable
B 6	STP Upstream, Thalangama N	28.5	6.84	231.6	0.1	30	70.2	0.4	4.22	3.295	<0.005	54,000	17,000	19.6	141	Unobjectionable
B 8	Diyawanna Oya Bottom Water	27.3	6.58	225	0.1	22	60.1	1.72	2.14	3.421	<0.005	4,900	3,300	12.4	140	Unobjectionable
Criteria		-	-	150	0.5	0.5	15	0.94	5	0.2	0.02	10,000	1,000	40	-	-
		-	-	General criteria for inland and estuarine water		Draft Environmental Standard				Limits for eutrophication (general values)		Draft Environmental Standard			-	-

Shadowed values: Over the criteria

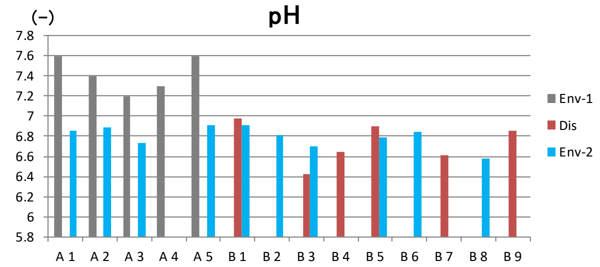
Source: JET

(3) Water Quality Results

The data for each significant parameter are shown below.

1) pH

pH values are normal for all locations but higher for water bodies. It is assumed that CO2 was consumed by photosynthetic reaction in the dry season. The water bodies should be monitored because the phytoplankton increase is one of the characteristics of eutrophication.

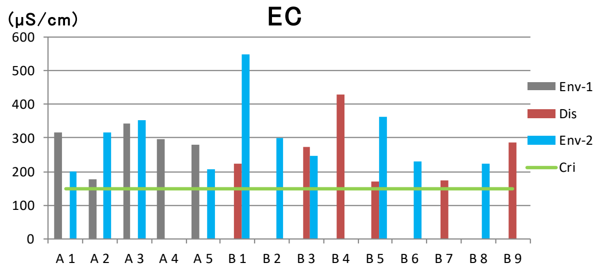


Source: JET

Figure A3.2-2 Water Quality Test Result - pH

2) Electric Conductivity (EC)

EC as an indicator of general contamination is higher than the criteria for general inland water bodies. It is very high at locations B1, B4 and B5.

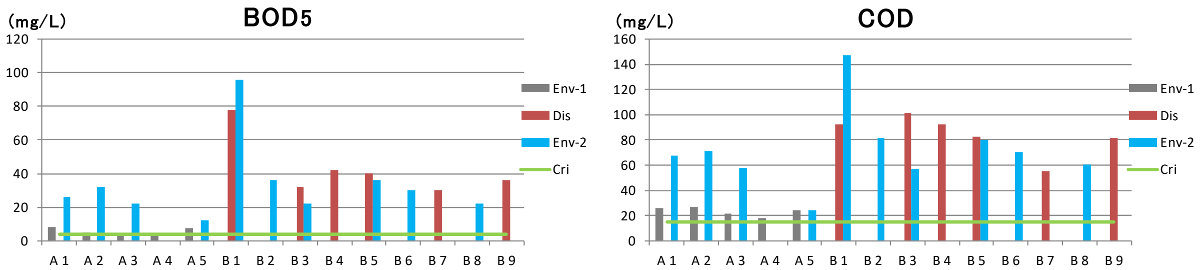


Source: JET

Figure A3.2-3 Water Quality Test Result - EC

3) BOD & COD

Most BOD and COD values are higher than the draft environmental standards and both sets of values show the same pattern, with B1 significantly higher than the other locations.

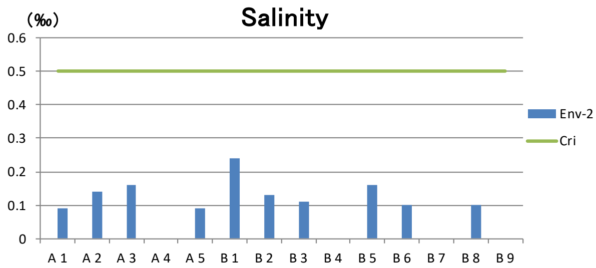


Source: JET

Figure A3.2-4 Water Quality Test Result - BOD&COD

4) Salinity

Salinity is below the lower-limit for general estuarine water, indicating that there is no sea water intrusion.

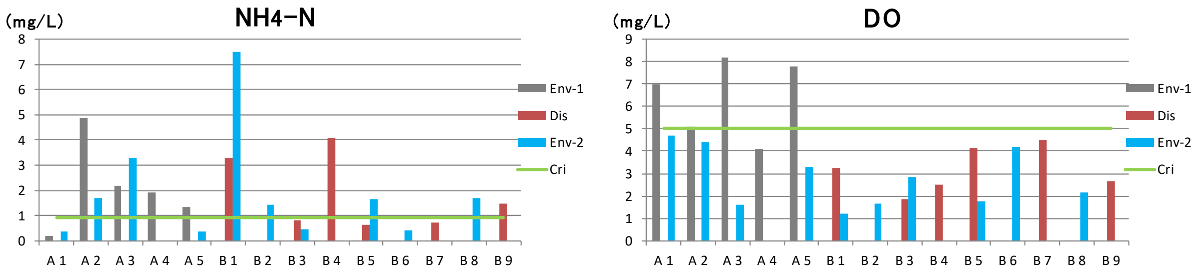


Source: JET

Figure A3.2-5 Water Quality Test Result - Salinity

5) Ammonium nitrogen (NH_4-N) and Dissolved Oxygen (DO)

In many locations, NH_4-N values are higher and DO values are lower than the draft environmental standards. This indicates anaerobic decomposition is taking place due to an over-abundance of nitrogen. B1 is significantly worse.

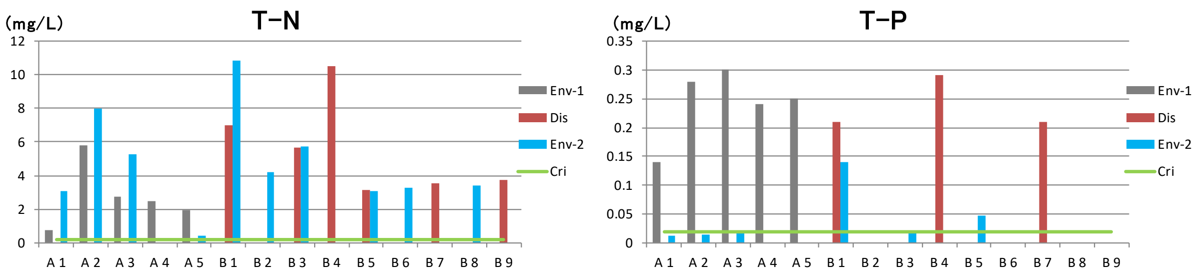


Source: JET

Figure A3.2-6 Water Quality Test Result - NH_4-N&DO

6) Total nitrogen (T-N) and Total phosphorus (T-P)

T-N and T-P exceed the limit for eutrophication at many sampling points. B1 and B4 are worse than others.

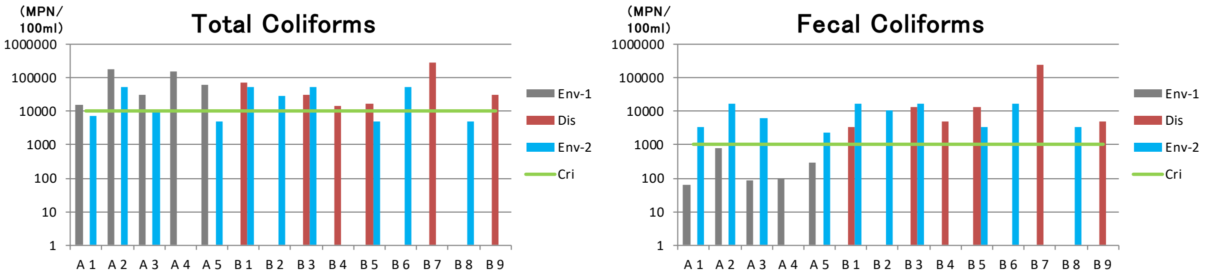


Source: JET

Figure A3.2-7 Water Quality Test Result - T-N&T-P

7) Total coliform and fecal coliform

At many sampling points, both types of coliforms are over the draft environmental standards. This suggests that there is contamination by human waste.



Source: JET

Figure A3.2-8 Water Quality Test Result - Total coliforms & Total fecal coliforms

Poor water quality of the water bodies in the service area is clearly indicated by the abundance of nutrients and organic materials. At some sampling points, the water is anaerobic and/or eutrophic, possibly caused by human waste contamination. Locations B1 and B4 appear to be the most contaminated areas where low-income households are located. There is no evidence of salt water intrusion.

APPENDIX 4-1 Population Projection (4.3)

This appendix describes the future population projection to determine the capacities of sewerage facilities.

Future populations by GND are estimated in the following procedure.

- For GNDs in which population has decreased or stagnated from 2001 to 2012, future population is determined as same as the population in 2012.
- For GNDs in which population has increased from 2001 to 2012, future population is determined considering the growth ratio from past years.

Estimated future population by GND is summarized in **Table A4.1-1.**

Table A4.1-1 Future Population Projection for GNDs showing increasing trend

Area	Population			Average Annual Growth Rate		A	B	Year		Projection							
	1981	2001	2012	81 - 01	01 - 12				2012	2015	2020	2025	2030	2035	2040	2045	2046
Sri Lanka	**14,846,274**	**18,797,257**	**20,277,597**	**1.19%**	**0.69%**	-1969.358	0.2568438	**Growth Rate**	**0.60%**	**0.58%**	**0.53%**	**0.48%**	**0.44%**	**0.41%**	**0.38%**	**0.35%**	**0.34%**
Western Province																	
Colombo	**1,675,847**	**2,251,274**	**2,323,826**	**1.49%**	**0.29%**	**-1987.26**	**0.055547**	**Growth Rate**	**0.22%**	**0.21%**	**0.18%**	**0.16%**	**0.14%**	**0.12%**	**0.11%**	**0.10%**	**0.10%**
Sri Jayawardenapura Kotte MC					-0.68%			**Growth Rate**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**
		116,366	107,925					**Population**	**107,925**	**107,925**	**107,925**	**107,925**	**107,925**	**107,925**	**107,925**	**107,925**	**107,925**
514C Obsekarapura					0.35%			Growth Rate	0.27%	0.25%	0.22%	0.19%	0.17%	0.15%	0.13%	0.12%	0.11%
		11,517	11,963					Population	11,963	12,054	12,188	12,303	12,405	12,497	12,580	12,656	12,670
514A Welikada West					2.17%			Growth Rate	1.69%	1.59%	1.38%	1.18%	1.04%	0.92%	0.83%	0.76%	0.72%
		5,532	7,004					Population	7,004	7,343	7,864	8,340	8,782	9,194	9,582	9,949	10,021
Kolonnawa UC					0.57%			**Growth Rate**	0.44%	0.42%	0.36%	0.31%	0.27%	0.24%	0.22%	0.20%	0.19%
		56,396	60,044					**Population**	60,044	60,802	61,915	62,887	63,751	64,529	65,238	65,890	66,014
502A Udumulla South					0.75%			Growth Rate	0.59%	0.55%	0.48%	0.41%	0.36%	0.32%	0.29%	0.26%	0.25%
		2,217	2,408					Population	2,408	2,448	2,507	2,559	2,606	2,648	2,686	2,722	2,729
503B Himbutana East					1.59%			Growth Rate	1.24%	1.17%	1.01%	0.87%	0.76%	0.68%	0.61%	0.55%	0.53%
		3,261	3,879					Population	3,879	4,016	4,224	4,410	4,580	4,737	4,883	5,020	5,046
503 Himbutana West					0.99%			Growth Rate	0.77%	0.72%	0.63%	0.54%	0.47%	0.42%	0.38%	0.34%	0.33%
		3,001	3,344					Population	3,344	3,417	3,526	3,622	3,709	3,787	3,860	3,926	3,939
Kaduwela MC					1.71%			**Growth Rate**	1.33%	1.25%	1.09%	0.93%	0.82%	0.73%	0.65%	0.59%	0.56%
		209,251	252,041					**Population**	252,041	261,617	276,124	289,222	301,209	312,293	322,627	332,324	334,197
479F Aruppitiya					2.00%			Growth Rate	1.56%	1.47%	1.27%	1.09%	0.96%	0.85%	0.77%	0.70%	0.66%
		1,893	2,354					Population	2,354	2,459	2,620	2,766	2,901	3,026	3,144	3,255	3,277
479E Batapotha					1.34%			Growth Rate	1.05%	0.99%	0.86%	0.73%	0.64%	0.57%	0.51%	0.47%	0.44%
		6,546	7,582					Population	7,582	7,808	8,148	8,452	8,727	8,979	9,213	9,431	9,472
491A Walpola					0.69%			Growth Rate	0.54%	0.50%	0.44%	0.38%	0.33%	0.29%	0.26%	0.24%	0.23%
		7,899	8,518					Population	8,518	8,648	8,839	9,006	9,155	9,290	9,413	9,526	9,548
492C Udumulla					0.07%			Growth Rate	0.05%	0.05%	0.04%	0.04%	0.03%	0.03%	0.03%	0.02%	0.02%
		2,447	2,465					Population	2,465	2,469	2,474	2,478	2,482	2,486	2,489	2,492	2,492
477 Thalangama North A					0.90%			Growth Rate	0.70%	0.66%	0.57%	0.49%	0.43%	0.38%	0.34%	0.31%	0.30%
		8,383	9,250					Population	9,250	9,434	9,707	9,947	10,163	10,359	10,538	10,704	10,736
479D Kumaragewatta					1.85%			Growth Rate	1.44%	1.35%	1.18%	1.01%	0.88%	0.79%	0.71%	0.64%	0.61%
		4,150	5,076					Population	5,076	5,285	5,603	5,892	6,156	6,402	6,632	6,848	6,890
Maharagama UC					0.54%			**Growth Rate**	0.42%	0.39%	0.34%	0.29%	0.26%	0.23%	0.21%	0.19%	0.18%
		185,193	196,423					**Population**	196,423	198,751	202,167	205,145	207,790	210,172	212,340	214,332	214,712
523A Mirihana South					0.46%			Growth Rate	0.36%	0.34%	0.29%	0.25%	0.22%	0.20%	0.18%	0.16%	0.15%
		5,745	6,043					Population	6,043	6,104	6,194	6,273	6,342	6,405	6,461	6,513	6,523
524A Pragathipura					0.68%			Growth Rate	0.53%	0.50%	0.43%	0.37%	0.32%	0.29%	0.26%	0.24%	0.22%
		5,420	5,838					Population	5,838	5,925	6,054	6,167	6,268	6,358	6,441	6,518	6,532
525A Udahamulla East					0.39%			Growth Rate	0.31%	0.29%	0.25%	0.22%	0.19%	0.17%	0.15%	0.14%	0.13%
		6,042	6,309					Population	6,309	6,364	6,444	6,514	6,575	6,630	6,680	6,726	6,735
525B Udahamulla West					1.05%			Growth Rate	0.82%	0.77%	0.67%	0.57%	0.50%	0.45%	0.40%	0.37%	0.35%
		4,261	4,780					Population	4,780	4,891	5,057	5,204	5,336	5,456	5,566	5,669	5,689
493A Thalawathugoda West					1.09%			Growth Rate	0.85%	0.80%	0.69%	0.59%	0.52%	0.46%	0.42%	0.38%	0.36%
		4,876	5,492					Population	5,492	5,624	5,822	5,997	6,154	6,298	6,430	6,552	6,576
493B Thalawathugoda East					1.37%			Growth Rate	1.07%	1.01%	0.87%	0.75%	0.66%	0.58%	0.53%	0.48%	0.45%
		5,351	6,217					Population	6,217	6,407	6,691	6,946	7,177	7,389	7,585	7,768	7,804
526B Gangodavila South B					1.12%			Growth Rate	0.87%	0.82%	0.71%	0.61%	0.53%	0.47%	0.43%	0.39%	0.37%
		6,541	7,391					Population	7,391	7,574	7,847	8,089	8,307	8,507	8,690	8,860	8,893

APPENDIX 4-2 Per Capita Water Consumption and Ratios of Non-Domestic/Domestic Flow and Daily Maximum Flow (4.5.2)

This appendix describes the source data and results of study regarding per capita water consumption and ratios of non-domestic/domestic flow and daily maximum flow. All source data was collected from NWSDB.

(1) Per Capita Water Consumption

Table A4.2-1 shows the management information of NWSDB regarding water supply. Household in the Table shows numbers and consumptions of water supply that were paid with normal rate of tariff, since customers of discount rate, such as Domestic, NonVAT, Tenaman Garden, Government Quarters etc. are categorised in others. Per capita consumption can be obtained from the category of Household and **Table A4.2-2** shows the values of last 5years ranging from 120 to 128 litter per capita per day (lpcd).

While, “NWSDB Design Manual D7 Wastewater Collection, Treatment, Disposal & Re-Use 2012” recommends range of per capita water consumption of 120 to 140 lpcd.

Based on the above data and manual, NWSDB employs 120 lpcd as per capita consumption in all Pre-F/S studies and proposals prepared by NWSDB, and variation of sewage amount is made by ratios of Non-domestic water flow and daily maximum flow depending on the nature of the objective area.

Table A4.2-1 Management Information of NWSDB

No.	Items	2013	2014	2015	2016	2017
1	No. of Customers					
1-1	Household	1,469,386	1,589,341	1,718,851	1,869,697	1,982,275
1-2	Commercial	98,723	106,807	116,259	126,290	136,398
1-3	Industrial	851	873	993	1,069	1,148
1-4	Governmental	9,429	8,267	8,585	8,975	9,366
1-5	Others	128,166	126,710	109,033	87,509	89,985
	Total	1,706,555	1,831,998	1,953,721	2,093,540	2,219,172
2	Billed amount of water (m^3/year)					
2-1	Household	257,700,650	282,463,510	306,473,041	350,264,520	361,242,538
2-2	Commercial	35,372,555	39,208,012	40,844,503	45,923,051	48,704,653
2-3	Industrial	2,409,438	2,332,241	2,745,566	3,259,537	3,158,229
2-4	Governmental	18,137,052	16,879,093	15,497,313	15,681,870	14,801,789
2-5	Others	70,351,389	74,908,815	76,943,091	79,287,285	81,168,439
	Total billed amount of water	383,971,084	415,791,671	442,503,514	494,416,263	509,075,648

Source: NWSDB

Table A4.2-2 Estimate of Per Capita Consumption

Items	2013	2014	2015	2016	2017
No. of Customers					
Household (No.)	1,469,386	1,589,341	1,718,851	1,869,697	1,982,275
Billed amount of water (m^3/year)	257,700,650	282,463,510	306,473,041	350,264,520	361,242,538
Per capita consumption (lpcd)	120	122	122	128	125

Source: JET, Estimate with 4 persons of household size

(2) Non-Domestic/Domestic Flow Ratio

Existing data of domestic and non-domestic consumption from 2011 are shown in **Table A4.2-3**. The Table shows the trend that the ratio of non-domestic/domestic increases constantly from 2011.

Table A4.2-3 Actual Yearly Data of Domestic and Non-Domestic Consumption

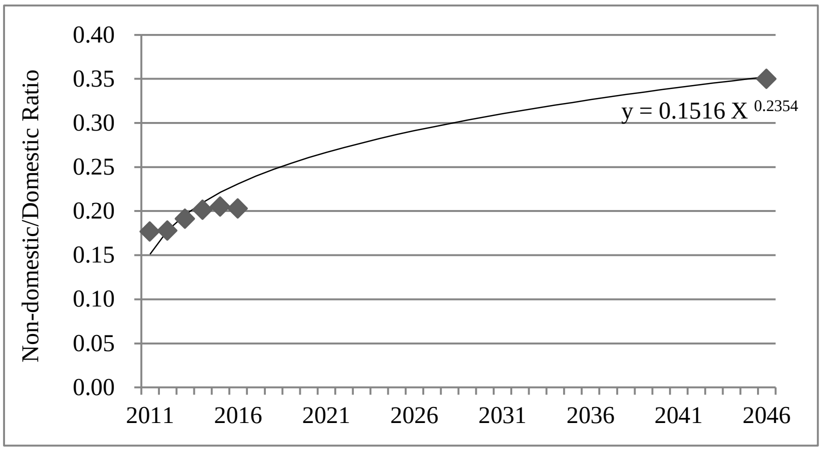
Year	2011	2012	2013	2014	2015	2016
Domestic (m^3)	9,085,408	9,412,708	9,423,291	9,691,889	9,924,752	10,529,243
Non Domestic (m^3)	1,605,666	1,674,836	1,802,600	1,952,096	2,036,315	2,137,592
Total (m^3)	10,691,074	11,087,544	11,225,891	11,643,985	11,961,067	12,666,835
Non Domestic /Domestic	0.177	0.178	0.191	0.201	0.205	0.203

Source: NWSDB adjusted by JET

Based on the trend obtained from actual data, the non-domestic/ domestic ratio projection is considered the following points:

- The ratio should increase for the coming years, following this trend since 2011
- However Non-domestic / Domestic ratio is a seasonal variation, so it should be constant in the future as well.

Considering the above points, the Non-domestic / Domestic ratio in the project area is projected to be 0.35 at 2046 by adopting the trend line using a parabolic curve to reflect a slight increase as shown in **Figure A4.2- 1**.



Source: NWSDB adjusted by JET

Figure A4.2- 1 Actual Trend and Future Prediction of Non Domestic /Domestic Ratio

(3) Daily Maximum Flow Ratio

For the confirmation of the daily maximum flow ratio, the monthly consumption data was collected from 2011 to 2016 as shown in **Table A4.2-4**. The converted daily consumption of each year is shown in **Table A4.2-5** shows the each year's peak factor ranging 1.06 to 1.14. As the result, peak factor of daily maximum flow ratio of 1.15 is applied in this study.

Table A4.2-4 Monthly water consumption (Raw data)

Month	Monthly consumption (m^3/month)					
	2011	2012	2013	2014	2015	2016
January	870,744	889,451	911,620	1,007,289	971,420	1,003,328
February	873,864	929,789	966,415	1,021,689	1,016,545	1,125,264
March	895,449	930,904	935,901	968,053	1,044,390	1,140,080
April	897,968	930,595	974,070	985,742	1,014,707	1,073,965
May	881,390	919,491	965,298	967,693	968,051	1,022,681
June	893,559	1,010,189	906,809	974,028	961,213	979,466
July	915,602	1,004,350	858,111	975,122	970,696	1,052,747
August	911,506	856,967	944,427	1,030,669	1,036,589	1,074,399
September	891,361	887,707	942,714	1,005,113	1,011,637	1,095,883
October	912,346	931,910	942,322	913,448	1,000,044	1,067,795
November	896,499	897,325	958,704	911,260	986,083	1,025,015
December	850,786	898,866	919,500	883,879	979,692	1,006,212

Source: NWSDB

Table A4.2-5 Daily Consumption and Peak Factor

Month	Daily consumption (m^3/day)					
	2011	2012	2013	2014	2015	2016
January	28,089	28,692	29,407	32,493	31,336	32,365
February	31,209	32,062	34,515	36,489	36,305	38,802
March	28,885	30,029	30,190	31,228	33,690	36,777
April	29,932	31,020	32,469	32,858	33,824	35,799
May	28,432	29,661	31,139	31,216	31,227	32,990
June	29,785	33,673	30,227	32,468	32,040	32,649
July	29,536	32,398	27,681	31,456	31,313	33,960
August	29,403	27,644	30,465	33,247	33,438	34,658
September	29,712	29,590	31,424	33,504	33,721	36,529
October	29,431	30,062	30,397	29,466	32,259	34,445
November	29,883	29,911	31,957	30,375	32,869	34,167
December	27,445	28,996	29,661	28,512	31,603	32,458
Average	29,312	30,312	30,794	31,943	32,802	34,633
Peak Factor	1.06	1.11	1.12	1.14	1.11	1.12

Source: JET

APPENDIX 4-3 CEA subject to treatment levels stricter than the national standards(4.5.4)

Due to the proximity of Project components to the Diyawanna Oya Wetland, installation of the STP has been approved by CEA subject to treatment levels stricter than the national standards, as evidenced in the letter below.

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தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை
National Water Supply & Drainage Board

සභාපති / தலைவர் / Chairman — Tel : 2634488, Fax : 2611234
උප සභාපති / உப தலைவர் / Vice Chairman — Tel : 2635883, Fax : 2610034
ප්‍රධාන කාර්යාලය / தலைமை அலுவலகம் / Head Office — Tel 2638246, 2638256, 2638259, 2638260, 2621621
තැ.පෙ. / த.பெ. இல / P.O. Box 14, ගල්කිස්ස / கல்கிசை / Mt. Lavinia
සාමාන්‍යාධිකාරී / பொது முகாமையாளர் / General Manager — Tel /Fax 2636449
ක්‍රියාකාරී අධ්‍යක්ෂ / தொழிற்பாட்டுப் பணிப்பாளர் / Working Director — Tel : 2636901, Fax : 2611590
Hunting No : 2638999
Fax : 2636449
E-mail : nwsdbch@sltnet.lk
ගාලු පාර / காலி வீதி / Galle Road, රත්මලාන / இரத்மலானை / Ratmalana, Sri Lanka.

මගේ අංකය / எனது இல / My No. AGM/P&D/SEW/SJKSP/17-08
ඔබේ අංකය / உமது இல / Your No.
දිනය / திகதி / Date March 08, 2017

Director General
Central Environmental Authority
"Parisara Piyasa"
104, Denzel Kobbekaduwa Mawatha
Battaramulla.

Dear Sir,

REF : SRI JAYAWARDENAPURA KOTTE WASTEWATER DISPOSAL PROJECT
SUB : CONFIRMATION ON TREATED EFFLUENT QUALITY FOR DIYAWANNAWA

This is further to the discussion we had with CEA officials from EIA Division and EPC Division along with JICA Master Plan Study Team on 28th February 2017.

NWSDB intend to implement Sri Jayawardenapura Kotte Project by introducing sewage collection network, 35,000 m^3/day wastewater treatment plant at Kalapaluwawa and effluent disposal to Diyawannawa . At the above meeting it was informed to NWSDB to request DG, CEA to obtain formal approval for the treated effluent quality proposed by NWSDB for Sri Jayawrdenapura Kotte. Effluent quality need to be finalized in order to consider for the EIA study and to finalize the proposed treatment system. Proposed treatment standards and a process flow diagram of the biological wastewater treatment system intended to be used for the above project are shown below giving due consideration to the existing and proposed inland surface discharge standards.

	Influent Wastewater Characteristics	Treated Effluent Standards	
		Proposed for SJK	Inland Surface Standards
BOD_5	240	15	30
COD	600	75	250
TSS	160	15	50
T-N	45		
TKN		2.5	150
Ammonical N		2.5	50
NO_3-N		10	10*
T-P	6	3	
Soluble P		2	5

* Included in proposed standard

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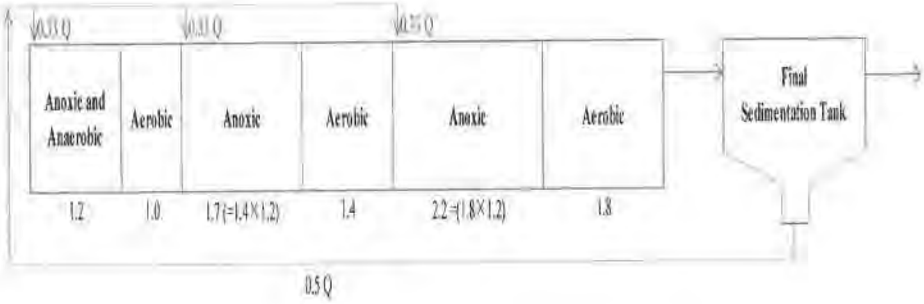
Page 1 of 2

Hydraulic Retention Time (HRT) = 9.5 hr



By implementing this project, the NWSDB will be able to collect and properly manage wastewater generated in Sri Jayawardanepura Kotte which is presently managed by on-site treatment systems which are not functioning properly due to presence of high seasonal ground water table and finally ending up in Diyawannawa catchment as non point source pollution.

Therefore, we would appreciate if you could grant approval to the **proposed effluent standards for Sri Jayawardenepura Kotte** which is very much stringent compared to the existing/proposed inland surface discharge standards in order to adopt the same during implementation of this project which is of national importance.

Yours faithfully,

Addl. General Manager (Sewerage)
NATIONAL WATER SUPPLY & DRAINAGE BOARD

CC : Team Leader, JICA Strategic Master Plan Study Team - f.y.i.pl.

Page 2 of 2

APPENDIX 4-4 NWSDB Letter for Effluent Quality Standards(4.5.4)

According to the EIA report, NESDB decided the additional requirement for effluent quality standard for WWTP, as evidenced in the letter below.

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தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை
National Water Supply & Drainage Board

Chairman — Tel : 2634488, Fax : 2611234
Vice Chairman — Tel : 2635883, Fax : 2610034
Head Office — Tel : 2638246, 2638256, 2638259, 2638260, 2621621
P.O. Box 14, Mt. Lavinia
General Manager — Tel/Fax 2636449
Working Director — Tel : 2636901, Fax : 2611590
Addl GM/S/Proj/SJKP
Hunting No : 2638999
Fax : 2636449
E-mail : nwsdbch@sltnet.lk
Galle Road, Ratmalana, Sri Lanka.

My No.
Your No.
Date 11.02.2019

Team Leader, EIA

Central Engineering Consultancy Bureau

No. 415,Bauddaloka Mawatha

Colombo 07

Attn. Mr. Ishastha Perera

Dear Sir,

Ref: EIA for Proposed Sri Jayawardanapura Kotte Sewerage Project

Sub: Effluent Quality Standards

Reference is made to the EIA report for proposed Sri Jayawardhanapura Kotte Sewerage Project.

In order to meet the present water quality in "sea plain bay" of Diyawannawa, the revised target for treated wastewater from the proposed Step Feed Biological Nutrient Process is shown as follows;

BOD<10mg/l
Total P<1mg/l
Dissolve P<0.5mg/l
Organic P<0.5mg/l

Nitrate N<10mg/l
Ammonium N<1.0 mg/l.
Organic N<1.0 mg/l

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In future, the revised target for Phosphorous in treated wastewater can be further improved by rapid sand filtration in the event if stringent standards are proposed by CEA in the future by keeping provision for the same as follows;

Total P<0.6mg/l
Dissolve P<0.3mg/l
Organic P<0.3mg/l

Therefore you are kindly requested to include above parameters in the EIA report combining the most stringent value comparing with the already approved CEA values for SJKSP as the target treatment quality of the proposed treatment plant.

Also please include letter from M/s Unilever Sri Lanka Limited confirming soap and detergents manufactured do not contain phosphorous (letter dated 6th February 2013) and future tend will follow the same direction.

11th Feb 2019

Additional General Manager (Sewerage)
National Water Supply & Drainage Board

CC : DDG (EIA) ,CEA – f.y.i.pl
DDG (EPC), CEA – f.y.i.pl
JET-To include in the EIA report

Enclose- Letter from Unilever- to be attached in the EIA report giving reference in the text of the EIA report under phosphorous removal

APPENDIX 5-1 The profile and proposed land for construction of Major Pump Station (5.2.3)

(1) Major Pumping Station 2

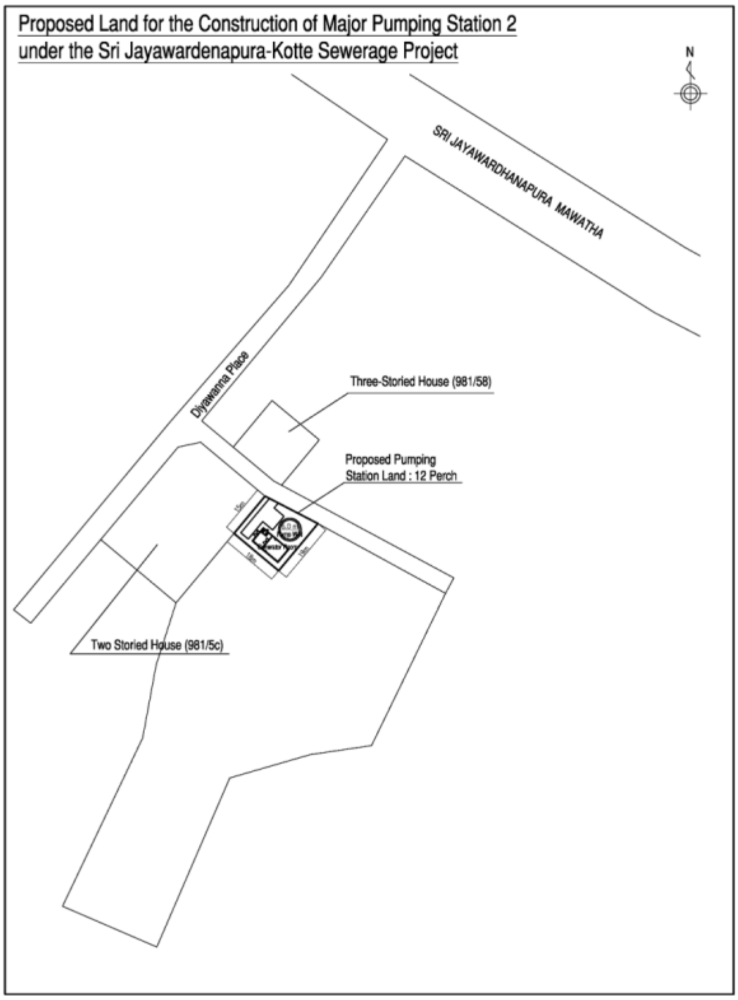
Major Pumping Station 2 is located near Diyawanna Place which connects to the SRI JAYAWARDHANAPURA MAWATHA.

Table A5.1-1shows the profile of Major Pumping Station 2. **Table A5.1-1** shows the proposed land for the construction of Major Pumping Station 2.

Table A5.1-1 Major Pumping Station 2

Item No.	Design Flow (m^3/min)	Total Pump Head (m)	Main Process
MPS-2	5.7	40	Screen Basket 2.9m^3/min×2unit+（1）

Notes: MPS: Major Pumping Station, (1): One pump unit for stand-by
Source: JET



Source: JET

Figure A5.1-1 Proposed land for the construction of major pumping station 2

Required land area is about 300m^2.

(2) Major Pumping Station 3

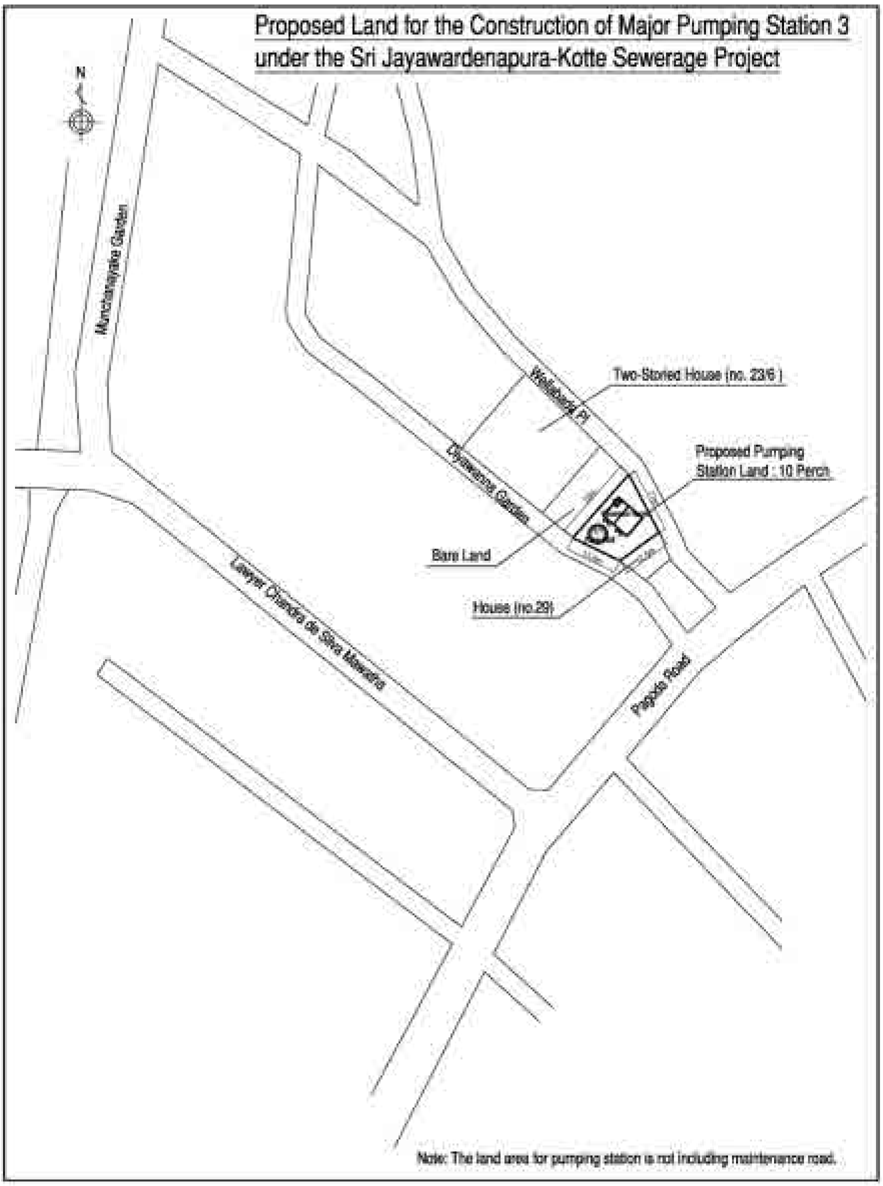
Major Pumping Station 3 is located along Wellabada P1 which connects to the Pagoda Road.

Table A5.1-2 shows the profile of Major Pumping Station 3. **Figure A5.1-2**shows the proposed land for the construction of Major Pumping Station 3.

Table A5.1-2 Major Pumping Station 3

Item No.	Design Flow (m^3/min)	Total Pump Head (m)	Main Process
MPS-3	5.4	40	Screen Basket 2.7m^3/min×2unit+（1）

Notes: MPS: Major Pumping Station, (1): One pump unit for stand-by
Source: JET



Source: JET

Figure A5.1-2 Proposed land for the construction of major pumping station 3

Required land area is about 235m^2.

(3) Major Pumping Station 4

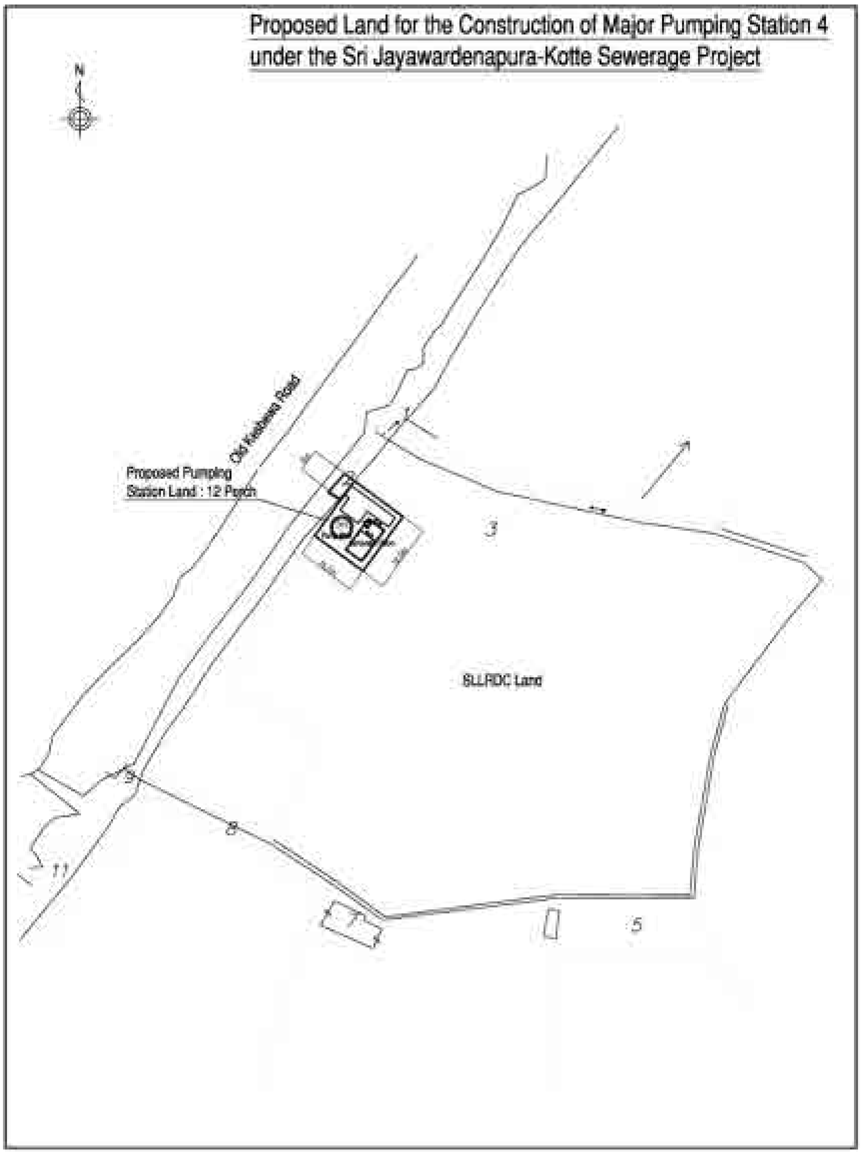
Major pumping Station 4 is located near Delkanda Sub Post Office which is located along Old Kesbewa Road.

Table A5.1-3 shows the profile of Major Pumping Station 4. **Figure A5.1-3** shows the proposed land for the construction of Major Pumping Station 4.

Table A5.1-3 Major Pumping Station 4

Item No.	Design Flow (m^3/min)	Total Pump Head (m)	Main Process
MPS-4	3.8	40	Screen Basket 1.9m^3/min×2unit+（1）

Notes: MPS: Major Pumping Station, (1): One pump unit for stand-by
Source: JET



Source: JET

Figure A5.1-3 Proposed land for the construction of major pumping station 4

Required land area is about 280m^2.

(4) Major Pumping Station 5

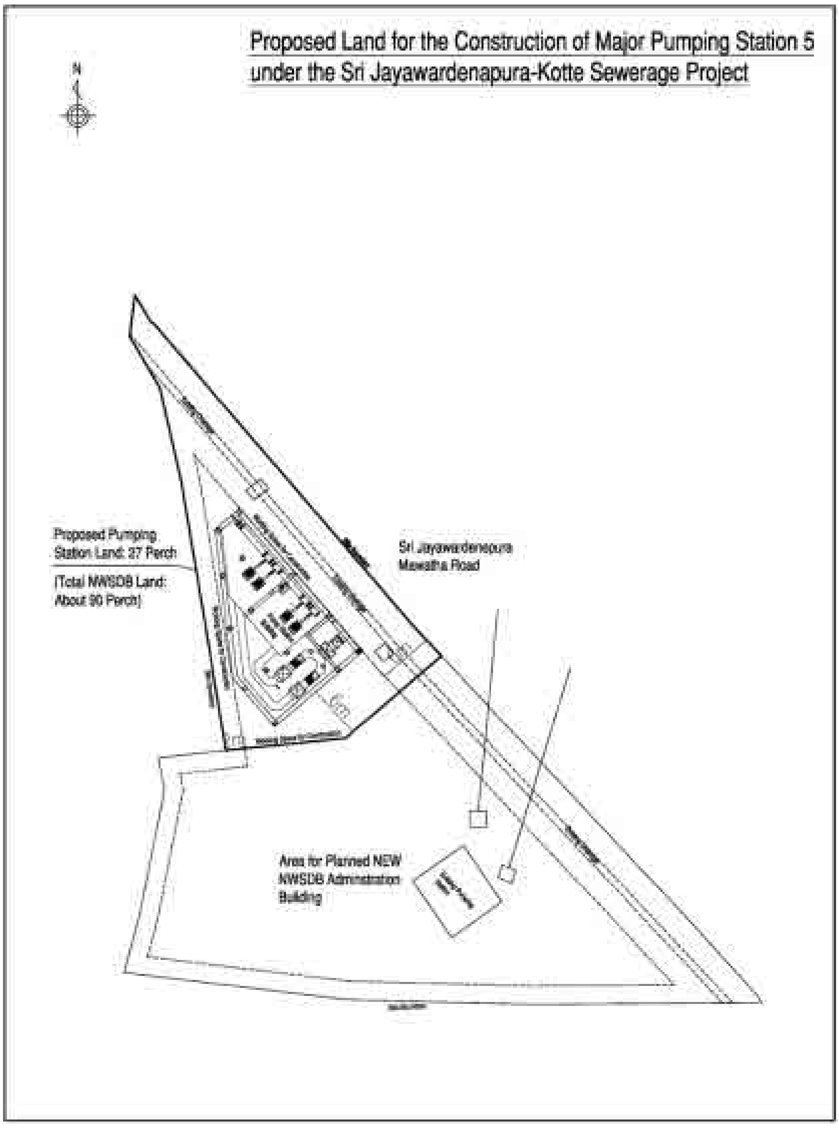
Major Pumping Station 5 is located in front of Linear Park-Diyawannawa which is located along Sri Jayawardenpura Mawatha.

Table A5.1-4 shows the profile of Major Pumping Station 5. **Figure A5.1-4** shows the proposed land for the construction of Major Pumping Station 5.

Table A5.1-4 Major Pumping Station 5

Item No.	Design Flow (m^3/min)	Total Pump Head (m)	Main Process
MPS-5	19.6	20	Manual Coause Screen Compact Grit Chamber 6.6m^3/min×3unit+（1）

Notes: MPS: Major Pumping Station, (1): One pump unit for stand-by
Source: JET



Source: JET

Figure A5.1-4 Proposed land for the construction of major pumping station 5

Required land area is about 650m^2.

(5) Major Pumping Station 6

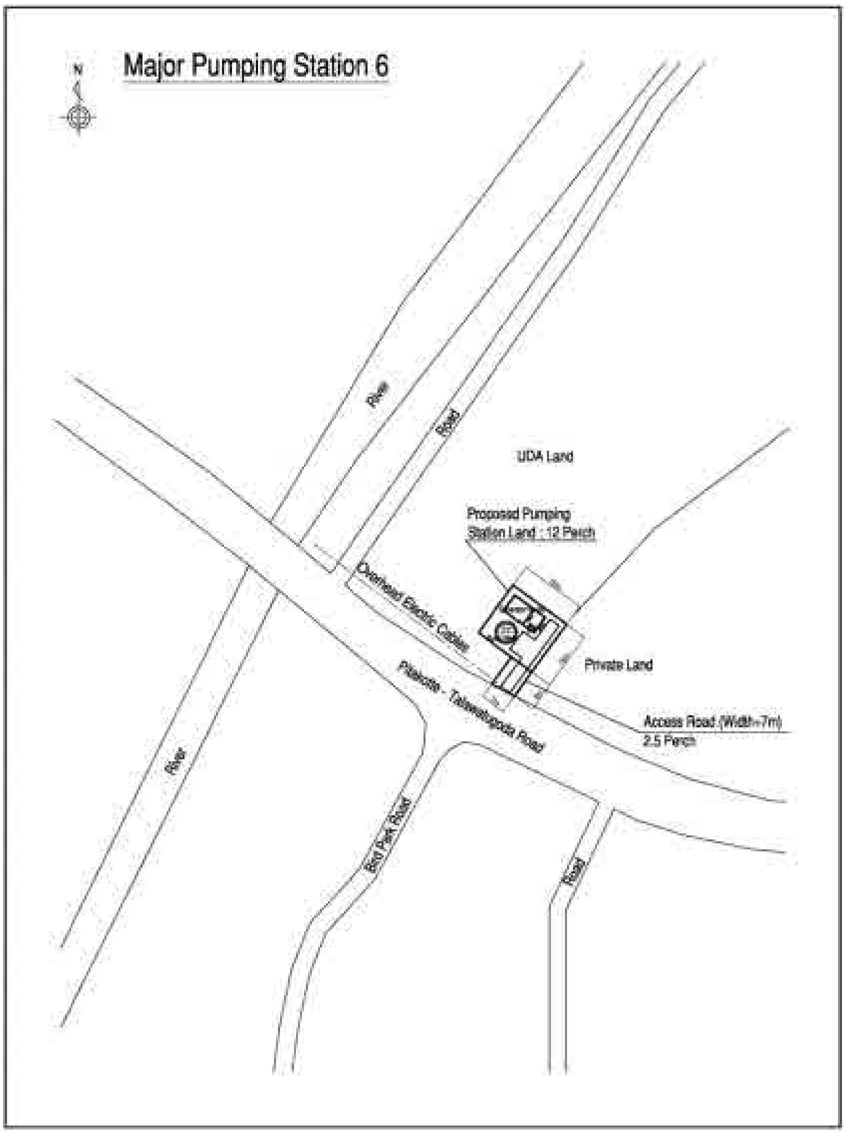
Major Pumping Station 6 is located in front of the entrance of Bird Park Road which connects to the Pitakotte-Talawatugoda Road.

Table A5.1-5 shows the profile of Major Pumping Station 6. **Figure A5.1-5** shows the proposed land for the construction of Major Pumping Station 6.

Table A5.1-5 Major Pumping Station 6

Item No.	Design Flow (m^3/min)	Total Pump Head (m)	Main Process
MPS-6	1.3	40	Screen Basket 1.3m^3/min×1unit+（1）

Notes: MPS: Major Pumping Station, (1): One pump unit for stand-by
Source: JET



Source: JET

Figure A5.1-5 Proposed land for the construction of major pumping station 6

Required land area is about 288m^2.

(6) Major Pumping Station 7

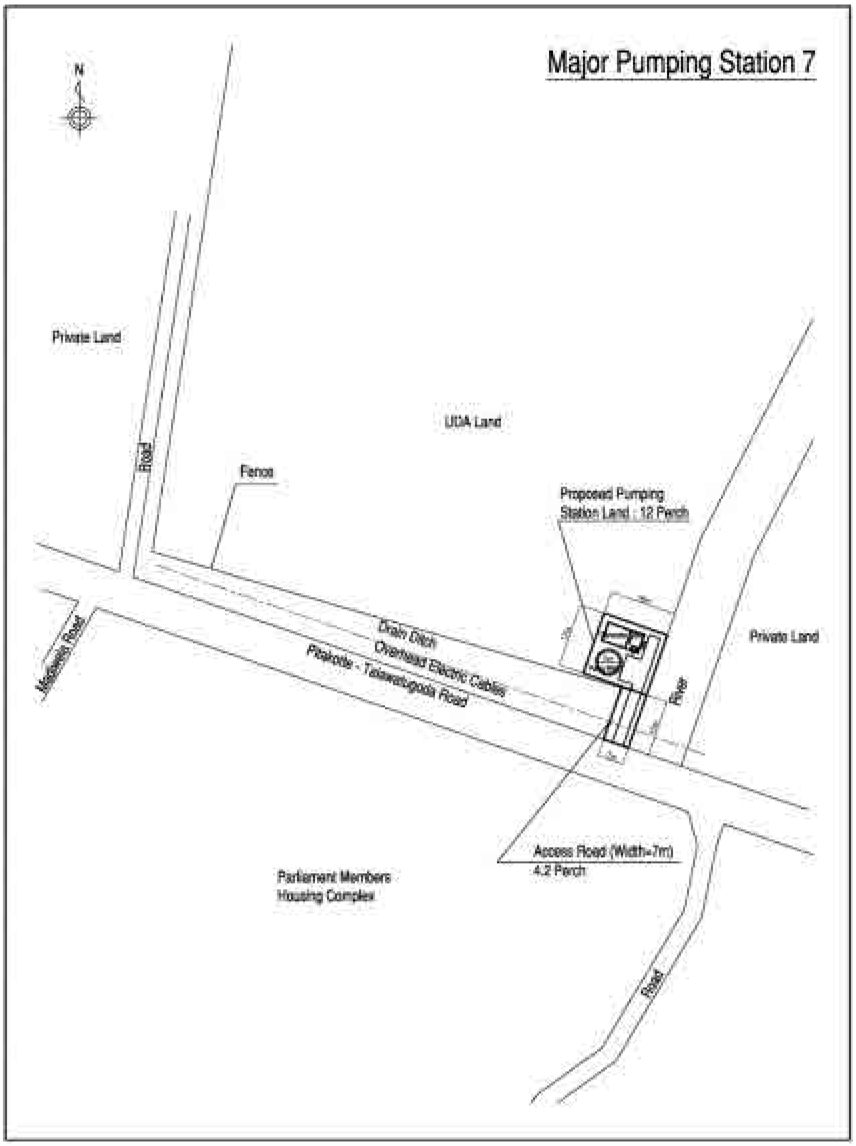
Major Pumping Station 7 is located in front of Parliament Members Housing Complex which is located along Pitakotte-Talawatugoda Road.

Table A5.1-6 shows the profile of Major Pumping Station 7. **Figure A5.1-6** shows the proposed land for the construction of Major Pumping Station 7.

Table A5.1-6 Major Pumping Station 7

Item No.	Design Flow (m^3/min)	Total Pump Head (m)	Main Process
MPS-7	6.2	40	Screen Basket 3.1m^3/min×2unit+（1）

Notes: MPS: Major Pumping Station, (1): One pump unit for stand-by
Source: JET



Source: JET

Figure A5.1-6 Proposed land for the construction of major pumping station 7

Required land area is about 306m^2.

(7) Major Pumping Station 8

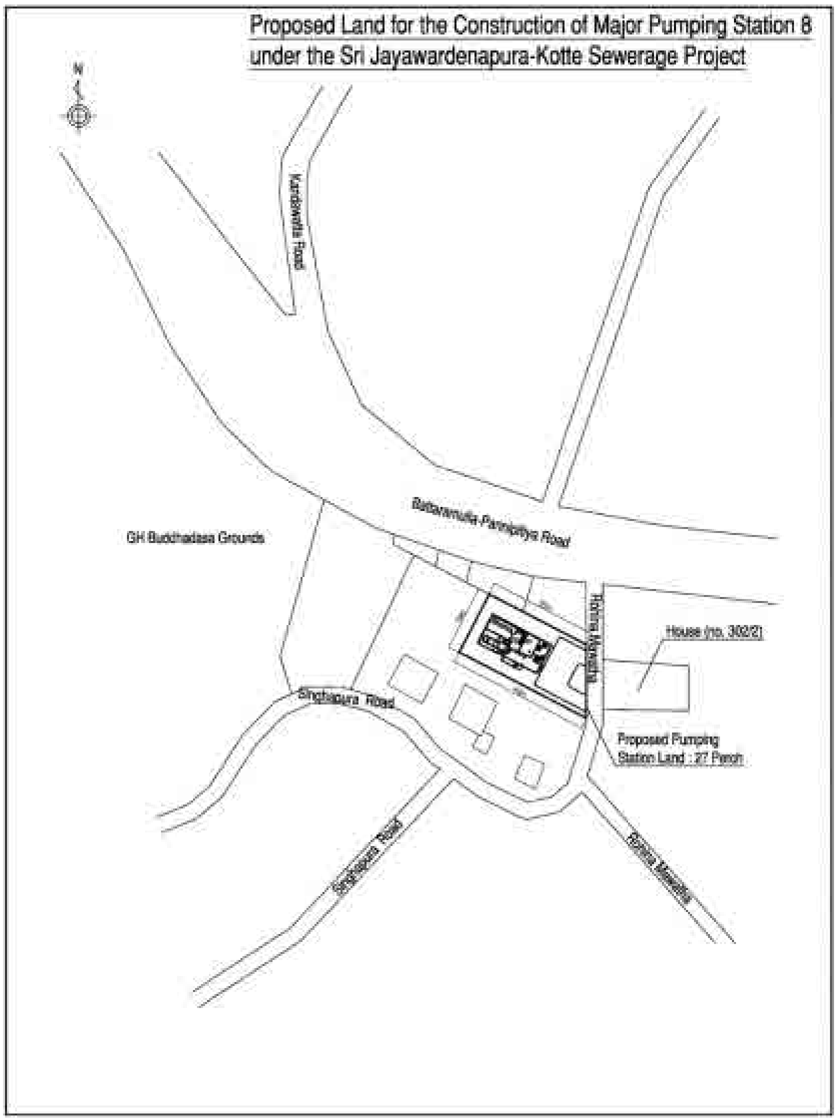
Major Pumping Station 8 is located along Rohina Mawatha which connects to the Battaramulla-Pannipitiya Road.

Table A5.1-7 shows the profile of Major Pumping Station 8. **Figure A5.1-7** shows the proposed land for the construction of Major Pumping Station 8.

Table A5.1-7 Major Pumping Station 8

Item No.	Design Flow (m^3/min)	Total Pump Head (m)	Main Process
MPS-8	13.1	20	Manual Coause Screen Compact Grit Chamber $4.4m^3$/min×3unit+（1）

Notes: MPS: Major Pumping Station, (1): One pump unit for stand-by
Source: JET



Source: JET

Figure A5.1-7 Proposed land for the construction of major pumping station 8

Required land area is about $630m^2$.

APPENDIX 5-2 The letter of acceptance received from SLLRDC for co composting of dried sludge (5.3.1)

Sludge generated in thea treatment process will be dewatered and dried. The dried sludge will be transported to the waste management facility at Kerawalapitiya for disposal and composing. Disposal of sludge at Kerawalapitiya has been approved by SLLRDC.

මහානගර හා බස්නාහිර සංවර්ධන අමාත්‍යාංශය
ශ්‍රී ලංකා ඉඩම් ගොඩකිරීමේ සහ සංවර්ධනය කිරීමේ සංස්ථාව

மாநகர மற்றும் மேல் மாகாண அபிவிருத்தி அமைச்சு
இலங்கை காணி மீட்பு மற்றும் அபிவிருத்திக் கூட்டுத்தாபனம்

MINISTRY OF MEGAPOLIS & WESTERN DEVELOPMENT
SRI LANKA LAND RECLAMATION AND DEVELOPMENT CORPORATION

த.பெ.இ.56, இல.03, ஸ்ரீ ஜயவர்தனபுர மாவத்தை, வெலிகட, ராஜகிரிய.
තැ.පෙ. 56, අංක 03, ශ්‍රී ජයවර්ධනපුර මාවත, වැලිකඩ, රාජගිරිය.
P.O. Box 56, No. 03, Sri Jayawardenepura Mawatha, Welikada, Rajagiriya.

Ref: WM/WWPM/185/Gov16

2018-02-12

Addl. General Manager (Sewarage),
National Water Supply and Drainage board,
P.O Box. 14,
Mt. Lavinia,
Galle Rd,
Ratmalana.

Approval for acceptance of dried sewage sludge to Compost Production Facility at Kerawalapitiya

This has reference to the letter dated 25th January 2018 on above. The permission could be granted to deliver dried sewage sludge generated through the Proposed Sri Jayewardenepura Kotte Sewerage Project to the Compost Production Facility at Kerawalapitiya.

We accept dried sewage sludge at a rate of Rs. 3,000/- (without tax) per metric ton and conditions will apply.

Please note that, you have to renew this approval before the commencement of the project.

Thank You.

Yours Sincerely,

Asela Iddawela
Chairman
Sri Land Reclamation and Development Corporation

Copies:
1. Mr. N.G.H.L. Keerthi
2. Mr. P.K. Wickmaarachchi
3. O/C

දුරකථනය / தொலைபேசி / Telephone: 2867369, 2889485, 2863705, 2889486, 2867533, 2889487
සභාපති / தலைவர் / Chairman: 2863696
ෆැක්ස් / பெக்ஸ் / Fax: 2862457, 2868001
Website : www.landreclamation.lk
E-mail: sllrdc@sltnet.lk

APPENDIX 5-3 The structural outline drawing based on capacity calculation (5.3.2)

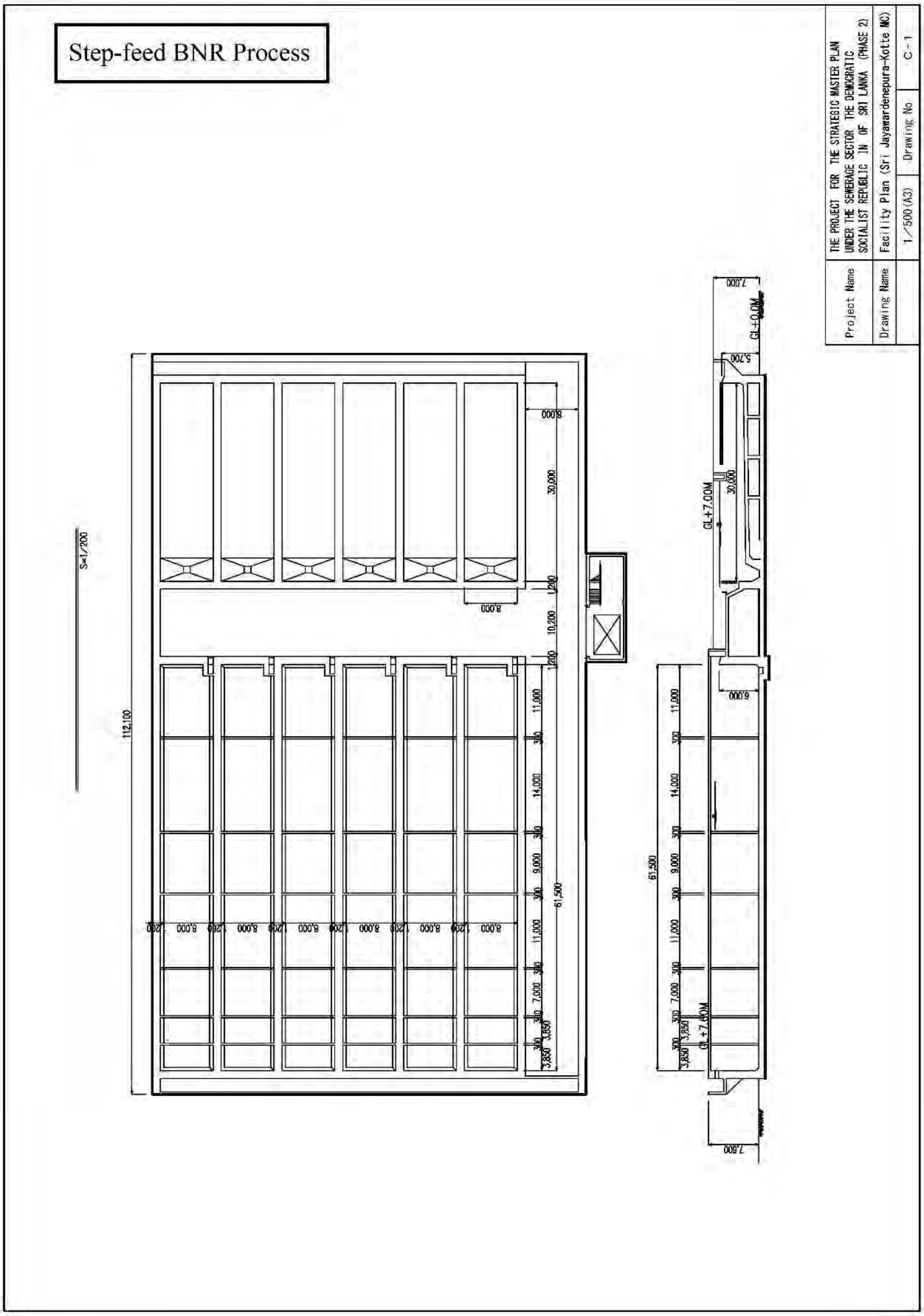
This appendix describes the structural outline drawing based on capacity calculation.

(1) The structural outline drawing of Step-feed BNR process

The structural outline drawing of Step-feed BNR process is shown in **Figure A5.3-1**

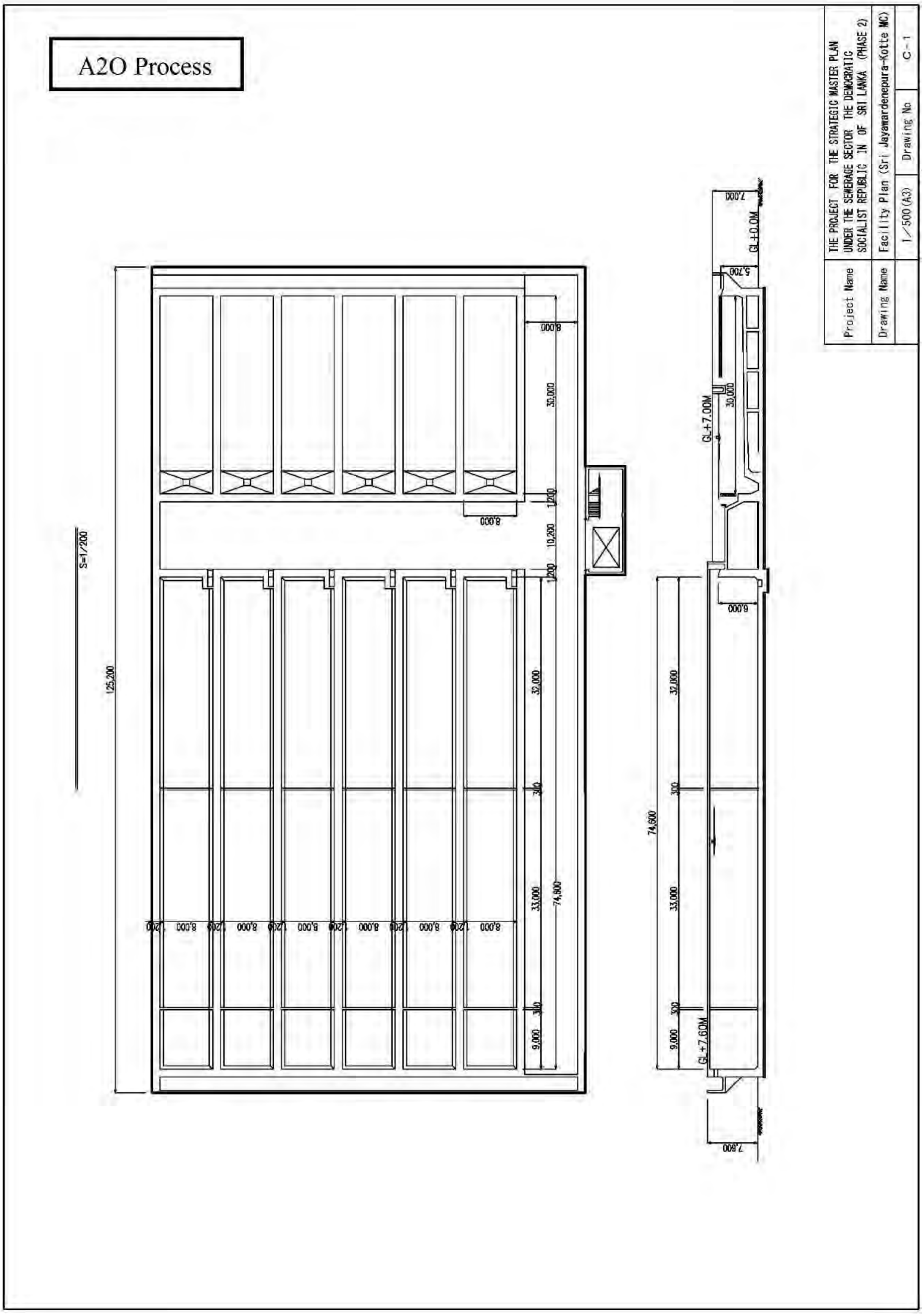
(2) The structural outline drawing of A_2O process

The structural outline drawing of A_2O process is shown in **Figure A5.3-2**



Source: JET

Figure A5.3-1 The structural outline drawing of Step-feed BNR process



Source: JET

Figure A5.3-2 The structural outline of A_2O Process

APPENDIX 5-4 Layout Plan for Sewage Treatment Plant (5.3.3)

This appendix show the layout plans for Sewage Treatment Plant.

Figure A5.4-1: Layout Plan near the STP Site

Figure A5.4-2: Layout Plan near in STP Site

Figure A5.4-3: Influent Pump Building

Figure A5.4-4: Sewage Treatment Plant and Administartion Building Basement Floor

Figure A5.4-5: Sewage Treatment Plant and Administartion Building Ground Floor

Figure A5.4-6: Sewage Treatment Plant and Administartion Building 1st Floor

Figure A5.4-7: Sewage Treatment Plant and Administartion Building 2nd Floor

Figure A5.4-8: Sewage Treatment Plant and Administartion Building 3rd Floor

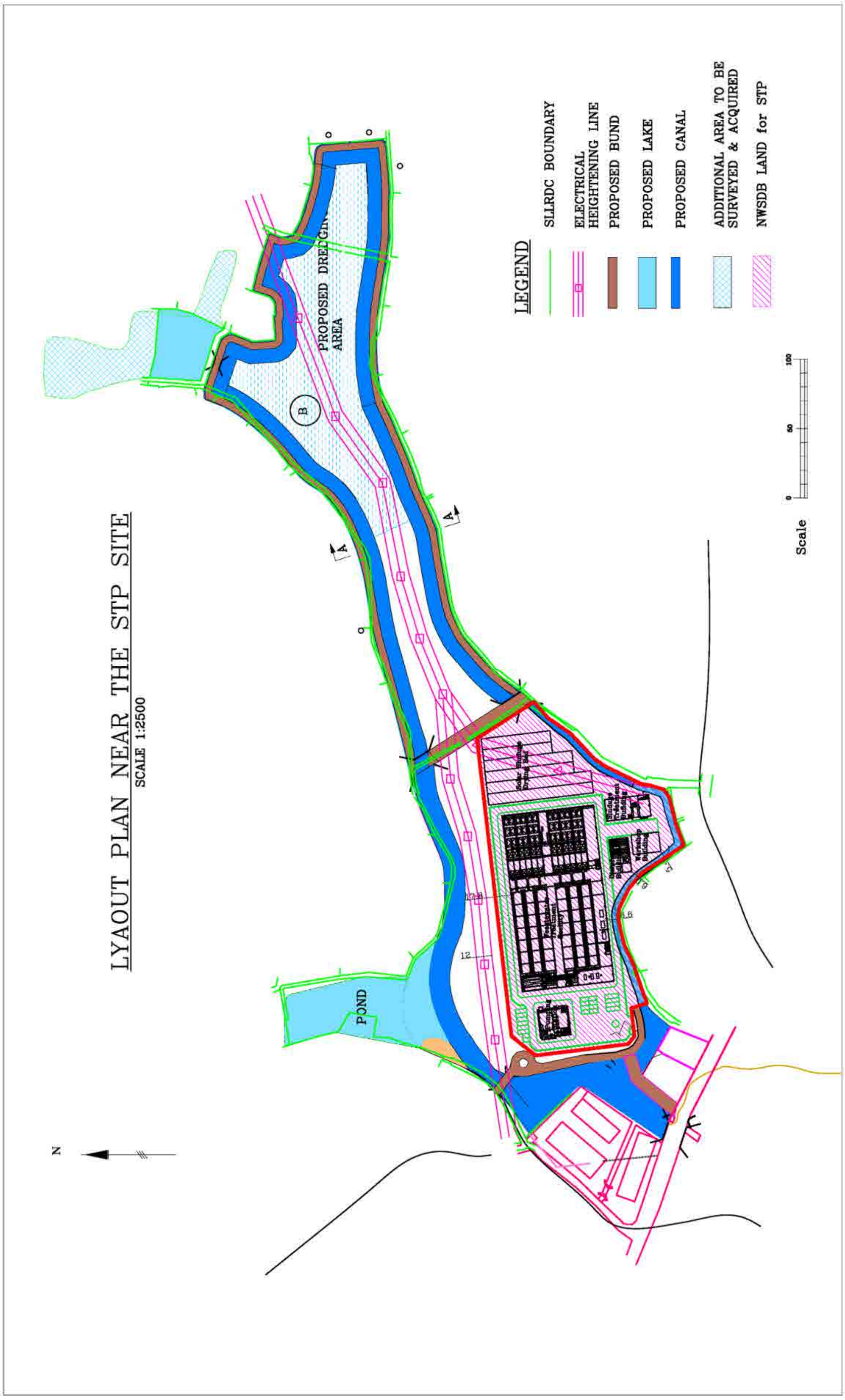
Figure A5.4-9: Sewage Treatment Plant and Administartion Building 4th Floor

Figure A5.4-10: Sewage Treatment Plant and Administartion Building Typical Section

Figure A5.4-11: Disinfection Building

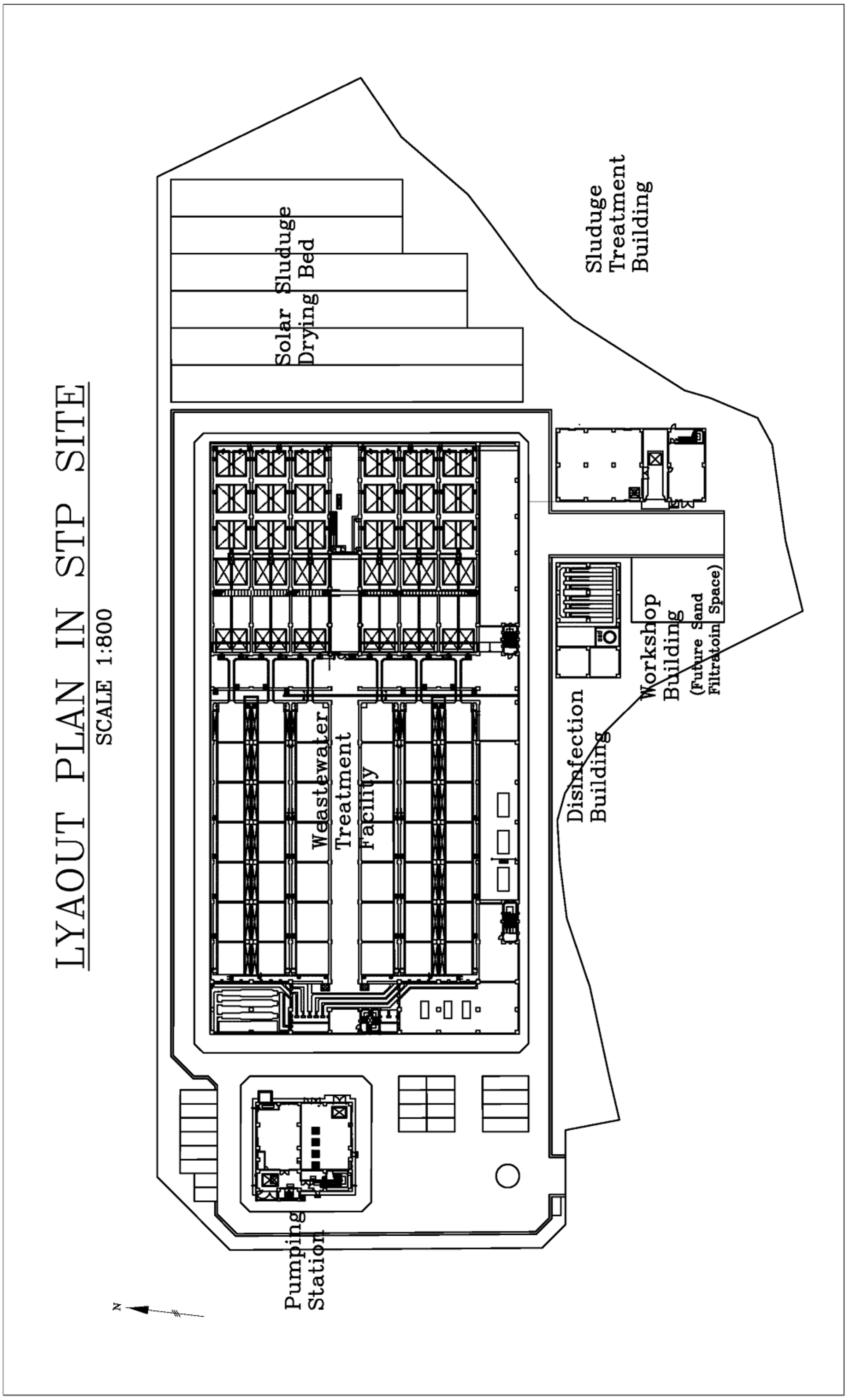
Figure A5.4-12: Slduge Treatment Building

Figure A5.4-13: Solar Sludge Drying Bed



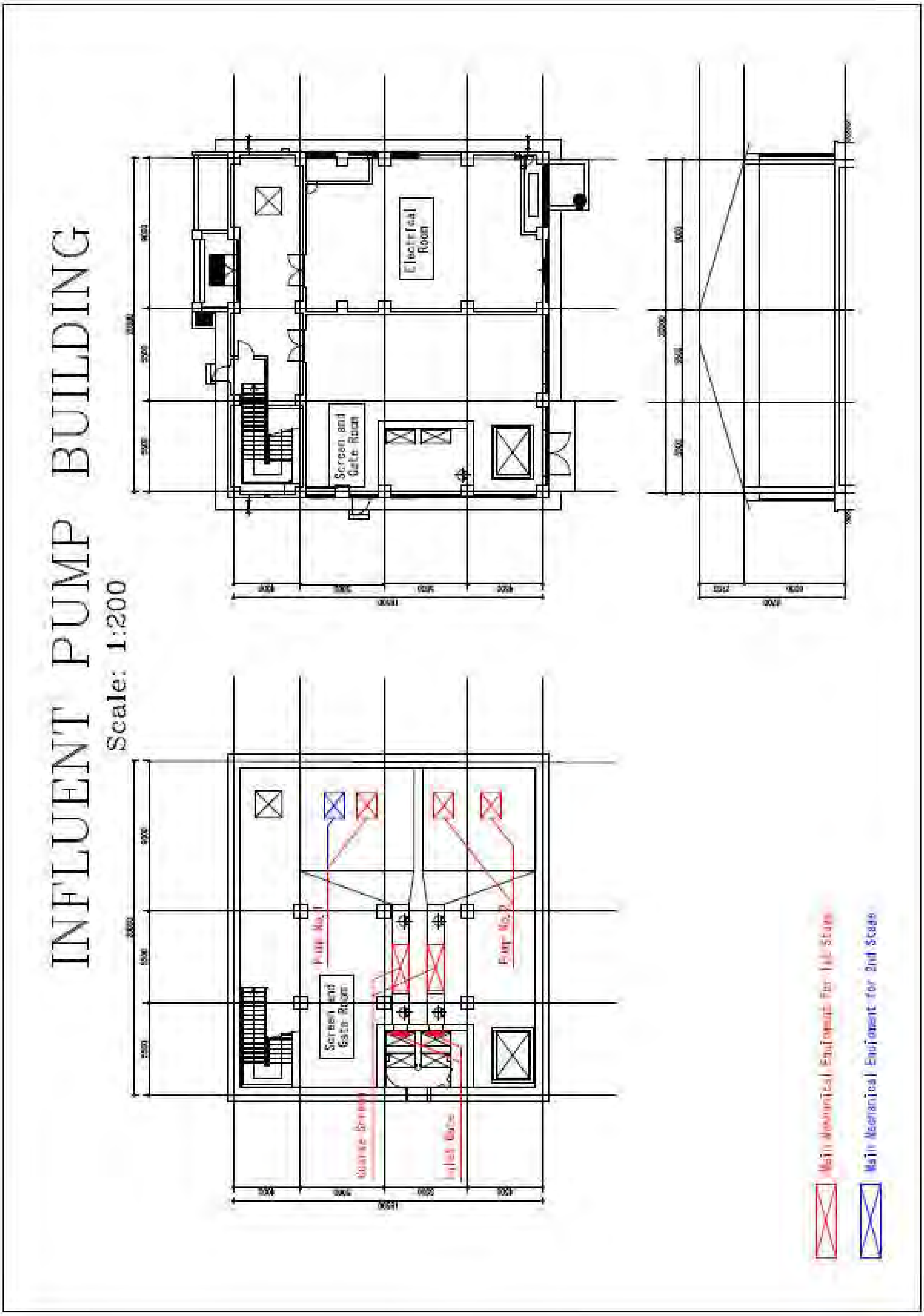
Source: JET

Figure A5.4-1: Layout Plan near the STP Site



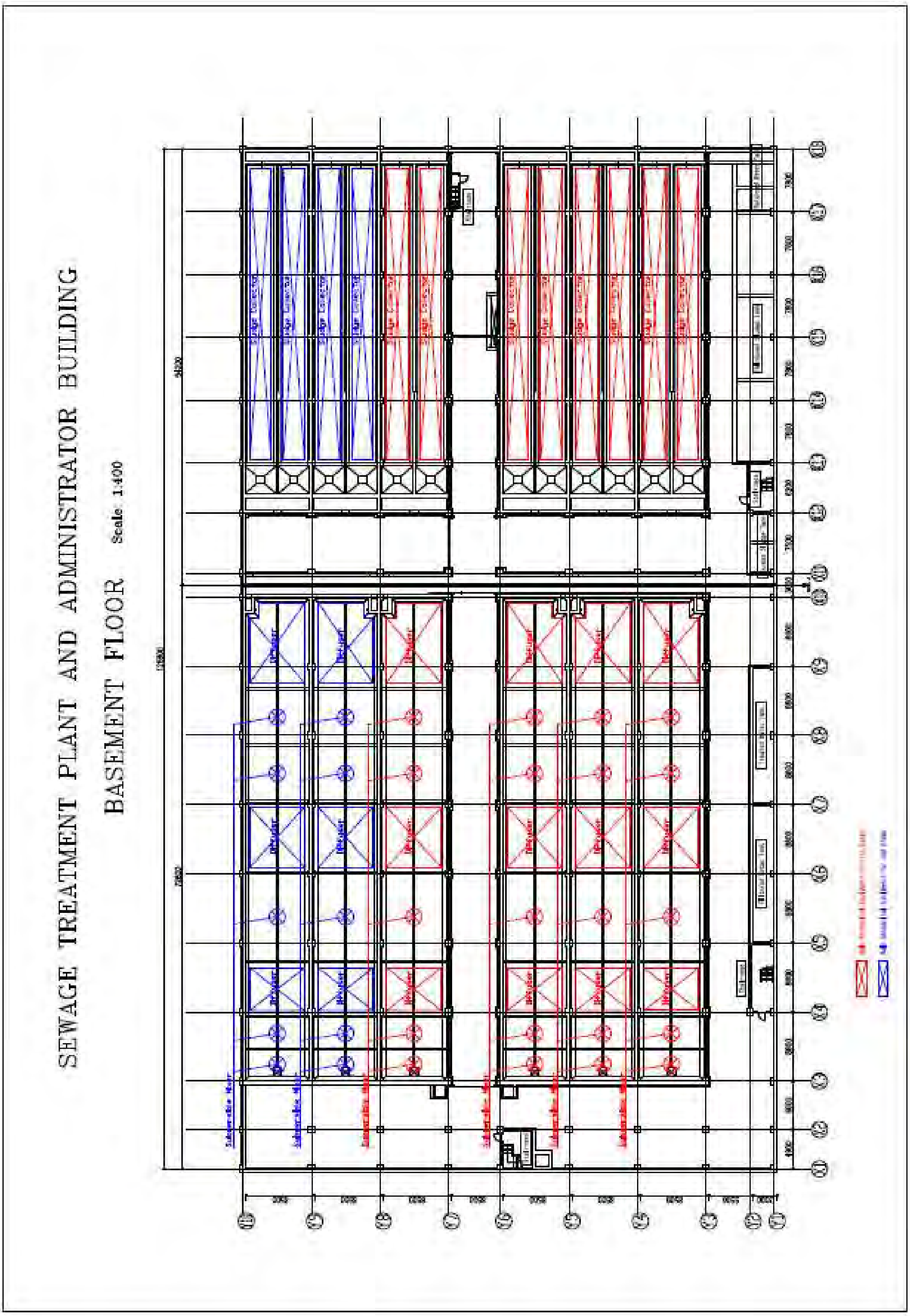
Source: JET

Figure A5.4-2: Layout Plan near in STP Site



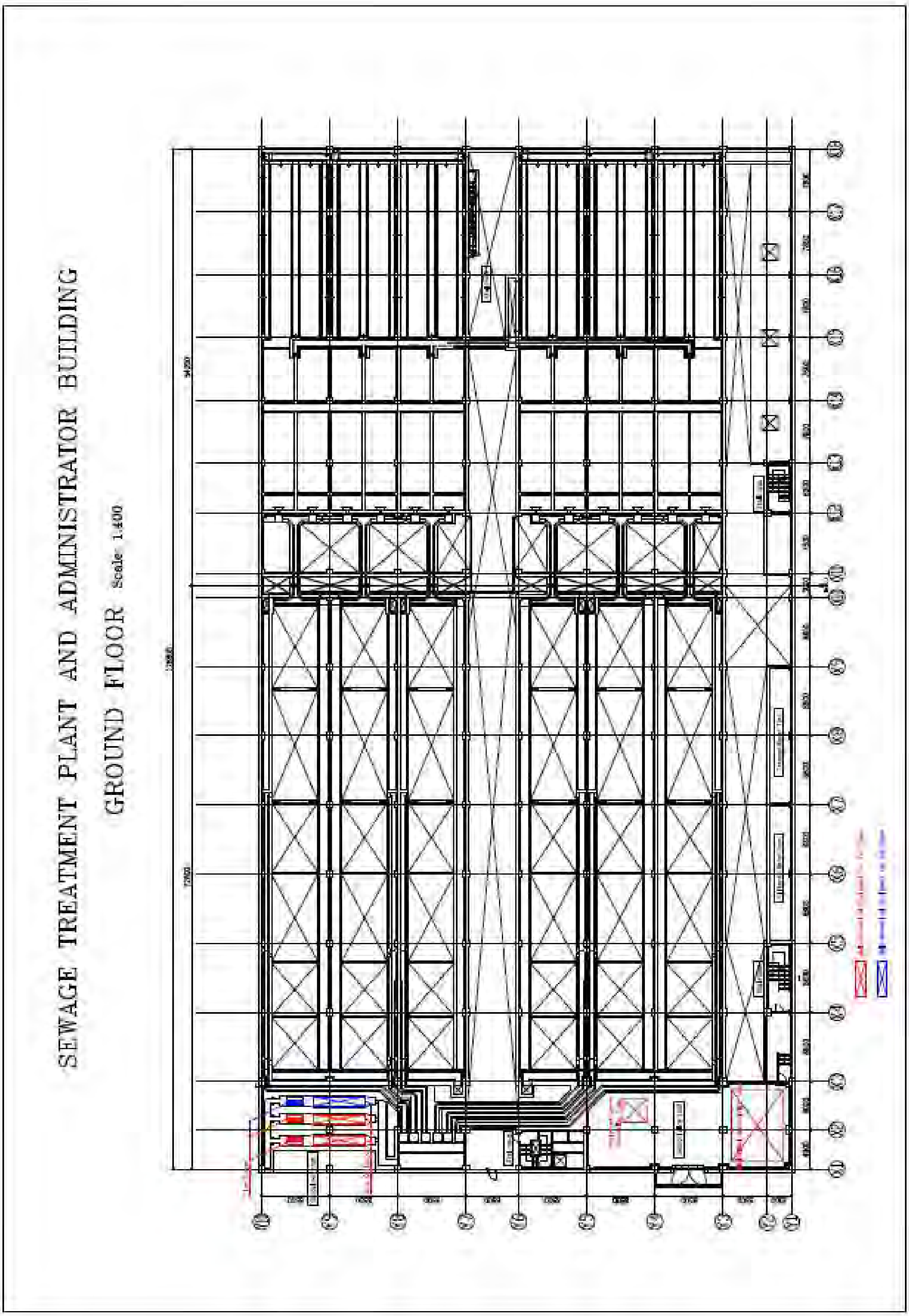
Source: JET

Figure A5.4-3: Influent Pump Building



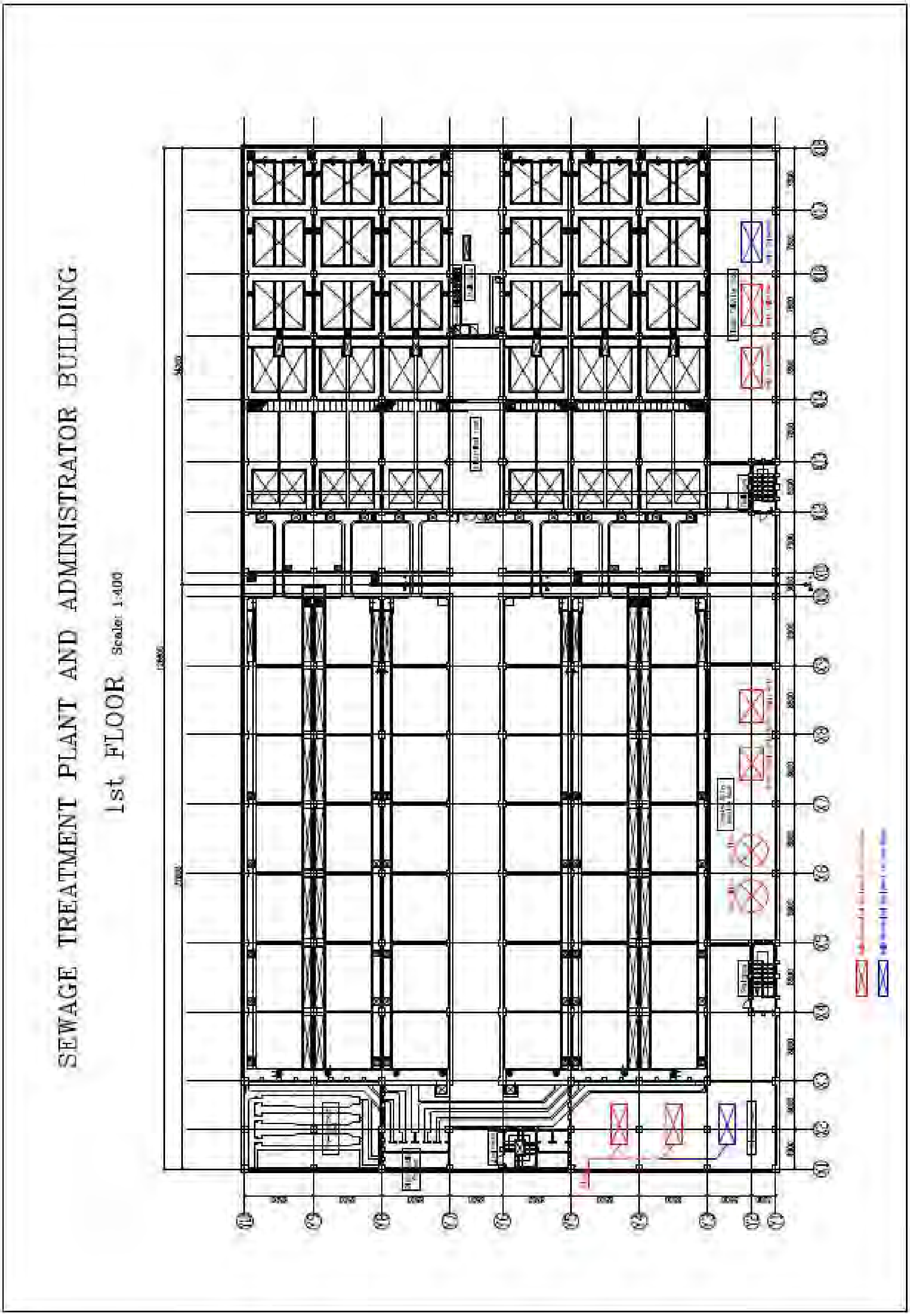
Source: JET

Figure A5.4-4: Sewage Treatment Plant and Administartion Building Basement Floor



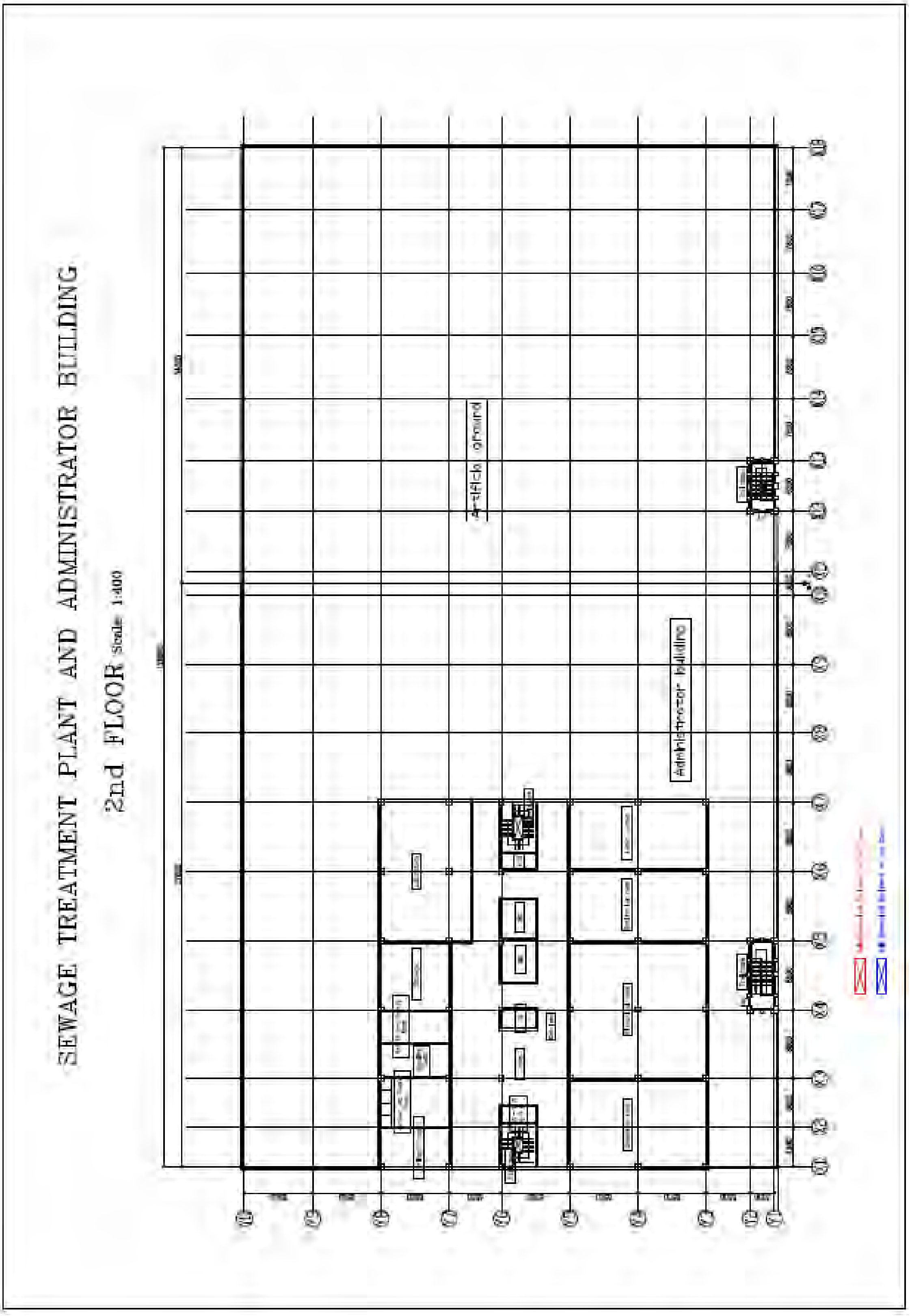
Source: JET

Figure A5.4-5: Sewage Treatment Plant and Administartion Building Ground Floor



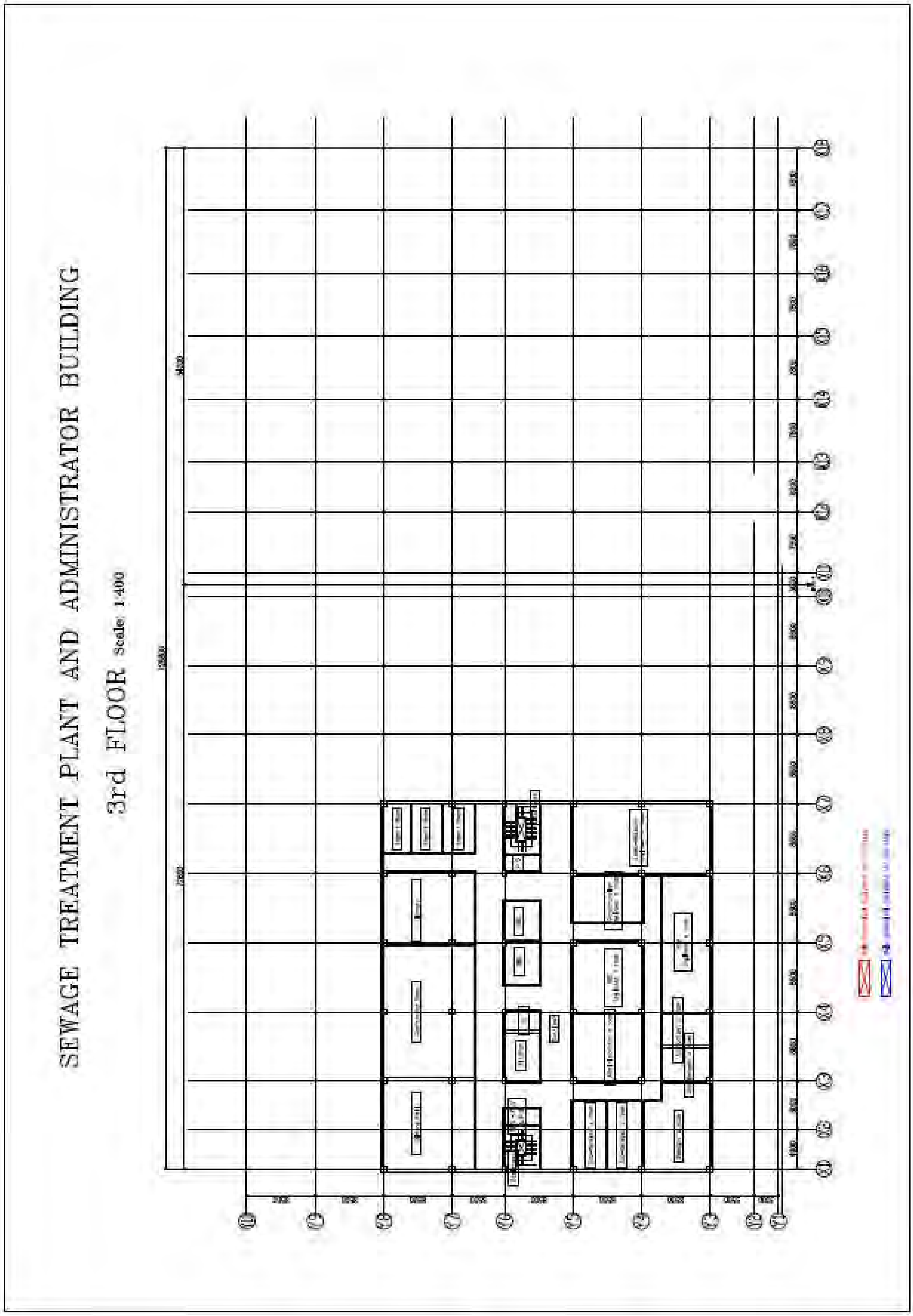
Source: JET

Figure A5.4-6: Sewage Treatment Plant and Administartion Building 1st Floor



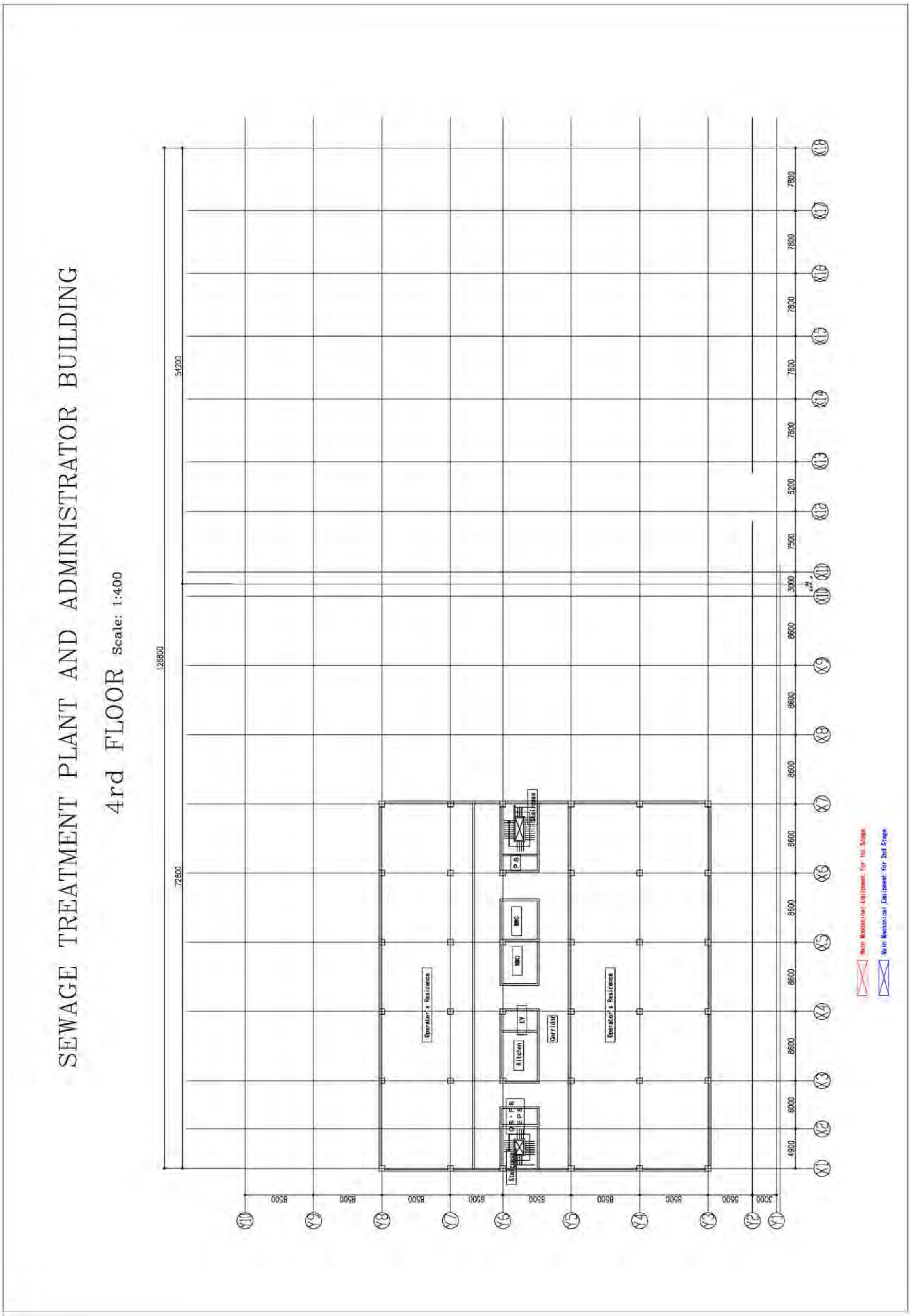
Source: JET

Figure A5.4-7: Sewage Treatment Plant and Administartion Building 2nd Floor



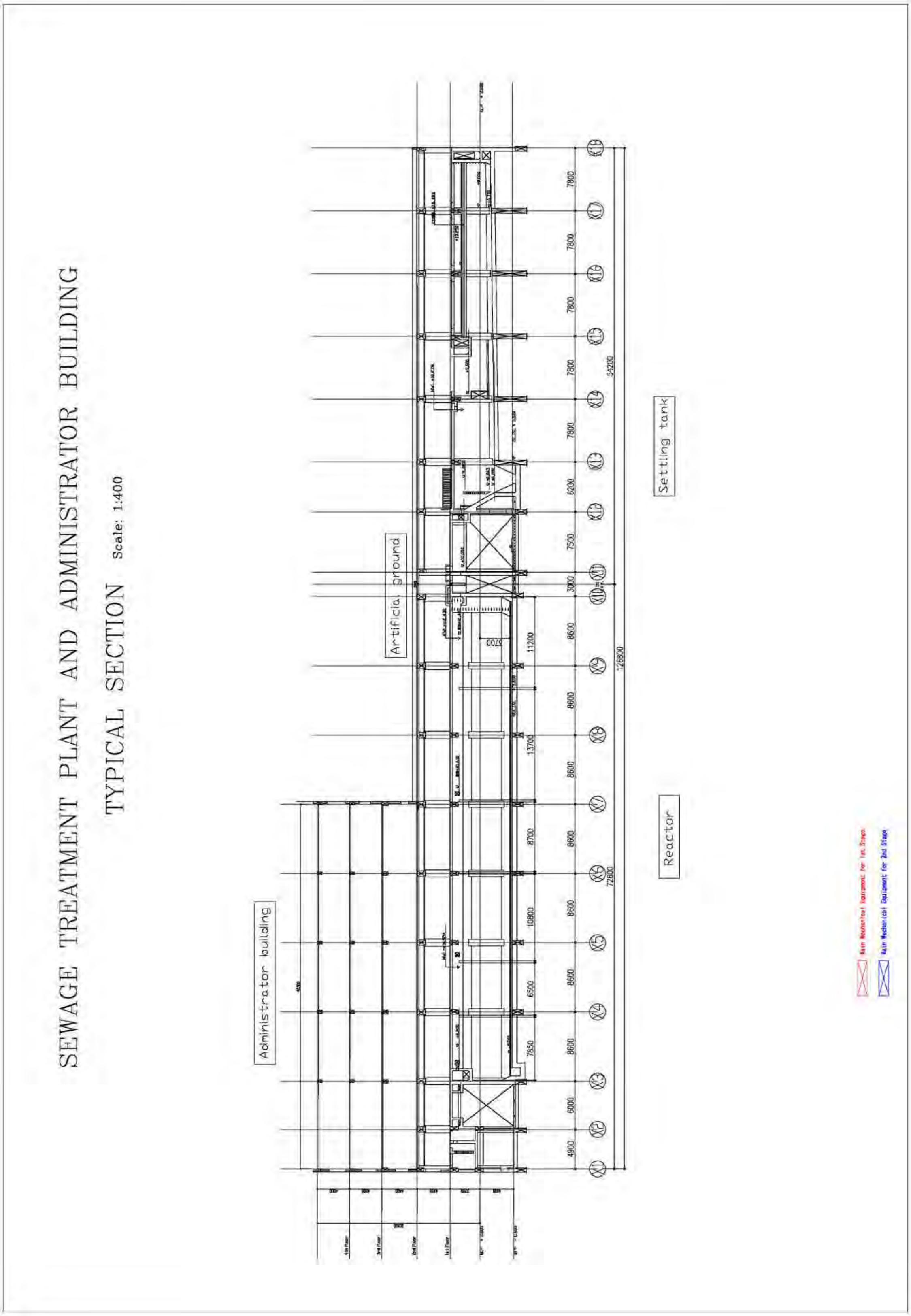
Source: JET

Figure A5.4-8: Sewage Treatment Plant and Administartion Building 3rd Floor



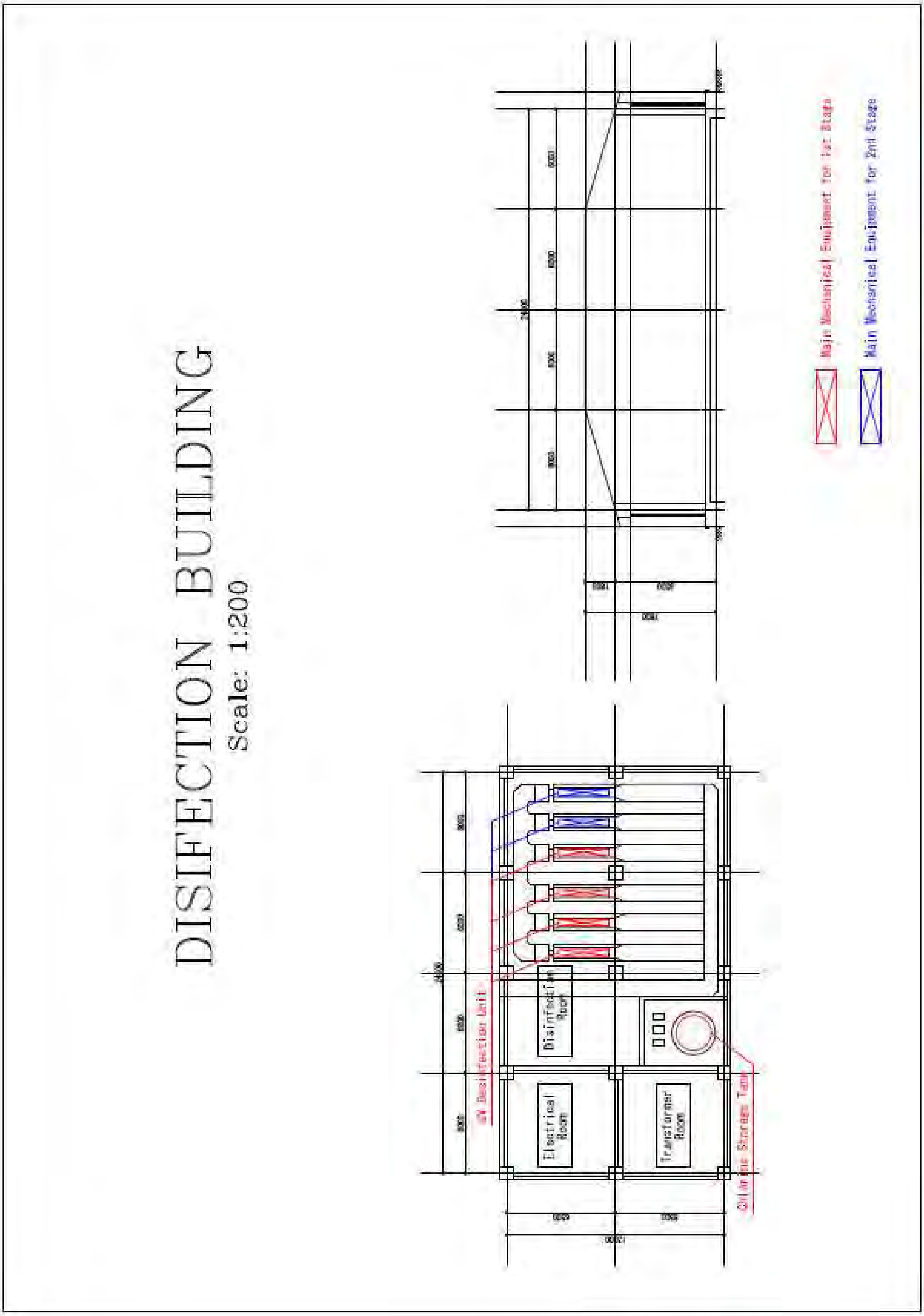
Source: JET

Figure A5.4-9: Sewage Treatment Plant and Administartion Building 4th Floor



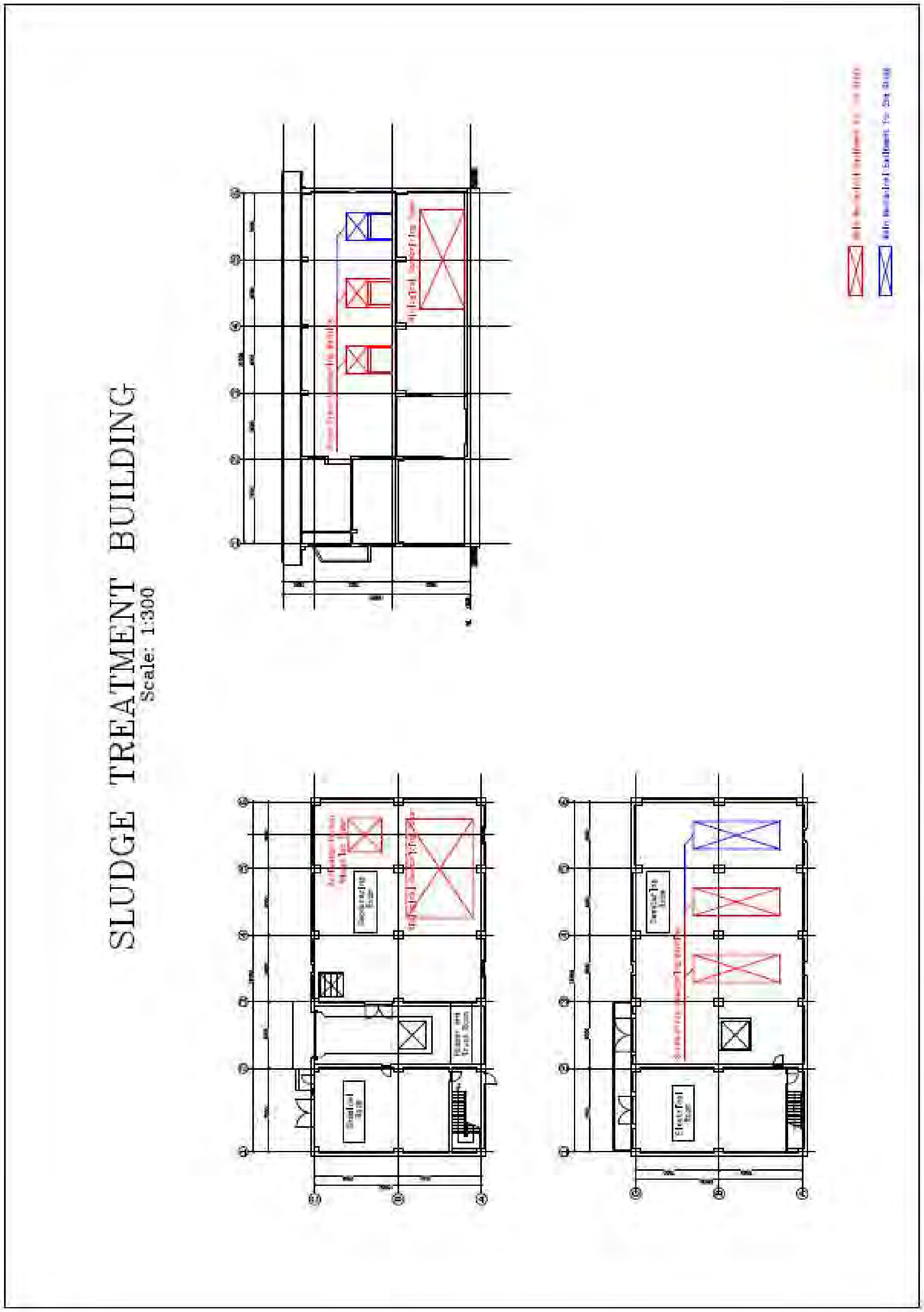
Source: JET

Figure A5.4-10: Sewage Treatment Plant and Administartion Building Typical Section



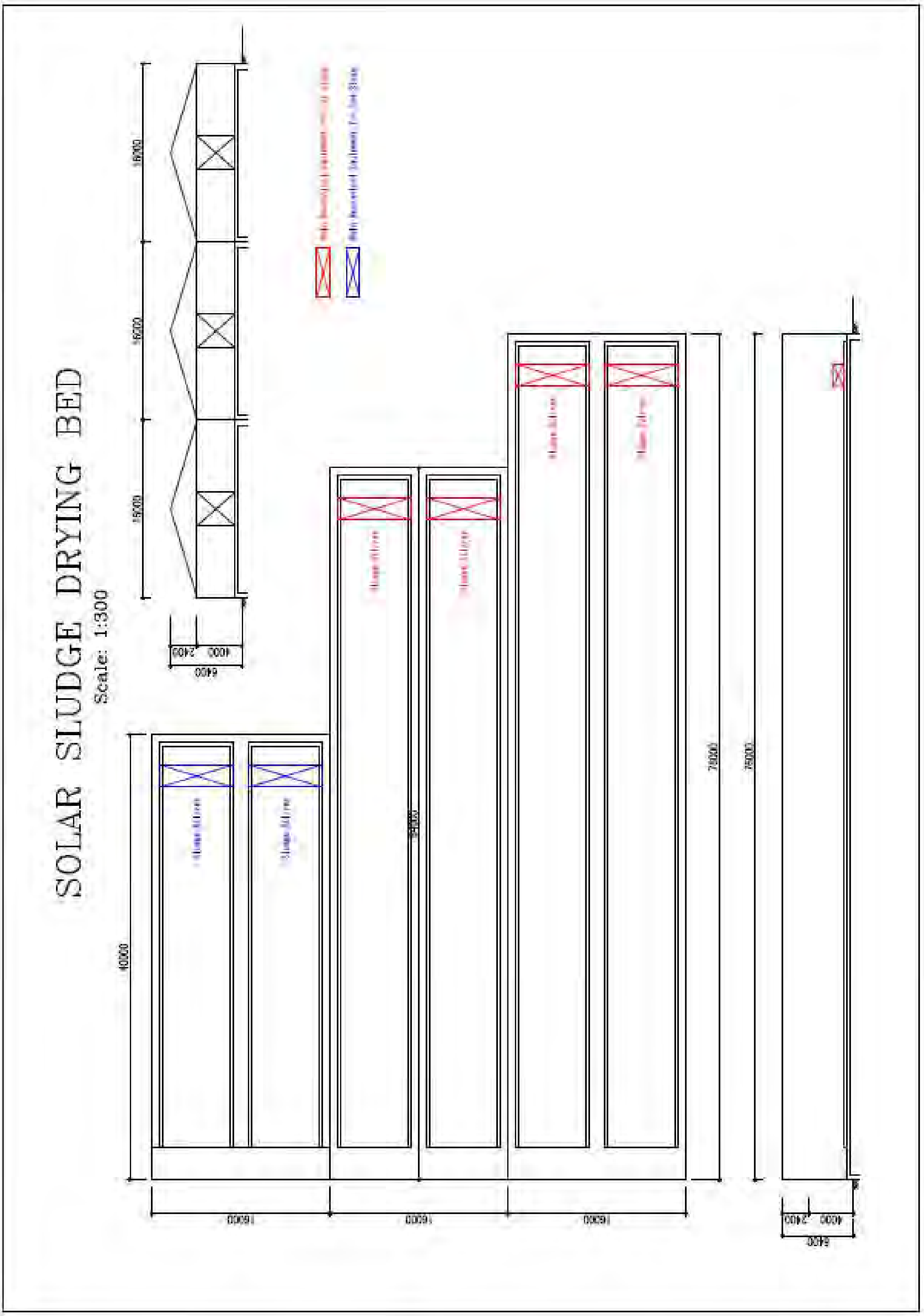
Source: JET

Figure A5.4-11: Disinfection Building



Source: JET

Figure A5.4-12: Slduge Treatment Building



Source: JET

Figure A5.4-13: Solar Sludge Drying Bed

APPENDIX 5-5 Mass Balance (5.3.4)

(1)Master Plan

（Influent）

Influent				
Q	39,400	m^3/day	Solids	
S S	160	mg/l	6.30	t/day
BOD	240	mg/l	9.46	t/day
COD	600	mg/l	23.64	t/day
T-N	45	mg/l	1.77	t/day
T-P	6	mg/l	0.24	t/day

Return Supernatant				
Q	1,164	m^3/day	Solids	
S S	1,254	mg/l	1.31	t/day
BOD	1,117	mg/l	1.16	t/day
COD	662	mg/l	0.69	t/day
T-N	86	mg/l	0.12	t/day
T-P	43	mg/l	0.05	t/day

Mixed Tank

Activated Sludge Reactor Inflow				
Q	40,564	m^3/day	Solids	
S S	188	mg/l	7.61	t/day
BOD	262	mg/l	10.62	t/day
COD	600	mg/l	24.33	t/day
T-N	46.6	mg/l	1.89	t/day
T-P	7.1	mg/l	0.29	t/day

Activated Sludge Reactor Inflow				
Q	40,564	m^3/day	Solids	
S S	188.0	mg/l	7.61	t/day
BOD	262.0	mg/l	10.62	t/day
COD	600.0	mg/l	24.33	t/day
T-N	46.6	mg/l	1.89	t/day
T-P	7.1	mg/l	0.29	t/day
S-BOD	131.0	mg/l	a half of BOD value	

Excess Sludge				
Q	1,345	m^3/day	Solids	
S S	0.75	%	9.12	t/day
			0.97	t/day
				t/day
Total			10.09	t/day

Mechanically Thickened Machine Supernatant				
Q	1,105	m^3/day	Solids	
S S	0.05	%	0.50	t/day
BOD	1,000	mg/l	1.11	t/day
COD	600	mg/l	0.66	t/day
T-N	100	mg/l	0.11	t/day
T-P	40	mg/l	0.04	t/day

Mechanical Thickener

Return Sludge Excess Sludge

Activated Sludge Reactor

Final Sdedimentation Tank

Flocculant
76 ml/m^3
Flocculant
3 m^3/day

Mechanically Thickened sludge				
Q	240	m^3/day	Solids	
S S	4.0	%	9.59	t/day

Final Sedimentation Tank Effluent				
Q	39,222	m^3/day	Solids	
S S	9.4	mg/l	0.37	t/day
BOD	7.9	mg/l	0.31	t/day
COD	60.0	mg/l	2.35	t/day
T-N	10.3	mg/l	0.40	t/day
T-P	0.99	mg/l	0.04	t/day

Dewatering Machine Input				
Q	240	m^3/day	Solids	
S S	4.0	%	9.59	t/day

Dewatering Machine Supernatant				
Q	186	m^3/day	Solids	
S S	5,161	mg/l	0.96	t/day
BOD	1,000	mg/l	0.19	t/day
COD	600	mg/l	0.11	t/day
T-N	100	mg/l	0.02	t/day
T-P	40	mg/l	0.01	t/day

Dewaterring Machine

Disinfection Tank

Effluent				
Q	39,222	m^3/day	Solids	
S S	9.4	mg/l	0.37	t/day
BOD	7.9	mg/l	0.31	t/day
COD	60.0	mg/l	2.35	t/day
T-N	10.3	mg/l	0.40	t/day
T-P	0.99	mg/l	0.04	t/day

Cake				
Q	54	m^3/day	Solids	
Moisture Content	84	%	8.63	t/day

（Removal）

(Effluent)

(2)Priority Area

（Influent）

Influent				
Q	24,000	m^3/day	Solids	
S S	160	mg/l	3.84	t/day
BOD	240	mg/l	5.76	t/day
COD	600	mg/l	14.40	t/day
T-N	45	mg/l	1.08	t/day
T-P	6	mg/l	0.14	t/day

Return Supernatant				
Q	753	m^3/day	Solids	
S S	1,222	mg/l	0.96	t/day
BOD	1,089	mg/l	0.86	t/day
COD	651	mg/l	0.51	t/day
T-N	106	mg/l	0.08	t/day
T-P	40	mg/l	0.03	t/day

Mixed Tank

Activated Sludge Reactor Inflow				
Q	24,753	m^3/day	Solids	
S S	194	mg/l	4.80	t/day
BOD	267	mg/l	6.62	t/day
COD	602	mg/l	14.91	t/day
T-N	47	mg/l	1.16	t/day
T-P	6.9	mg/l	0.17	t/day

Activated Sludge Reactor Inflow				
Q	24,753	m^3/day	Solids	
S S	194.0	mg/l	4.80	t/day
BOD	267.0	mg/l	6.62	t/day
COD	602.0	mg/l	14.91	t/day
T-N	47.0	mg/l	1.16	t/day
T-P	6.9	mg/l	0.17	t/day
S-BOD	133.5	mg/l	a half of BOD value	

Excess Sludge				
Q	843	m^3/day	Solids	
S S	0.75	%	5.73	t/day
			0.59	t/day
				t/day
	Total		6.32	t/day

Mechanical Thickener

Mechanically Thickened Machine Supernatant				
Q	693	m^3/day	Solids	
S S	0.05	%	0.32	t/day
BOD	1,000	mg/l	0.69	t/day
COD	600	mg/l	0.42	t/day
T-N	100	mg/l	0.07	t/day
T-P	40	mg/l	0.03	t/day

Return Sludge Excess Sludge

Activated Sludge Reactor

Final Sdedimentation Tank

Flocculant	
76	ml/m^3
Flocculant	
2	m^3/day

Mechanically Thickened sludge				
Q	150	m^3/day	Solids	
S S	4.0	%	6.00	t/day

Final Sedimentation Tank Efflunet				
Q	23,912	m^3/day	Solids	
S S	9.7	mg/l	0.23	t/day
BOD	8.0	mg/l	0.19	t/day
COD	60.2	mg/l	1.44	t/day
T-N	10.3	mg/l	0.25	t/day
T-P	0.97	mg/l	0.02	t/day

Dewatering Machine Input				
Q	150	m^3/day	Solids	
S S	4.0	%	6.00	t/day

Dewaterring Machine

Dewatering Machine Supernatant				
Q	116	m^3/day	Solids	
S S	5,172	mg/l	0.60	t/day
BOD	1,000	mg/l	0.12	t/day
COD	600	mg/l	0.07	t/day
T-N	100	mg/l	0.01	t/day
T-P	40	mg/l	0.00	t/day

Disinfection Tank

Efflunet				
Q	23,912	m^3/day	Solids	
S S	9.7	mg/l	0.23	t/day
BOD	8.0	mg/l	0.19	t/day
COD	60.2	mg/l	1.44	t/day
T-N	10.3	mg/l	0.25	t/day
T-P	0.97	mg/l	0.02	t/day

Cake				
Q	34	m^3/day	Solids	
Moisture Content	84	%	5.40	t/day

（Removal）

(Effluent)

APPENDIX 5-6 The Capacity Calculation of Facilities (5.3.4)

Items	Master plan				Priority Area			
1.Lift Pump Facility								
1-1. Inflow Pipe								
Pipe Diameter	φ 1,350 mm				φ 1,350 mm			
Set Point Varying Rate	0.5‰				0.5‰			
Sewer Invert Elevation	-4.380 M				-4.380 M			
	Full Pipe Flow	1.878 m^3/sec				1.878 m^3/sec		
	Full Pipe Flow Velocity	0.934 m/sec				0.934 m/sec		
Inflow Water Level		Daily Average Flow	Daily Maximum Flow	Hourly Maximum Flow		Daily Average Flow	Daily Maximum Flow	Hourly Maximum Flow
Flow(m^3/sec)		0.405	0.455	0.607		0.247	0.277	0.370
Flow Ratio		0.216	0.242	0.323		0.132	0.147	0.197
Velocity(m/sec)		0.754	0.778	0.837		0.658	0.679	0.736
Water Height(m)		0.543	0.579	0.682		0.417	0.443	0.517
Water Level(M)		-3.837	-3.801	-3.698		-3.963	-3.801	-3.863

Items	Master plan	Priority Area
b）Inflow Gate		
Number of Unit	2 Unit	2 Unit
Dimension	1,600H×800B	1,600H×800B
Install Lvel	-4.200 M	-4.200 M
Water Level Height(h)	＝ -3.698 － (-4.200)	＝ -3.863 － (-4.200)
	＝ 0.502 m	＝ 0.337 m
Velocity at the gate		
（V)	$= \dfrac{0.607}{2\times0.502\times0.8}$	$= \dfrac{0.370}{2\times0.337\times0.8}$
	＝ 0.756 m/sec	＝ 0.686 m/sec
Inflow Gate Loss(hg)	(Gate Loss Parameter fg:1.5)	(Gate Loss Parameter fg:1.5)
	$= 1.5 \times \dfrac{0.756\text{^}2}{2g}$	$= 1.5 \times \dfrac{0.686\text{^}2}{2g}$
	＝ 0.044 m	＝ 0.036 m
Water Level through the Gate	＝ -3.698 － 0.044	＝ -3.863 － 0.036
	＝ -3.654 m	＝ -3.827 m
Gate material	Cast Iron	Cast Iron
Gate Operation	Electrically Operated	Electrically Operated
c） Coarse Screen		
Coarse Spacing	100 mm	100 mm
Coarse Width	2.0 m	2.0 m
Screen Install Level	-4.200 ～	-4.200 ～
	-4.300 M	-4.300 M
Unit	2 unit	1 unit
Head Loss	0.100 m	0.100 m
g) Pump		
Water Level	T.P. -3.754 M	T.P. -3.927 M
h）Pumo		
1)Pump Capacity and Unit		

Items	Master plan	Priority Area
No.1 Pump		
	9.2 m^3/min×2unit	9.2 m^3/min×2unit
No.2 Pump		
	18 m^3/min×2unit	18 m^3/min×2unit
2) Pump Diameter	(Stand-by unit 1)	(Stand-by unit 1)
No.1 Pump		
	$D= 146 \left(\frac{\text{Capacity}}{\text{Velocity}}\right)^{1/2}$	
	$= 146 \left(\frac{9.2}{2.5}\right)^{1/2} =$	
	= 280 mm	
	→ 300 mm	
No.2 Pump		
	$D= 146 \left(\frac{\text{Capacity}}{\text{Velocity}}\right)^{1/2}$	
	$= 146 \left(\frac{18}{2.5}\right)^{1/2} =$	
	= 392 mm	
	→ 400 mm	
3) Pump Head		
Maximum Level		
	HWL= -3.754 M(Hourly Flow Level)	
Minmum Lvel		
	HWL= +6.500 M(Hourly Flow Level)	
Water level Difference	= +8.800 -(-3.754)	
	= 10.254 m	
4) Head Loss(h)		
	No.1 Pump	No.2 Pump
	$V= \frac{9.2}{\pi/4\times0.3^2\times60} =$ 1.22 m/sec	$V= \frac{18}{\pi/4\times0.4^2\times60} =$ 1.061 m/sec
	Inflow Loss Parameter(fi) 0.2	
	Bend Loss Parameter(fg)3×0.20= 0.6	
	Check Valve Loss Parameter 1.0	
	Efflunet Loss Parameter (fe) 1.0	
	Friction Loss Parameter(ff)	

items	Master plan	Priority Area
	$0.021 \times \frac{40}{0.4} = 2.1$	$0.021 \times \frac{40}{0.6} = 1.40$
	Total Loss Parameter(f) 4.9	Total Loss Parameter(f) 4.20
	$h = 4.90 \times \frac{1.220^2}{2g} = 0.372$ → 2.0m	$h = 4.20 \times \frac{1.061^2}{2g} = 0.241$ → 2.0m
5)Total Head	$H = 10.254 + 2.0 = 12.254$ → 12.5 m	$H = 10.254 + 2.0 = 12.254$ → 12.5 m
6)Motor Output	No.1 Pump $PS = \frac{0.163 \times \gamma \times Q \times H}{\eta}$ γ : Gravity of water(kg/m^3) Q : Pump Capacity(m^3/min) H : Total Head η : Pump Efficiency $PS = \frac{0.163 \times 1.0 \times 9.2 \times 12.5}{0.7}$ = 27 KW	No.2 Pump $PS = \frac{0.163 \times 1.0 \times 18.0 \times 12.5}{0.74}$ = 50 KW
7) Motor Output	No.1 Pump PS = 1.15×27.0 = 31.1 KW	No.2 Pump PS = 1.15×50.0 = 57.5 KW

items	Master plan No.1 Pump	Master plan No.2 Pump	Priority Area No.1 Pump	Priority Area No.2 Pump
Pump Specification				
Pump Types	Vertical Shaft Mixed Flow Pump with Volute Casing	Same as on the left	Vertical Shaft Mixed Flow Pump with Volute Casing	Same as on the left
Pump Diameter	φ300	φ400	φ300	φ400
Pump Capacity	9.2 m^3/min	18 m^3/min	9.2 m^3/min	18 m^3/min
Pump Head	12.5 m	12.5 m	12.5 m	12.5 m
Motor Output	45 KW	75 KW	45 KW	75 KW
Number	2 Unit	2 Unit (Stand-by Unit 1)	2 Unit	2 Unit (Stand-by Unit 1)
Total Pump Capacity	36.4 m^3/min		36.4 m^3/min	

Items	Master plan				Priority Area			
Operation Plan of Pump								
	Item	Flow m^3/sec m^3/min	Operation Plan of Pump	Pump Capacity m^3/min	Item	Flow m^3/sec m^3/min	Operation Plan of Pump	Pump Capacity m^3/min
	Daily Average Flow	0.405 24.3	No.1×2Unit No.2×2Unit	36.4	Daily Average Flow	0.247 14.8	No.1×2Unit No.2×1Unit	18.0
	Daily Maximum Flow	0.455 27.3	No.1×2Unit No.2×2Unit	36.4	Daily Maximum Flow	0.277 16.6	No.1×2Unit No.2×1Unit	18.0
	Hourly Maximum Flow	0.607 36.4	No.1×2Unit No.2×2Unit	36.4	Hourly Maximum Flow	0.370 22.2	No.1×2Unit No.2×2Unit	27.2

Items	Master plan			Priority Area		
2.Screen and Grid chamber						
Inflow Water Level	Dailty Average Flow	Daity Maximum Flow	Hourly Maximum Flow	Dailty Average Flow	Daity Maximum Flow	Hourly Maximum Flow
Flow(m^3/sec)	0.405	0.455	0.607	0.247	0.277	0.370
Water Level	+6.50 M			+6.50 M		
1) Inflow Movable Weir Gate						
Number	3 unit			2 unit		
Dimension	1,000H×500B			1,000H×500B		
Install Height	6.550 M			6.550 M		
Gate material	Cast Iron			Cast Iron		
Gate Operation	Electrically Operated			Electrically Operated		

Items	Master plan	Priority Area
2）Fine screen		
Screen Width	4 mm	4 mm
Screen Channel Width	1.2 m	1.2 m
Bar Dimension	9mmt×75mmB	9mmt×75mmB
Install Angle	75 °	75 °
Bottom Level	6.000 M	6.000 M
Number	3 unit	2 unit
Water Level at the Screen	0.300 m	0.300 m
Blockage Ratio	50 %	50 %
Approach Velocity	$= \dfrac{0.607}{0.300\times0.5\times3／1.2} =$	$= \dfrac{0.370}{0.300\times0.5\times2／1.2} =$
	= 1.124 m/sec	= 1.028 m/sec
Loss		
	$hs=\beta\sin\alpha\left(\dfrac{t}{b}\right)^{(4/3)} \dfrac{V^2}{2g}$	
	$=2.34\sin75^\circ\left(\dfrac{9}{25}\right)^{(4/3)} \dfrac{V^2}{2g}$	
	$=0.579 \times \dfrac{1.124^2}{19.6} =$	$=0.579 \times \dfrac{1.028^2}{19.6} =$
	= 0.037 m	= 0.031 m
Water Level through the Screen	6.263 M	6.269 M

Items	Master plan	Priority Area
3） Inflow Gate to the Chamber		
Number	3 unit	2 unit
Dimension	800H×400B	800H×400B
Install level	6.000 M	6.000 M
Water Height	＝ 6.263 － (6.000) ＝	＝ 6.269 － (6.000) ＝
	＝ 0.263 m	＝ 0.269 m
	→ 0.263	→ 0.269
Velocity through the gate	$= \frac{0.607}{3 \times 0.263 \times 0.4}$	$= \frac{0.370}{2 \times 0.269 \times 0.4}$
	＝ 0.769 m/sec	＝ 0.688 m/sec
Inflow Gate Loss(hg)	(Gate Loss Parameter fg : 1.5)	
	$= 1.5 \times \frac{0.769^2}{2g}$	$= 1.5 \times \frac{0.688^2}{2g}$
	＝ 0.045 m	＝ 0.036 m
Water Level throught the Gate	＝ T.P 6.263 － 0.045	＝ T.P 6.269 － 0.036
	＝ 6.218 M	＝ 6.233 M
Gate material	Cast Iron	Cast Iron
Gate Operation	Electrically Operated	Electrically Operated
Water Level	6.218 M	6.233 M

Items	Master plan	Priority Area
4) Grid Chamber		
Bottom Level	5.700 M	5.700 M
Surface Loading	1,800 $m^3/m^2 \cdot day$	1,800 $m^3/m^2 \cdot day$
Recquired Surface	$= \dfrac{\text{Hourly Maximum Flow}(m^3/day)}{\text{Surface Loading}(m^3/m^2 \cdot day)}$	$= \dfrac{\text{Hourly Maximum Flow}(m^3/day)}{\text{Surface Loading}(m^3/m^2 \cdot day)}$
	$= \dfrac{52{,}487}{1{,}800}$	$= \dfrac{32{,}020}{1{,}800}$
	= 29.1 m^2	= 17.8 m^2
Width	1.5 m	1.5 m
Length	6.4 m	6.4 m
Number	3 unit	2 unit
Actual Surface Loading	$= \dfrac{52{,}487}{1.5 \times 6.4 \times 3}$	$= \dfrac{32{,}020}{1.5 \times 6.4 \times 2}$
	1,821 $m^3/m^2 \cdot day$	1,665 $m^3/m^2 \cdot day$
Water Height	= 6.218 − (5.700) =	= 6.233 − (5.700) =
	= 0.518 m	= 0.533 m
Velocity at the Pond	$V = \dfrac{\text{Hourly Maximum Flow}(m^3/sec)}{\text{Water Height}(m) \times \text{Width}(m) \times \text{unit}}$	
	$= \dfrac{0.607}{0.518 \times 1.5 \times 3}$	$= \dfrac{0.370}{0.533 \times 1.5 \times 2}$
	= 0.26 m/sec	= 0.231 m/sec
Retention Time	$t = \dfrac{\text{Length}(m)}{\text{Velocity}(m/sec)}$	
	$= \dfrac{6.4}{0.260}$	$= \dfrac{6.4}{0.231}$
	= 25 sec	= 28 sec

Item / Level	Master Plan	Priority Area
3.Wastewater Treetment Process		
1. Design Condition		
1.1 Design Flow Rate	39,400 m^3/d (Daily Maximum Flow [Qin,Dmax]) 35,000 m^3/d (Daily Average Flow [Qin,Dave]) 52,500 m^3/d (Hourly Maximum Flow [Qin,Hmax])	24,000 m^3/d (Daily Maximum Flow [Qin,Dmax]) 21,300 m^3/d (Daily Average Flow [Qin,Dave]) 32,100 m^3/d (Hourly Maximum Flow [Qin,Hmax])

1.2. Design Temperature

25.0 ℃ (Minimum Value of Monthly Average Temperature)

※Refer to the design temperature of Soyzapura STP

1.3. Design Quality

Unit : mg/L

Item	Influent Quality		Influent Quality to Grit Chamber (including return wastewater)	Influent Quality to Reactor	Effluent Quality from Final Sedimentation Tank	Effluent Quality		
	Planned※1)	Design				Designed Value	Sri Lankan Standard	
							Notified by NWSDB	Tentative Criteria
BOD_5	240	240	262.0	262.0	7.9	≦15	≦10	≦30
Dissolved BOD_5 (S-BOD)	120※2)	—	131※2)	131.0	—	—	—	—
COD	600	600	600.0	600.0	60.0	≦100	≦100	≦250
SS	160	160	188.0	188.0	9.4	≦15	≦50	≦50
T-N	45.0	45.0	46.6	46.6	12.0	—	—	—
NH_X-N	34.0※1)	34.1※1)	35.5※1)	35.5	1.0	≦1.0	≦50	≦50
NO_X-N	1.0※1)	1.0※1)	1.0※1)	1.0	10.0	≦10	≦10	≦10
Org-N	8.7※1)	8.7※1)	8.7※1)	8.7	1.0	—	—	—
K_j-N	42.7※1)	42.8※1)	44.2※1)	44.2	2.0	≦1.0	≦150	≦150
T-P	6.0	6.0	7.1	7.1	0.99※4)	≦1.0	≦1	—
Dissolved P	—	—	—	3.6※3)	0.50※5)	≦0.5	—	≦5
Organic P	—	—	—	3.6※3)	0.50※5)	≦0.5	—	≦5

※1) NH4-N in Influent Flow is estimated by 80% of the value of T-N excluding Org-N, NOx-N is estimated by 20% of the value of T-N excluding Org-N, Org-N is estimated 1 mg/l by experience.

※2) The value of Dissolved BOD in Reactor is estimated a half of influent BOD by the result of influent wastewater quality survey.

※3) The value of Dissolved P and Organic P in Reactor is estimated a half of influent T-P by the result of influent wastewater quality survey.

※4) The value of T-P in treated wastewater is estimated by the removal of P including removed sludge (SS).

※5) The value of Dissolved P and Organicl P in treated wastewater is set a half of influent of effluent T-P.

1.4. Removal Efficiency

Item	Removal Efficiency (%)		
	Reactor + Final Sedimentation Tank	Rapid Sand Filtration Facility*2	Total Removal Efficiency*3
BOD_5	97.0	40	98.2
COD	90.0	20	92.0
SS	95.0	60	98.0
T-N	78.0	10	80.2
T-P	86.0※1)	40	91.6

※1) The Removal Efficiency of T-P in treated wastewater is estimated by the removal of P including removed sludge (SS) with flocculant.

※2) The rapid sand filtration facility will be introduced to reduce T-P if required in future.

※3) The removal efficency with rapid sand filtration facility are shown for reference only in future.

1.5. Design Parameter

Item		Unit	Standard Value	Design Value
Primary Sedimentation tank	Overflow Rate	$m^3/m^2/d$	Below 50	NA
Reactor	MLSS	mg/L	2,000～3,000	2,500
Reactor	Safety Factor for Denitrification Rate (δ2)	—	0.8～1.0	1.0
Reactor	Ratio of Sludge Conversion from Dissolved BOD (a)	gMLSS/gSBOD	0.4～0.6	0.5
Reactor	Ratio of Sludge Conversion from SS (b)	gMLSS/gSS	0.9～1.0	0.95
Reactor	Factor of Sludge Autodigestion (c)	1/d	0.03～0.05	0.04
Reactor	Dissolved Oxygen at the End of Reactor ($C_{O,A}$)	mg/L	1.5	1.5
Reactor	Return Sludge Rate	%	50 Normal	50 Normal
Reactor	Return Sludge Rate	%	100 Maximum	100 Maximum
Final Sedimentation Tank	Overflow Rate	$m^3/m^2/d$	Below 25	20

※Overflow Rate for Final Sedimentation Tank shall be checked in Section 2.2.

2. Wastewater Treatment

2.1. Reactor

（１） Nitrogen Removal Rate for Nitrification and Denitrification

a） Influent T-N in Rector	＝	46.6	mg/L	
b） Effluent T-N	＝	12.0	mg/L	
c） Effluent NO_X-N	＝	10.0	mg/L	
d） T-N in Excess Sludge	＝	13.2	mg/L	※）
e） Nitrogen for Nitrification Process	＝	22.3	mg/L	Influent NH_X-N in Rector - d)
f） Nitrogen for Denitrification Process	＝	23.3	mg/L	Influent NH_X-N in Rector + Influent NO_X-N in Rector - d)
g） Nitrogen Removal Rate for Nitrification and Denitrificati	＝	0.57	(-)	1 - Influent NO_X-N in Rector / f)）
h） Nitrogen Rate for Nitrification Process	＝	0.76	(-)	Influent NH_X-N in Rector ÷ a）

※） Volume of Excess Sludge is estimated as same as the volume of influent SS in Reactor.

The content rate of nitrogen in Excess Sludge is estimated about 7 %.

（２） Number of Step

Rate of Return Sludge: R_r ＝ 0.50

Rate of Circulation Sludge: R_C ＝

Flow Rate of Return Sludge (Q_r) is estimated as follows;

$$Q_r = Q_{in,max} \times R_r$$
$$= 39{,}400 \times 0.50$$
$$= 19{,}700 \ m^3/d$$

Flow Rate of Circulation Sludge (Q_C) is estimated as follows;

$$Q_C = Q_{in,max} \times R_C$$
$$= 39{,}400 \times 0.00$$
$$= 0 \ m^3/d$$

Theoretical Removal Rate of Nitrification and Denitrification I (η_{DN}) is calculated by following formula.

$$\eta_{DN} = 1 - \frac{1}{N} \times \frac{1}{1+R_r+R_C}$$

N : Number of Step

R_r : Rate of Return Sludge

R_C : Rate of Circulation Sludge

In case of N＝2 steps : η_{DN} ＝ 0.667

In case of N＝3 steps : ηDN ＝ 0.778

（３） Influent Rate of Flow at Each Step

Influent Rate at the 1st Step (r1): 0.33333

Influent Rate at the 2nd Step (r2): 0.33333

Influent Rate at the 3rd Step (r3): 0.33334

（４） Concentration of MLSS and Return Sludge

The Concentration of MLSS in the Reactor of 3rd step (X3) is set as 2,500 (mg/L).

The rate of Return Sludge is set as 0.50 . The concentration of Return Sludge is estimated as follows;

$$\frac{Xr \times Rr}{R_r + 1} = X3$$

$$Xr = \frac{X3 \times (Rr + 1)}{Rr}$$
$$= \frac{2{,}500 \times 1.5}{0.5}$$
$$= 7{,}500 \ mg/L$$
$$\rightarrow 7{,}500 \ mg/L$$

Concentration of MLSS in the Reactor of 1st step（X1） is estimated by following formula.

$$X1 = \frac{1 + Rr}{r\,1 + Rr} \times X3$$
$$= \frac{1 + 0.5}{0.3333 + 0.5} \times 2{,}500$$
$$= 4{,}500 \ mg/L$$
$$\rightarrow 4{,}500 \ mg/L$$

Concentration of MLSS in the Reactor of 2nd step（X2） is estimated by following formula.

$$X2 = \frac{1 + Rr}{(r\,1 + r2) + Rr} \times X3$$
$$= \frac{1 + 0.5}{0.6667 + 0.5} \times 2{,}500$$
$$= 3{,}214 \ mg/L$$
$$\rightarrow 3{,}220 \ mg/L$$

(5) A-SRT

Solid Retention Time in Aerobic Condition for Nitrification (θ_{XA}) is estimated by following formula.

$$\theta_{XA} = 29.7 \times EXP^{-0.102 \times T}$$

T = 25 ℃

θ_{XA} = 2.32 d

→ 2.4 d

(6) Total Volume of Aerobic Tank ($V_{A1}+V_{A2}+V_{A3}$)

Total Volume of Aerobic Tank ($V_{A1}+V_{A2}+V_{A3}$) is estimated as following formula.

$$(V_{A1} \times X_1 + V_{A2} \times X_2 + V_{A3} \times X_3) = Q_{in,max} \times \frac{\theta_{XA} \times (a \times C_{S\text{-}BOD,in} + b \times C_{SS,in} + \gamma \times C_{Al} + \text{Increasing Rate by Organic Addition})}{(1 + c \times \theta_{XA})}$$

By the relationship of the MLSS volume in each reactor ($V_{A1} \times X_1 = V_{A2} \times X_2 = V_{A3} \times X_3$),

$$V_{A1} = Q_{in,max} \times \frac{\theta_{XA} \times (a \times C_{S\text{-}BOD,in} + b \times C_{SS,in} + \gamma \times C_{Al} + \text{Increasing Rate by Organic Addition})}{(1 + c \times \theta_{XA}) \times 3 \times X1}$$

= 1,659

→ 1,700 m^3

$Q_{in,max}$	:	Design Flow	=	39,400	m^3/d
θ_{XA}	:	A-SRT	=	2.4	d
a	:	Conversion Rate of S-BOD	=	0.5	
$C_{S\text{-}BOD.in}$	:	Influent Dissolved BOD (S-BOD)	=	131.0	mg/L
b	:	Sludge Conversion Rate of SS	=	0.95	
$C_{SS\cdot in}$	:	Influent SS in Reactor	=	188.0	mg/L
γ	:	Generated Rate of Sludge by Aluminum Addition	=	5	
C_{Al}	:	Ratio of Aluminum Addition	=	3.1	mg/L refer to 2.2.3(2)
C	:	Factor of Sludge Autodigestion	=	0.04	
X1	:	Concentration of MLSS in 1st Step Reactor Tank	=	4,500	mg/L
Increasing Rate by Organic Addition※)	:	No need	=	0.0	mg/L

Volume of Aerobic Tank for 2nd Step (VA2) is estimated as follows;

$$V_{A2} = \frac{X1}{X2} \times VA1$$

$$= \frac{4{,}500}{3{,}220} \times 1{,}700$$

= 2,376 m^3

→ 2,400 m^3

Volume of Aerobic Tank for 3rd Step (VA3) is estimated as follows;

$$V_{A3} = \frac{X1}{X3} \times VA1$$

$$= \frac{4{,}500}{2{,}500} \times 1{,}700$$

= 3,060 m^3

→ 3,100 m^3

(7) Volume of Anoxic Tank (Standard Type)

Volume of Anoxic Tank for 1st Step (VDN1) is estimated as follows;

V_{DN1} = 0.3 V_{A1} = 510 m^3

V_{AN1} = 0.9 V_{A1} = 1,530 m^3

Volume of Anoxic Tank for 2nd Step (VDN2) is estimated as follows;

V_{DN2} = 1.20 V_{A2} = 2,880 m^3

Volume of Anoxic Tank for 3rd Step (VDN3) is estimated as follows;

V_{DN3} = 1.20 V_{A3} = 3,720 m^3

(8) Validation of Anoxic Tank Volume by Denitrification Factor (K_{DN})

① Calculation for Loading Rate of NOx-N at each step in Anoxic Tank

Concentration of NOx-N at each step in Anoxic Tank is calculated as follows;

$$C\ NOX.A1 = (C_{NHX\text{-}N,in} + C_{NOX\text{-}N,in} - C_{NOX\text{-}N,out}) \times \frac{r1}{r1 + R\,r}$$

= 10.6 mg/L

$$C\ NOX.A2 = (C_{NHX\text{-}N,in} + C_{NOX\text{-}N,in} - C_{NOX\text{-}N,out}) \times \frac{r2}{r1 + r2 + R\,r}$$

= 7.6 mg/L

$$C\ NOX.A3 = (C_{NHX\text{-}N,in} + C_{NOX\text{-}N,in} - C_{NOX\text{-}N,out}) \times \frac{r3}{r1 + r2 + r3 + R\,r}$$

= 3.7 mg/L

Concentration of NOx-N in Return Sludge is estimated the value as same as effluent from 3rd Aerobic Tank.

C NOX.RS = $(C_{NHX\text{-}N,in} + C_{NOX\text{-}N,in} - C_{NOX\text{-}N,out})$.A3
= 3.7 mg/L

Loading of NOx-N in each Anoxic Tank is calculated as follows;

L NOX.DN1 = C NOX.RS・Q in・R r $\times 10^{-3}$
= 73 kg-N/d

L NOX.DN2 = C NOX.A1・Q in・（r1＋R r）$\times 10^{-3}$
= 348 kg-N/d

L NOX.DN3 = C NOX.A2・Q in・（r1＋r2＋R r）$\times 10^{-3}$
= 349 kg-N/d

② Calculation for Required Denitrification Rate at Each Step in Anoxic Tank

Required Denitrification Rate at 1st step in Anoxic Tank (K DNreq,1) is calculated by the following formula.

$$K\,DNreq,1 = \frac{L\,NOX.DN1 \times 10^{6}}{24\ V\,DN1 \cdot X_1}$$

= 1.33 mg-N/(g-SS・h)

Required Denitrification Rate at 2nd step in Anoxic Tank (K DNreq,2) is calculated by the following formula.

$$K\,DNreq,2 = \frac{L\,NOX.DN2 \times 10^{6}}{24\ V\,DN2 \cdot X_2}$$

= 1.56 mg-N/(g-SS・h)

Required Denitrification Rate at 3rd step in Anoxic Tank (K DNreq,3) is calculated by the following formula.

$$K\,DNreq,3 = \frac{L\,NOX.DN3 \times 10^{6}}{24\ V\,DN3 \cdot X1}$$

= 1.56 mg-N/(g-SS・h)

③ Calculation of Potential Denitrification Rate at Each Step in Anoxic Tank and Validation of Anoxic Tank Volume

Loading of BOD-SS at each step is estimated as follows;

$$L_{BOD/X,1} = \frac{C_{BOD,in} \times Q_{in,1}}{V_{A1+AN1+DN1} \times X_1}$$

= 0.20 kgBOD/kgMLSS/d

$C_{BOD,in}$	:	Concentration of BOD in influent of reactor	=	262 mg/L
$Q_{in,1}$	:	Design flow for 1st step	=	13,133 m^3/d
$V_{A1+AN1+DN1}$	:	Reactor Volume for 1st step	=	3,740 m^3
X1	:	Concentration of MLSS in 1st step	=	4,500 mg/L

$$L_{BOD/X,2} = \frac{C_{BOD,in} \times Q_{in,2}}{V_{A2+DN2} \times X_2}$$

= 0.20 kgBOD/kgMLSS/d

$C_{BOD,in}$	:	Concentration of BOD in influent of reactor	=	262 mg/L
$Q_{in,2}$	:	Design flow for 2nd step	=	13,133 m^3/d
V_{A2+DN2}	:	Reactor Volume for 2nd step	=	5,280 m^3
X_2	:	Concentration of MLSS in 2nd step	=	3,220 mg/L

$$L_{BOD/X,3} = \frac{C_{BOD,in} \times Q_{in,3}}{V_{A3+DN3} \times X_3}$$

= 0.20 kgBOD/kgMLSS/d

$C_{BOD,in}$	:	Concentration of BOD in influent of reactor	=	262 mg/L
$Q_{in,3}$	:	Design flow for 3rd step	=	13,134 m^3/d
V_{A3+DN3}	:	Reactor Volume for 3rd step	=	6,820 m^3
X_3	:	Concentration of MLSS in 3rd step	=	2,500 mg/L

Potential Denitrification Rate is estimated by following formula.

$K_{DN,lim} = \delta 2 \times (7.7 \times L_{BOD\text{-}SS} + 0.6)$

δ2 : Safety Factor for Denitrification = 1.0

Denitrification Rate at each step is validated to compare with potential denitrification rate.

【Verification for Volume of 1st step Anoxic Tank】 Denitrification Ratio (for reference)

$K_{DN,lim,1}$ = 2.14 ≧ 1.33 ($K_{DN,Req,1}$) 1.609

Volume of 1st step Anoxic Tank is valid.

【Verification for Volume of 2nd step Anoxic Tank】

Denitrification Ratio (for reference): 1.372

$K_{DN,lim,2} = 2.14 \geqq 1.56 \ (K_{DN,Req,1})$

Volume of 2nd step Anoxic Tank is valid.

【Verification for Volume of 3rd step Anoxic Tank】

Denitrification Ratio (for reference): 1.372

$K_{DN,lim,3} = 2.14 \geqq 1.56 \ (K_{DN,Req,1})$

Volume of 3rd step Anoxic Tank is valid.

（１０）Total Volume of Reactor and Retention Time

Total Volume of Reactor Tank is calculated as follows;

$$V = V_{DN1} + V_{AN1} + V_{A1} + V_{DN2} + V_{A2} + V_{DN3} + V_{A3}$$
$$= 510 + 1,530 \quad 1,700 + 2,880 + 2,400 + 3,720 + 3,100$$
$$= 15,840 \ m^3$$

Retention time for Daily Maximum Flow is calculated as follows;

Retention Time in Reactor Tank : t (hr)

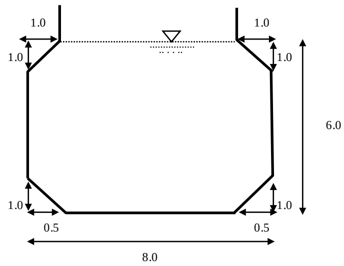
$$t = \frac{24 \times V}{Q_{in,max}} = \frac{24 \times 15,840}{39,400}$$
$$= 9.65 \ hr$$
$$\rightarrow 9.7 \ hr$$

Retention Time in 1st Step Aerobic Tank : tA1(hr)

$$tA1 = \frac{24 \times VA1}{Q_{in,max}} = \frac{24 \times 1,659.0}{39,400}$$
$$= 1.01 \ hr$$
$$\rightarrow 1.1 \ hr$$
$$\fallingdotseq 0.046 \ d$$

（１１）Dimension of Reactor

Width of Tank	:	8.0 m
Depth of Tank	:	6.0 m
Total Length of Tank	:	61.8 m
Number of Tanks	:	6 tank
Corner Cutoff at upside	:	1.0 × 1.0 m
Corner Cutoff at downside	:	0.5 × 1.0 m
Partition（Thickness 0.3m）	:	6 part
Cross-sectional Area	:	46.5 m^2/tank
Effective Volume (exclusive)	:	16,740 m^3



List of Each Tank Volume and Concentration of MLSS

Name	Required Volume (m^3) [①]	Dimension (m、tank) Width		Depth		Length		Number	Actual Volume (m^3) [②]	Capacity Evaluation [①≦②]
1st Step Anoxic Tank	2,100	8.0	×	6.0	×	8.0	×	6	2,232	O K
1st Step Aerobic Tank	1,800	8.0	×	6.0	×	6.5	×	6	1,814	O K
2nd Step Anoxic Tank	3,000	8.0	×	6.0	×	11.0	×	6	3,069	O K
2nd Step Aerobic Tank	2,400	8.0	×	6.0	×	9.0	×	6	2,511	O K
3rd Step Anoxic Tank	3,800	8.0	×	6.0	×	14.0	×	6	3,906	O K
3rd Step Aerobic Tank	3,100	8.0	×	6.0	×	11.5	×	6	3,209	O K
Total	16,200					60.0			16,741	—

Required HRT (hr) [①]	Actual HRT (hr) [②]	Time Evaluation [①≦②]
9.7	10.2	O K

2.2. Final Sedimentation Tank

（１） Design Flow

Design Flow (Daily Maximum Flow)	＝ 39,400 m^3/d	= 24,000 m^3/d

（２） Dimention

Shape	:	Rectangle	Same as left
Width	:	8.0 m	Same as left
Length	:	41.0 m	Same as left
Effective Deptl	:	3.5 m	Same as left
Number	:	6 Unit	4 Unit

※） Calculation of Total Surface	※） Calculation of Total Surface
8.00 × 41.0 × 6	8.00 × 41.0 × 4
＝ 1,968 m^2	＝ 1,312 m^2
Actual Overflow Rate ＝ $\frac{39,400}{1,968}$	Actual Overflow Rate ＝ $\frac{24,000}{1,312}$
＝ 20.0 $m^3/m^2/d$	＝ 18.3 $m^3/m^2/d$

Design Overflow Rate

= 20.0 $m^3/m^2/d$ **O K**	= 20.0 $m^3/m^2/d$ **O K**
Volume ＝ 1,968.0 × 3.5	Volume ＝ 1,312.0 × 3.5
＝ 6,888 m^3	＝ 4,592 m^3
Retention Time ＝ $\frac{6,888 \times 24}{39,400}$	Retention Time ＝ $\frac{4,592 \times 24}{24,000}$
＝ 4.1 hr	＝ 4.5 hr

（３） Verification of Overflow Rate

Overflow rate in sedimentation tank is validated by the prediction formula for sedimentation rate of sludge-liquid interface.
The following formula for sedimentation rate of sludge-liquid interface had been proposed by the experience in Japan.
(Source : Technical Evaluation Report for Step Feed Nitrification and Preanoxic Denitrification Process, May of 2006
Technical Evaluation Committee in Japan Sewerage Works Association)

$V_0 = 1.78 \times 10^7 \times T^{0.852} \times X^{-1.46} \times [SVI]^{-0.804}$

V_0	:	Average Rate for sludge-liquid interface sedimentation of activated sludge (m/d)	
T	:	Water Temperature in Reactor (℃)	(＝ 25)
X	:	Concentration of MLSS at the end of Reactor (mg/L)	(＝ 2,500)
SVI	:	Sludge Volume Index (mL/g)	(＝ 200)

Required Overflow Rate in Final Sedimentation Tank is calculated by following formula considered with daily variation of treated wastewater.

$S_{Cr} < V_0 / rd$

S_{Cr}	:	Required Overflow Rate in Final Sedimentation Tank (m/d)	
rd	:	Ratio for Daily Variation of Treated Wastewater (-)	(＝ 1.34)

Required Overflow Rate is estimated as follows;

V_0 ＝ 42.7 m/d
S_{Cr} ≦ 31.8 m/d

Actual Overflow Rate is satisfied the Required Overflow Rate as follows;

Actual Overflow Rate ＝ $\frac{39,400}{1,968}$	Actual Overflow Rate ＝ $\frac{24,000}{1,312}$
＝ 20.0 $m^3/m^2/d$	＝ 18.3 $m^3/m^2/d$
≦ 31.8 $m^3/m^2/d$ **O K**	≦ 31.8 $m^3/m^2/d$ **O K**

2.5.UV Disinfection	(1) Design Flow Daily Maximum Flow = 52,500 m^3/d (2) Dimension Format : Rectangle Channel Width : 1.0 m Unit : 1 unit Length : 3.0 m Water Heighe : 2.0 m Number : 6 unit	= 24,000 m^3/d Same as left Same as left Same as left Same as left Same as left 4 unit
2.6. Rapid Sand Filtration Facility	(1) Design Flow Daily Maximum Flow = 52,500 m^3/d (2) Design Filtration Rate Daily Maximum Flow = 300 m/d以下 (3) Required Filtration Area Filtration Area = 52,500 m3/d / 300 = 175 m2 → 180 m2 (4) Dimension Format : Rectangle Channel Width : 6 m Length : 10 m Unit : 3 unit	

items	Master Plan	Priority Area
4.Sludge Treatment Process		
1) Sludge Thickening		
a)Capacity Design	Input Solids Volume = 9.12 t/d	Input Solids Volume = 5.73 t/d
	Input Sludge Volume = 1,345 m^3/d	Input Sludge Volume = 843 m^3/d
	Output Sludge Volume ＝ 9.12 × 0.95 × 100/4.0 ＝ 217 m3/d	Output Sludge Volume ＝ 5.73 × 0.95 × 100/4.0 ＝ 136 m3/d
	Actual Capacity＝ 30 m^3/hr	Actual Capacity＝ 30 m^3/hr
	Operation Time＝ 21hr/d、7days/week	Operation Time＝ 24hr/d、7days/week
	Required Capacity＝ $\dfrac{1345\times10\text{^}3}{21 \times 7/7}$ ＝ 64.0 m^3/hr	Required Capacity＝ $\dfrac{843\times10\text{^}3}{24 \times 7/7}$ ＝ 35.1 m^3/hr
	Requierd Number ＝ $\dfrac{64}{30}$ ＝ 3 Unit	Requierd Number ＝ $\dfrac{35.1}{30}$ ＝ 2 Unit
b)Specification	Specification Belt Filtration Thickening	Specification Belt Filtration Thickening
	Acutal Capacity 30.0 m^3/hr	Acutal Capacity 30 m^3/hr
	Unit 3 Unit (Stand-by unit 1)	unit 2 Unit (Stand-by unit 1)

items	Master Plan	Priority Area
2) Sludge Dewatering		
a)Capacity Design	Model Name Screw Press Dewatering	Model Name Screw Press Dewaterring
	Input Solids Volume 9.59 t/d	Input Solids Volume 6.00 t/d
	Input Sludge Volume 240 m^3/d	Input Sludge Volume 150 m^3/d
	Solids Loading 36 kg-ds/h･φ100	Solids Loading 36 kg-ds/h･φ100
	Screen Size 1100 mm	Screen Size 1100 mm
	Q=（1100/300)^2.2×36	Q=（1100/300)^2.2×36
	Acutal Capacity 0.628 t/hr	Acutal Capacity 0.628 t/hr
	Operation Time 7hr 5day/week	Operation Time 7hr 5day/week
	$9.59 \times \frac{7}{5} \times \frac{1}{7} = 1.92$ t/hr	$6.00 \times \frac{7}{5} \times \frac{1}{7} = 1.20$ t/hr
	Required Number ＝ $\frac{1.92\times10^3}{0.628}$ = 4 Unit	Required Number ＝ $\frac{1.20\times10^3}{0.628}$ = 2 Unit
	Output Solids Volume	Output Solids Volume
	$9.59 \times 0.95 \times 1.000 = 9.11$ t/d	$6.00 \times 0.95 \times 1.000 = 5.70$ t/d
	Cake Volume	Cake Volume
	$9.11 \times \frac{7}{5} \times \frac{100}{100-84} = 80$ wt/d	$5.70 \times \frac{7}{5} \times \frac{100}{100-84} = 50$wt/d
b)Specification		
	Model name Screw Press Dewatering	Model name Screw Press Dewatering
	Specification φ1100 mm or twin φ800	Specification φ1100 mm or twin φ800
	Acutal Capacity 628 kg/hr	Acutal Capacity 628 kg/hr
	Unit 3 unit	Unit 2 unit

items	Master Plan			Priority Area		
3)Sludge Drying Bed	Input Cake Volume:Q			Input Cake Volume:Q		
	Daily Maximum =	54	wt/d	Daily Maximum =	34	wt/d
	Daily Average =	47	wt/d	Daily Average =	30	wt/d
	Drying time:T	14	day	Drying time:T	14	day
	Input Cake thickness:D	30.00	cm	Input Cake thickness:D	30.00	cm
	Required Area: A=(Q・T)/D			Required Area: A=(Q・T)/D		
	Ar =	2,193	m^2	A =	1,400	m^2
	Drying Bed			Drying Bed		
	W =	6.0	m	W =	6.0	m
	L1 =	72.0	m	L1 =	72.0	m
	(Set =	2)		(Set =	2)	
	L2 =	60.0	m	L2 =	60.0	m
	(Set =	2)		(Set =	2)	
	L3 =	36.0	m	L3 =	36.0	m
	(Set =	2)		(Set =	0)	
	Total Length =	336	m	Total Length =	264	m
	Total Area =	2,016	m2	Total Area =	1,584	m2

APPENDIX 5-7 The Calculation of Greenhouse Effect Gas Emission (5.3.6)

(1) Base line emission

The deduction of greenhouse effect gas is studied based on the UNFCCC/CCNUCC III.I./Version08. Base line emission is calculated by the following equation which is stipulated in UNFCC/CCNUCC III.I./Version08.

$$BE_y = BE_{ww,treatment,y} + BE_{ww,discharge,y} + BE_{s,treatment,y} + BE_{s,final,y}$$

Where:

BE_y	Baseline emissions in the year y (tCO_2e)
$BE_{ww,treatment,y}$	Methane produced in the anaerobic baseline wastewater treatment system(s) that is/are being replaced with the biological aerobic system(s) (tCO_2e):0 Because at present sewage treatment is not conducted aerobically or anaerobically.
$BE_{ww,discharge,y}$	Methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into river/lake/sea etc. (tCO_2e)
$BE_{s,treatment,y}$	Methane produced in the baseline sludge treatment system(s) (tCO_2e): 0 Because of no sewage treatment at present
$BE_{s,final,y}$	Baseline methane emissions from anaerobic decay of the final sludge produced (tCO_2e): 0 Because there is no collection and disposal of sludge at present.

In base line emission calculation, $BE_{ww,discharge,y}$, methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into river/lake/sea etc., is a baseline emission because of no sewage treatment at present. Therefore, the baseline emission is 93 t as CO_2/year (BE_y = 0+ 93+0 + 0).

The calculation is as follows;

$$BE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_o * UF_{BL} * COD_{ww,discharge,BL,y} * MCF_{ww,discharge,BL}$$

$$= 39{,}300 \times 365 \times 21 \times 0.21 \times 0.94 \times 600 \times 10^{-6} \times 0.1 = 3{,}568 \text{ t as } CO_2/year$$

Where:

$Q_{ww,y}$	Volume of treated wastewater discharged in year y (m^3): 39,300×365(m^3/y) because of 39,300 m^3/d as daily average flow
GWP_{CH4}	Global Warming Potential for CH_4 (value of 21)
B_o	Methane producing capacity for the wastewater (IPCC default value of 0.21 kg CH_4/kg COD)
UF_{BL}	Model correction factor to account for model uncertainties (0.94)
$COD_{ww,discharge,BL,y}$	Chemical oxygen demand of the treated wastewater discharged into sea, river or lake in the baseline situation in year y (tonnes/m^3): 600×10^{-6}(tonnes/m^3) Because actual COD of wastewater is 600 mg/L
$MCF_{ww,discharge,BL}$	Methane correction factor based on the discharge pathway (e.g., into sea, river or lake) of the wastewater (fraction) (MCF value as per below table): (0.1) Because of “Discharge of wastewater to sea, river or lake”.

Table A5.7-1 IPCC default values for Methane Correction Factor (MCF)

Type of wastewater treatment and discharge pathway or system	MCF value
Discharge of wastewater to sea, river or lake	0.1
Aerobic treatment, well managed	0
Aerobic treatment, poorly managed or overloaded	0.3
Anaerobic digester for sludge without methane recovery	0.8
Anaerobic reactor without methane recovery	0.8
Anaerobic shallow lagoon (depth less than 2 meters)	0.2
Anaerobic deep lagoon (depth more than 2 meters)	0.8
Septic system	0.5

Source: UNFCC/CCNUCC III.I./Version

(2) Project activity emission

Project activity emissions are calculated by the following equation based on UNFCCC/CCNUCC III.I./Version08.

$PE_y = PE_{power,y} + PE_{ww,treatment,y} + PE_{ww,discharge,y} + PE_{s,treatment,y} + PE_{s,final,y}$

Where

PE_y	Project activity emissions in year *y* (tCO_2e)
$PE_{power,y}$	Emissions on account of electricity or fossil fuel consumption in the year *y* (tCO_2e)
$PE_{ww,treatment,y}$	Methane emissions from the biological aerobic wastewater treatment in the year *y* (tCO_2e)
$PE_{ww,discharge,y}$	Methane emissions on account of inefficiencies in the project wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into river/lake/sea etc. (tCO_2e)
$PE_{s,treatment,y}$	Methane produced in the project sludge treatment system(s) (tCO_2e) : 0 Because only dewatering is conducted and sludge treatment such as a digestion is not conducted. The electricity of dewatering is considered in $PE_{power,y}$ calculation.
$PE_{s,final,y}$	Methane emissions from anaerobic decay of the final sludge produced in year *y* (tCO_2e):0 Because dried sludge is delivered to the Compost Production Facility.

Each term is calculated as below.

$PE_{power,y}$ is 4,676t as CO_2/year （＝$8,580,000\times0.545\times10^{-3}$） because of yearly electrical consumption,

8,580,000kWh/y based on manufacture data and CO_2 emission per kwh: 0.545 in Sri Lanka

0.545kg as CO_2/kwh based on 2016 International Energy Agency.

$PE_{ww,treatment,y}$ is 0 t as CO_2/y because of 0 as MCF value on the assumption that aerobic treatment is well managed.

$PE_{ww,treatment,y} = \Sigma\ (Q_{ww,k,y} * COD_{removed,k,y} * MCF_{aerobic,k}) * B_o * UF_{PJ} * GWP_{CH4}$
$=39,300\times365\times(600\text{-}75)\times10^{-6}\times0\times0.21\times0.94\times1.21=0$ *t as* CO_2/*y*

Where:

$Q_{ww,k,y}$	Volume of the wastewater treated by the aerobic system *k* during the year *y* (m^3): 39,300×365(m^3/y)
$COD_{removed,k,y}$	Chemical oxygen demand removed by the aerobic system *k* in year *y* (tonnes/m^3)
$MCF_{aerobic,k}$	Methane correction factor for the aerobic wastewater treatment system *k* (MCF value for well managed aerobic biological systems or for poorly managed or overloaded systems as per above table): 0 on the assumption that aerobic treatment is well managed.
UF_{PJ}	Model correction factor to account for model uncertainties (1.06)

$PE_{ww,discharge,y}$ is 670.5t as CO_2/y as below calculation.

$PE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_o * UF_{PJ} * COD_{ww,discharge,y} * MCF_{ww,discharge}$
$=39,300\times365\times21\times0.21\times1.06\times75\times10^{-6}\times0.1=670.5$ *t as* CO_2/*y*

Where:

$Q_{ww,y}$	Volume of wastewater treated in the year *y* (m^3): 39,300×365(m^3/y)
UF_{PJ}	Model correction factor to account for model uncertainties (1.06)
$COD_{ww,discharge,y}$	Chemical oxygen demand of the final treated wastewater discharged into sea, river or lake in the year *y* (tonnes/m^3): 75×10^{-6}(tonnes/m^3) Because effluent COD is 75mg/L.
$MCF_{ww,discharge}$	Methane correction factor based on discharge pathway of the wastewater (fraction) (MCF value in above table for sea, river and lake discharge):(0.1)

Table A5.7-2 Electricity Use Estimation

STP	Daily Electricity use (kWh)	Annual Electricity use (kWh)
Pumping Station	2,689	981,529
Pre-treatment Facility	131	47,990
3-Step Feed Reactor Tank	1,267	462,528
Final Sedimentation Tank	1,081	394,667
Blower Facility	5,764	2,103,743
Disinfection Facility	1,156	421,882
Treated Water Reusing Facility	1,551	566,130
Mechanical Sludge Thickening Facility	1,401	511,336
Sludge Dewatering Facility	1,476	538,915
Solar Sludge Drying Facility	565	206,152
Septage Receiving Facility	564	206,035
Deodorizing Facility	131	47,990
Solar Pawer Generation Panel	-1,332	-486,130
Total		6,002,767

Major Pump Station	Effective power (kW)	Daily total run time (hour/unit)		Daily Electricity use (kWh)	Annual Electricity use (kWh)
MPS-02	30	32	1	960	350,400
MPS-03	30	32	1	960	350,400
MPS-04	22	32	1	704	256,960
MPS-05	37	48	1	1,776	648,240
MPS-06	15	16	1	240	87,600
MPS-07	37	32	1	1,184	432,160
MPS-08	22	48	1	1,056	385,440
Total					2,511,200

Manhole Type Pump Station (Type 1)	Effective power (kW)	Number of units	Daily run time (hour/unit)	Daily Electricity use (kWh)	Annual Electricity use (kWh)
Pump Facilities	15	6	8	120	43,800
Total	50	Manholes			

Manhole Type Pump Station (Type 2)	Effective power (kW)	Number of units	Daily run time (hour/unit)	Daily Electricity use (kWh)	Annual Electricity use (kWh)
Pump Facilities	5.5	9	8	44	16060
Total	200	Manholes			

Manhole Type Pump Station (Type 3)	Effective power (kW)	Number of units	Daily run time (hour/unit)	Daily Electricity use (kWh)	Annual Electricity use (kWh)
Pump Facilities	2.2	1226	8	17.6	6424
Total	800	Manholes			

		kWh
Total		8,580,251

Source: JET

$PE_{s,final,y}$ is 0 t as CO_2/y as below calculation.

$PE_{s,final,y} = S_{final,PJ,y} * DOC_s * MCF_s * UF_{PJ} * DOC_F * F * 16/12 * GWP_{CH4}$
$= 0×0.5×1.0×1.06×0.5×0.5×16/12×21=0$ t as CO_2/year

Where:

$S_{final,PJ,y}$	Amount of dry matter in final sludge generated by the project wastewater treatment systems in year *y* disposed on a landfill (tonnes): yearly sludge volume is 0 t/y. Because dried sludge is delivered to the Compost Production Facility.
DOC_s	Degradable organic content of the untreated sludge generated in the year y (fraction, dry basis). It shall be estimated using default values of 0.5 for domestic sludge and 0.257 for industrial sludge.
MCF_s	Methane correction factor of the landfill that receives the final sludge, estimated as described in AMS-III.G: (1.0 based on AMS-III.G/Version01)
UF_{PJ}	Model correction factor to account for model uncertainties (1.06)
F	Fraction of CH_4 in biogas (IPCC default of 0.5)

Based on above calculations, the project activity emissions is 5,346.5 t as CO_2/year (PE_y＝4,676 +0 + 670.5 + 0 + 0).

APPENDIX 5-8 Comparison of Equivalent Annual Cost for MTPS (5.2.4)

Developing the sewerage system such a narrow and steep dead-end lanes, following 2 types of installation system were studied as shown in **Figure A5.8-1**.

- the open-cut installation method with MTPS
- the micro tunnelling installation method without MTPS,

The result of the cost comparison between 2 cases shows that the latter method has an advantage in case of the length of sewer within 310m as shown in **Figure A5.8-2**.

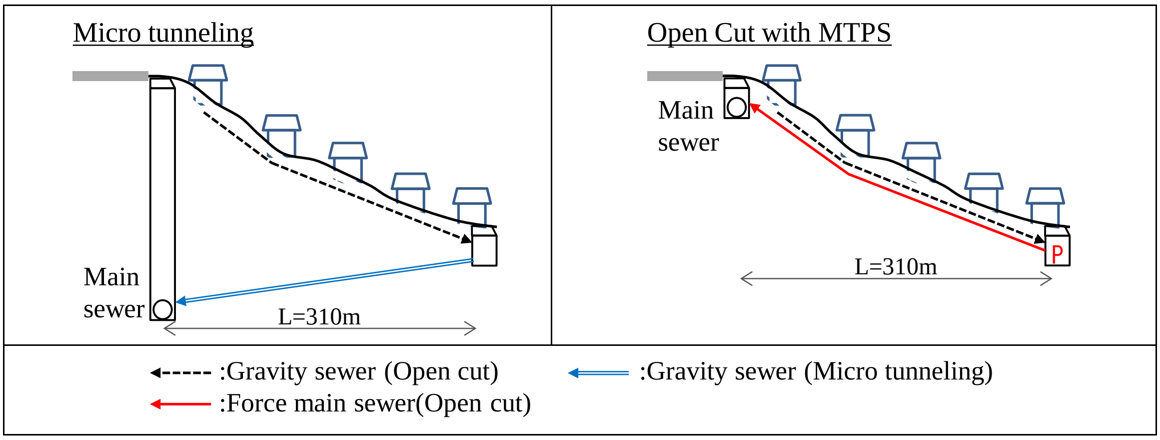


Figure A5.8-1 Condition of Cost Comparison between Micro Tunnelling and Open cut

Length (m)	Equivalent Annual Cost(1000JYP/year) Micro Tunneling Method	Open cut with MTPS
50	207	1,140
100	415	1,171
150	622	1,201
200	829	1,232
250	1,037	1,263
300	1,244	1,294
310	1,286	1,300
350	1,454	1,327
400	1,663	1,360
450	1,873	1,394
500	2,083	1,427

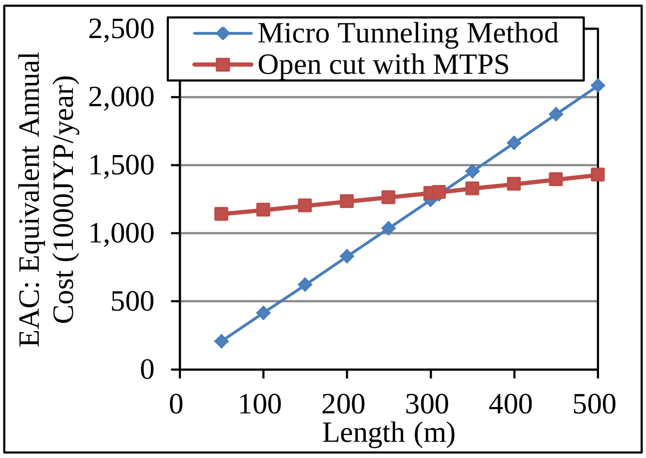


Figure A5.8-2 Summary of Equivalent Annual Cost

Based on the condition shown in **Table A 5.8-1**, breakdown of cost estimation are shown in **Table A 5.8-2**.

Table A5.8-1 Condition of Cost Comparison

Item		Unit Cost		Expected lifetime		Remark
Construction Cost	Sewer gravity (Micro Tunnelling)	184.8	1000JYP/ m	50	year	Including Cost of shaft
	Sewer gravity (Open cut)	25.0	1000JYP/ m	50	year	Including Cost of manhole
	Force main sewer (Open cut)	8.3	1000JYP/ m	50	year	
	MTPS	20,900	1000JYP /nos.	20	year	
Maintenance Cost	MTPS	64	1000JYP /nos./year	--	--	

Table A5.8-2 Breakdown of Cost Estimation

Length (m)	310

		Micro Tunnelling method		Open cut method with MTPS	
Sewer length (m)		Gravity (M.T)	310	Force Main(O.C.)	310
		Gravity (O.C)	280	Gravity (O.C)	280
No. of MTPS			0		1
Total Initial Cost (1000JYP)	Sewer	Gravity (M.T)	57,288	Force Main(O.C.)	2,573
		Gravity (O.C)	7,000	Gravity (O.C)	7,000
	MTPS		0		20,900
Running Cost (1000JYP/ year)	MTPS		0		64
Equivalent Annual Cost (1000JYP/year)	Sewer (Initial)		1,286		191
	MTPS (Initial)				1,045
	MTPS (Running)				64
	Total		1,286		1,300

APPENDIX 5-9 The Sludge Production for Septic Tanks in the Service Area (5.3.1)

(1) Sludge production of Septic Tank

Sludge production is estimated based on the following assumptions;

Sludge accumulation rate is 0.04 m^3/capita/year (Source: Metcalf & Eddy, Water Use, 2006, Malaysia Sewerage GidelineVol.5)

Population using septic tanks in the service area at the 1st Stage is 109,400.

Production safety factor is 10 because sludge accumulation rate is affected by the temperature.

Based on the assumptions, sludge production is 43,760 m^3/year (= 0.04 ×10× 109,400) in areas outside the project service area.

(2) Volume of Sludge per day

Sludge volume is estimated on the following assumptions;

Cleaning is carried out every two years.

Cleaning is carried out 5 days a week.

The amount of sludge collected every day is 182 m^3/day (=43,760×2 / (5×4×12×2)).

APPENDIX 5-10 Comparison of Collection Systems

	Current Plan **Separate collection systems for the entire service area** **(sewer installation under public roads)**	**Alternative Plan 1** **Separate collection systems for the entire service area** **(sewer installation under public roads & private land)**	**Alternative Plan 2** **Separate collection systems for 85% of the service area & Modified Septic Tank for the rest of the service area**
Description	Separate collection networks for the entire service area and treatment at a centralized STP. All sewers will be installed under public roads.	Separate collection networks for the entire service area and treatment at a centralized STP. Some sewers would pass through private land and areas near the lake shore to minimize the number of MTPSs.	Separate collection networks for 85% of the service area, with approx. 300 MTPSs, and treatment at a centralized STP. Modified septic tanks will be installed for the rest of the service area.
	Attached drawing (Image 1)	Attached drawing (Image 2)	Attached drawing (Image 3)
Topographical Feature	- Hilly and undulating terrain, with ground elevation varying from 5 to 10 m. - Many steep downhill dead-end lanes branching off the main road. These side roads do not connect with each other when they end at the low-lying area. - Branch roads have only small drains that take the sewage through private land. The points of discharge to the wet lands or lake cannot be confirmed because of the lack of accessibility to the private properties.		
Required Facilities			
Sewer	≥ 800 mm: approx. 1,600 m (gravity sewer)	≥ 800 mm: approx. 1,600 m (gravity sewer)	≥ 800 mm: approx. 1,100 m (gravity sewer)
	≤ 700 mm: approx. 638,000 m	≤ 700 mm: approx. 638,000 m	≤ 700 mm: approx. 506,000 m
	(gravity sewers: approx. 508,000 m)	(gravity sewers: approx. 570,000 m)	(gravity sewers: approx.. 445,000 m)
	(force main sewer: approx. 130,000 m)	(force main sewer: approx. 68,000 m)	(force main sewer: approx. 61,000 m)
Sewage Treatment Plant	40,000 m^3/day	40,000 m^3/day	33,400 m^3/day
Major Pumping Station	7	7	7
MTPS Total	approx. 1,200	approx. 400	approx. 300
(Type 1: < 2.0 m^3/min)	6	6	6
(Type 2: < 1.0 m^3/min)	9	9	9
(Type 3: < 0.5 m^3/min)	288	400	288
(Type 4: < 0.1 m^3/min)	938	-	-
Septic Tank	0	0	6,800 (modified type)
Technical Aspects			
Proposed collection system	Separate collection systems for the entire service area.	Separate collection systems for the entire service area. Fewer small MTPSs for connecting to main truck sewer, by installing gravity sewers on private land and along the lake front. This will require the property owners' approval.	Separate collection systems for 85% of the service area. Remaining service area will be served by modified septic tanks, assuming that there is sufficient space for their installation in each private land.
Issues	The large number of workers required to deal with the large number of MTPSs is a concern. The number of MTPSs can be reduced to some extent by installing the sewer on private land or along the lake front.	If the availability of private land for sewer installation cannot be confirmed at the detailed design/construction phase, there will be some uncertainty regarding additional cost for land acquisition and more MTPSs. Access to sewers installed on private land will pose constraints for inspection/maintenance.	This option cannot be implemented if there is no space to install modified septic tanks. The effluent quality from modified septic tanks will vary depending on how the property owners maintain the facilities. The treatment performance is expected to be lower than that of centralized treatment system.
Effluent Quality (regulations for effluent quality from STP determined by CEA.)	STP BOD: ≤ 10 mg/L T-N: ≤ 15 mg/L T-P: ≤ 1 mg/L	STP BOD: ≤ 10 mg/L T-N: ≤ 15 mg/L T-P: ≤ 1 mg/L	STP BOD: ≤ 10 mg/L T-N: ≤ 15 mg/L T-P: ≤ 1 mg/L Septic Tanks BOD: ≤ 50 mg/L (75% removal) T-N: ≤ 45 mg/L (0% removal) T-P: ≤ 6 mg/L (0% removal) Average (Weighted) BOD: ≤ 16 mg/L (160% of current system) T-N: ≤ 20 mg/L (130% of current system) T-P: ≤ 1.8 mg/L (180% of current system)
	Modelling of water quality for receiving water body must be requested by CEA.		
O/M performance			
MTPS	NWSDB must manage 1,200 MTPSs and establish the staff for inspection, maintenance and equipment renewal. Outsourcing should be considered.	NWSDB will still have to manage about 400 MTPSs.	NWSDB will still have to manage about 300 MTPSs.
Sewer	Proper maintenance of the sewerage network is required. Maintenance can be done anytime because all the sewers are installed under public roads.	Permission from property owners will be required to access branch sewers on private land. Maintenance roads to access manholes will be required along the lake front.	Proper maintenance of sewerage network is required. Maintenance can be done anytime because all the sewers are installed under public roads.
Major Pumping Station	No impact on normal operation.		
Sewage Treatment Plant	No impact on normal operation.		O/M will be the same as with the other options although the sewage inflow will be less (85%).
Septic Tank	The sewerage system will replace the use of septic tanks.		Modified septic tanks will require proper maintenance by property owners, including desludging to achieve the intended performance. If NWSDB were to manage all the modified septic tanks (6,800 in total), staff for regular inspection and desludging will be required, same as the current system for MTPSs.
Environmental aspect			
Water quality of Diyawanna Oya Lake	Centralized sewage treatment can reduce the pollution load of the discharged effluent. The project will contribute significantly to the improvement of		Effluent from modified septic tanks will have a higher pollution load than

		Current Plan **Separate collection systems for the entire service area** **(sewer installation under public roads)**	**Alternative Plan 1** **Separate collection systems for the entire service area** **(sewer installation under public roads & private land)**	**Alternative Plan 2** **Separate collection systems for 85% of the service area & Modified Septic Tank for the rest of the service area**
		the water environment.		that from the STP. The improvement in water quality of the lake will be less than the other 2 options. EIA will have to take this into consideration.
Cost performance (million JPY)				
Initial Cost	Total	50,633	41,456	35,335
	Main Sewers	11,260	11,260	8,857
	MPS, MPTS	19,823	10,646	8,382
	STP	9,548	9,548	8,631
	Branch Sewers	5,402	5,402	4,485
	House Connections	4,600	4,600	4,600
	Septic Tanks	-	-	380
Running Cost (per year)	Total	591	446	403
	Staffing Cost (Incl. outsourcing)	91	61	56
	Electricity	111	97	84
	Sludge disposal, chemicals	64	64	60
	Septage disposal	0	0	14
	Repairs	248	166	137
	Indirect costs	77	58	52
LCC (per year)	Total	2,294	1,723	1,473
	AEC of Initial cost	1,703	1,277	1,070
	O/M	591	446	403
Overall Evaluation				
Improvement to Environmental Conditions		Significant improvement to the water environment and living conditions.		Lesser impact on water quality improvement and living conditions because of the varied performance of modified septic tanks in areas not served by centralized sewage treatment.
Project Cost (LCC)		Highest	Moderate	Lowest
Ease of O/M		Outsourcing or significant staff increase will be required to deal with 1,200 MTPSs.	Outsourcing or staff increase will be required even with 400 MTPSs.	Outsourcing or staff increase will be required even with 300 MTPSs.
Other issues		-	Access to private land must be confirmed before project implementation. Otherwise there will be some risk of cost increase and implementation delay.	Effluent quality from modified septic tanks will vary depending on how the property owners manage the facilities. Improvement to the water environment may also be compromised. If NWSDB were to manage all the modified septic tanks, this would have to be reflected in sewerage tariff for the implicated service areas.
Overall		Highest construction and O/M costs. However, the sewerage network will be installed under public roads, and the STP will be managed by NWSDB. Water environment and living conditions will be improved with few risks for project implementation.	Sewer installation on private properties may increase the risks for project implementation if the access to private land cannot be confirmed. Construction cost may go up. Expected impacts on improved water environment and living conditions may not be realized.	Total project cost as well as improvement to water environment will be lower. The residents who will use modified septic tanks must be properly informed about the proposed option and related implications.
		Good	**Fair**	**Fair**

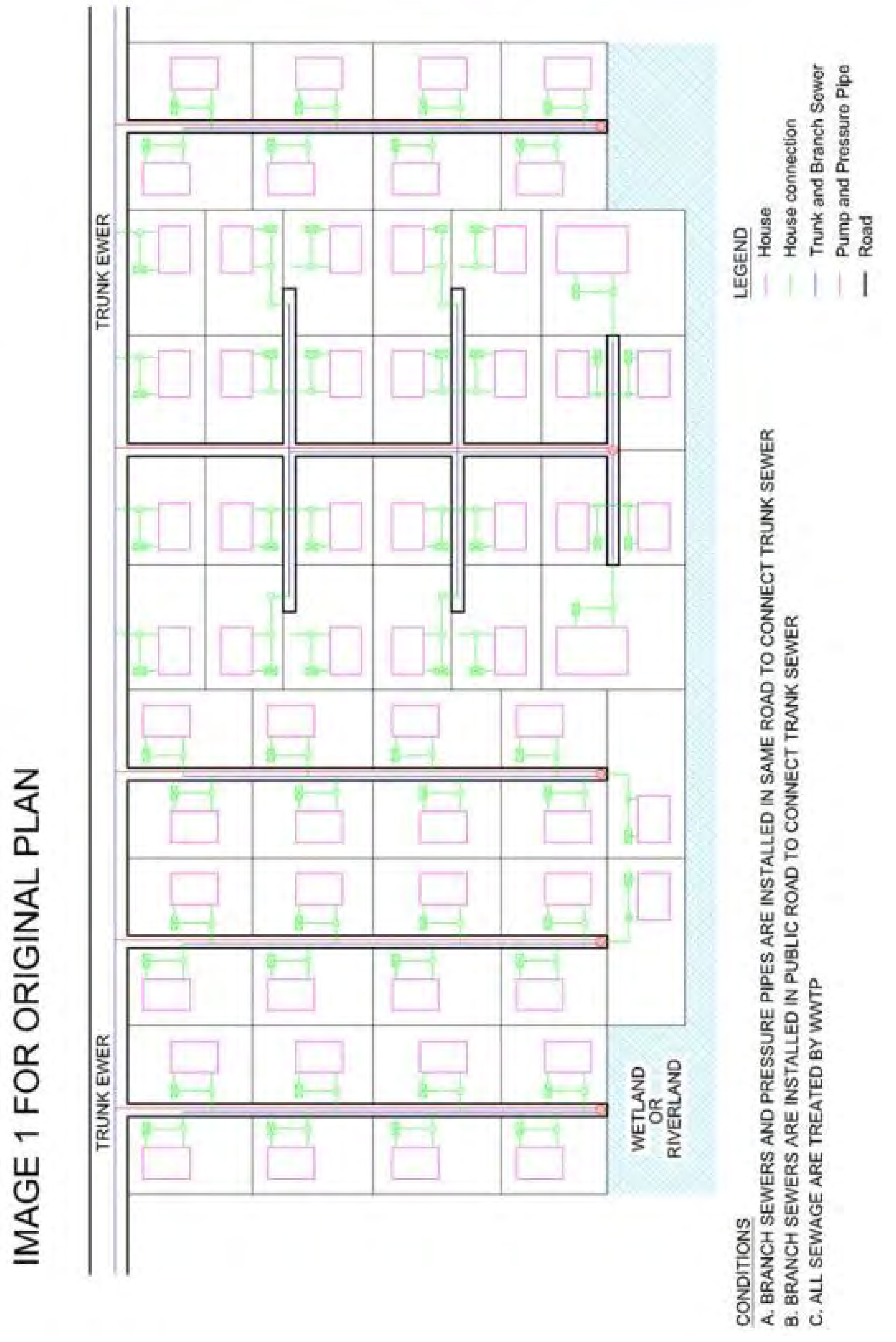


IMAGE 1 FOR ORIGINAL PLAN
TRUNK EWER
TRUNK EWER
WETLAND
OR
RIVERLAND
LEGEND
House
House connection
Trunk and Branch Sewer
Pump and Pressure Pipe
Road
CONDITIONS
A. BRANCH SEWERS AND PRESSURE PIPES ARE INSTALLED IN SAME ROAD TO CONNECT TRUNK SEWER
B. BRANCH SEWERS ARE INSTALLED IN PUBLIC ROAD TO CONNECT TRANK SEWER
C. ALL SEWAGE ARE TREATED BY WWTP

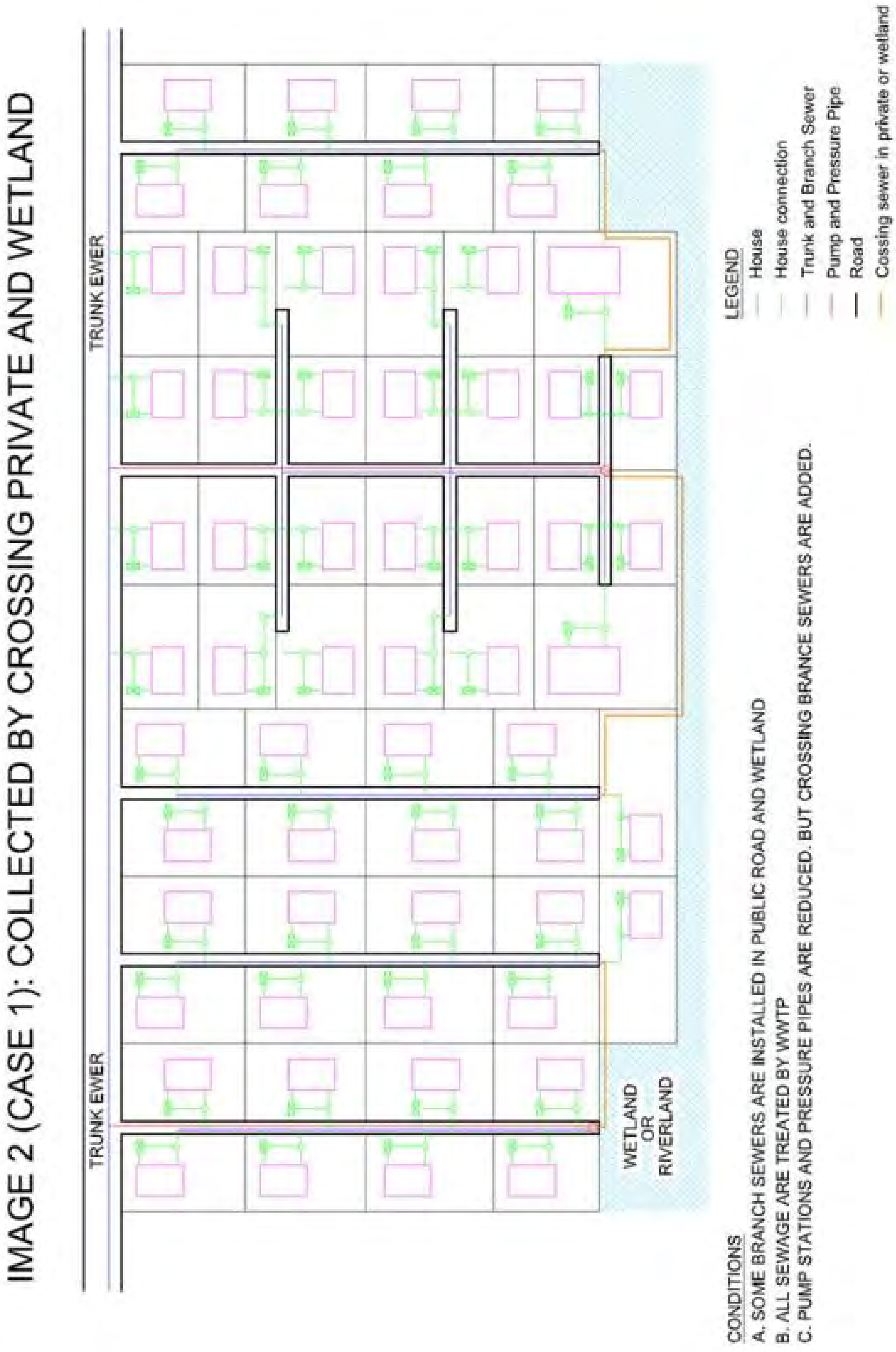


IMAGE 2 (CASE 1): COLLECTED BY CROSSING PRIVATE AND WETLAND
TRUNK EWER
TRUNK EWER
WETLAND
OR
RIVERLAND
LEGEND
House
House connection
Trunk and Branch Sewer
Pump and Pressure Pipe
Road
Cossing sewer in private or wetland
CONDITIONS
A. SOME BRANCH SEWERS ARE INSTALLED IN PUBLIC ROAD AND WETLAND
B. ALL SEWAGE ARE TREATED BY WWTP
C. PUMP STATIONS AND PRESSURE PIPES ARE REDUCED. BUT CROSSING BRANCE SEWERS ARE ADDED.

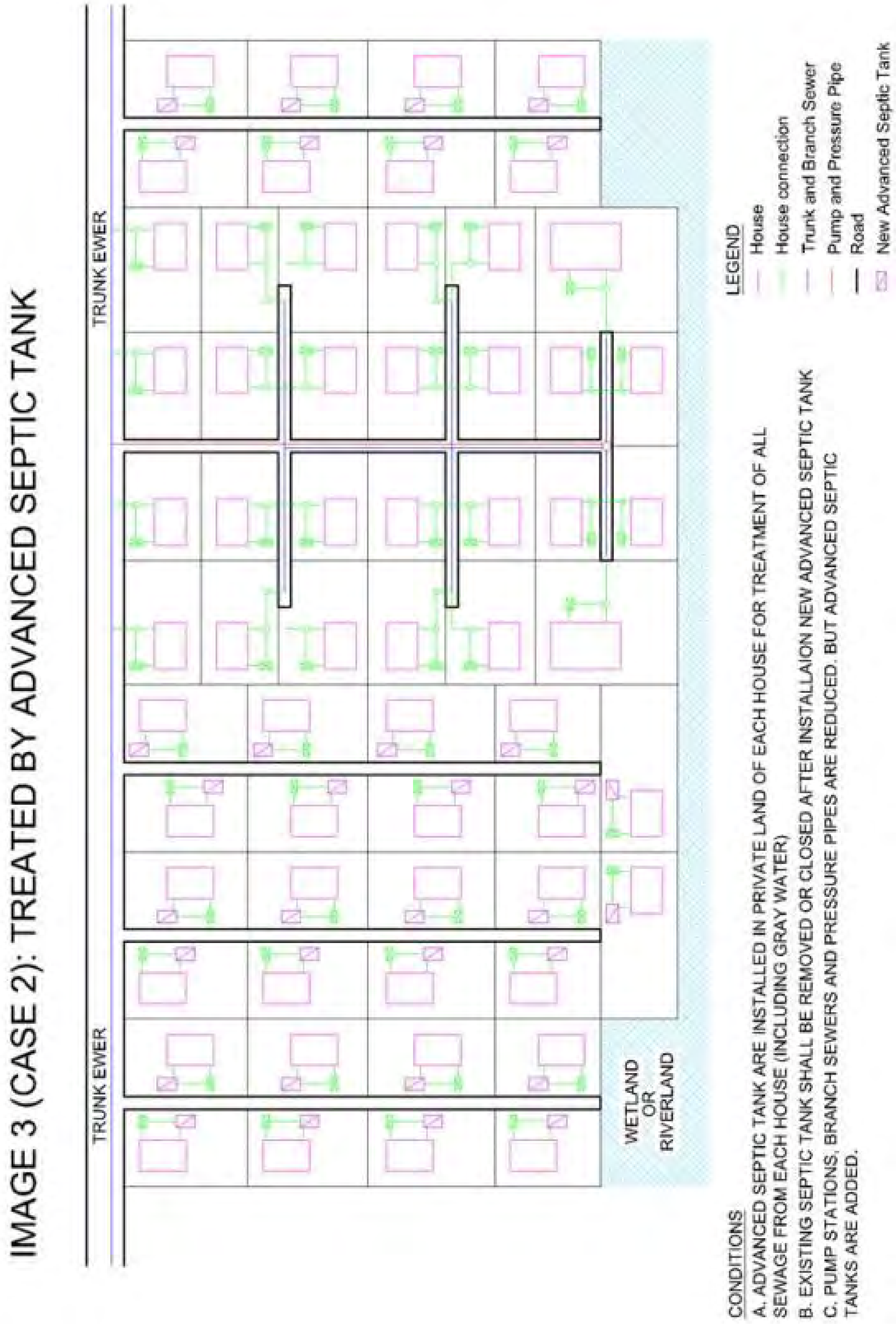
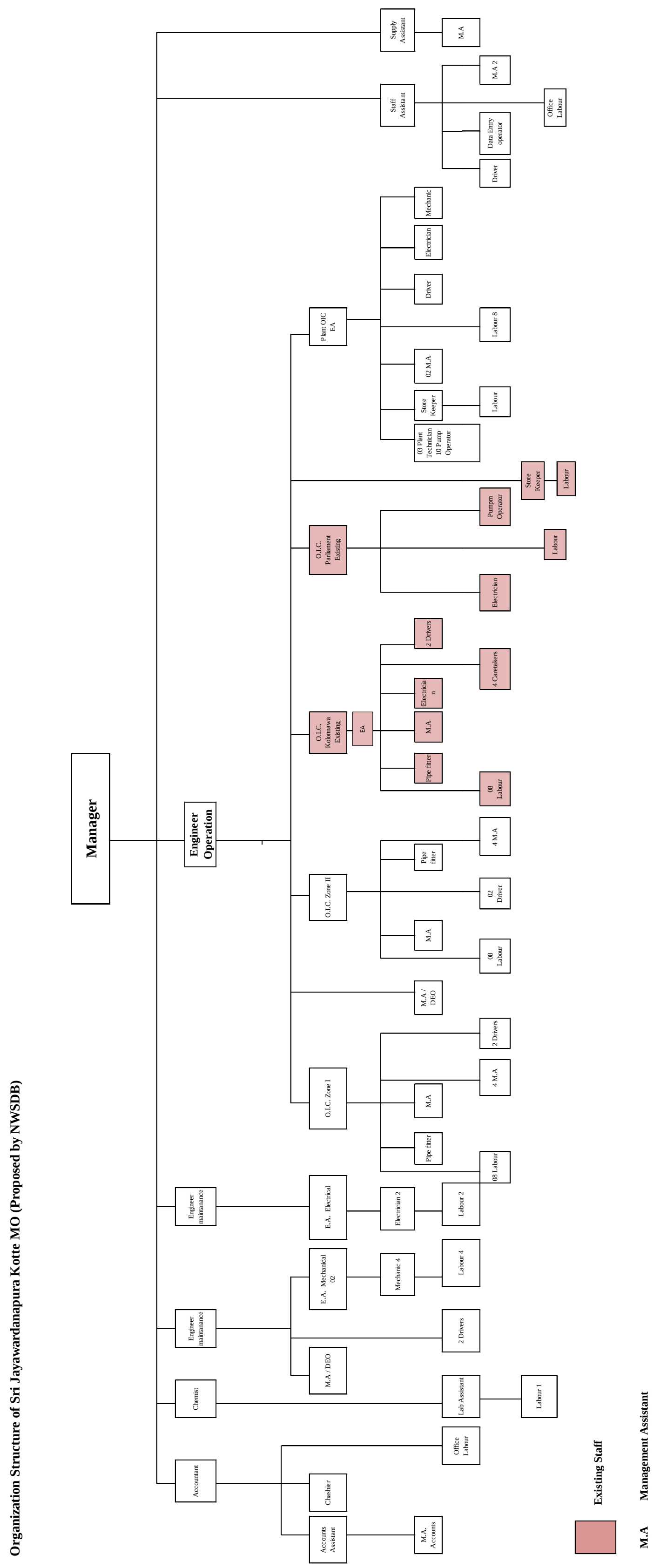


IMAGE 3 (CASE 2): TREATED BY ADVANCED SEPTIC TANK
TRUNK EWER
TRUNK EWER
WETLAND
OR
RIVERLAND
LEGEND
House
House connection
Trunk and Branch Sewer
Pump and Pressure Pipe
Road
New Advanced Septic Tank
CONDITIONS
A. ADVANCED SEPTIC TANK ARE INSTALLED IN PRIVATE LAND OF EACH HOUSE FOR TREATMENT OF ALL SEWAGE FROM EACH HOUSE (INCLUDING GRAY WATER)
B. EXISTING SEPTIC TANK SHALL BE REMOVED OR CLOSED AFTER INSTALLAION NEW ADVANCED SEPTIC TANK
C. PUMP STATIONS, BRANCH SEWERS AND PRESSURE PIPES ARE REDUCED. BUT ADVANCED SEPTIC TANKS ARE ADDED.

APPENDIX 6-1 Proposed Organizaiton Chart by NWSDB



APPENDIX 7-1 TOR for Consulting Service for the SRI JAYAWARDENAPURA KOTTE SEWERAGE CONSTRUCTION PROJECT Phase I (7.3)

Appendix 7-1 is undisclosed.

APPENDIX 7-2 Estimated Project Implementation Schedule (7.4.4)

Appendix 7-2 is undisclosed.

APPENDIX 7-3 Detailed Breakdown of Construction Cost (7.5.1)

Appendix 7-3 is undisclosed.

APPENDIX 7-4 Breakdown of Operation and Maintenance Cost (7.5.2)

Appendix 7-4 is undisclosed.

APPENDIX 7-5 Annual Fund Requirement (7.6)

Appendix 7-5 is undisclosed.

APPENDIX 7-6 Calculation for Share of Japanese Product in Total Construction Cost (7.6)

Appendix 7-6 is undisclosed.

APPENDIX 8-1 Financial Conditions of Related Organizations (8.2.1, 8.2.2, 8.3.4)

Appendix 8-1 is undisclosed.

APPENDIX 8-2 Social Condition Survey (8.3.3)

Appendix 8-2 is undisclosed.

APPENDIX 8-3 Economic Analysis of the Proposed Sewerage Project (8.4.2)

Appendix 8-3 is undisclosed.

APPENDIX 9-1 Environmental Checklist (9.12)

Table 9.1: JICA Environmental Checklist

Category	Environmental Item	Main Check Items	YES: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1. Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	(a) (Y)	(a) Submitted on 12th-Apr. 2019.
		(b) Have EIA reports been approved by authorities of the host country's government?	(b) (N)	(b) In Progress
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c) (N)	(c) In Progress
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(d) (N)	(d) In Progress
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(a) (N)	(a) In Progress
		(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(b) (N)	(b) In Progress
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Alternatives treatment methods, STP locations, pumping station locations, pumping station types, were examined to minimize environmental and social impacts.
2. Pollution Control	(1) Water Quality	(a) Do pollutants, such as SS, BOD, COD, pH contained in treated effluent from a sewage treatment plant comply with the country's effluent standards?	(a) Y	(a) Japanese advanced technology (BNR) is selected for the treatment process to ensure high treatment capacity and meet Sri Lankan effluent requirements.
		(b) Does untreated water contain heavy metals?	(b) N	(b) Untreated waste water does not contain heavy metals above the limits stipulated in "Draft Amendment of Tolerance Discharge Limits"
	(2) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) Sludge generated will be transferred to private / official plant and composted at its composing facility.
	(3) Soil Contamination	(a) If wastes, such as sludge are suspected to contain heavy metals, are adequate measures taken to prevent contamination of soil and groundwater by leachates from the wastes?	(a) NA	(a) Heavy metals are not expected in the influent waste water
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as sludge treatment facilities and pumping stations comply with the country's standards?	(a) Y	(a) No sensitive facilities have been identified around the STP and other construction sites. EMP is prepared during to minimize noise and vibration during construction and operation.
	(5) Odor	(a) Are adequate control measures taken for odor sources, such as sludge treatment facilities?	(a) Y	(a) Advanced deodorizing technology has been selected to eliminate odors generated by the STP.
3. Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) Beddagana Bird Sanctuary is located within the Project area. The construction will be conducted approximately 10 m away from the sanctuary. No local environmental regulations restrict construction for the Project components, but care should still be taken to prevent accidental impacts to wildlife coming out of the area during construction. Wastewater collection and treatment is expected to have positive impacts on the surrounding environment.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a) N	(a) Beddagana Bird Sanctuary is located within the Project area but is not part of the component.
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	(b) N	(b) Beddagana Bird Sanctuary is located within the Project area but is not part of the component.
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(c) NA	(c) Adverse impacts were avoided by the EIA study. Significant adverse ecological impacts are not anticipated. The Project is expected to have positive impacts on the environment and society.
		(d) Is there a possibility that the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(d) N	(d) The Project is expected to have positive impacts on the environment and society.
4. Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	(a) N	(a) Resettlement is not expected within the project components while land acquisition is necessary for STP, STP access road and MPSs. STP: 3.5 ha, Access road 0.2 ha, MPS 3 locations are required
		(b) Is adequate explanation on compensation and resettlement given to affected people prior to resettlement?	(b) Y	(b) Public Awareness Campaigns were held to explain the project to nearby residents. SHM will be held subsequently.
		(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	(c) Y	(c) Household income surveys and asset surveys were performed. The compensation is based on full replacement cost. Restoration of livelihood is also included in the resettlement action plan prepared.
		(d) Are the compensations going to be paid prior to the resettlement?	(d) Y	(d) All compensation will be paid in full prior to taking over of land in case of land acquisition
		(e) Is the compensation policies prepared in document?	(e) Y	(e) Compensation policies have been developed based on JICA Project Policy Guidelines.
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(f) NA	(f) Social-Economic Surveys were performed at several scales throughout the project. Social conditions survey and site surveys show no disproportionate distribution of indigenous or ethnic populations in the project area.
		(g) Are agreements with the affected people obtained prior to resettlement?	(g) Y	(g) Compensation plans will be agreed to before land acquisition.
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) Y	(h) Organizational framework, including budget and GRM, has been established for land acquisition and compensation payment.
		(i) Are any plans developed to monitor the impacts of resettlement?	(i) Y	(i) Monitoring plan has been developed to monitor progress of land acquisition and compensation.
		(j) Is the grievance redress mechanism established?	(j) Y	(j) A GRM has been established in the Project area to identify and resolve issues quickly and effectively.
	(2) Living and Livelihood	(a) Is there a possibility that changes in land uses and water uses due to the project will adversely affect the living conditions of inhabitants?	(a) N	(a) Land acquisition is limited but mitigation measures are considered such as keeping green land possibly to be cultivated, creating a park for children and giving free access to the surrounding road. Adverse effects to the water environment are not expected.
		(b) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(b) Y	(b) The Project is possible to adversely affect the community by its odor but complete deodorizing methods and equipment will be introduced to prevent the problem. When resettlement is necessary, full resettlement cost will be compensated based on socio-economic survey.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archaeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) The STP and other facilities are not located near such sites. Pipelines will be installed along existing roads and will not affect heritage sites.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) Y	(a) The STP may affect landscape. Effects will be mitigated through tree planting and other beautification methods. Pipelines will be installed underground along existing roads and will not affect landscape.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	(a) NA	(a) No such populations are found in the area.
		(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to lands and resources respected?	(b) NA	(b) No such populations are found in the area.
	(6) Working Conditions	(a) Is the project proponent ~~not~~ violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	(a) N	(a) All national and local laws and ordinances associated with working conditions will be strictly adhered to during all phases of the Project. EMP and EMoP will be formulated to ensure compliance to these requirements.
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous	(b) Y	(b) All national and local laws and ordinances associated with working conditions will be strictly adhered to during all phases of the Project. EMP and EMoP will be formulated to ensure compliance to these requirements.

			materials?				
		(c)	Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	(c)	Y	(c)	All national and local laws and ordinances associated with working conditions will be strictly adhered to during all phases of the Project. EMP and EMoP will be formulated to ensure compliance to these requirements.
		(d)	Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(d)	Y	(d)	All national and local laws and ordinances associated with working conditions will be strictly adhered to during all phases of the Project. EMP and EMoP will be formulated to ensure compliance to these requirements.
5. Others	(1) Impacts During Construction	(a)	Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	(a)	Y	(a)	Measures to reduce impacts during construction will be considered carefully and implemented through the EMP and EMoP.
		(b)	If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	(b)	Y	(b)	Measures to reduce impacts during construction will be considered carefully and implemented through the EMP and EMoP.
		(c)	If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(c)	Y	(c)	Sri Lankan and JICA guidelines for land acquisition and social protections will be implemented. Other measures to reduce impacts during construction will be considered carefully in implemented through the EMP and EMoP.
		(d)	If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(d)	Y	(d)	Measures to reduce impacts during construction will be considered carefully and implemented through the EMP and EMoP, including traffic control plans.
	(2) Monitoring	(a)	Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	(a)	Y	(a)	EMP and EMoP have been prepared based on recommendations from the JICA Expert Team.
		(b)	What are the items, methods and frequencies of the monitoring program?	(b)		(b)	Items to be monitored, methods, and frequencies are detailed in the EMP and EMoP. Items are; - Noise level (Day and Night time Noise level (dB)) - Air quality / Odour (SO_x, NO_x, O_3, PM_{10}, $PM_{2.5}$, SPM, VOCs, Ammonia, H_2S) - Water Quality (EC, TSS, DO, BOD, COD, pH, Oil and grease, E-coli)
		(c)	Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	(c)	Y	(c)	Organizational structure, budget, and responsible organizations for implementing the EMP and EMoP are set and included in the EMP and EMoP.
		(d)	Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(d)	Y	(d)	CEA details requirements and procedures for reporting and information disclosure during the project implementation phase.
6. Note	Note on Using Environmental Checklist	(a)	If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a)	NA	(a)	No transboundary impacts are expected.

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

APPENDIX 9-2 Stakeholder Meeting- September 2019 (9.10)

Event	Stakeholder Meeting for Sri Jayawardenapura Kotte Wastewater Management Project
Date/Time	From 9.30 am to 1.30 pm on September 17th, 2019.
Place	Raffles Residencies, Jubilee Post, Kotte Road, Kotte.
Organized by	NWSDB/JET

Participants

Organization / Affiliation	No. of Attendants	Organization / Affiliation	No. of Attendants
Invitees from Institutions & Organizations		Members of NWSDB and JET	
NPD	1	NWSDB	9
SLLRDC	1	JET	10
CEA	1	Media	
Survey Dept.	1	Newspaper writer	5
ADB	1	Total	83
DS Maharagama	1		
Dehiwela- Mt. Lavinia MC	1		
CECB	2		
Landowner	14		
HFPS	5		
WHUWS	1		
Business Leader	2		
Engineer	1		
NGO Leader	3		
CBO Leader	10		
CBO Member (Resident)	9		
Bank Society	1		
Kotte Heritage Foundation	1		
MOH, Kotte MC	1		
NWSDB (other section)	2		
Sub total	59		

Topics

The final Stakeholder Meeting organized by NWSDB with the assistance of JET was a large-scale awareness meeting for Government and Non-Government stakeholders, donors, media, members of Community Based Organizations and Business Organizations, paddy-field farmers, land owners and residents to be impacted by the proposed Sri-Jayawardenapura Kotte Wastewater Management Project (SJKWMP).

A total number of 83 participants (including NWSDB and JET representatives) representing Central and Local Government, various institutions and community members from areas such as Obeysekarapura, Heenatikumbura, Rajagiriya, Welikada, Bandaranayakapura, Maharagama, Dehiwela Ethul-Kotte and Arunodhayapura areas attended the meeting out of the total of 110 that were invited. These numbers also included several participants who turned up at the meeting as replacements for other invited guests, although not having been personally sent an invitation.

Objectives of the Stakeholder Meeting:

- Present the final outcomes and findings of the Feasibility Study for the proposed SJKWMP to be implemented in the area, to the representatives of government and non-government organizations, beneficiaries, community members and stakeholders to be impacted by the project.

- Inform the residents of communities belonging to areas covered by the proposed SJKWMP regarding the outcomes and findings of the Environmental Impact Assessment (EIA) Report, as well as the awareness programs conducted over the past year for the SJKWMP, and ensure that all stakeholders are up to-date with the latest results.

- Allow a platform for discussion for the stakeholders of the project regarding any further queries or clarifications that they might have regarding the project procedures.

- Address the issues or concerns raised by residents by providing clarifications about the project, backed by the findings from the Feasibility Study and the EIA Report.

- Inform the stakeholders on ways that they may access the findings and reports in physical copies and online.

Invitees:

1. Heads of relevant Government Institutions
2. Municipal Commissioners / Secretaries of relevant Local Authorities
3. Divisional Secretaries of relevant Divisional Secretariats
4. Land owners of all lands scheduled to be acquired under project (for varied purposes: i.e., STP, flood retention, access roads, pumping stations etc.)
5. Officials of NGO's (Environmental Organizations) active in the proposed project area
6. Officials of Business Societies active within the proposed project area
7. Leaders of Community Based Organizations active within the proposed project area
8. Members of the Heenatikumbura Paddy Field Protection Society (HFPS)
9. Heenatikumbura CBOs & Groups who are actively opposed to the project
10. Officials of the National Water Supply and Drainage Board (NWSDB)
11. JICA Expert Team (JET)

Method of Invitation:

1. Groups No: 1, 2, 3, 4, 8, 9 of the aforementioned categories were invited for the meeting by sending Invitations via courier service. Courier service had submitted receipts for the delivery of invitations as documentary evidence.

2. Invitations to the Groups No: 5, 6, 7, 10 and 11 were hand delivered and the invitees'/recipients' signatures were obtained as documentary evidence.

Meeting Proceedings

Agenda:

Item	Time
1. *Registration of Participants and Morning Break*	09:00am - 09:30am
2. *Welcome Speech by Project Director*	10:00am - 10:10am
3. *Outline of the JICA Preparatory Survey*	10:10am - 10:40am
4. *Summary of Public Awareness Activities*	10:40 am - 11:00am
5. *Presentation of Results of the Environmental Impact Study*	11:00am - 11.30am
6. *Queries and Clarifications*	11.30am - 12.00pm
7. *Summary of Proceedings and Way Forward*	12:00pm - 12.30pm
8. *Lunch*	12.30pm - 01:30pm

1. Registration of Participants and Morning Break

The day's proceedings for the Stakeholder Meeting were commenced at 9.00 am with the registration of participants using attendance sheets corresponding to the lists of invitees. A total of 83 participants including representatives of the NWSDB and JET attended the meeting on 17/09/2019 out of the 110 that were invited in total. In addition, around 4-6 participants turned up uninvited, but were permitted to take part in the meeting given that there was adequate space to accommodate them.

Morning Break was provided for the participants at 9.30 am, following which the Stakeholder Meeting

	proceedings were officially commenced at 10.00 am. ▪ Mr. AAA of JET, on behalf of NWSDB and JET, welcomed the audience to the meeting for stakeholders of the SJKWMP. He stated that he would be moderating the day's proceedings and also provided a brief overview of the agenda laid-out for the day. Mr. AAA described that the presentations would be conducted in Sinhala; however, mentioned that two Japanese officials of JET would like to address a few words in English to the participants as well. ▪ Following an outline of the agenda, he made a special request that any queries by participants would be kept until the Queries & Clarifications session and not be put forward in between presentations by the keynote speakers and that the queries during the Q&C would be kept brief and to the point. Finally, he also requested that the sheets that were handed out at the time of registration be used to fill in their responses and suggestions. He encouraged all participants to write their thoughts in the survey sheets. 2. <u>Welcome Speech by Project Director – Mr.BBB</u> As the opening item on the agenda, Mr. AAA then invited the Project Director of the proposed SJKWMP, Mr.BBB of NWSDB to address the gathering with his welcome speech. ▪ Project Director Mr.BBB thanked all the participants for their presence here today and proceeded to give an introduction to the background of the project. He described that the coverage of sewerage pipelines in the city area had hitherto been at an extreme low of 2.5%, and that there was a serious problem of sewerage pollution. Hence, the Government of Sri Lanka had identified the need for a sewerage project to develop sewerage infrastructure in the Sri Jayawardenapura-Kotte area. For this purpose, Mr.BBB explained, the Sri Lankan Government requested the necessary funds from Japan and the JICA organization in order for the NWSDB to develop and increase the sewerage coverage to 7.0% by 2035. ▪ Thus, Mr.BBB elaborated that the Japanese government had chosen 15 main cities of Sri Lanka to survey, out of which 5 were identified as high-priority, with Sri Jayawardenapura-Kotte emerging as the highest priority in terms of needing sewerage infrastructure development. Accordingly, he described that the planning for the SJKWMP was carried out in two phases; one, the overview and Background Study for the project and two, the Feasibility Study and Environmental Impact Assessment (EIA). ▪ Hence, Mr.BBB described that the objective of the day's meeting was to organize a collective assembly of all participants and stakeholders in the process thus far and to provide a platform for informing and discussing regarding the progress of the project proceedings so far. He explained that today was aimed at a formal description of the status of the project to the general public, and that there would be an opening for anyone to freely ask questions during the Q & C session. ▪ Finally, Mr.BBB warmly welcomed all Government institutions such as Ministries, NWSDB and JET/JICA, representatives of local communities and societies, media, land owners for pumping stations etc., residents from Heenatikumbura and other localities; and wished for the meeting to be a success. 3. <u>Outline of the JICA Preparatory Survey - Mr.CCC of NWSDB</u> Following the end of the Project Director's speech, Mr. AAA invited Team Lead of JICA Expert Team, Mr.DDD, to deliver a few words to the audience as well. <u>JET Team Leader Mr.DDD</u> ▪ Mr.DDD thanked the audience for their active participation and stated that the study for the proposed SJKWMP is almost completed. He described that the findings and conclusions of the study would be presented to the general public today via the Stakeholder Meeting, where everyone could receive information on the current status of the project. ▪ He further stated that the comments and suggestions of the people would be considered of great importance in finalizing the study; and therefore, requested all participants to write down their ideas and suggestions in the papers that were handed out to them at the time of registration. ▪ Mr.CCC of NWSDB thanked the audience for their presence today and stated that he would be presenting a Sinhala translation of the presentation prepared by JET Team Leader Mr.DDD, on his behalf. This presentation, he described, was based on a report made from the compiled data and findings of the survey and study conducted for the proposed SJKWMP.

	▪ Mr.CCC elaborated that the objective of the project would be to collect all the wastewater in the city area via an underground pipe which would be connected to different pumping stations, following which it would all be directed to a Treatment Plant. Here, the collected wastewater would be treated close to the levels of drinking water, and then released into an open water source such as Diyawanna Lake, aimed to result in an absolute cleansing of drainage systems in the area. ▪ Next, Mr.CCC went on to elaborate on the PowerPoint presentation, describing the contents of the study, its scope and what it entailed. He described that the Japanese had conducted their own survey on where and how to implement a sewerage infrastructure project in Sri Lanka, stating that Sri Jayawardenapura-Kotte had been lucky to have been chosen as the most vital in need of a sewerage management system, out of 15 cities. Furthermore, Mr.CCC went on to describe Phase I and Phase II of the study and the need for an EIA and Feasibility Study report. He also described the national policies behind the implementation of this project to the audience. ▪ Next, Mr.CCC described the present conditions and needs for the proposed project, stressing on the fact that this was a highly populated and increasingly urbanizing area with many government institutions, apartments and multiple-storied buildings etc. Using the data and graphs depicted on the PowerPoint slides, he elaborated on the planning basis for the project. He demonstrated how the sewerage system was proposed to be constructed using expert Japanese technology and the most modern methods, such as using an underground drilling system instead of an open trench one. ▪ After explaining the preliminary plan and design of the proposed sewerage system, Mr.CCC went into detail regarding the steps and functions of the wastewater treatment process. He described the use of UV Radiation over the process of Chlorination in treating the collected wastewater, and then detailed the sludge treatment process which was planned for the SJKWMP. For example, Mr. CCC elaborated how the sludge waste would not be allowed to collect. Instead, according to JET recommendations, it would be thickened using the Belt Filtration system, dewatered and finally turned into compost. ▪ Next, Mr.CCC mentioned that a key common concern of all residents was that of the resulting odor from the Sewerage Treatment Plant once the wastewater treatment was in process. He stated that this had been among the main reasons for the opposition towards the project and the objection by communities to have the STP constructed in their area. However, Mr.CCC assured that the utmost measures are being taken for odor prevention and minimization, such as the added procedure of Activated Carbon Consumption which is proposed to be used at SJKWMP in addition to the usual Biological Filter Treatment system being used at most STPs thus far. He further described that this would be a closed Treatment Plant, where the ensuing gases would be collected and also purified before being released. ▪ Mr.CCC then demonstrated a variety of adopted Japanese technologies such as Micro-Tunnelling, BNR and BFT using the slides of the PowerPoint presentation. ▪ Next, Mr.CCC described the Environmental and Social considerations taken into account during the planning of the proposed project. He described that the JICA guidelines specifically consider 30 different items in its ESC Study, to ensure that everything is strictly standardized. Elaborating in detail on the environmental management plans and monitoring, Mr. CCC also pointed out that the EIA mitigation measures would also ensure that these are properly implemented in order to ascertain that the project would function smoothly and successfully. ▪ Speaking on the land acquisition and resettlement processes for the project, Mr.CCC made it a special point to stress that 4 alternative sites had been considered for the location of the Sewerage Treatment Plant, before Heenatikumbura was decided upon due to many factors. He explained that the Section II has been issued for the purposes of land acquisition and that procedures are underway. He further assured that steps are being taken to ensure that all affected parties and land donors will receive due compensation for their lands. ▪ Progressing towards the final slides, Mr.CCC went on to describe the Land Acquisition and Resettlement Action Plan (RAP). He elaborated in detail its scope, the location of properties to be used for STP and Pumping Stations and the compensation policies of both the Sri Lankan Government and JICA in order to minimalize any negative impacts and effects of the project on the resident population. ▪ Finally, Mr.CCC summed up his presentation with the conclusions and presented the recommendations of the study conducted by JET under JICA funding. He further described that the JICA and NWSDB teams planned to proceed in future taking into account all of these recommendations and conclusive findings;

following which he concluded his presentation on behalf of Mr.DDD.

Mr. AAA thanked Mr.CCC for his detailed presentation.

4. <u>Summary of Public Awareness Activities - Mr. AAA of JET</u>

Then Deputy Team Leader of JET, Mr.EEE, was invited to address a few words to the gathering regarding his area of Environmental and Social Considerations.

- Mr.EEE addressed the participants and stated that the NWSDB and JET teams had been organizing Public Awareness Campaigns since August, last year. He described that these meetings and awareness workshops were held for the purpose of understanding and answering the general public's concerns and issues regarding the proposed project. He further mentioned that all of these opinions and views had been duly noted in reports since last year, and the consolidation of their contents was deemed of high importance to the final outcomes of the study as it was the voice of the people.

Mr.EEE then invited Mr. AAA of JET to provide a more detailed presentation regarding the NWSDB/JET Public Awareness activities to the participating audience.

- Consultant Sociologist for Environmental and Social Considerations, Mr.AAA thanked Mr.EEE and on behalf of Mr.EEE commenced his presentation on public awareness activities conducted by NWSDB and JET. He first described that on March 15th of last year a meeting had been conducted at Heenatikumbura temple with the attendance of 300-400 participants, where serious concerns such as the problems of odor and decrease of land value had come up in objection to the proposed SJKWMP. Following this meeting, JICA had made the recommendation to NWSDB to conduct multiple awareness programs in the communities in order to disseminate accurate information and dispel the people's concerns.

- As a result of this, Mr. AAA stated, Phase I of the awareness campaign had first seen mass numbers of leaflets being distributed by NWSDB Battaramulla by including them with residents' water bills in order to raise public awareness regarding the proposed SJKWMP.

- As the next step, he described that a total of over 100 awareness meetings had been held for different localities and target groups of the proposed project area, breaking the numbers down as
  - 17 Large-scale Awareness Meetings
  - 24 Community/Public Awareness Workshops
  - 64 Religious Leaders' Awareness Discussions
  - 3 School Students Awareness Meetings (for dissemination of scientific knowledge regarding the sewerage treatment process in Sri Lanka and the world)
  - 4 Field Visits to STP for residents
  - 3 Business Leaders' Awareness Meetings, and
  - 1 Kurunegala STP Site Visit for Media Awareness.

- Following this, Mr. AAA moved on to describe that during these awareness meetings, the HFPS as well as the residents of communities had raised several issues and concerns regarding the project. He mentioned that these had then been analyzed and identified by the NWSDB/JET team as 11 key issues. Thus, Mr. AAA proceeded to address each of these 11 issues using PowerPoint slides; which clearly demonstrated the points for concern, as well as the NWSDB/JET team's response to each of them.

- For example, answers to the residents' concern regarding unpleasant odors from the STP was addressed through different points such as there being a deodorization system for SJK STP, odor causing areas of the STP being covered and odors neutralized before being released to the atmosphere. In addition, the issue of odors being released during the gull bowser unloading process would be solved by there being separate unloading locations for the gully bowsers and not at the STP in Henatikumbura.

- Demonstrating various images on slides, Mr. AAA further explained how the land surrounding the STP would be used for the purposes of building a road, community recreational projects, beautification and children's parks etc. in order to heighten the social and environmental value of the area, while aiding in flood prevention and control.

- Furthermore, Mr. AAA described that a key point raised in opposition for the STP being located in Heenatikumbura was that the site had historical significance as a place where rice for offering to the sacred Tooth Relic was harvested. He explained that in order to investigate this point, the NWSDB and JET team had consulted 3 Professors of Archaeology from the Sri Jayawardanepura University and conferred upon this topic.

	He explained that the professors had stated that there was no written evidence supporting the claim as Heenatikumbura was not mentioned in the book, "Historical Villages of Sri Lanka", but that they could not refute any cultural claims made in the folklore of the people. Hence, he elaborated that NWSDB had then consulted the Archaeological Department; following which NWSDB had arranged a field visit with archaeologists to the Heenatikumbura site. While they had been unable to find any historical evidence there, the Archaeological Department had stated the condition that if, during construction activities for the STP, any such evidence should be found, it should immediately be reported to the relevant authorities. ▪ Mr. AAA next addressed then residents' concern of the lack of capacity by NWSDB to conduct operations or maintenance for the STP in the long term. He explained that the capability of O&M will be particularly evaluated in the loan evaluation, and that the giving of the loan is contingent upon meeting the set standards. He further explained that it is a condition of the loan agreement that these standards will be adhered to; and also described proposed SCADA systems as largely requiring very little manual maintenance. ▪ Finally, Mr. AAA of JET elaborated that the STP will not negatively affect residents despite it being in a highly residential zone, as most STPs in urbanized areas in Japan are green recreational areas. With this, Mr. AAA concluded his presentation. 5. <u>Presentation of Results of the Environmental Impact Study- EIA Team Leader Mr. FFF of CECB</u> Then, Mr. FFF, Team Leader of the Environmental Impact Assessment team was invited to next address the gathering. ▪ Mr. FFF of CECB thanked Mr. AAA and addressed the audience, stating that his task today was to present the findings of the Environmental Impact Assessment report to the participants of the Stakeholder Meeting. ▪ Next, Mr. FFF explained the legal and social need behind conducting an EIA prior to any large-scale project such as the proposed SJKWMP to be implemented in the Kotte area and its surrounding municipalities. He described the specific objectives of the EIA such as assessing the existing environment at project sites, assessing cumulated impact, identifying any major environmental impacts and minimizing these; as well as developing environmental management and monitoring plans. In addition, he especially thanked the Water Board for making their environmental considerations even more stringent through improved technology and increased standards when recommended so by the EIA and CECB. ▪ Furthermore, Mr. FFF explained the objectives of the proposed project, as well as the justification of its need for the Sri Jayawardenapura-Kotte area. Following these points, he also noted the four alternative sites that had been evaluated, out of which the Heenatikumbura site in Walpola was selected as the most suitable location due to several factors which he explained in detail. ▪ Next, Mr. FFF demonstrated multiple slides depicting the existing physical, socio-economic and biological environment of the proposed project area. He explained through graphs and figures several points including the water quality, ground water quality, treated effluent disposal and quality, air quality, road networks, infrastructure and flood issues etc. Elaborating in great detail on all the slides, Mr. FFF stressed that a flood control project was also essential for a highly metropolitan area such as Sri Jayawardenapura-Kotte. ▪ Following the physical environment pertaining to the project, he then proceeded to describe the socio-economic environment of the area, where a social survey had been conducted via questionnaires to assess the impacts of the project. He went on to elaborate on the various social fears and anxieties that were expressed by the villagers of communities and answered these from the perspective of the EIA study. ▪ For instance, he stressed that it has been specifically mentioned even in the EIA report that gully bowsers being unloaded at the STP site location is wholly going to be prevented; whereas instead they will be unloaded at separate pumping stations instead. Another point that he made was that since the denomination of "sewerage Treatment Plant" had negative connotations for the people, the project was to be renamed "Reclamation Project/Water Recycling Project" in consideration of social concerns. ▪ Finally, Mr. FFF presented the conclusions and findings of the EIA report in considerable detail to the participating audience, and thereby concluded his presentation. Mr. AAA thanked Mr. FFF and then announced that the floor was now open for any queries, comments or suggestions to be made by the participants regarding the proceedings of the meeting today.

6. Queries and Clarifications Session

▪ President of HFPS, Mr. GGG, levelled the accusations that very few/no participants were invited from Heenatikumbura itself to the stakeholder meeting today; a displeasing fact since they were the community who had the highest stakes in the project. He further pointed out that several facts Mr. AAA stated were untrue: i.e.
- That the Soyzapura STP was known to be a failure, not a success like Mr. AAA stated.
- That no schools in the Heenatikumbura area were informed or targeted to receive any awareness programs regarding the STP process; which was ironic since they were the area most affected by the proposed project.
- Inquired the specific names of the 3 supposed Professors from the Department of Archaeology at Sri Jayawardenapura University that Mr. AAA had mentioned, who allegedly affirmed that Heenatikumbura was not a historical site.

□ He also strongly pointed out that:
- The NWSDB/JET team were purposefully depicting a different portrait to the JICA than an actual picture of the true situation.
- That the people were being portrayed an inaccurate picture with regard to the STPs in order to gain their support for the project.
- The EIA report is inaccurate and inconclusive.
- That the method of choosing the STP location was wrong; while the most suitable location was situated in a land in close proximity to the Parliament.
- There is news being circulated in the media regarding the odors from the Soyzapura STP. The NWSDB is now portraying a false image at the meeting; they cannot be trusted.

▪ Mr. AAA responded to these statements by Mr. GGG and gave the 3 names of the Professors from the University as requested. Further, he pointed out that these professors had not disclaimed a historical value of the Heenatikumbura area as could be present in folklore. He explained that they had only refuted any claims of written evidence to the fact; and that even the Archaeological Department had left room for the possibility of any evidence to emerge during future excavations and constructions. However, for now, he states that there is no solid physical proof to back any such historical claims.

▪ Mr.HHH stated that they had a letter of thanks by the residents of Soyzapura addressed to the GM NWSDB expressing their pleasure at the solutions to the issue of odour from the STP. This letter was displayed using multimedia to show the names of the signatories as well. Both Mr.HHH and Mr.BBB explained the new steps that had been taken to solve the odour issue at the Soyzapura STP and how they were taking measures to provide green belt around the STP using planted trees, covering of the gully sucker discharge point re located to the center of the treatment plant and physical constructions. In addition, Mr.HHH demonstrated further images and video clips of successful STPs in Sri Lanka.

▪ Co-President of HFPS, Mr.III, in a more reconciliatory tone than the rest of the HFPS members, stated that the facts were being twisted in order to represent a more ideal picture to the JICA. He stated that the history and folklore of the area was being negated and that the majority of Heenatikumbura are still strongly against the project; a fact that was being concealed from JICA. He further mentioned that the people of Heenatikumbura were educated and not aggressive goons, hence wished to find a viable solution for this issue. Mr.III stressed that they all wanted the project and were in support of the initiative; but were definitely not in favor of it being located in Heenatikumbura.

▪ Mr. AAA replied once more that the 3 University professors had stated that there was no written evidence regarding the historical value of Heenatikumbura, but that they cannot refute cultural claims of the area. Hence, JET had consulted the Archaeological Department and NWSDB had arranged a field visit to Heenatikumbura, which had also been disrupted by HFPS members. However, he again reinstated, that if any such evidence were to be found, it was a condition stated in the letter by the Archaeology Department that the officials had to be immediately informed.

▪ Mr. JJJ, representative of HFPS, pointed out that none of their societies had been invited from the Heenatikumbura area and inquired as to the reasons why the location could not be in Denzel Kobbakaduwa Road. He pointed out that even the Secretary of HFPS, Mr. KKK (also present there at the meeting today) had not received an invitation to today's meeting and that they had merely decided to turn up to analyze the proceedings. Overall aggressive and disruptive behavior from HFPS members; talking over attempts at explanation from JET and NWSDB, who pointed out that invitations had been couriered to the necessary representatives with delivery confirmation from Courier company.

▪ Mr. JJJ then further stated that even in a previous meeting with Mr.LLL, he too had stated that Heenatikumbura was not the only option for the STP site and inquired as to why alternate lands such as

	Denzel Kobbakaduwa Road were not being considered for this purpose. However, he praised the standards of the JICA and stated that they were all in support of the initiative being taken for the project. ▪ Mr.MMM mediated and responded that the presidents of all 3 CBO's in Heenatikumbura area who were concerned in this issue had been invited, and that there was documented evidence that these had been couriered to all areas. ▪ In addition, Mr. FFF of CECB addressed the points made by Mr. JJJ stating the reasons why the Denzel Kobbakaduwa Road was not chosen as the STP site location; explaining also citing that this land declared as a flood retention area for parliament catchment by the SLLRDC had affirmed that this land could not be used for developmental project. ▪ HFPS members monopolized the session; making it difficult for others to voice their opinions. A lot of loud commotion and multiple people attempting to speak at the same time. ▪ Landowner of Pumping Station No. 08 stated that she is currently facing issues with the compensation for her land and is in urgent need of the money for her children's affairs. Thus, she made a special request that the land acquisition and compensation would be completed soon as they had given up their lands for the project purposes. Manager (Premises) NWSDB, Mr. NNN, responded that this was being delayed due to some further oppositions in this regard, but assured that the matter of compensation will be looked into soon. ▪ Secretary of Senior Citizens' Society Mr. OOO stated his opinion that they were taken by NWSDB and JET to visit the Ja-Ela and Soyzapura STP sites and had overall had a very positive experience with no indication of the terrible odour issue that was being much discussed. He described that they were taken on an entire guided tour of the STP process, and specifically stated that he himself touched the treated water that was the final output of the wastewater treatment. He proclaimed that the water had been clear and had no odour as such to be mentioned. Thus, Mr. OOO stressed that the SJKWMP was essential and reinstated that there were no odours at STPs they visited and informed HFPS to visit NWSDB treatment plant sites. ▪ HFPS loudly refuted this comment by Mr. OOO by displaying several cutouts of published newspaper articles which described the situation at Soyzapura STP etc. as still highly problematic. The HFPS representatives including Mr. GGG, Mr. PPP and Mr. JJJ repeatedly showed articles and acted in an aggressive manner. They responded to the comments by Mr.HHH stating they had never been invited to any STP field visits and pointed out that the Soyzapura residents' letter had only five signatures. Furthermore, they accused that there were no media persons present at meeting today either. HFPS further continuously stressed that the JICA should be informed that they should relocate the project elsewhere. ▪ In response to these comments, Mr.MMM specifically pointed out the media personnel present at the meeting today; and further stated that large awareness event had been conducted for media in Kurunegala months back. He further mentioned that even though HFPS representatives had been invited for the STP field visits several times, they had adamantly refused to take part. In addition, Mr.HHH responded that the letter by Soyzapura residents was by the affected residents themselves; and was written without any prior knowledge by NWSDB. The reason that there were fewer signatures, he stated, was most probably that it was the residents of houses in nearest proximity whose properties were most affected by the earlier issue of odour, who would have written the letter. ▪ President of the Nugegoda Community Development Society, Mr.QQQ stated that this project is essential as Maharagama itself has 16 GN divisions, all of which are affected by the present sewerage problem and therefore included in the proposed SJKWMP. A couple of other individuals too tried to give their comments, but the HFPS group continued to act aggressively and overpower the attempted comments by other residents with their collective loud remarks. ▪ Mr. RRR, introduced him-self as an engineer by profession, next wished to state his opinion. Addressing the gathering in English, he mentioned several contradictions in the presentations by the previous speakers, such as: - The location of gully bowser discharging points of proposed STP being unclear and not being named clearly, although it was repeated that it would not be at Heenatikumbura. - A previous speaker mentioning that the treated wastewater would supposedly be at drinking water level - The most suitable location for the STP being chosen as Heenatikumbura when Denzel Kobbakaduwa Road was in fact lowest point in area. ▪ In addition, Mr. RRR also mentioned a strong lack of faith in NWSDB to conduct proper maintenance of STP, stating that he had evidence to back the claim that the Water Board was incapable of carrying out projects such as these responsibly.

	▪ Mr.HHH and Mr.FFF responded to these queries and clarified contentions; specifically naming the discharging points (Ethul-Kotte and Jayawadanagama) that were, they stated, clearly mentioned in the EIA report now available for public reference. Mr. FFF of the EIA team stressed that this was not a gully sucker project, and no gully suckers would be located at the STP. They further encouraged the participants today and the general public who were interested to obtain a copy of the EIA Report which was available online for comments of the general public until the 07th of October. In addition, the NWSDB and CECB representatives also responded to the point of Denzel Kobbakaduwa Road, stating that this has been demarcated as a flood retention area and hence could not be used for the construction of an STP, as it is different purpose to the gazette notification. ▪ HFPS member Mr. PPP thanked the panel for the clarifications to their questions but stressed that they cannot allow project to be located in their area, while Mr.JJJ contested that Denzel Kobbakaduwa was not being chosen on purpose as it would be an issue since Parliament was in vicinity. Inquired what were the exact reasons that the alternative location was deemed unsuitable. Mr.BBB responded that mostly it was due to SLLRDC having confirmed unavailability of land and also that STP cannot be built <u>on</u> location declared as a flood retention area. ▪ Next, Mr.JJJ inquired whether they could have tours and field visits organized to visit these supposedly successful STP sites; to which Mr.HHH responded with enthusiasm that the NWSDB could definitely organize such field visits once the participation and dates were confirmed. ▪ Finally, Mr.JJJ again stressed the historical and cultural value of Heenatikumbura; and demanded that project be taken elsewhere. He requested that the Sri Lankan and Japanese Governments definitely proceed with the project as this is vital for the SJK area, but continuously reiterated that the STP location should definitely be changed and not constructed in Heenatikumbura. 7. <u>Summary of Proceedings and Way Forward - DGM of NWSDB Mr.HHH</u> ▪ DGM (Sewerage) of NWSDB, Mr.HHH commenced his presentation on the summary and way forward by displaying several photographs of the Kurunegala STP, which was situated right in the middle of Kurunegala hospital. As some representatives of HFPS had requested today that they would now like to take part in field visits to the STP sites, Mr.HHH invited them to visit the current STPs such as Soyzapura, Ja-Ela and Kurunegala to witness the actual status of the sites for themselves. He requested them to accompany NWSDB on tours of the sites, which they would gladly organize on their behalf should they wish to gain a first-hand experience of the treatment plants. ▪ Using further images, he described Kurunegala treatment plant 'green belt' created around the STP to attract birds, insects and small animals and bring the site up to a park level in terms of recreational value and beauty. Mr.HHH further explained that the Kandy STP is under construction on the left bank of Mahaweli River while the Getambe Temple located on right bank, and that there too had initially been great opposition to a sewage treatment plant being built in such proximity, adjoining and facing a prominent temple. However, he explained that now the opposition had greatly died out as the Kandy STP is about to function this year and maintained to very good standards as treated effluent is discharged just 3km upstream from Katugastota intake. In addition, he mentioned that the Deputy Mayor of Kurunegal MC had suggested that the treated water from the Kurunegala STP to be distributed to fulfill non potable needs in Kurunegala MC area. ▪ Mr.HHH further described that most of the public were yet unaware that there even were sewage treatment plants at the Sri Dalada Maligawa premises which were implemented in collaboration with the University of Peradeniya, tertiary treatment by subsurface wetlands and disinfection at Jaffna University Female Hostel is being re used for gardening purpose; all aimed towards a clean, beautiful, environment. He proceeded to show more images of the STPs at Kandy and Soyzapura etc. and mentioned that JET and JICA have taken even more steps to ensure that the proposed STP for Sri Jayawardenapura-Kotte was of even higher standards; using the highest technology and standards. To ensure the best possible level of maintenance, he reinstated that the quarters of the Operations and Maintenance staff would be constructed directly on top of the STP as well. Furthermore, he described that there were plans to develop a walking track along the proposed canal system and children's park in the flood retention to ensure the beautification of the locality as well. ▪ Next, Mr.HHH described that the Feasibility Study for the proposed SJKWMP was now in its final stages; and that a final EIA meeting will now be conducted to assess and finalize the study and report. He elaborated on the next steps of the way forward, such as: - End of the Feasibility Study - Reassessment and presenting of EIA to CEA

	- Approval by CEA (Central Environment Authority) - Loan signing agreement - Planning and selection of Supervisory Consultants - Descriptions of the next planning stages of the proposed project for Sri Jayawardenapura-Kotte. ▪ Finally, Mr.HHH ended his presentation with his heartfelt wish to resolve the current issues and problems pertaining to the project and proceed ahead with a clear aim. He further mentioned that efforts had been taken regarding an alternative location for the STP site in consideration to a common suggestion made by many participants, but that they had been unable to find a suitable one. However, he stated that they could continue to look into the matter and try to find some alternative if possible. On this note, Mr.HHH thanked the participants at the Stakeholder Meeting today and concluded his presentation on the project’s way forward. ▪ To conclude the Stakeholder Meeting for the proposed SJKWMP, Mr. AAA then thanked the guest speakers for their presentations and the participants for their time and attendance. He then requested that the participants fill in and hand over the survey forms distributed to them; and, to formally conclude the day’s proceedings, invited all the participants to partake in lunch which was arranged for them outside the hall. ▪ In addition, Mr. MMM of JET too thanked the participants for their participation and invited them to lunch and refreshments in order to conclude the day’s proceedings.
Final Participant Comments (After formal conclusion of Meeting)	1. Ms. SSS (President of Women’s Society) thanked NWSDB/JET for the information and clarifications provided at the stakeholder meeting; and stressed that this was an essential project for country and area. She also mentioned that they had attended several previous awareness meetings such as these. Ms. SSS expressed that although the opposition voice by HFPS was predominant during today's meeting, a fact which should also be taken into consideration; it was however also essential that she pointed out how much the project was needed for the SJK areas. Hence, she expressed their encouragement and support of the community for the project’s speedy commencement. 2. Mr. TTT (Secretary of the Pensioner’s Society of Colombo) thanked NWSDB and JET for the clear explanations provided at the meeting today. With regard to the views expressed today, Mr. TTT expressed the need for representation of all residents' opinions and need for National Policies in light of this project in order to ensure a sustainable solution to all issues. He also emphasized on the need to not politicize the issues at hand; but instead find a sustainable answer for these community concerns. 3. Another participant, Mrs. UUU, mentioned that she is a land owner and that her husband is attached to the NWSDB. Nevertheless, she wished to state her opinion that she too was against the project being implemented in Heenatikumbura as well (although it was believed otherwise by the HFPS members). She mentioned that it was important to consider the villagers’ rights and best interests prior to those of the city or country. She also wished to make the statement to HFPS publicly that she too was against this project being implemented in their home village. Hence, she wished to once more add her request to the requests by other residents that the project be taken to another location.

APPENDIX 12-1 Risk Management Framework (12.4)

TableA12.1-1 Risks Management Framework

Risks	Mitigation Measures
1. For Stakeholders	Probability: L
(1) Change in government: new party in power may modify project implementation	Impact: L
	Analysis of probability and impact
	This risk should be minimal because the project is consistent with the national sewerage policy and the need for sewage treatment is well-recognized.
	Mitigation measures:
	NWSDB should conduct public outreach on the need for sewage treatment in the greater Colombo area using mass media. The public should also be informed of the policy on infrastructure development. NWSDB should also appeal to other ministries for their support for sewage treatment.
	Action during the implementation:
	Monitor relevant policies, and dialogues of relevant governmental agencies.
	Contingency plan (if applicable)
	Not yet due.
2. For Executing Agency	
2.1Capacity Related	Probability: L
(1) Delay in establishing PMU and Steering Committee (SC) (2) Inadequate budget allocation by the Government of Sri Lanka	Impact: M
	Analysis of probability and impact
	(1) Delay in project preparation and implementation. (2) Budget shortfall will affect the work to be carried out by the Sri Lankan side: land acquisition, compensation for resettlement of people and building drainage channel and in turn will delay STP and pumping station construction. Inability to secure adequate budget after commissioning will affect facility operation and service delivery.
	Mitigation measures:
	(1) Establishment of PMU, and SC should be confirmed before signing L/A. (2) NWSDB should confirm commitment by the Ministry of City Planning and Water Supply on budget for land acquisition and compensation for resettlement, and by the Ministry of Megapolis for building drainage channels before signing L/A. The RSC managing STP operation should report to PMU on budget request, the details of operating expenses, and the budgeting procedure should be established.
	Action during the implementation:
	Same as above.
	Contingency plan (if applicable)
	Not yet due.
2.2 Staff complement	Probability: L

<u>Delay or suspension of the project due to personnel changes</u>	Impact: M
	Analysis of probability and impact
	Unexpected or unscheduled personnel change or reshuffling may hinder project implementation.
	Mitigation measures:
	Meetings with SC and PMU should be held regularly and whenever necessary, to share information on progress. Discussions and decisions should be documented and shared among participants and reported to the Project Director. It is recommended to prepare the TOR and manual of proceedings with the assistance of consultants, so that the Project can be implemented as planned even if there are changes to the members of SC and PMU.
	Action during the implementation:
	Same as above.
	Contingency plan (if applicable)
	Not yet due.
2.3 Fraud & Corruption	Probability: L
<u>Procurement of equipment</u>	Impact: M
	Analysis of probability and impact
	Sewage treatment equipment is costly and the temptations for corruption related to procurement are enormous.
	Mitigation measures:
	PMU should have a good understanding of the JICA ODA Loan Guidelines, and make sure that bidding is fair and competitive. Technical Evaluation Committee (TEC) and General Auditor should be vigilant in curbing corruption.
	Action during the implementation:
	Same as above.
	Contingency plan (if applicable)
	Not applicable
3. Design Related	
3.1 Cost Increases	Probability: M
(1) <u>For building foundations, pipe trenching, and micro Tunnelling</u>. (2) <u>For building road crossings, under-river crossings of sewers and micro tunnelling.</u>	Impact: H
	Analysis of probability and impact
	(1) Sewerage facilities are spread out over the entire project area in the Highland Complex, where there are different soil conditions. (2) Government buildings in the area have different security levels. The construction methods and schedule may have to be adjusted based on the requirement of the implicated agencies.
	Mitigation measures:
	(1) Soil tests should be carried out at proper sampling points to confirm conditions. (2) The scope of work and costs should be discussed with authorities having jurisdictional authority. Provisional sums should be included in the cost estimates.

	Action during the implementation:
	Same as above.
	Contingency plan (if applicable)
	Not yet due.
3.2 To Project & Donor	Probability: M
Delay in Project implementation (1) If the identified land is not acquired before the commencement of the project. (2) If the drainage channels to be built by SLLRDC at the STP site is not finished before the commencement of project.	Impact: H
	Analysis of probability and impact
	(1) The sewage treatment plant, an access road and three pumping stations are to be built on private land. Construction of the access load requires land acquisition. Land acquisition may take time. (2) After land acquisition and the building of the access road, SLLRDC has to design and construct drainage channels around the STP site for flood prevention. This should be finished before the construction of STP.
	Mitigation measures:
	(1) PMU, NWSDB, UDA, Ministry of Land and other relevant agencies must have project sites ready. The budget for land acquisition should be allocated to NWSDB. Awareness meetings for residents surrounding sites should be held for enhancing their understandings of the project to promptly conduct land acquisition and construction. (2) Budget for the drainage channels should be allocated to SLLRDC. SLLRDC and Ministry of Megapolis must design and build the channels before the start of the STP construction.
	Action during the implementation:
	Same as above.
	Contingency plan (if applicable)
	Not yet due.
3.3 Delivery Quality	Probability: M
(1) Low inflow: at the treatment plant, if sewer construction and house connections are delayed. (2) Poor treated water quality: as a result of equipment and process malfunction because staffs do not have adequate training.	Impact: M
	Analysis of probability and impact
	(1) It may take time to get permission for the construction of sewers under busy streets and in high security areas. Delays in sewer construction and wastewater collection may mean targeted treatment operation would not be achieved according to schedule. (2) Insufficient skilled operators may hinder the smooth operation of the treatment plant.
	Mitigation measures:
	(1) Allocate enough time for meetings to explain to relevant agencies in advance, the construction methods (such as micro tunnelling), time required for the work and where sewer lines have to be routed. (2) Implement capacity building program for O&M staff including technical assistance during construction and at commissioning. Sewerage tariff should be raised to adequately cover the costs of maintenance and equipment replacement.

	Action during the implementation:
	Same as above.
	Contingency plan (if applicable)
	Not yet due.
4. Other Risk	Probability: M
Deterioration of water quality in the project area caused by discharge of untreated non-domestic wastewater	Impact: M
	Analysis of probability and impact
	Illegal wastewater discharge may cause deteriorated water quality in water bodies in the project area.
	Mitigation measures:
	NWSDB should regularly share information on wastewater from small business monitors and ask to inspect wastewater disposal situation to prevent illegal wastewater dumping to public water bodies in the project area.
	Action during the implementation:
	Same as above.
	Contingency plan (if applicable)
	Not yet due.
Potential project risks	Assessment
5. Overall Risk Rating	Probability: M
	Impact: M

Possible major risks in the Project can be summarized as follows:

1. Program:

   SLLRDC must build the drainage channels before STP construction can start. SLLRDC and Ministry of Megapolis should be well-informed of the STP construction schedule and understand the critical nature of this step to timely project implementation. NWSDB and PMU should monitor the progress in drainage channel construction and take appropriate action to prevent any delay.

2. Delivery quality:

   - Adequate sewage flow is essential for determining if the Project is successful. Effort must be made to ensure sewer construction progresses on schedule. This includes regular meetings with and good coordination among relevant agencies.
   - An adequate budget should be secured for preventive maintenance of equipment to prevent breakdowns.