THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF CITY PLANNING AND WATER SUPPLY
MINISTRY OF POLICY PLANNING AND ECONOMIC AFFAIRS
NATIONAL WATER SUPPLY AND DRAINAGE BOARD

THE PROJECT FOR THE STRATEGIC MASTER PLAN UNDER THE SEWERAGE SECTOR IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA (PHASE 1)

SECTION II STRATEGIC SEWERAGE MASTER PLAN ④NUWARA ELIYA

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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TABLE OF CONTENTS

TABLE OF CONTENTS i

LIST OF TABLES iv

LIST OF FIGURES vi

ABBREVIATIONS AND TERMINOLOGY vii

EXECUTIVE SUMMARY ix

CHAPTER 1 BACKGROUND AND OBJECTIVES 1-1

1.1 BACKGROUND 1-1
1.2 OBJECTIVES AND SCOPE 1-2

CHAPTER 2 EXISTING CONDITIONS 2-1

2.1 ENVIRONMENTAL AND NATURAL CONDITIONS 2-1
2.1.1 Climate 2-1
2.1.2 Topography 2-2
2.1.3 Geology 2-3
2.1.4 Hydrology 2-3
2.1.5 Surface Water Quality and Quantity 2-4
2.1.6 Environmental Quality 2-7
2.1.7 Protected Areas 2-7
2.1.8 Fauna and Flora 2-8
2.2 SOCIAL CONDITIONS 2-10
2.2.1 Administration 2-10
2.2.2 Population and Demography 2-11
2.2.3 Health and Diseases 2-12
2.2.4 Religion and Ethnicities 2-12
2.2.5 Poverty Rate 2-13
2.2.6 History and Culture (Heritage) 2-13
2.2.7 Economy 2-13
2.2.8 Land Use 2-16
2.2.9 Water Supply and Sanitation 2-18
2.2.10 Solid Waste 2-20
2.3 NEED FOR THE PROJECT 2-22

CHAPTER 3 PLANNING BASIS FOR SEWERAGE SYSTEM 3-1

3.1 SANITATION PROVISION 3-1
3.1.1 Target Year 3-1
3.1.2 Planning and Design Basis and Criteria 3-1
3.1.3 Service Area Selection 3-3
3.1.4 Design Sewage Flow 3-4
3.1.5 Design Influent Wastewater Quality 3-5

CHAPTER 4 PRELIMINARY PLAN AND DESIGN OF THE SEWERAGE SYSTEM 4-1

4.1 GENERAL LAYOUT 4-1
4.2 SEWAGE COLLECTION FACILITIES 4-1
4.2.1 Sewer Network 4-1
4.2.2 SewagePumping Stations 4-2
4.2.3 Service/House Connections 4-2
4.3 SEWAGE TREATMENT FACILITY 4-2
4.3.1 Treatment Method 4-2
4.3.2 STP Site and General Layout of Unit Processes 4-5
4.3.3 Odour Control 4-6

4.3.4 Sewage Treatment Process 4-6
4.3.5 Sludge Treatment and Disposal 4-8
4.4 ON-SITE FACILITIES AND SEPTAGE MANAGEMENT 4-10
4.4.1 On-site Facilities 4-10
4.4.2 Septic Tanks 4-10
4.4.3 Septic Tank Operation & Maintenance 4-10

CHAPTER 5 INSTITUTIONAL ARRANGEMENTS FOR IMPLEMENTATION 5-1

5.1 PROJECT IMPLEMENTATION AND MANAGEMENT 5-1
5.1.1 Examples of Implementation Structures in Sri Lanka 5-1
5.1.2 Public Works in Nuwara Eliya MC 5-1
5.1.3 Organizational Options for Implementing Sewerage Works 5-3
5.1.4 Preferred Implementation Structure for Sewerage Works 5-3
5.2 ORGANIZATION FOR IMPLEMENTATION 5-4
5.2.1 Organization of the NWSDB Sewerage Department 5-4
5.2.2 Organization of RSC Central 5-5
5.2.3 Organization of Nuwara Eliya MC 5-6
5.3 CAPACITY DEVELOPMENT 5-6
5.3.1 Securing Human Resources 5-6
5.3.2 Development of Human Resources 5-8
5.3.3 Sewer Maintenance Equipment and Vehicles 5-8
5.3.4 Customer Service 5-9
5.4 CONSTRUCTION MANAGEMENT FOR THE PROJECT 5-9
5.4.1 PMU 5-9
5.4.2 Project Office 5-9

CHAPTER 6 COST ESTIMATE AND PROCUREMENT 6-1

6.1 PROJECT COST 6-1
6.1.1 Construction and Project Costs 6-1
6.1.2 Operation and Maintenance (O&M) Cost 6-1
6.2 PHASED CONSTRUCTION 6-2

CHAPTER 7 FINANCING SEWERAGE PROJECT 7-1

7.1 FINANCIAL CONDITION OF NUWARA ELIYA MUNICIPAL COUNCIL 7-1
7.1.1 Financial Statements 7-1
7.1.2 Financial Condition of the Water Supply Sector in Nuwara Eliya MC 7-4
7.2 FINANCING SEWERAGE FACILITY CONSTRUCTION AND O&M 7-5
7.2.1 Construction, O&M and Replacement Costs 7-5
7.2.2 Sewage Tariffs 7-5
7.2.3 Assumptions for Calculating the Proposed Tariff 7-7
7.2.4 Sewage Tariff Calculation 7-7
7.2.5 Ability to Pay 7-8
7.2.6 Sewage Tariff Tables (Type 2 NWSDB) 7-9
7.3 FINACIAL PLAN CONCLUSIONS 7-10

CHAPTER 8 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS 8-1

8.1 EXISTING CONDITIONS 8-1
8.2 REGULATIONS AND ORGANIZATIONS RELEVANT TO ESC 8-1
8.3 COMPARISON WITH JICA GUIDELINES 8-1
8.4 INTERNATIONAL COMMITMENTS 8-1
8.5 ENVIRONMENTAL SCOPING 8-1
8.6 TOR FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS STUDY 8-3
8.6.1 Purpose 8-3
8.6.2 Items to be Targeted and Evaluated in the Study 8-3
8.6.3 Target Areas 8-3
8.6.4 Target Periods 8-3

8.6.5 Contents and Methods for ESC Study 8-3
8.6.6 Prediction and Evaluation of Potential Impacts 8-5
8.6.7 EMP and EMoP 8-5
8.6.8 Stakeholder Consultation 8-5
8.7 DRAFT EMP AND EMOP 8-5
8.8 SCHEDULE OF ESC ACTIVITIES 8-6

CHAPTER 9 CONCLUSION AND RECOMMENDATION 9-1

9.1 F/S IMPLEMENTATION 9-1
9.2 RISK AND MITIGATION MEASURES 9-1
9.3 CONCLUSION AND RECOMMENDATIONS 9-1

APPENDICES A-1

APPENDIX 1:Nuwara Eliya Waste Water Flow Calculation A-1
APPENDIX 2: Inflow Sewage Quality A-2
APPENDIX 3:Draft Amendment of Tolerance Discharge Limits A-4
APPENDIX 4: Draft Amendment of Tolerance Discharge Limits A-18
APPENDIX 5: Land Confirmation for STP A-21
APPENDIX 6: General Layout of Septic Tank A-22
APPENDIX 7: Regulations and Organizations Related to ESC A-24
APPENDIX 8: Detail of Annual Fund Requirement A-25
APPENDIX 9: Breakdown of Operating Expenditure A-26
APPENDIX 10: Regulations and Organizations Related to ESC A-27
APPENDIX 11: Comparison with JICA Guidelines A-31
APPENDIX 12: International Commitments related to ESC A-32
APPENDIX 13: Record of Consultation with Public and Authorities A-33
APPENDIX 14: Draft EMP and EMoP A-36

LIST OF TABLES

Table 2.1-1 Surface Water Quality (Nuwara Eliya) 2-4
Table 2.1-2 Flow Rates (Nuwara Eliya) 2-7
Table 2.1-3 Survey of Fauna in the Project Area 2-9
Table 2.1-4 Survey of Flora in the Project area 2-9
Table 2.2-1 Population of Nuwara Eliya MC Area 2-12
Table 2.2-2 Prevalence of Chronic Illnesses by Age Group 2-12
Table 2.2-3 Prevalence of Diabetes and Hypertension 2-12
Table 2.2-4 Population by Religion 2-13
Table 2.2-5 Population by Ethnicity 2-13
Table 2.2-6 Poverty Rates 2-13
Table 2.2-7 Culturally Significant Sites in the Project Area 2-13
Table 2.2-8 GDP by Industry Sector in Central Province (Current Prices) 2-14
Table 2.2-9 Nuwara Eliya District Tourist Arrival and Revenue 2-14
Table 2.2-10 Breakdown of Monthly Household Income for Nuwara Eliya District (2012/13) 2-16
Table 2.2-11 Land Use in Nuwara Eliya District 2-17
Table 2.2-12 Land Use in Nuwara Eliya MC 2-17
Table 2.2-13: Drinking Water Facilities by Type in Nuwara Eliya MC Area 2-19
Table 2.2-14 Water Consumption by Consumer Type 2-19
Table 2.2-15 Sanitation Facilities in the Project Area 2-20
Table 2.2-16 Solid Waste Generation by Sector 2-21
Table 2.2-17 Types of Solid Waste – Nuwara Eliya MC 2-21
Table 3.1-1 Design Basis for Estimating Sewage Flow 3-1
Table 3.1-2 Coefficients for Sewer Design 3-2
Table 3.1-3 Pipe Materials 3-2
Table 3.1-4 Type of Pumping Stations 3-2
Table 3.1-5 DSDs and GNDs in the M/P Area 3-4
Table 3.1-6 Design Sewage Flow 3-4
Table 3.1-7 Design Influent Wastewater Quality 3-5
Table 4.2-1 Major Sewer Mains 4-2
Table 4.2-2 Main Pumping Stations 4-2
Table 4.3-1 Assumed Quality of Influent and Effluent 4-7
Table 5.1-1 Organization of Water and Sewerage Works in 6 Municipalities 5-1
Table 5.1-2 Public Works in Nuwara Eliya MC 5-2
Table 5.1-3 Organizational Options for Implementing Sewerage Works 5-3
Table 5.2-1 Roles of NWSDB and MC at Various Project Implementation Stages 5-4
Table 5.2-2 Sewerage System Tasks and Responsibilities 5-6
Table 5.3-1 Faculties at National Universities and Technical Colleges/High Schools 5-7
Table 5.3-2 Comparison of Salaries and Benefits between NWSDB and Private Sector 5-7
Table 5.3-3 Required Training Programs for Sewerage Systems 5-8
Table 5.3-4 Sewer Maintenance Equipment & Vehicles Used at Existing Sewerage Systems 5-9
Table 6.1-1 Estimated Project Cost 6-1
Table 6.1-2 Estimated O&M Cost 6-2
Table 7.1-1 Financial Balance Sheet for Nuwara Eliya MC 7-1
Table 7.1-2 Revenue & Expenditure Statement for Nuwara Eliya MC 7-2
Table 7.1-3 Cash Flow Statement for Nuwara Eliya MC 7-2
Table 7.1-4 Revenue from Admission Fees 2009-2015 for 3 Tourist Attractions 7-3
Table 7.1-5 2015 Income and Expenditures - Nuwara Eliya MC Water Supply 7-4
Table 7.1-6 Income and Expenditure Trend - Nuwara Eliya MC Water Supply 7-4
Table 7.2-1 Calculation of Type 1 Sewage Tariff for Nuwara Eliya MC 7-7
Table 7.2-2 Calculation of Type 2 Sewage Tariff (3rd Increment) for Nuwara Eliya MC 7-8
Table 7.2-3 Example of Domestic Sewage Tariff (for 2024) 7-9
Table 7.2-4 Example of Non-Domestic Sewage Tariff: (in 2024) 7-10

Table 8.5-1 Environmental Scoping..... 8-1
Table 8.6-1 The ESC Study Associated with the Project 8-3
Table 9.2-1 Risks and Mitigation Measures..... 9-1

LIST OF FIGURES

Figure 2.1-1 Average Monthly Maximum and Minimum Temperatures 2-1
Figure 2.1-2 Average Monthly Precipitation 2-1
Figure 2.1-3 Elevation Map of the Project Area 2-2
Figure 2.1-4 Regional Geology 2-3
Figure 2.1-5Figure 2.1-5: Drainage Network and Surface Water Bodies in the Project Area 2-4
Figure 2.1-6 Water Sampling Locations 2-5
Figure 2.1-7 Water Pollution in Nuwara Eliya 2-6
Figure 2.1-8 Environmental Protection Areas of Lake Gregory 2-8
Figure 2.2-1 Administrative Areas of Nuwara Eliya MC 2-11
Figure 2.2-2 Nuwara Eliya District Tourist Arrival 2-15
Figure 2.2-3 Nuwara Eliya District Tourism Revenue 2-15
Figure 2.2-4 Comparison of Monthly Household Income 2-16
Figure 2.2-5 Land Use in the Project Area 2-18
Figure 2.2-6 Moon Plains Semi-Engineered Sanitary Landfill Site 2-21
Figure 3.1-1 Service Area Selected in the M/P for Nuwara Eliya MC 3-3
Figure 4.1-1 Proposed Sewerage Development in Nuwara Eliya MC 4-1
Figure 4.3-1 Nitrogen Cycle 4-3
Figure 4.3-2 Kandy Sewage Treatment Plant 4-4
Figure 4.3-3 Schematic of Oxidation Ditch Process 4-4
Figure 4.3-4 Candidate Site (Left: Viewed from South, Right: Viewed from North) 4-5
Figure 4.3-5 Treatment Plant Layout 4-6
Figure 4.3-6 Flow Schematic for Sludge Treatment 4-8
Figure 4.3-7 Diagram of Pressurized Screw Press 4-8
Figure 4.3-8 Sludge Disposal Options 4-9
Figure 4.3-9 Pile Composting 4-9
Figure 5.2-1 Organization of the NWSDB Sewerage Department 5-4
Figure 5.2-2 Proposed Re-organization of the NWSDB Sewerage Department 5-5
Figure 5.2-3 NWSDB Sewerage Department Responsibilities for Project Implementation 5-5
Figure 7.1-1 Trend of Victoria Park Admission Revenue 7-3
Figure 7.1-2 Trend of Gregory Lake Admission Revenue 7-3
Figure 7.1-3 Trend of Moon Plane Admission Revenue 7-3
Figure 7.1-4 Trend of Total Admission Revenue 7-3
Figure 7.1-5 Income & Expenditure Trend - Nuwara Eliya MC Water Supply 7-5
Figure 7.2-1 Difference Between Type 1 and Type 2 Sewage Tariff 7-6
Figure 7.2-2 Implementation Schedule for Tariffs 7-7
Figure 7.2-3 Comparison of Type 1 7-9
Figure 7.2-4 Comparison of Type 2 Sewage Tariff and Ability to Pay 7-9
Figure 8.8-1 Schedule for ESC Surveys 8-6

ABBREVIATIONS AND TERMINOLOGY

ADB	Asian Development Bank
ADWF	Average Dry Weather Flow
AFD	Agence Française de Development
Addl. GM	Additional General Manager
ASRT	Aerobic Solids Retention Time
AGM	Assistant General Manager
ATP	Ability to Pay
BOD	Biochemical Oxygen Demand
BOI	Board of Investment
CBO	Community Based Organization
CP	Counterpart
CEA	Central Environmental Authority
CMC	Colombo Municipal Council
CODCr	Chemical Oxygen Demand
DCS	Department of Census and Statistics
DGM	Deputy General Manager
DMMC	Dehiwala – Mt. Lavinia Municipal Council
DNB	Department of National Budget
DNP	Department of National Planning
DO	Dissolved Oxygen
DS	Divisional Secretariats
EC	Electric Conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMoP	Environmental Monitoring Plan
EPL	Environmental Protection License
EPZ	Export Processing Zone
ERD	Department of External Resource
ETWWA	Energy, Transport, and Water department of the World Bank
F/S	Feasibility Study
FY	Financial Year
GC	Greater Colombo
GOSL	Government of Sri Lanka
GCS	Greater Colombo Sewerage
IBRD	International Bank for Reconstruction and Development
IEE	Initial Environmental Examination
IFRS	IEE
IRR	Internal Rate of Return
JBIC	Japan Bank for International Cooperation
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
JECES	Japan Education Centre of Environmental Sanitation
JPY	Japanese Yen
JSWA	Japan Sewage Works Agency
LKR	Sri Lanka Rupee
MASL	Mahaweli Authority in Sri Lanka

M&E	Mechanical and Electrical
MC	Municipal Council
M/M	Minutes of Meeting
MOPPEA	Ministry of Policy Planning and Economic Affairs
MOCPWS	Ministry of City Planning and Water Supply
MOPCLG	Ministry of Provincial Councils & Local Government
MRT	Minimum Rate Test
MTPS	Manhole Type Pumping Station
NH3-N	Ammonia Nitrogen
NWSDB	National Water Supply & Drainage Board
O&M	Operation and Maintenance
OD	Oxidation Ditch
PDWF	Peak Dry Weather Flow
PMU	Project Management Units
PO	Plan of Operations
PPIAF	Public-Private Infrastructure Advisory Facility
PS	Pradeshiya Sabha
ROA	Return on Asset
ROE	Return on Equity
RSC	Regional Support Centre
R/D	Record of Discussion
SIDA	Swedish International Development Cooperation Agency
SJKMC	Sri Jayawardenapura Kotte Municipal Council
SLS	Sri Lanka Standard
SRT	Solids Retention Time
STP	Sewage Treatment Plant
PPTA	Project Preparatory Technical Assistance
T-N	Total Nitrogen
TOR	Terms of Reference
T-P	Total Phosphorus
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
UC	Urban Council
UDA	Urban Development Authority
UNDP	The United Nations Development Programme
WACC	Weighted Average Cost of Capital
WAST	Weighted Average Sewage tariff
WB	World Bank
WDF	Wastewater Discharge Fee
WHO	World Health Organization
WQI	Water Quality Index
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

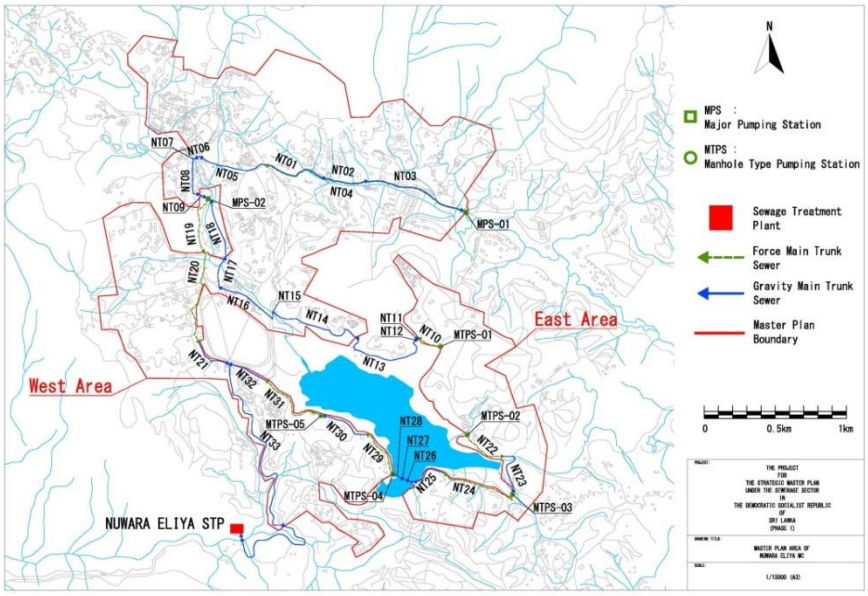
Chapter 1 describes the Project background and objectives and the Strategic Sewerage Master Plan for the entire country. The Strategic Master Plan identifies 15 priority cities and explains the process used to select the following five cities to be covered by the City Sewerage Master Plan.

- Sri Jayawardenapura Kotte MC
- Anuradhapura MC
- Badulla MC
- Nuwara Eliya MC
- Dehiwala-Mount Lavinia MC

Chapter 2 examines the environmental and socio-economic conditions of Nuwara Eliya MC and the need for a sewerage system. Increasing levels of Biochemical Oxygen Demand (BOD) and coliform bacteria are detected in Lake Gregory, nestled in a nature reserve, indicating the deterioration of its water quality due to human activities. The average household income in Nuwara Eliya District is 17% lower than the national average. This means that the service area of the sewerage system needs to be limited to locations where sewage can be collected and treated more cost effectively than other options.

Chapter 3 sets out the basic conditions for the preparation of the sewerage plan for Nuwara Eliya. The plan is to serve an area of 515 ha by 2046. The served population is estimated to be 19,100 and the maximum daily wastewater flow will be 4,700 m^3.

Chapter 4 describes the sewerage facility plan and design. The sewer route and locations of pumping stations and sewage treatment facilities are shown in **Figure 1**. Treatment will be achieved by the oxidation ditch (OD) process similar to the one in Kandy MC, because of its low maintenance requirements and high capability to perform advanced treatment such as nitrogen removal. Sludge generated will be dewatered with screw press machines and then composted.



Source: JET

Figure 1 Map of Sewer System Plan for Nuwara Eliya MC

Chapter 5 proposes that the sewerage system be operated and maintained by Nuwara Eliya MC, as it already administers the water supply system. Since engineers specialized in sewage treatment are in short supply, it is recommended that O&M be entrusted to National Water Supply & Drainage Board (NWSDB), which should also take charge of the planning and construction phases because of its extensive experience in these activities.

Chapter 6 estimates the project costs at approximately 7.9 billion Japanese Yen (JPY) (excluding tax), and the annual maintenance cost at 52 million JPY, as shown in **Table 1**.

Table 1 Estimated Project Cost

			Amount		Total Amount	Total Amount
			L.C. (LKR)	F.C. (JPY)	LKR	JPY
1	Construction Cost					
	A	Nuawra Eliya STP (Q=4,700m3/day)	786,161,039	758,016,000	1,770,597,403	1,363,360,000
	B	Trunk Sewer & Pump Station	1,544,441,000	1,168,923,000	3,062,523,000	2,358,143,000
	C	Branch Sewer & Pump Station	1,048,513,000	352,170,000	1,505,877,000	1,159,525,000
	D	House Connection	477,500,000	0	477,500,000	367,675,000
	Sub-total of 1(A-D)		3,856,615,039	2,279,109,000	6,816,497,403	5,248,703,000
2	Administration cost		484,000,000	0	484,000,000	372,680,000
3	Consulting cost		374,000,000	682,000,000	1,259,714,000	969,980,000
4	Physical contingency for construction cost		239,000,000	125,000,000	401,338,000	309,030,000
5	Price escalation for construction cost		926,000,000	218,000,000	1,209,117,000	931,020,000
6	Land acquisition and compensation		-	-	-	-
7	Interest during construction		0	64,000,000	83,117,000	64,000,000
8	Front-end Fee		0	15,000,000	19,481,000	15,000,000
9	Tax and duty		1,753,000,000	0	1,753,000,000	1,349,810,000
	Sub-total of (2-9)		3,776,000,000	1,104,000,000	5,209,766,000	4,011,520,000
	Total including Tax and Duty		7,632,615,039	3,383,109,000	12,026,263,000	9,260,223,000
	Total excluding Tax and Duty		5,879,615,039	3,383,109,000	10,273,263,000	7,910,413,000
	Eligible Portion (1, 3, 4, 5 and 7)		5,395,615,039	3,368,109,000	9,769,783,000	7,522,733,000
	Non-Eligible Portion (2, 6, 8 and 9)		2,237,000,000	15,000,000	2,256,481,000	1,737,490,000

Source: JET

Chapter 7 proposes two sewage tariff schemes to recover the maintenance cost. Type 1 tariff would cover the maintenance cost for the sewerage system in Nuwara Eliya, while Type 2 is based on the sewerage systems operated by NWSDB. Type 1 is calculated to be 50.42 LKR/m^3, and Type 2, 39.66 LKR/m^3, both are within the limits of affordability estimated by the World Bank (WB). The construction cost will be borne by the central government.

Chapter 8 describes the factors that are likely to affect the local natural or social environment and proposes the parameters to be appraised in an Environmental and Social Considerations Study in the F/S phase.

Chapter 9 concludes that the Nuwara Eliya Sewerage Project will make a significant positive impact on the preservation and improvement of Lake Gregory water quality, which is of high priority because of the area's importance as an internationally popular tourism destination.

The site for building the Sewage Treatment Plant (STP) has been selected for this Project. The locations of the pumping stations have yet to be identified. All facility locations and required areas should be determined during the F/S. The Project includes the construction of a bridge to access the STP, by excavating and grading the plot belonging to the Forestry Bureau at the foot of a mountain. The F/S should include geotechnical and other basic investigations so that the construction cost can be estimated accurately.

CHAPTER 1 BACKGROUND AND OBJECTIVES

1.1 BACKGROUND

The Democratic Socialist Republic of Sri Lanka had a per capita income of 3,162 USD in 2013, and an economic growth rate of 7.3% (source: JETRO website, Basic economic indicators of Sri Lanka). Steady economic growth increased the per capita income to 4,000 USD by 2016, and most Sri Lankans are approaching upper-middle income. The robust economic growth has spurred urbanization and increased water usage, and the volume of domestic and industrial wastewater has increased sharply.

In 2014, only 2.4% of the country had urban sewerage coverage. A considerable amount of untreated wastewater is discharged into the ocean, rivers, and streams, causing problems related to hygiene and environmental degradation.

The national policy formulated in 2010 (Source: Department of National Planning (DNP), Mahinda Chintana Vision for the Future), highlights the importance of poTable water supply and sewerage services as an integral element of sustainable development. The Government announced its intention to achieve 100% sanitation coverage by 2025 through the provision of on and off-site sanitation facilities. NWSDB sets forth the objective to achieve 7.0% sewerage coverage by 2020.

The Government committed to developing the Strategic Master Plan for the sewerage sector to achieve the 2025 target as well as meet the stringent environmental standards introduced by the Central Environmental Authority (CEA) to mitigate pollution of water environment. The Government sought assistance from Japan. The Japanese government accepted the request and subsequently Japan International Cooperation Agency (JICA) signed the Record of Discussions (R/Ds) on this project with the Sri Lankan side in August 2015 and was assigned to carry-out a study and formulate the Strategic Master Plan.

As agreed upon with the Sri Lankan side, the outline of the project is as follows:

(1) Purpose

To develop the Strategic Master Plan (M/P) to address sewerage issues in the major cities of Sri Lanka, to mitigate to some extent the pollution of rivers and ocean.

(2) Outputs

1) Strategic Sewerage M/P for Sri Lanka
2) City Sewerage M/P for priority cities
3) Feasibility Studies (F/S) for selected cities
4) Enhanced capacity at the National Water Supply and Drainage Board (NWSDB) and cities selected for F/S

The Strategic Sewerage M/P was formulated in 2016 (from January to June) and can be found in Section I of this Report. The M/P aims to improve the overall water environment through the development of sewerage systems and improvement of on-site sanitation facilities. 79 major cities in the country were evaluated using the following six criteria. An approach to the sewerage system development was proposed.

- Urbanization
- Sanitation
- Urban development

- Sustainability of sewerage service
- Water environment
- Maturity of sewerage project plan

15 cities are designated as priorities for the implementation of sewerage systems to achieve the target of 7.0% coverage by 2035. These are: Colombo MC, Kandy MC, Sri Jayawardenapura Kotte MC, Anuradhapura MC, Badulla MC, Kelaniya PS, Nuwara Eliya MC, Galle MC, Dehiwala-Mount Lavinia MC, Negombo MC, Koticawatta-Mulleriyawa PS, Ratnapura MC, Hambantota MC, Trincomalee UC, and Maharagam UC.

Septic tanks are commonly used for domestic wastewater treatment. It is important to de-sludge and treat septage to maintain proper operation. The M/P outlines the approach to improve on-site sanitation with septage treatment facility. 11 cities are identified as urgently requiring septage treatment facilities, and another 13 cities will be targeted in the next phase.

Five of the 15 priority cities are selected for the development of sewerage master plans based on the following criteria.

- Colombo MC and cities that have sewerage projects with funding assistance from other countries and international donors.
- Cities that are targeted for local development but have no sewerage services.

The five cities selected are:

- Sri Jayawardenapura Kotte MC
- Anuradhapura MC
- Badulla MC
- Nuwara Eliya MC
- Dehiwala-Mount Lavinia MC

The Report (Section II-(4)) presents the Sewerage M/P for Nuwara Eliya MC as part of the Project's Output (2).

1.2 OBJECTIVES AND SCOPE

This Report describes the sewerage development plan to improve the water environment in Nuwara Eliya MC. The sewerage service area and the conditions for implementing the project are identified.

CHAPTER 2 EXISTING CONDITIONS

2.1 ENVIRONMENTAL AND NATURAL CONDITIONS

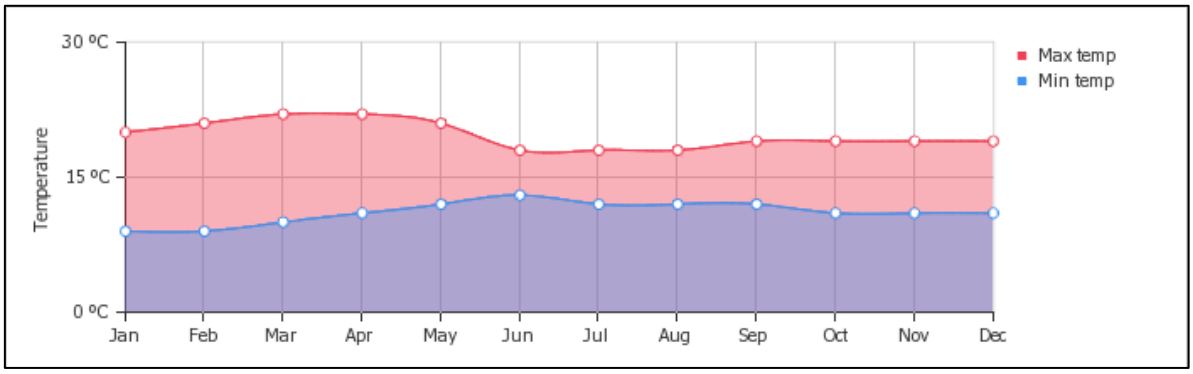
2.1.1 Climate

(1) General

Nuwara Eliya lies in the Central Province of Sri Lanka, bordered by Kandy District to the north, Kegalle District to the north-west, Ratnapura District to the south-west and Badulla District to the east. It records the highest rainfall and the lowest temperature in the country.

(2) Temperature

Temperatures vary from 60°F to 80°F for most of the year. February temperature can go down to 7.2°C or below freezing.

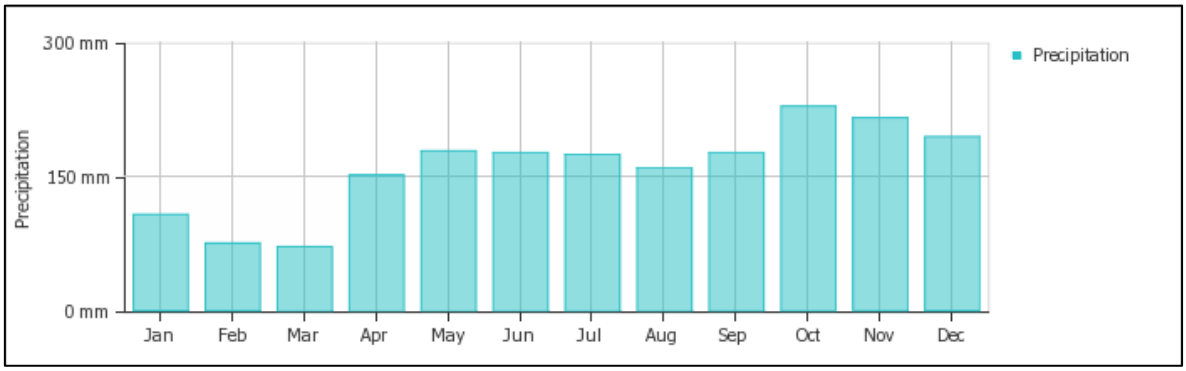


Source: JET, using Department of Meteorology data

Figure 2.1-1 Average Monthly Maximum and Minimum Temperatures

(3) Precipitation

Southeast and northwest monsoons bring heavy rain. Northeast monsoon starts in June and lasts until September, bringing heavy rain and wind to the area. Annual average rainfall is 2,500 mm. Watawala has the highest annual rainfall, exceeding 5,588 mm.



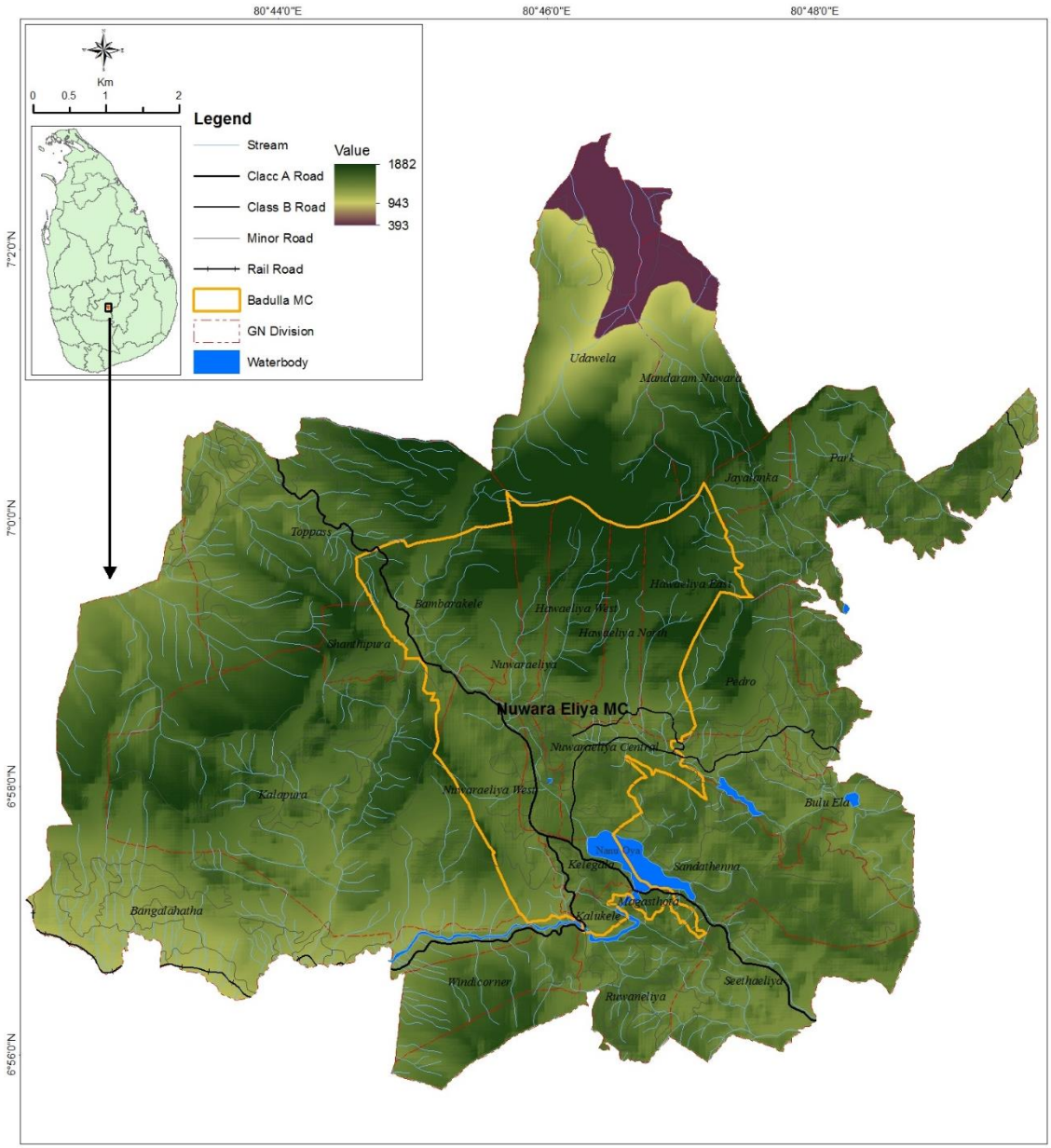
Source: JET, using Department of Meteorology data

Figure 2.1-2 Average Monthly Precipitation

2.1.2 Topography

Nuwara Eliya is situated 1,868 meters above sea level. An elevation map of the area is given in **Figure 2.1-3**.

Nuwara Eliya is in the middle of the country's highest Peneplain. The surrounding area consists of massive mountain ranges, plateaus, valleys, basins and escarpments. Horton Plains, Hawa Eliya, Mipilimana, Sita Eliya and Ambewela are the high plains. Rivers are fast flowing except for the Mahaweli River, which cuts across the central mountains.



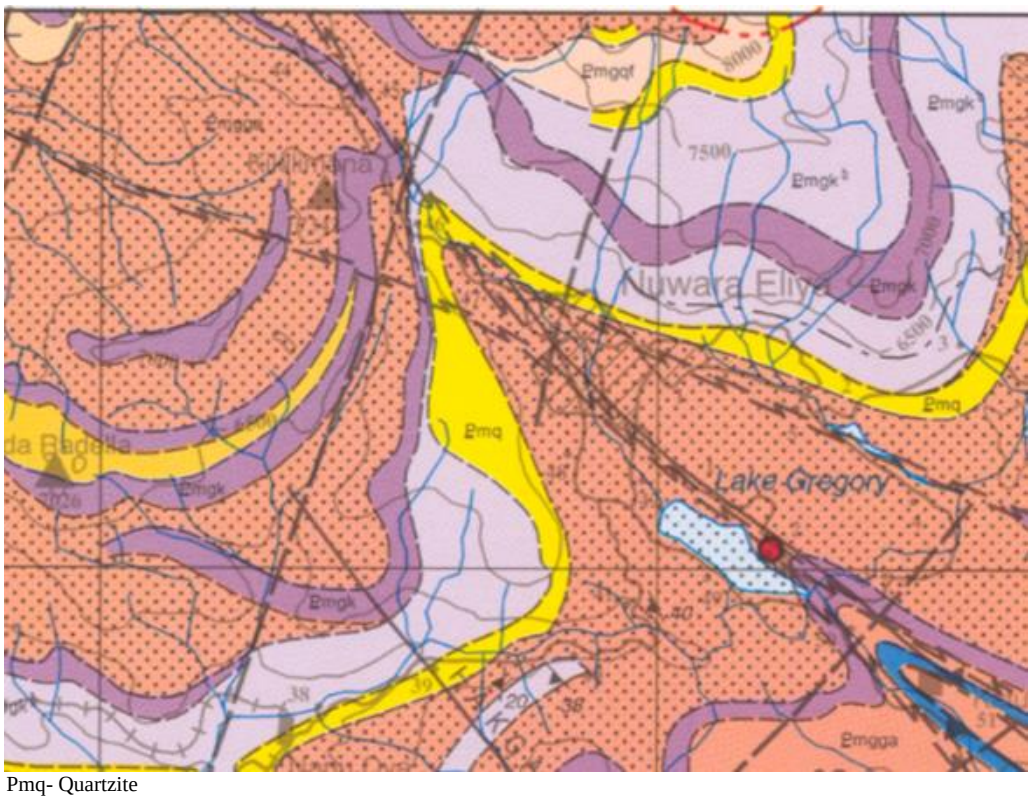
Source: Survey Department of Sri Lanka

Figure 2.1-3 Elevation Map of the Project Area

The southern edge of the highest Peneplain forms the southern wall of the hill country, stretching for more than 50 miles from Adam's Peak or Sri Pada (7,360') on the west to the Nine Peaked Mountain (6,360') on the east, and as high as 7,857' (Kirigalpotta) to 8,292' (Pidurutalagala).

2.1.3 Geology

The area is situated in the highland series of the Precambrian Complex. The granulite facies rocks (gneisses, sillimanite-graphite gneisses, quartzite, marbles, and some charnokites) make up most of the area of Nuwara Eliya. The area is generally covered by dense soil, and the bed rock is not visible in most places. The quartzites give rise to frequent landslides. Regional geology of the area is shown in **Figure 2.1-4**.



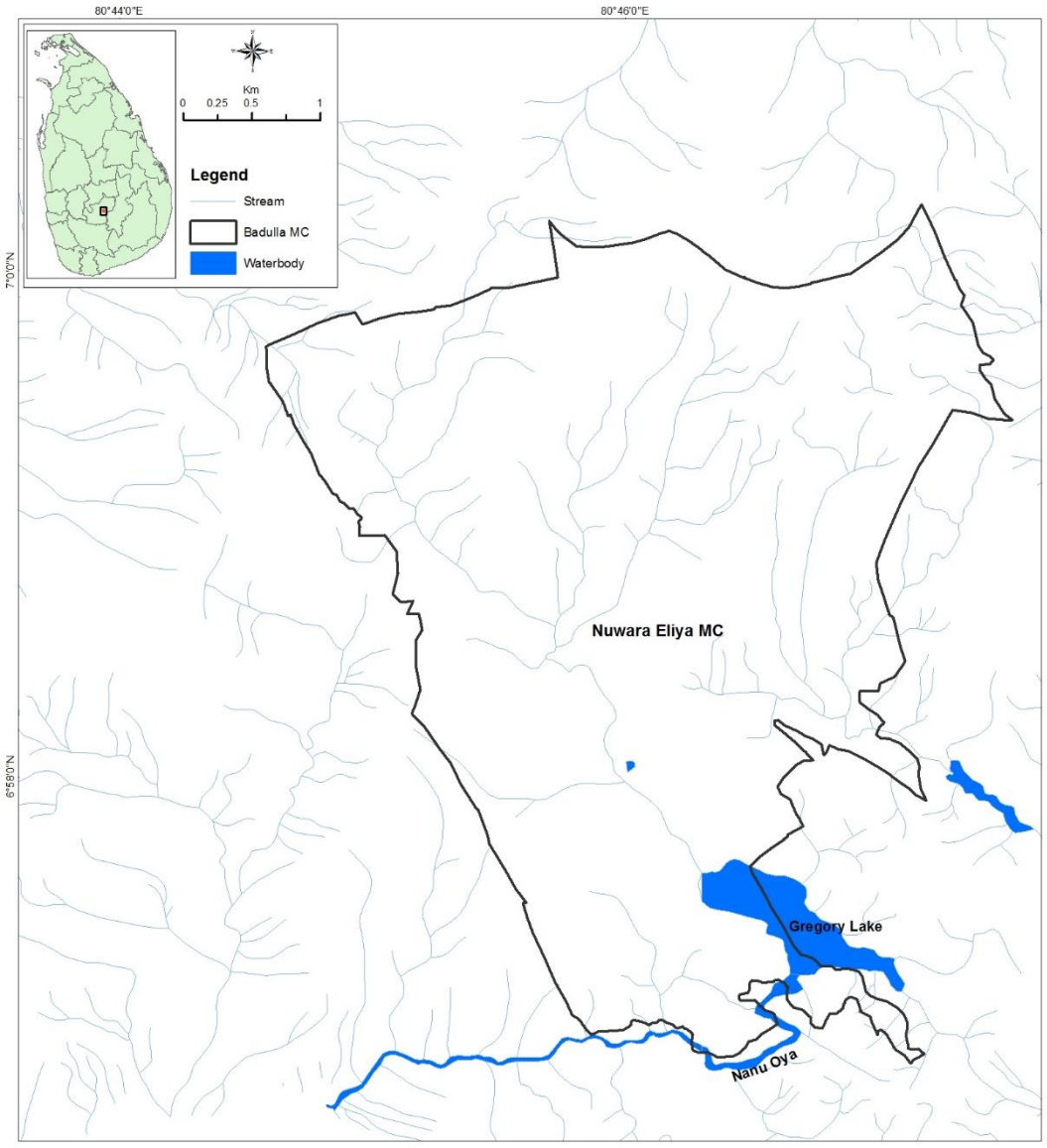
Pmq- Quartzite
Pmgga- Garnet Sillimanite Biotite Gneiss
Pmgk- Charnockckitik Gneiss
Source: Geological Surveys and Mines Bureau

Figure 2.1-4 Regional Geology

2.1.4 Hydrology

The district of Nuwara Eliya is drained by head streams of the Mahaweli, Kelani and Walawe river systems. Cross faults resulting in steep escarpments allow the streams to descend steeply from one level to another, forming cascades of waterfalls.

All the main drainage paths flow towards Lake Gregory, a small, man-made lake, located within the Nuwara Eliya Municipality. Nanu Oya stream, which originates from Pidurutalagala Peak, is a major tributary. Most of the streams in the catchment area have been changed over the years because of commercial agriculture. Drainage network and surface water bodies in the area are shown in **Figure 2.1-5**.



Source: Survey Department of Sri Lanka

Figure 2.1-5Figure 2.1-5: Drainage Network and Surface Water Bodies in the Project Area

2.1.5 Surface Water Quality and Quantity

(1) Water Quality

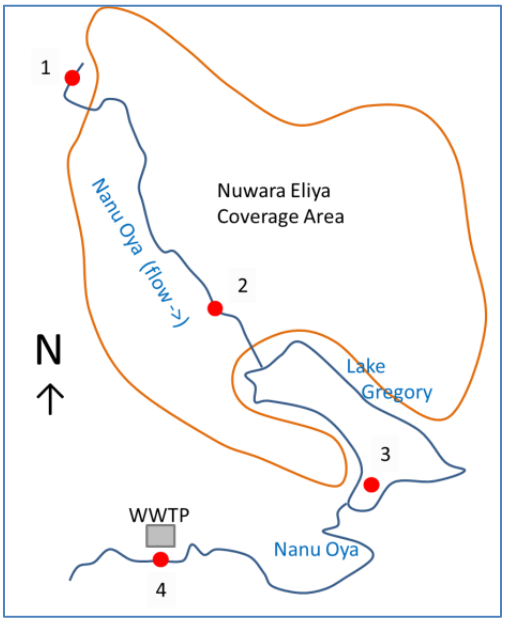
Water quality at sampling stations (1-4) in Nuwara Eliya is shown in the **Table 2.1-1**. The locations of sampling stations are shown in the **Figure 2.1-6**.

Table 2.1-1 Surface Water Quality (Nuwara Eliya)

Nuwara Eliya		1	2	3	4	Criteria
pH	-	8.5	8.5	8.8	8.4	-
Temperature	^{o}C	17.3	18.1	22.1	20.7	-
Odor	-	unobjectionable				ND
Color	mg Pt/L	30	<15	<15	27	100

Nuwara Eliya		1	2	3	4	Criteria
EC	uS/cm	69	126	124	127	700
Turbidity	NTU	6	10	56	27	-
Total Suspended Solids (TSS)	mg/l	3	12	34	14	40
TDS	mg/l	56	90	80	90	-
DO	mg/l	6.1	2	7.7	7	5
BOD	mg/l	<4	<4	12	<4	4
COD	mg/l	<4	19	44	42	15
Nitrate	mg/l	0.64	1.22	0.3	1.22	10
Ammonia	mg/l	0.08	0.11	<0.02	0.32	0.59
Total Phosphorus (T-P)	mg/l	0.05	0.13	0.19	0.15	-
PO_4^{3-} - P	mg/l	0.04	0.11	0.13	0.11	0.4
Cl	mg/l	2.5	7	7	7.7	600
Total Nitrogen (T-N)	mg/l	0.75	0.85	0.36	1.6	-
Fecal Coliform	/100ml	93	$3x10^2$	$3x10^2$	100	$1x10^3$
Total Coliform	/100ml	$18x10^4$	$68x10^4$	$20x10^5$	$10x10^5$	$1x10^4$

*) Over the criteria
Source: JET



Source: JET

Figure 2.1-6 Water Sampling Locations

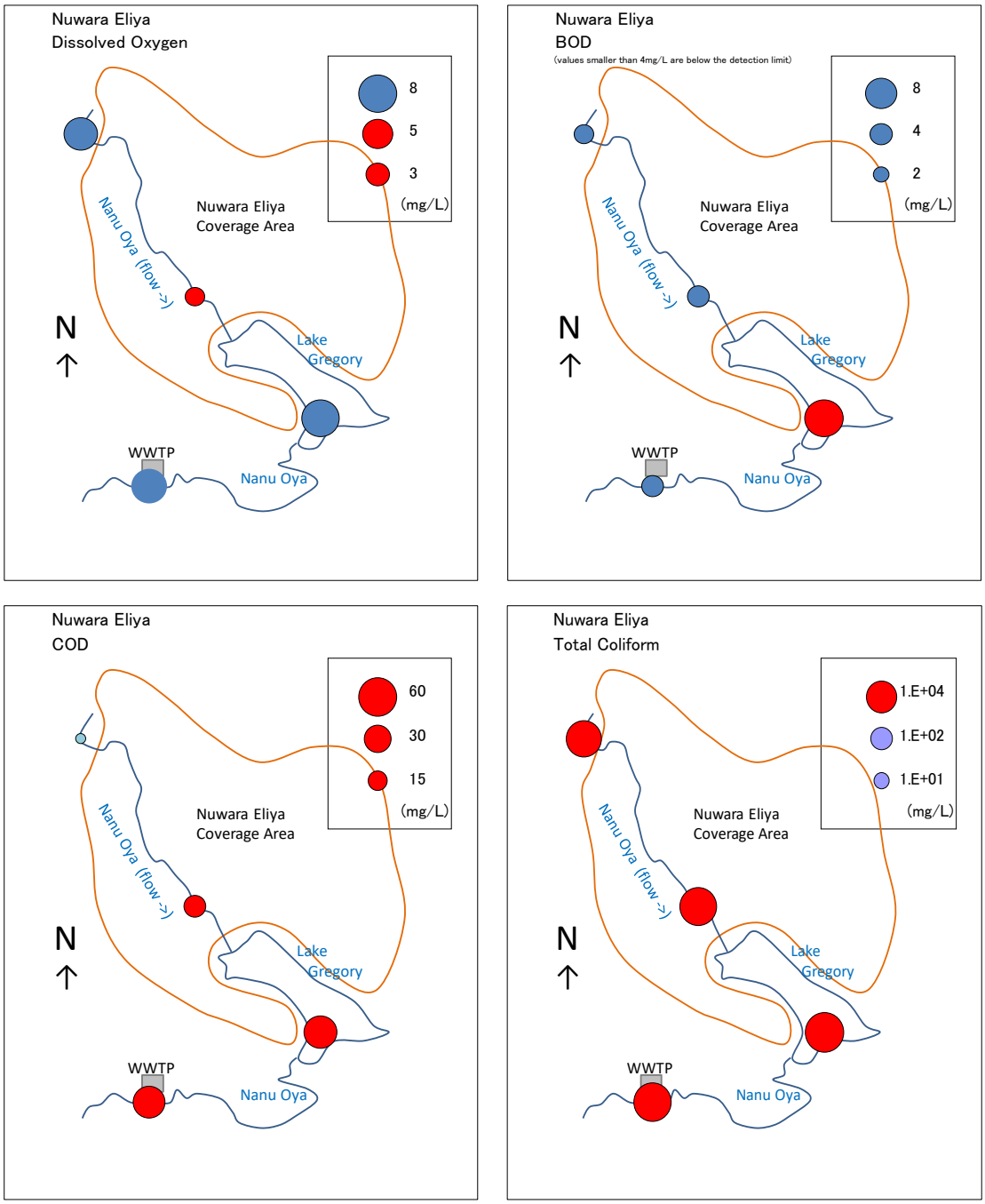
The criteria for evaluating water quality are based on the "National Environmental Regulations, No.1 of 2014" and "Draft Revised Ambient Water Quality Standards (2016)". The values are chosen from Category C (Fish and Aquatic Life Water) for normal environmental standards. When they are not available from Category C, the lowest values from Categories D, E and F are used.

DO, BOD, COD and total coliform levels at all 4 sampling locations exceed the standard values.

Sampling station 1 is upstream and 2 is downstream of the planned coverage area. 3 is in the lake near

the outlet and 4 is downstream of the planned STP discharge area. All four locations show some level of pollution (**Figure 2.1-7**).

DO distribution indicates pollution in the coverage area (town area). DO values can be improved by dilution and movement downstream. BOD distribution indicates pollution by accumulation of pollutant in the lake. COD distribution indicates a combination of pollution by the coverage area and by the accumulation in the lake. Total coliform distribution indicates pollution in the whole area.



*) Red indicators shows the values are above the criteria
Source: JET

Figure 2.1-7 Water Pollution in Nuwara Eliya

(2) Effect of Implementing a Sewerage System

Sewage treatment will deal with DO, BOD, COD and total coliform, the typical types of pollution in Nuwara Eliya MC. Water with low DO will be improved by aeration in the reactor tank at the STP. Organic decomposition in the activated sludge process will reduce the BOD load in the lake and the COD load in the river and the lake. Total coliform will be reduced by chlorination. The sewerage system will contribute to improvement of water environment in Nuwara Eliya MC.

(3) Water Quantity

The flow rates at the sampling stations 3, 4 and 7 on 2nd September 2016 are shown below.

Table 2.1-2 Flow Rates (Nuwara Eliya)

Station	Flow Rate (m^3/s)	Incremental Flow (%)	Date
1	0.577	-	02-09-2016
2	0.985	70.71	
4	1.488	51.11	

Source: JET

2.1.6 Environmental Quality

(1) Air Quality

No recent records on air quality measurements in the Nuwara Eliya area are available.

Vehicle movements along A5 highway (Peradeniya-Badulla-Chenkaladi highway), A7 highway (Awissawella-Hatton-Nuwara Eliya highway), B332 (Uda Pussellawa Road) and side roads and trains contribute to elevated levels of air pollutants, such as dust, particulate matter and smoke, especially during peak hours when traffic is very congested. Solid wastes thrown in the canals rot and produce foul odours, especially during dry weather when water level is low.

Volatile pesticides used in agriculture can easily escape into the air. As the area receives heavy rainfall, the accumulation of these pollutants in the atmosphere for long periods are quite unlikely.

(2) Noise and Vibration

No records on noise level or vibration measurements in Nuwara Eliya area are available.

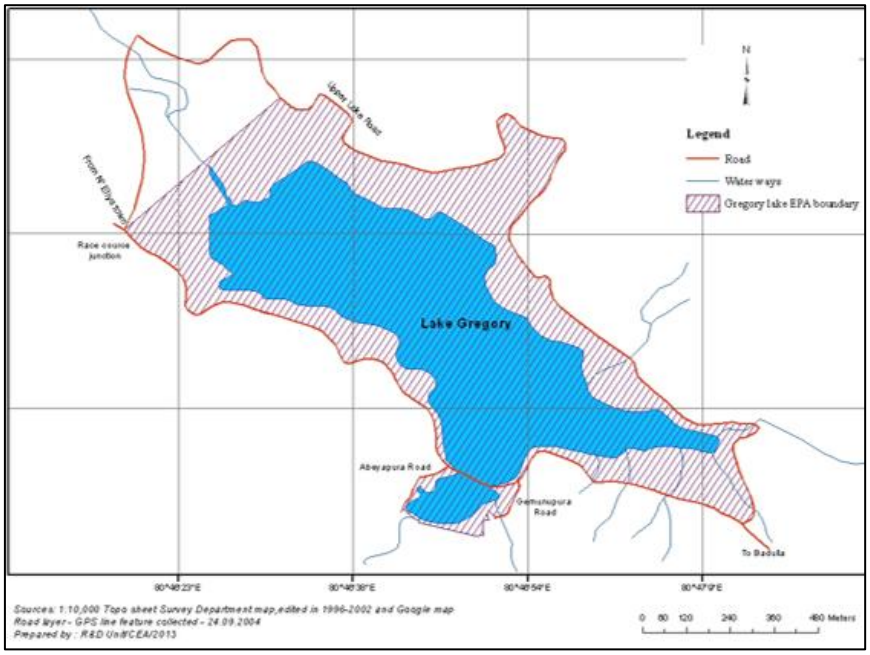
Ambient noise and vibration levels are as expected for urban areas with light industries, businesses, hotels, and restaurants. There is also traffic noise from A5 highway (Peradeniya-Badulla-Chenkaladi highway), A7 highway (Awissawella-Hatton-Nuwara Eliya highway), B332 (Uda Pussellawa Road) which are congested during peak hours. All these urban activities contribute to high noise levels in the project area.

2.1.7 Protected Areas

(1) Gregory Lake Environmental Protection Area

Gregory Lake was built by damming the Nanu Oya during the British Colonial Period (1872-1877).

The Lake was declared as a protected area by the Central Environmental Authority, the Order published under Section 24 C and 24 D of National Environmental Act in the Government Gazette Notification Number 1487/10 dated 5th March 2007.



Source: CEA

Figure 2.1-8 Environmental Protection Areas of Lake Gregory

(2) Galway's Land National Park

Galway's Land National Park is a small national park (0.29 km^2) within the city limits of Nuwara Eliya. It was declared a wildlife sanctuary on 27 May, 1938 and elevated to national park status on 18th May 2006 to conserve the montane ecosystems. Field Ornithology Group of Sri Lanka considers Victoria Park and Galway's Land as two of the most significant birding sites in the country. Galway's Land harbours about 20 rare migrant bird species and 30 native species. The park also has valuable floral species of native and foreign origins.

2.1.8 Fauna and Flora

Fauna and flora of the general area as documented in literature and site surveys are summarized in

Table 2.1-3 and **Table 2.1-4**. Further investigation is necessary to determine the fauna and flora specific to the project sites.

Table 2.1-3 Survey of Fauna in the Project Area

Class	Type	Taxa		Significant Species (common name)	Conservation Status (IUCN 3.1)
		Family	Species		
Birds		phasianidae		*Gallus lafayeti* (Sri Lankan Jungle Fowl)	LC
		Turnicidae		*Turnix suscitator* (Barred button quail)	LC
		Picidae		*Dendrocopos nanus* (Brown capped woodpecker	LC
				Dinopium benghalense (Black rumped flameback)	LC
				Picus chlorolophus (Lesser yellownape)	LC
		Capitonidae		*Megalaima flavifrons* (Sri Lanka yellow barbet)	LC
				Megalaima rubricapillus (Crimson barbet)	LC
		Pittidae		*Pitta brachyuran* (Indian pitta)	LC
		Alcedinidae		*Alcedo atthis* (Common kingfisher)	LC
				Halcyon smymensis (White throated kingfisher)	LC
		Meropidae		*Merops leschenaultia* (Chestnut headed bee-eater)	LC
				*Merops philippinus (*Blue tailed bee-eater)	LC
		Cuculidae		*Clamatorjacobinus* (Jacobin cuckoo)	LC
				Cacomantis sonneratii (Banded by cuckoo)	LC
				Eudynamys scolopaceus (Asian koel)	LC
				Centropus sinensis (Greater coucal)	LC
		Psittacidae		*Loriculus beryllinus* (Sri Lanka hanging parrot)	LC
				Psittacula krameri (Rose ringed parakeet)	LC
				Psittacula cyanocephala (Plum headed parakeet)	LC
		Apodidae		*Collocalia unicolour* (Indian swiftlet)	LC
				tachymarptis Melba (Alpine swift)	LC
		Tytonidae		*Ketupa zeylonensis* (Brown fish owl)	LC
				Strix leptogrammica (Brown wood owl)	LC
				Otus bakkamoena (Cooared scops owl)	LC
		Colombidae		*Spilopelia chinensis* (Spotted dove)	LC
				Chalcophaps indica (Emerald dove)	LC
				Treron pompadora (Pompadour green pigeon)	LC
		Ralidae		*Gallirallus striatus* (Slaty breated rail)	LC
				Amauromis phoneicurus (White breasted water hen)	LC
				Pernis ptilorhyncus (Oriental honey buzzard)	LC
Mammals		Felidae		*Prionailurus rubiginosu* (Rusty-spotted cat)	NT
		Cervidae		*Muntiacus muntjak* (Indian muntjac)	LC
		Cercopithecidae		*Trachypithecus vetulus* (Purple-faced langur)	EN
				Macaca sinica (Toque macaque)	EN
Fish		Salmonidae		*Oncorhynchus mykiss* (Rainbow trout)	LC
				Salmo trutta (Brown trout)	LC

Sources: :
Manamendraarachchi and Adikari (2014)
IUCN Redlist
JET

Legend: IUCN 3.1 scale

Dom: Domesticated
Def: Data deficient
NA: Data not available

Table 2.1-4 Survey of Flora in the Project area

Taxa		Significant Species (common name)	Conservation Status (IUCN 3.1)
Family	Species		
Moraceae		*Ficus religiosa* (Bodhi tree)	LC
Putranjivaceae		*Drypete sepiaria* (Weera)	LC
Sapotacceae		*Manilkara hexandra* (Palu)	LC
Rutaceae		*Chloroxylon swietenia* (Ceylon stainwood)	VU
Malvaceae		*Berrya cordifolia* (Trinomalee wood)	VU
Meliaceae		*Azadirachta indica* (Neem wood)	LC
Moraceae		*Artocarpus heterophyllus* (Jackfruit)	LC
Anacardiaceae		*Mangifera indica* (Mango)	LC
Anacardiaceae		*Anchardium occidentale* (Cashew)	LC

Anacardiaceae		*Mangifera zeylanica* (Eth amba)	VU
Arecaceae		*Cocus nucefera* (Coconut)	LC
Lamiaceae		*Tectona grandis* (Teak)	LC
Fabaceae		*Gliricidia sepium*	LC
Fabaceae		*Leucaena leucocephala* (White leadtree)	LC
Ebenaceae		*Diospyros ebenum* (Ceylon ebony)	LC
		Felicium leucocephala	
Lamiaceae		*Vitex altissima*	LC
Rubiaceae		*Canthium dicoccum*	
Ochnaceae		*Ochna obtusata*	LC
Alangiaceae		*Alangium salviifolium*	LC
		Mixeomwlum minurum	
		Drypetes lanceolate	
Celastra		*Gymnosporia emarginata*	
Salviniaceae		*Salvinia molesta* (Kariba weed)	LC
Pontederiaceae		*Eichhrnia crassipes* (Water hyacinth)	LC
Typhaceae		*Typha anguistifolia* (Narrowleaf cattail)	LC
Araceae		*Pistia stratiotes*	LC
Anisophyleaceae		*Anisophyllea cinnamomoides* (Weli piyanna)	VU
Asteraceae		*Vernonia zeylanica* (Ironweed)	LC
Apocynaceae		*Willughbeia cirrhifera*	VU

Source:
Egodawatta and Warnasooriya (2014)
Manamendraarachchi and Adikari (2014)
Munashingha et al., (2009)
Dharmasena, (1993)
Wijerathna and Baladurage
IUCN Redlist
JET

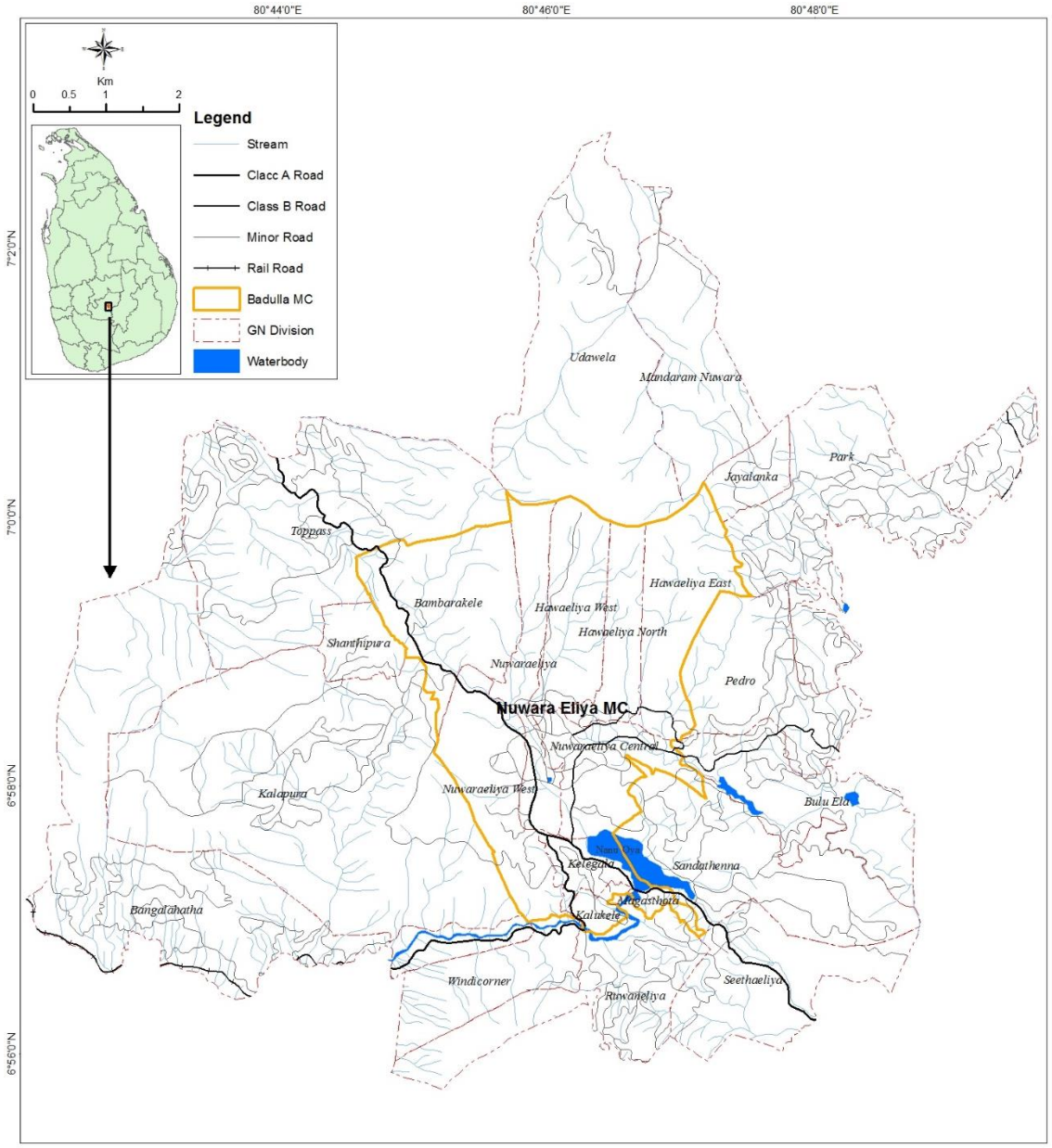
Legend: IUCN 3.1 scale

Dom: Domesticated
Def: Data deficient
NA: Data not available

2.2 SOCIAL CONDITIONS

2.2.1 Administration

Nuwara Eliya MC was established in 1949 to handle all aspects of the development of the city. It comes under Nuwara Eliya Divisional Secretariat Division (DSD), Nuwara Eliya District, Central Province of Sri Lanka. The total area of Nuwara Eliya is 13 km^2,consisting of 10 wards. Nuwara Eliya DSD is 478 km^2 and Nuwara Eliya District 741 km^2, while the Central Province is 5,674 km^2. Details of the administrative area of Nuwara Eliya MC are shown in **Figure 2.2-1**.



Source: Survey Department of Sri Lanka

Figure 2.2-1 Administrative Areas of Nuwara Eliya MC

2.2.2 Population and Demography

According to the Census and Statistics Department of Sri Lanka, the population density of the Nuwara Eliya DSD is 454 per km^2 compared to 421 per km^2 in Nuwara Eliya District, and 465 per km^2 in the Central Province. The population of the Nuwara Eliya Municipality Council was 30,129 in 2012, while the Nuwara Eliya Divisional Secretariat had a population of 212,094. Nuwara Eliya Municipality Council accounts for 14% of the population in the Divisional Secretariat. The population Figures and gender distribution based on the Grama Niladari Division are shown in **Table 2.2-1**.

Table 2.2-1 Population of Nuwara Eliya MC Area

Name of GND	Total	Male		Female	
		No	%	No	%
Hawaeliya East	2,273	1,080	48%	1,193	52%
Bambaralkele	3,143	1,508	48%	1,635	52%
Nuwara Eliya West	2,481	1,353	55%	1,128	45%
Kalapura	3,465	1,726	50%	1,739	50%
Nuwara Eliya	1,290	708	55%	582	45%
Nuwara Eliya Central	4,292	2,016	47%	2,276	53%
Hawaeliya North	2,216	1,044	47%	1,172	53%
Hawaeliya West	2,072	1,014	49%	1,058	51%
Bulu Ela	1,751	846	48%	905	52%
Sandathanna	2,816	1,398	50%	1,418	50%
Kalegala	1,829	857	47%	972	53%
Kalukele	1,093	512	47%	581	53%
Magasthota	1,408	705	50%	703	50%
Total	30,129	14,767	49%	15,362	51%

Source: Census of Population and Housing 2012, Department of Census and Statistics (DCS)

The population and population growth rates of Nuwara Eliya District compared to the country Figures are given below. According to the Tables below, Population growth rate has decreased over the years.

2.2.3 Health and Diseases

The prevalence of chronic illnesses of the Nuwara Eliya District compared to national data by age group is shown in **Table 2.2-2**. 15.6% of the total population of the Nuwara Eliya District is prone to chronic illnesses.

Table 2.2-2 Prevalence of Chronic Illnesses by Age Group

	Under 15 years	15-24 years	25-59 years	60 and older
Nuwara Eliya District	2.8%	3.4%	14.5%	51.7%
Sri Lanka	2.8%	3.3%	18.5%	55.2%

Source: National Survey on Self-Reported Health in Sri Lanka 2014, Department of Census, and Statistics

The District's prevalence of chronic illnesses including diabetes and hypertension is equal to or less than the country's average.

Table 2.2-3 Prevalence of Diabetes and Hypertension

	Diabetes	High Blood Pressure
Nuwara Eliya District	3.0%	6.6%
Sri Lanka	7.2%	9.2%

Source: National Survey on Self-Reported Health in Sri Lanka 2014, Department of Census, and Statistics

2.2.4 Religion and Ethnicities

The majority of the population is either Hindu or Buddhist, with a higher proportion of the former (**Table 2.2-5**).

Table 2.2-4 Population by Religion

Buddhist	Hindu	Islam	Roman Catholic	Other Christian	Other	Nuwara Eliya District Total
276,281	361,073	21,198	32,504	14,837	707	706,600
39.1%	51.1%	3.0%	4.6%	2.1%	0.1%	

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

Indian Tamil and Sinhalese are the dominant ethnic groups (**Table 2.2-6**).

Table 2.2-5 Population by Ethnicity

Sinhala	SL Tamil	Indian Tamil	SL Moor	Other	Nuwara Eliya District Total
279,814	31,797	375,911	16,958	2,120	706,600
39.6%	4.5%	53.2%	2.4%	0.3%	

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

2.2.5 Poverty Rate

The household income and expenditure survey (HIES) was carried out by the Census and Statistics Department of Sri Lanka. Poverty rates at the district, province, and national levels are shown in **Table 2.2-7**. The data indicates that poverty levels in the district are about the same as the provincial and national averages.

Table 2.2-6 Poverty Rates

	Poor HH %		
	1990/91	2006/07	2009/10
Sri Lanka	26.1	12.6	7.0
Central Province	30.7	18.2	8.2
Nuwara Eliya District	20.1	27.5	7.1

Source: Census and Statistics Department

2.2.6 History and Culture (Heritage)

The sites of cultural importance are concentrated mostly in the Hanguranketha, Kothmale, and Walapane DSDs and are associated with ancient places of worship and Sinhala kings.

Some sites and their importance are summarized below.

Table 2.2-7 Culturally Significant Sites in the Project Area

Location	Significance
Hanguranketha	Ancient cave temples
Pothgul Vihara	Rooftop made of stone slates covered in copper sheets
Arathana Raja Maha Vihara	Wood carvings from Kandyan Era
Liniyagala Maha Vihara	Wall paintings dating to 300 BC

Source: Development Plan for Nuwara Eliya Urban Development Area', Urban Development Authority (UDA)

2.2.7 Economy

(1) General Conditions

Nuwara Eliya, situated at around 2,000 m above sea level in Central Province, is the centre of tea industry in Sri Lanka which is the world's largest exporter of tea. Around the city centre, there are acres

of tea plantations and many tea factories. **Table 2.2-9** shows the gross domestic products (GDP) contribution of Central Province which covers Kandy, Matale, and Nuwara Eliya.

Table 2.2-8 GDP by Industry Sector in Central Province (Current Prices)

Unit: Million Sri Lanka Rupee (LKR)

No	Sector	2010		2011		2012		2013	
1	Agriculture	101,741	18.1%	113,969	17.7%	117,963	15.6%	148,885	15.5%
2	Industry	161,227	28.7%	179,054	27.8%	224,035	29.7%	336,117	35.0%
3	Services	299,776	53.3%	351,309	54.5%	433,583	57.4%	474,917	49.5%
	Provincial GDP	562,744	100.0%	644,332	100.0%	755,580	100.0%	959,918	100.0%
	% share of National GDP	10.0		9.8		10.2		11.1	

Source: CBSL Annual Report 2014

Central Province contributes to 10 to 11% of the national GDP. The service industry is the largest sector, contributing to 50 to 60% of the total GDP of the Province.

(2) Tourism

Nuwara Eliya is a famous tourist destination in the country, blessed with a cool climate and beautiful sceneries. There are many tourist attractions, such as golf courses, Hakgala botanical garden, Gregory Lake, Victoria Park. **Table 2.2-10**, **Figure 2.2-2** and **Figure 2.2-3** show the tourist arrival number at Hakgala Botanical Garden and Horton Plains National Park, and tourism revenue at these places for 2011-14.

Table 2.2-9 Nuwara Eliya District Tourist Arrival and Revenue

Year	Destination	2011	2012	2013	2014
No. of Foreign Visitors	Hakgala *1	10,092	12,489	14,713	18,071
	Horton Plains *2	29,854	39,123	34,065	69,979
No. of Local Visitors	Hakgala	500,024	587,743	511,873	578,825
	Horton Plain	166,818	184,744	46,511	198,274
Total No. of Visitors	Hakgala	510,116	600,232	526,586	596,896
	Horton Plain	196,672	223,867	80,576	268,253
Year		2011	2012	2013	2014
Revenue: Foreign Visitors (LKR)	Hakgala & Horton Plain	60,675,021	83,836,172	80,077,973	149,769,933
Revenue: Local Visitors (LKR)	Hakgala & Horton Plain	28,152,670	32,247,950	22,838,860	33,567,770
Total Revenue (LKR)	Hakgala & Horton Plain	88,827,691	116,084,122	102,916,833	183,337,703

Source: Annual Statistical Reports- Sri Lanka Tourism Development Authority (Annual Reports of 2011,2012,2013,2014)
Notes: *1; Hakgala Botanical Garden, *2; Horton Plains National Park

Majority of the visitors were local tourist. The number of foreign and local visitors to both places is on the rise. In 2014, there were at least 600,000 foreign and local tourists in Nuwara Eliya. Apart from admission fees, tourists also contribute to revenues of hotels, restaurants, transportations, souvenir shops, and related businesses. Tourism revenues are rapidly increasing and can be quite substantial.

The establishment of a sewerage system will preserve the water environment of the lake and river and contribute to the sustainable growth of the tourism industry and the economy of the area.

(3) Household Income

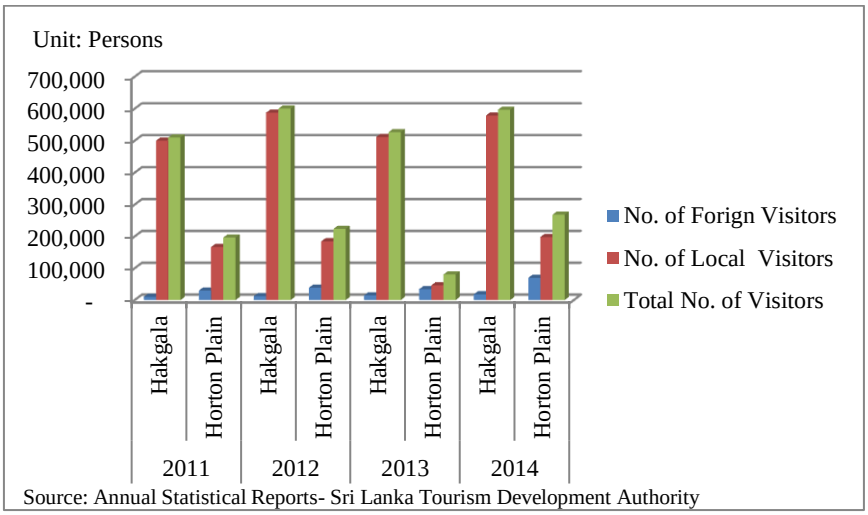


Figure 2.2-2 Nuwara Eliya District Tourist Arrival

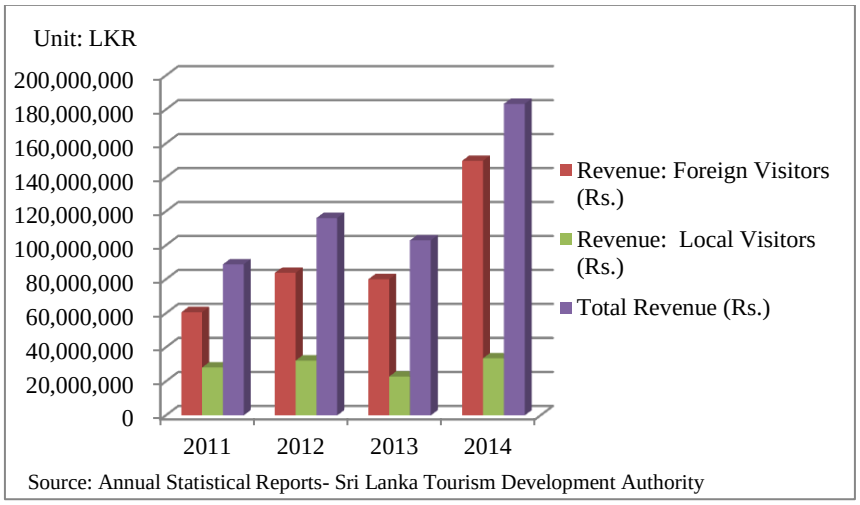


Figure 2.2-3 Nuwara Eliya District Tourism Revenue

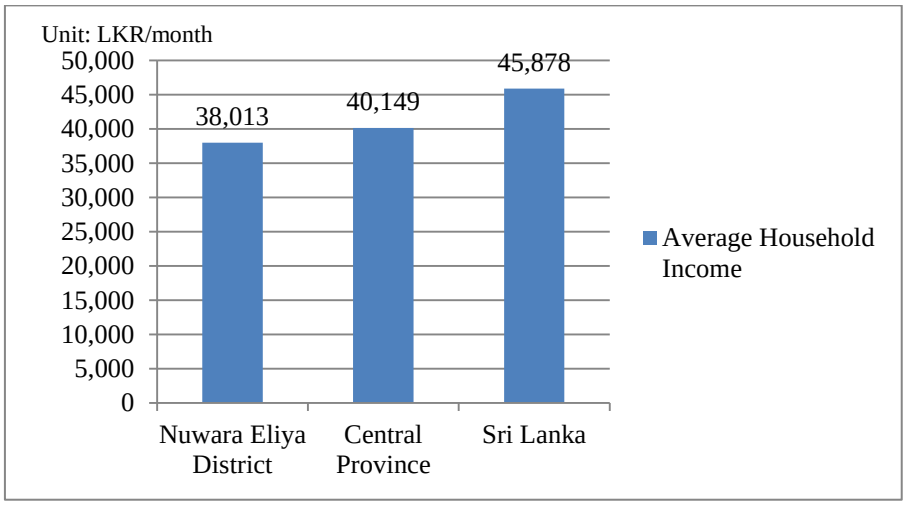
Average household income data are available from "Household Income and Expenditure Survey 2012/2013", some of which are presented in **Table 2.2-11** and **Figure 2.2-4** Average monthly household income in Nuwara Eliya District was 38,013 LKR in 2012/13. Most of the household income came from wage/salaries (42%). Household income in Nuwara Eliya District is 17% lower than the national average and slightly lower than that in Central Province. In Nuwara Eliya, the design of sewage tariff should take into consideration the ability to pay (ATP).

Table 2.2-10 Breakdown of Monthly Household Income for Nuwara Eliya District (2012/13)

Unit: LKR/month

No.	Sector	Nuwara Eliya District	%
1	Average Household Income	38,013	
2	Per capita	9,074	
3	Ave. No. of Income Receivers (persons)	1.9	
4	Wage/Salaries	16,686	42.1%
5	Agricultural Activities	2,647	6.7%
6	Non-Agriculture Activities	4,798	12.1%
7	Other Cash Income	4,678	11.8%
8	Income by Adhoc Gain	5,172	13.1%
9	Non-Monetary Income	4,032	10.2%
10	Income in Kind	1,600	4.0%

Source: Household Income and Expenditure Survey 2012/2013, DCS, Ministry of Policy Planning Economic Affairs



Source: Household Income and Expenditure Survey 2012/2013, DCS, Ministry of Policy Planning Economic Affairs

Figure 2.2-4 Comparison of Monthly Household Income

2.2.8 Land Use

Land use patterns in Nuwara Eliya District and Nuwara Eliya MC are shown in **Table 2.2-12** and **Table 2.2-13** and **Figure 2.1-5**. The area for development is limited. Residential neighbourhoods, forests, conservation areas and tea plantations are occupying about 30, 17, 13 and 10% of the area.

Table 2.2-11 Land Use in Nuwara Eliya District

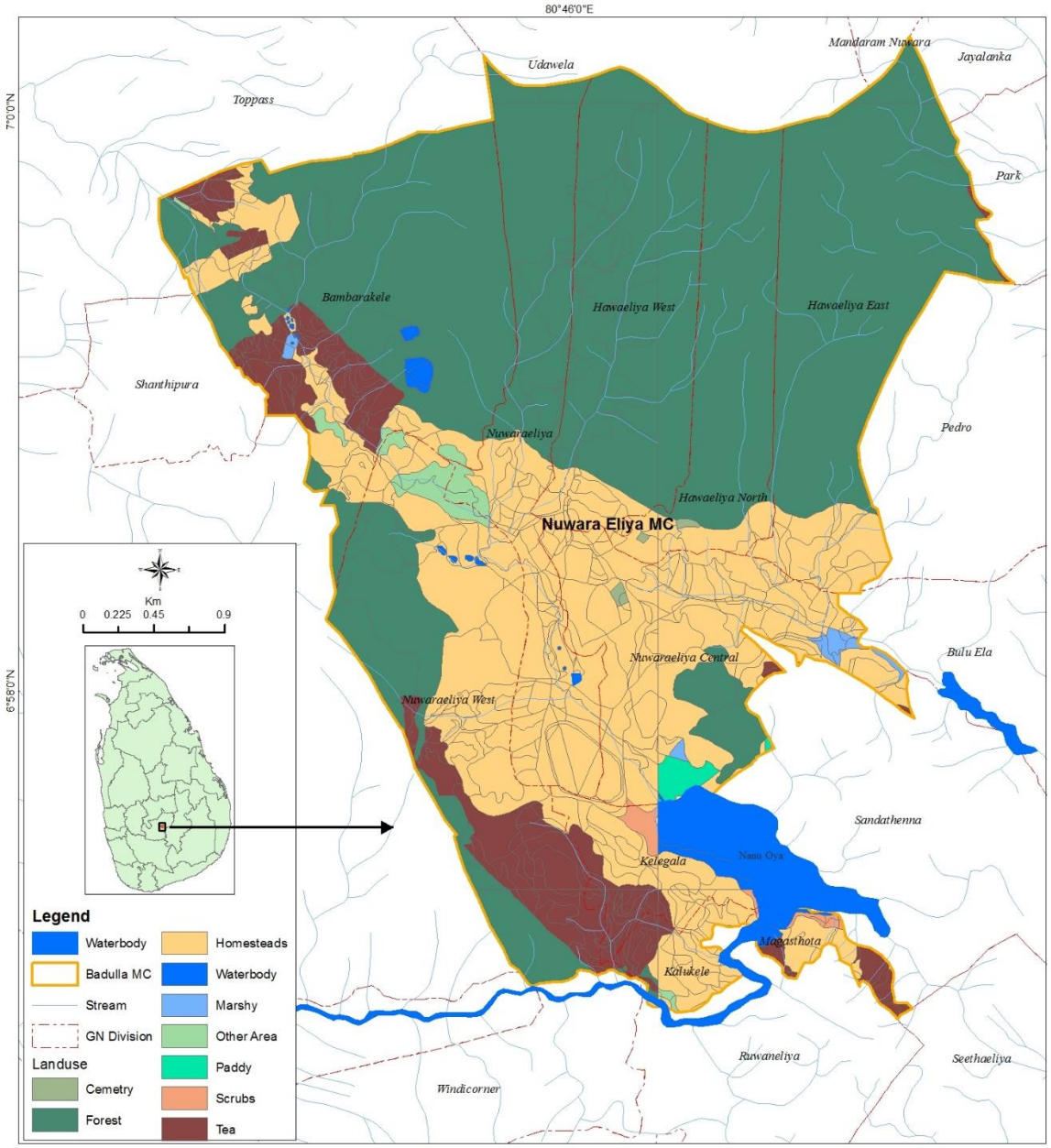
ඉඩම් ස්වභාවය Nature of land	භූමි ප්‍රමාණය (හෙක්ටයාර) Area (Hec)	ප්‍රතිශතය Percentage (%)
01.අස්වද්දන ලද කුඹුරු - Asweddumized paddy land		
1. වාරිමාර්ග - Irrigated	6,073.1	3.5
11.අහස්දියෙන් - Rainfed	76.1	0.0
02.තේ - Tea	40,826.0	23.4
03. රබර් - Rubber	23.0	0.0
04. පොල් - Coconut	8.0	0.0
05. කුරුදු- Cinnamon	32.0	0.0
06. වෙනත් වගාවන් - Other crops	23,040.4	13.2
07.වනාන්තර- Forests		
1. ඝන වනාන්තර - Dense forests	37,073.5	21.3
11. විවෘත වනාන්තර - Open forests	7,577.8	4.4
111. වගා කරන ලද වනාන්තර - Planted forests	10,404.0	6.0
08.ලදු කැළෑ හා හේන - Grass lands/Chena	16,098.0	9.2
09. වගුරු හා කඩොලාන කැළෑ - Marshes and Mangroves	560.4	0.3
10.ගෙවතු - Home gardens	13,243.7	7.6
11.ජලාශ - Reservoirs	3,500.0	2.0
12.ගොඩනැගිලි- Building	2,639.8	1.5
13වැලි හා ගල් පර - Sand and Mountain	2,044.0	1.2
14. මුඩු බිම් හා අත්හරින ලද ඉඩම් - Abandoned land	4,770.7	2.7
15.වෙනත් (පුජා භූමි, මාර්ග,සුසාන භූමි ආදිය)	6,109.5	3.5
Other (sacred places, roads,cemetery etc)		
එකතුව - Total	174,100.0	100.0

Source: District Land use Planning Office

Table 2.2-12 Land Use in Nuwara Eliya MC

Type of Land Use	Area (ha)
Residential Area	377
Commercial and Institutional Area	139
Agricultural Area	41
Water Area	52
Nature Conservation, Parks & Recreation	165
Tea Estate	142
Forest	231
Others	152
Total	1,299

Source: Land Use 2002- 2017 (Nuwara Eliya MC)



Source: District Land use Planning Office

Figure 2.2-5 Land Use in the Project Area

2.2.9 Water Supply and Sanitation

(1) Water Supply

Table 2.2-14 shows the distribution of drinking water facilities by type in Nuwara Eliya MC. The piped water supply system covers 96% of the households.

Table 2.2-13: Drinking Water Facilities by Type in Nuwara Eliya MC Area

No.	Name of GND	Total	Protected Well Within Premises	Protected Well Out Side Premises	Un Protected Well	Tap Within Unit	Tap Within Premises	Tap Outside Premises	Rural Water Project	Tube Well	Bourses	River , Tank, Stream	Rain Water	Bottle Water	Other
1	Hawaeliya East	580	8	2	17	360	138	15	0	0	0	39	0	0	1
2	Bambaralkele	787	32	10	22	428	117	17	56	14	0	76	0	0	15
3	Nuwara Eliya West	578	8	1	66	301	60	130	1	1	0	10	0	0	0
4	Kalapura	840	35	141	88	58	94	180	198	0	0	46	0	0	0
5	Nuwara Eliya	272	1	4	0	205	45	11	5	0	0	0	0	0	1
6	Nuwara Eliya Central	1017	24	4	7	718	103	16	125	1	0	0	0	0	19
7	Hawaeliya North	542	8	8	2	263	77	15	125	2	0	39	0	0	3
8	Hawaeliya West	490	13	0	1	392	67	14	1	0	0	2	0	0	0
9	Bulu Ela	429	25	4	7	329	52	1	2	0	0	8	0	0	1
10	Sandathanna	683	25	79	73	331	89	58	1	3	0	16	0	0	8
11	Kalegala	453	3	0	0	379	55	16	0	0	0	0	0	0	0
12	Kalukele	289	6	2	0	205	57	5	1	0	0	12	0	0	1
13	Magasthota	377	7	0	0	265	82	19	2	0	0	0	2	0	0
	Total	7,337	195	255	283	4,234	1,036	497	517	21	0	248	2	0	49

Source: Census of Population and Housing 2012, DCS

The main sources of water are:

- wells in the Upper Nanu Oya area
- wells in the Upper Bomburu Ela area
- some surface water sources

Water consumption by customer category is shown in **Table 2.2-15**.Household and commercial/industrial customers account for about 70% and 20% of the total consumption.

Table 2.2-14 Water Consumption by Consumer Type

Year Type of Consumption	2013	2014	2015
Household	1,612,459	1,120,804	1,077,381
Commercial and Industrial	246,707	286,997	280,232
Institutional	50,682	70,337	118,018
Others	4,480	8,310	13,573
Total (m^3/year)	1,914,328	1,486,448	1,489,204

Source: Nuwara Eliya MC

(2) Sanitation

Table 2.2-16 shows the distribution of sanitation facilities in Nuwara Eliya MC. About 97% of the households (6,852) have water sealed toilets (i.e. with traps to block odour) connected to septic tanks.

Table 2.2-15 Sanitation Facilities in the Project Area

No.	Name of GND	Total	Water Trap Toilet	Pour Flush Toilet (Not Water Trap)	Direct Pit	Other	Not Using Toilet
1	Hawaeliya East	580	570	10	0	0	0
2	Bambaralkele	787	721	65	0	0	1
3	Nuwara Eliya West	578	493	70	15	0	0
4	Kalapura	840	721	119	0	0	0
5	Nuwara Eliya	272	262	7	1	0	2
6	Nuwara Eliya Central	1,017	965	52	0	0	0
7	Hawaeliya North	542	530	12	0	0	0
8	Hawaeliya West	490	482	8	0	0	0
9	Bulu Ela	429	420	9	0	0	0
10	Sandathanna	683	610	68	0	0	5
11	Kalegala	453	437	16	0	0	0
12	Kalukele	289	277	12	0	0	0
13	Magasthota	377	364	13	0	0	0
	Total	7,337	6,852	461	16	0	8

Source: Census of Population and Housing 2012, DCS

Nuwara Eliya MC has no sewerage system. Toilet waste is treated in septic tanks while greywater from kitchens and bathrooms is discharged untreated to Bomburu Oya via public canals.

In urban centres and densely populated areas, toilet waste is not properly treated due to lack of space for installing septic tanks. During rainy season, overflows from septic or infiltration tanks often occurs, as the ground is saturated.

Sludge is taken from septic tanks by the MC at the request of the home owner, and disposed of at the Moon Plain landfill.

Nuwara Eliya General Hospital operates its own sewage treatment system, consisting of aeration/ sedimentation/anaerobic-degradation tanks and sludge drying beds. The treated sewer is disinfected with chlorine and discharged to a drainage canal and finally to the Bomburu Ela River.

There are no factories in Nuwara Eliya MC that have adverse impact on the water environment. Industrial wastewater from automobile repair shops, hotels, slaughterhouses, as well as hazardous wastewater from hospitals, is treated as required under the Environmental Protection License (EPL), issued by Nuwara Eliya District Office of the Central Environmental Agency (CEA).

2.2.10 Solid Waste

Commercial activities generate the largest amount of solid waste, followed by households (**Table 2.2-16**).

Table 2.2-16 Solid Waste Generation by Sector

Residential	27.2%
Commercial	48.4%
Institutions	13.2%
Industries	11.3%

Source: Nuwara Eliya MC

The solid waste generated in the Nuwara Eliya MC area consists of mainly of paper, grass, wood, and plastics (**Table 2.2-17**).

Table 2.2-17 Types of Solid Waste – Nuwara Eliya MC

Kitchen waste	74.6%
Paper	7.8%
Textiles	1.0%
Grass & wood	4.8%
Soft Plastics	4.2%
Hard Plastics	0.9%
Rubber & leather	0.4%
Metal	0.9%
Glass & bottles	1.7%
Stone & ceramic	0.5%
Other	3.2%

Source: Nuwara Eliya MC

Nuwara Eliya has a well-organized solid waste management system. Waste is collected from curb side and transported to a disposal site, 4 km from the town centre. The disposal site was constructed in 2003 as a JICA pilot project (The Study on Improvement of Solid Waste Management in the Secondary Cities in Sri Lanka).

The disposal area has a leachate treatment facility, septage treatment facility, infectious waste discharge pit, small-scale incinerator for garden waste, and a recovery facility (**Figure 2.2-6**). The area is approximately 2 ha, with a remaining useful life of 10-15 years.

Waste Disposal Area

Leachate Collection and Treatment System

Infectious Waste Disposal Facility
Source: JET

Figure 2.2-6 Moon Plains Semi-Engineered Sanitary Landfill Site

2.3 NEED FOR THE PROJECT

In its national policy enacted in 2010, Sri Lanka aims to achieve 100% access to adequate sanitation through on-site and off-site sanitation facilities by 2025. NWSDB's service plan sets the objective to achieve 7.0% piped sewer coverage by 2020.

The United Nations sets Sustainable Development Goals (SDGs) as the next development agenda for the Millennium Development Goals (MDGs). The goal related to sanitation and hygiene is to ensure universal access to safely and sustainably managed water and sanitation by 2030, and some of the specific targets include:

- By 2030, achieve access to adequate sanitation and hygiene facilities for all.
- By 2030, improve water quality by halving the proportion of untreated wastewater.

As of 2012, coverage of piped sewerage remains at 2.4% in Sri Lanka. Nuwara Eliya has no STP, and relies only on septic tanks and other on-site facilities, which, do not function adequately in densely-populated urban areas. Increasing levels of BOD and coliform bacteria are detected in Lake Gregory situated at the centre of the city (See 2.1.5).

Sewage treatment is necessary to deal with the increasing volumes of wastewater and to preserve and protect the water environment.

CHAPTER 3 PLANNING BASIS FOR SEWERAGE SYSTEM

3.1 SANITATION PROVISION

In February 1999, the Study on Greater Kandy and Nuwara Eliya Water Supply and Environmental Improvement Plan in the Democratic Socialist Republic of Sri Lanka was conducted with financial assistance from JICA. The plan proposed the need for 17 km of gravity sewer pipes and about 2 km of pressure feed pipes to treat 2,800 m^3/day of wastewater, using aerated lagoons for projected populations for 2005 and 2015 (Nuwara Eliya MC data).

The City M/P for a larger collection area, will be based on this study and use revised population projections based on the 2012 Census.

3.1.1 Target Year

According to "NWSDB Design Manual D7 Wastewater Collection, Treatment, Disposal & Re-Use 2012", the design period for collection network, pumping stations, STP, and effluent disposal and utilization is 30 years. Therefore, 2046 is selected as the target year for this M/P.

3.1.2 Planning and Design Basis and Criteria

(1) Sewage Flow Estimate

Table 3.1-1 Design Basis for Estimating Sewage Flow

Item	Value	Remarks
Per capita water consumption	120 lpcd	
Domestic flow	80%	of water consumption
Non-domestic flow	75%	of Domestic Flow
Average dry weather flow (ADWF)	Domestic + Non-domestic flow	
Daily maximum dry weather flow	1.25 times	of ADWF
Hourly maximum dry weather flow	1.6 times	of ADWF
Peak dry weather flow (PDWF)	3 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) Trunk Sewers

a. Hydraulic Calculations for Trunk Sewers

The Manning formula is used for the hydraulic calculation of gravity sewers, and the Hazen William formula is used for force mains (pressure flow):

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 3.1-2 Coefficients for Sewer Design

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

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 Velocities
Minimum velocity: 0.65 m/s
Maximum velocity: 3.0 m/s

c. Sewer Capacities
Diameter of 600 mm or less: capacity exceeds the estimated flow by at least 200%
Diameter greater than 600 mm: capacity exceeds the estimated flow by at least 150%

d. Minimum Earth Cover
1.0 m

e. Minimum Sewer Diameters
Trunk sewer: 225 mm, rider & branch sewer: 160 mm, lateral sewer: 110 mm

f. Pipe Materials

Table 3.1-3 Pipe Materials

Diameter	Purpose	Pipe Material
200 mm or less	Gravity	PVC Pipe
225 to 355 mm	Gravity	HDPE Pipe
400 mm or above	Gravity	GRP
100 to 400 mm	Force Main	HDEP
Above 400 mm	Force Main	DI Pipe

Source: JET

(3) Pumping Stations

Table 3.1-4 shows the types of pumping station: manhole type pumping station (MTPS) or major pumping station (MPS). The Ceylon Electricity Board (CEB) requires the electrical demand of a pumping facility to be 42 kVA or less, where a transformer is not provided. Where the electrical demand exceeds 42 kVA, a transformer will be necessary, in which case an MPS is more suitable. It should be noted that MTPS entails site acquisition, depending on the surrounding environment and location.

Table 3.1-4 Type of Pumping Stations

Type 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

(4) Treatment Facilities

The treatment process is selected by considering the following factors:

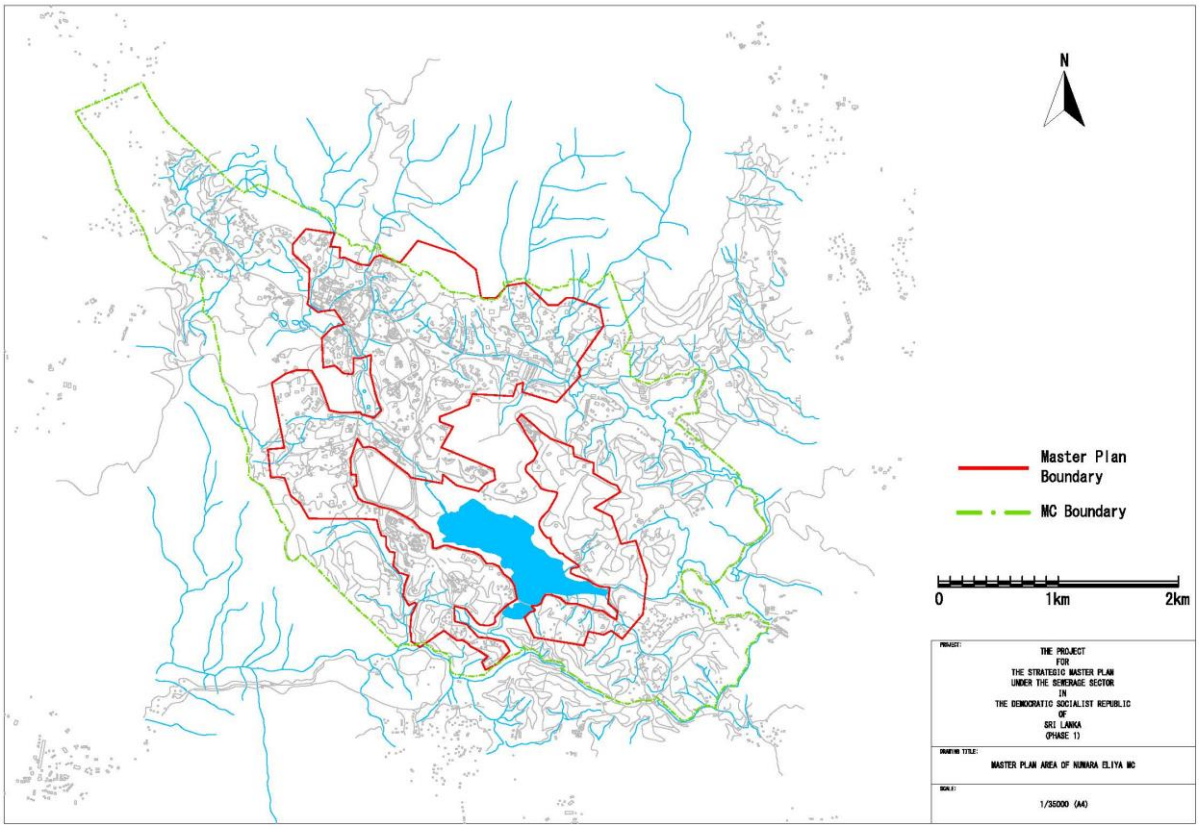
- influent sewage quality and effluent discharge standards
- land availability
- construction and O&M cost

- ease of operation and maintenance (O&M)

3.1.3 Service Area Selection

The sewerage service area selected for the Master Plan is shown in **Figure 3.1-1** and includes:

- developed and populated areas that will be almost fully saturated by 2046
- city centre including large-scale commercial areas, large-scale facilities, such as schools, hotels, housing estate, religious and institutional buildings
- high density residential areas
- areas suitable for applying centralized sewerage system.



Source: JET based on data of Survey Department of Sri Lanka

Figure 3.1-1 Service Area Selected in the M/P for Nuwara Eliya MC

Table 3.1-5 shows the Divisional Secretary Divisions (DSDs) and Grama Niladhari Divisions (GNDs) included in the target area.

Table 3.1-5 DSDs and GNDs in the M/P Area

S/No.	GND No.	GND
Nuwara Eliya DSD		
1.1	535H	Havaeliya East
1.2	535L	Nuwara Eliya West
1.3	535	Nuwara Eliya
1.4	535D	Nuwara Eliya Central
1.5	535G	Hawaeliya North
1.6	535F	Hawaeliya West
1.7	535C	Kelegala
1.8	535B	Kalukele
2.1	535D	Nuwara Eliya Central
2.2	535E	Sandathenna
2.3	535A	Magasthota

Source: JET based on data of DCS

3.1.4 Design Sewage Flow

Rate of population increase in the project area and planned population is calculated as shown in Section1 **APPENDIX 12**. Sewage flow to be treated is calculated as shown in **Table 3.1-6**. Detailed calculations can be found in **APPENDIX 1**.

Table 3.1-6 Design Sewage Flow

M/P Area (ha)	Item	2046			Remarks	
		West Area	East Area	Total		
West: 419 East: 96 Total: 515	a Population	16624	2,476	19,100		
	b Water Consumption (l/d/cap)	120	120	120		
	c Return Factor (%)	80	80	80		
	d Domestic Flow (m^3/d)	1,596	238	1,834	d = a x b x c	
	e Non-Domestic Flow (m^3/d)	1,197	179	1,376	e = d x 75%	
	f Point Source (m^3/d)					
	g Infiltration (m^3/d)	559	83	642	g = (d + e + f) x 20%	
	h Daily Average Flow (m^3/d)	3,352	500	3,852	h= d + e + f + g	
	i Daily Maximum Flow (m^3/d)	4,050	604	4,655	i = (d + e + f) x 1.1 + g	For STP design
	j Hourly Maximum Flow (m^3/d)	5,028	750	5,778	j = (d + e + f) x 1. 6+ g	For PS design
	k Peak Flow (m^3/d)	8,938	1,334	10,272	k= (d + e + f) x 3.0+ g	For Sewer design

Source: JET

3.1.5 Design Influent Wastewater Quality

The design influent wastewater quality, based on sampling and analysis, and in consultation with NWSDB, is shown in **Table 3.1-7**. Details of the design influent wastewater quality are shown in **APPENDIX 2**.

Table 3.1-7 Design Influent Wastewater Quality

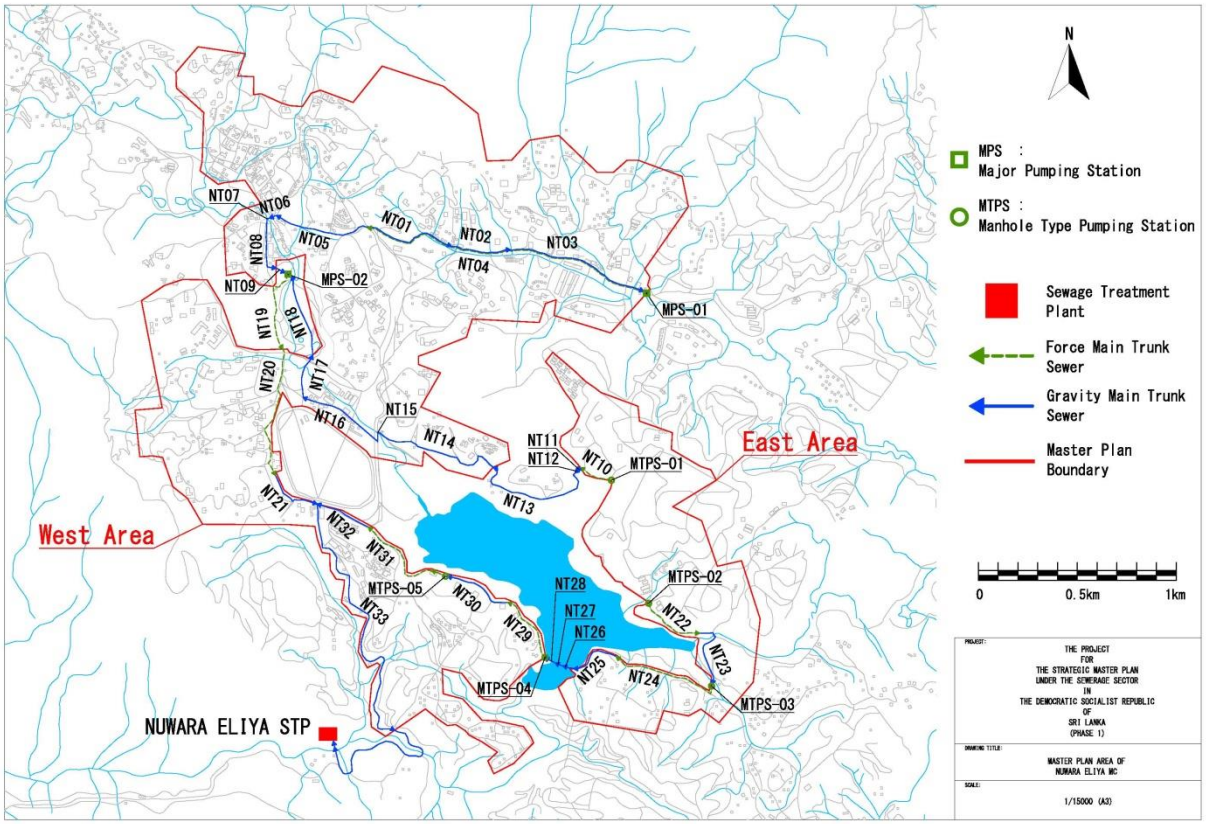
Parameter	Influent Wastewater
	Design Value
BOD_5	240
COD	600
TSS	160
T-N	45
T-P	6

Unit: mg/L
Source: JET

CHAPTER 4 PRELIMINARY PLAN AND DESIGN OF THE SEWERAGE SYSTEM

4.1 GENERAL LAYOUT

The proposed sewerage development plan for Nuwara Eliya MC is shown in **Figure 4.1-1**. An enlarged map, flow calculations, and a longitudinal sectional view are attached in **APPENDIX 3**.



Source: JET

Figure 4.1-1 Proposed Sewerage Development in Nuwara Eliya MC

4.2 SEWAGE COLLECTION FACILITIES

The design of the STP and location of major pumping stations depends on the layout of the trunk sewers. The length of branch sewers will be similar to those in other projects. The length of lateral sewers to the houses and buildings is estimated based on the projected population.

4.2.1 Sewer Network

The trunk sewer mains are listed in **Table 4.2-1**.

Table 4.2-1 Major Sewer Mains

Item	Diameter	Material	Length	Remarks
Branch Sewer	225mm	HDPE Pipe	77,250m	Including Force Main
	Sub-Total (Branch Sewer)		77,250m	
Trunk Sewer	225mm	HDPE Pipe	1,938m	Pipe Jacking (323m)
	280mm	HDPE Pipe	1,638m	Pipe Jacking (321m)
	315mm	HDPE Pipe	482m	Pipe Jacking (157m)
	400mm	GRP Pipe	1,897m	Pipe Jacking (762m)
	450mm	GRP Pipe	400m	
	600mm	GRP Pipe	292m	
	700mm	GRP Pipe	2,398m	Pipe Jacking (1,201m)
	110mm	HDPE Pipe	1,438m	Force Main, Pipe Jacking (252m)
	140mm	HDPE Pipe	580m	Force Main
	180mm	HDPE Pipe	19m	Force Main
	200mm	HDPE Pipe	1,524m	Force Main
	280mm	HDPE Pipe	9m	Force Main, Pipe Jacking (9m)
	315mm	HDPE Pipe	1,133m	
	Sub-Total (Trunk Sewer)		13,743m	Sub-Total (Pipe Jacking) 3,022m
Total	Branch Sewer + Trunk Sewer		90,993m	
	Crossing: Railway Crossing (None), River Crossing (7 locations)			

*Pipe Jacking of HDPE Pipe & GRP Pipe is installed by the slip lining method.
Source: JET

4.2.2 SewagePumping Stations

The main pumping stations are shown in **Table 4.2-2**.

Table 4.2-2 Main Pumping Stations

Item No.	Design Flow	Total Pump Head	Unit	Remarks
MPS-01	Approximately 2.0 m^3/min	70 m	3+(1)	land requirement is about 0.12 ha
MPS-02	Approximately 5.4 m^3/min	30 m	3+(1)	land requirement is about 0.08 ha
MTPS-01	Approximately 0.4 m^3/min	20 m	1+(1)	
MTPS-02	Approximately 0.3 m^3/min	10 m	1+(1)	
MTPS-03	Approximately 0.6 m^3/min	25 m	1+(1)	
MTPS-04	Approximately 0.7 m^3/min	30 m	1+(1)	
MTPS-05	Approximately 0.9 m^3/min	25 m	1+(1)	

Notes: MPS: Major Pumping Station MTPS: Manhole Type Pumping Station (1): One pump unit for stand-by
Source: JET

4.2.3 Service/House Connections

Based on the projected population of 19,100 and an average family size of four people, in 2046, there will be approximately 4,800 households (Household Income and Expenditure Survey 2012/13 issued by the DCS).

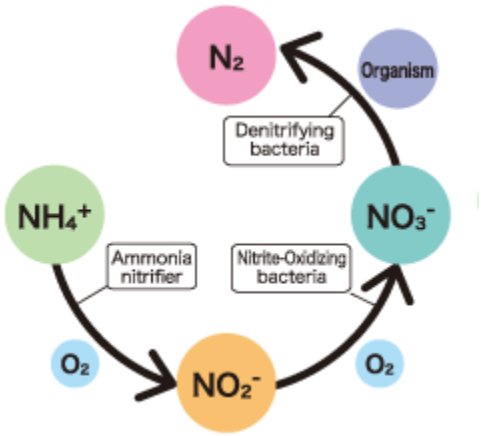
4.3 SEWAGE TREATMENT FACILITY

4.3.1 Treatment Method

(1) Compliance with the Allowable Discharge Limits

The allowable discharge limits (shown in **APPENDIX 4**) are being amended and a draft is available to the public, although it has not yet been gazetted. The effluent quality from the proposed treatment plant

will 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. The amendment introduces 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 treatment methods.



Source:http://www.zeolite-anammox.com/#!faq/c12z9

Figure 4.3-1 Nitrogen Cycle

Figure 4.3-1 shows the reaction cycle of nitrogen during biological wastewater treatment. Ammonia nitrogen (NH3-N) and a portion of organic nitrogen is converted to nitrite and nitrate through nitrification carried out by ammonia oxidizing bacteria (AOB) and nitrite oxidizing bacteria (NOB). Nitrate produced by the nitrification process should be reduced through denitrification to less than 10 mg/L to meet the amended allowable discharge limit. Nitrification occurs naturally in small-scale STP which are usually operated with long solids retention time (SRT). High wastewater temperature promotes nitrification. Suppression of nitrification in any biological process is therefore not easy and is not a realistic option. Therefore, the treatment process must have the ability to denitrify. Denitrification is relatively easy to achieve with activated sludge processes but is more difficult for biofilm processes and stabilization ponds.

(2) Selection of Treatment Process for Estimating Land Requirements

The site for the STP in Nuwara-Elia is not yet decided. The land requirement can be estimated based on the appropriate treatment process. The projected daily maximum sewage inflow for Nuwara-Elia is 4,700 m^3/d. The most commonly used process for such small-scale treatment plant is the OD process. The OD process can be modified to remove nitrogen. Kandy STP, (**Figure 4.3-2**) under construction, has adopted the OD process with nitrogen removal ability. The reactor is equipped with air diffusers and mixers that can be switched on and off to create equal periods of anoxic or aerobic condition.

Source: JFE

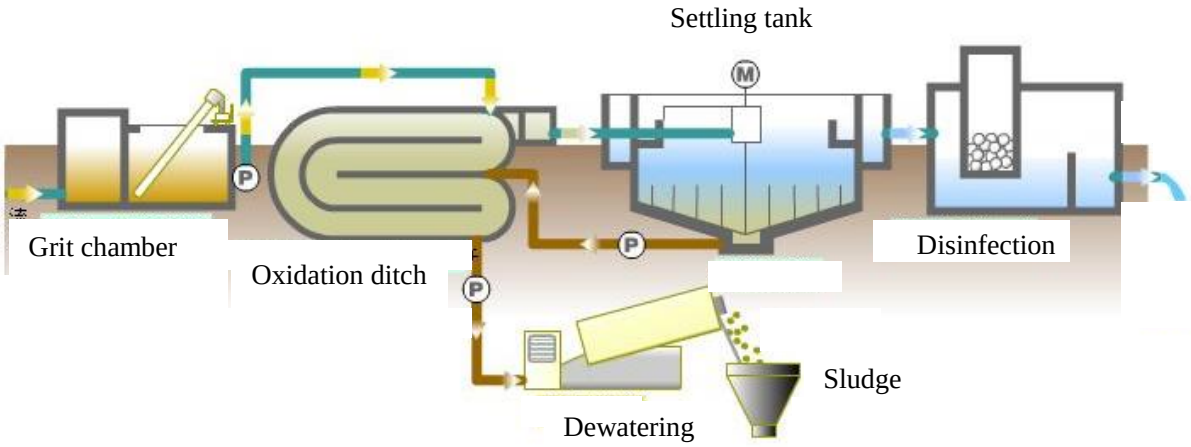
Figure 4.3-2 Kandy Sewage Treatment Plant
(14,000 m^3/day, OD Process with Nitrogen Removal)

It is assumed that the treatment process for Nuwara Eliya STP would be the OD process with nitrogen removal.

More information on the site condition is necessary for the final determination of the treatment process. Specific treatment technology cannot be discussed until a treatment plant site is determined. The discussion on treatment process at this point would be in general terms only.

(3) Characteristics of the Oxidation Ditch Process

The OD process is shown in **Figure 4.3-3**.



Source: JET

Figure 4.3-3 Schematic of Oxidation Ditch Process

The OD process is used mainly in small-scale STPs because it has the following characteristics:

- simple configuration, limited number of equipment and easy operation
- bioreactor is oval or horseshoe shape
- no primary settling tank
- large reactor can adapt to inflow load fluctuation and assure long HRT
- tolerance to minor problems due to redundancy of the process

- nitrogen is removed by introducing anoxic condition in the reactor
- low excess sludge production

It is not suitable for large-scale STP because of the large area requirement.

4.3.2 STP Site and General Layout of Unit Processes

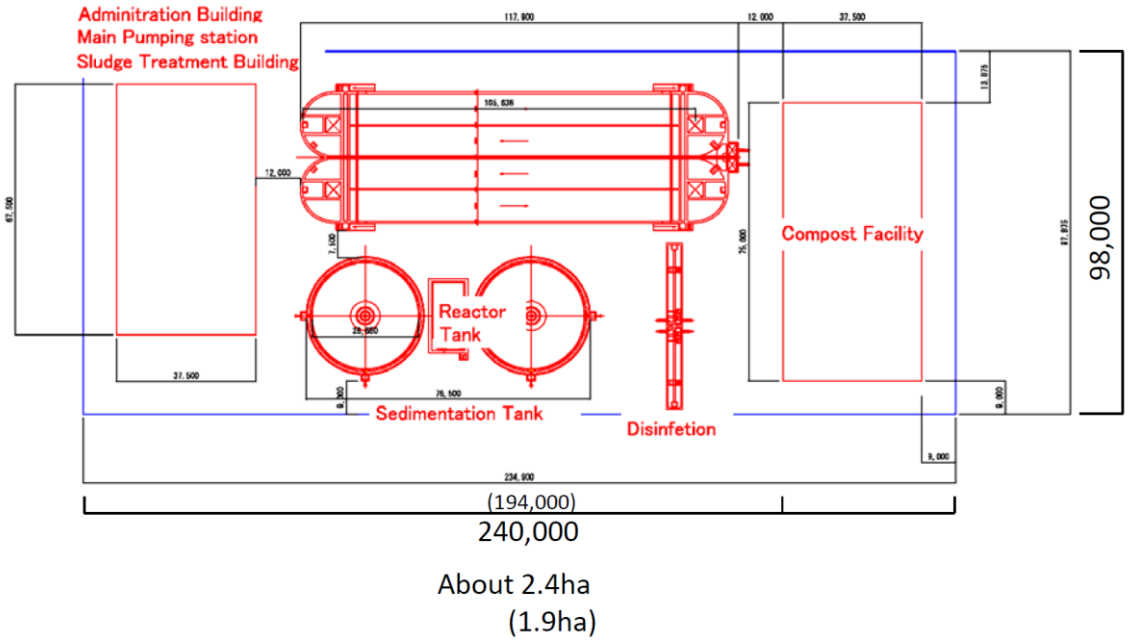
(1) STP Site

The candidate site is located on the slope of a hill along the Nanu Oya River in the southwest at the outskirt of the city with few nearby residences (refer to photos in **Figure 4.3-4**). The site is publicly owned and Nuwara-Elia MC is starting the process to acquire this land (**APPENDIX 5**). The construction of a relatively long access road and bridge over the Nanu Oya River is required.

Figure 4.3-4 Candidate Site (Left: Viewed from South, Right: Viewed from North)

(2) General Layout

The land required for the OD process with nitrogen removal is calculated to be 2.4 ha including a composting facility. **Figure 4.3-5** shows the layout arranged on a rectangular site.



Notes: Figure in the bracket denotes land area excluding composting facility
Source: JET

Figure 4.3-5 Treatment Plant Layout

4.3.3 Odour Control

Odour can come from:

- septage receiving facility
- grit chamber
- OD
- sludge treatment

The septage receiving facility, grit chamber and sludge treatment process are the main odour emission points. Odour from the OD is usually not very offensive.

The need to control odour depends on the neighbourhood. In this case, intensive odour control is not required since there are no nearby residences. Enclosing the grit chamber and sludge treatment facilities is sufficient for odour control.

4.3.4 Sewage Treatment Process

The treatment plant will accept septage from areas that will not be connected to the sewage collection network for the foreseeable future. Since there is no primary settling tank, the maximum amount of septage that can be accepted should be 0.5% of inflow wastewater volume.

(1) Required Treatment Level

The assumed quality of sewage influent and effluent treated by OD are shown in **Table 4.3-1**. The quality of sewage was determined in consultation with MWSDB taking into consideration the sewage

quality of Moratuwa/Ratmalana STP, Ja-Ela/Ekala STP and other STPs that are in the neighbourhood of Colombo City. The target effluent quality is set to meet the allowable discharge limits. The dilution ratio of the effluent will vary depending on the flow rate in the stream at the discharge point.

Table 4.3-1 Assumed Quality of Influent and Effluent

Unit: mg/L	Inflow	Effluent
	Design Raw Water Quality	Tolerance limit
BOD5	240	30
COD	600	250
TSS	160	50
T-N	45	-
TKN	-	150
NH4-N	-	50
NO3-N	-	10
T-P	6	-
Soluble-P	-	5

Source: JET

(2) Main Unit Processes

1) Screen and Grit Chamber

Wastewater first flows through the screens and grit chamber where grit and solid wastes are removed to prevent damage to machines and equipment.

2) Oxidation Ditch

After the grit chamber, wastewater flows into the OD, the bioreactor of the process. Wastewater is mixed with activated sludge and retained in the tank for about 24 hours. The mixed liquor is continuously agitated by rotor or propeller. Oxygen is supplied by rotor movement. When propellers are used, a diffuser supplies oxygen. Organic substances are biologically decomposed and ammoniac nitrogen is converted to nitrate. By introducing anoxic condition in the OD, denitrification occurs and nitrate is reduced to nitrogen gas. Anoxic condition can be introduced in some sections of the tank by intermittent aeration or by adjusting aeration intensity.

3) Settling Tank

The mixed liquor flows into circular settling tanks and is retained for about 6 hours while solid-liquid separation takes place. The clarified supernatant flows over the effluent weir of the settling tank. The activated sludge in the tank is collected in the sludge hopper. Some of the activated sludge is returned to the OD to keep the process going and the excess is sent to thickening and dewatering.

4) Disinfection Tank

Treated wastewater is disinfected before discharge to minimize the health risks associated with pathogens. Disinfection will be with chlorine in the form of sodium hypochlorite (NaOCl), added to the effluent after the final settling tank. If the receiving water is found to be sensitive to chlorine by-products (e.g. fish) then UV radiation will be considered as an alternative.

4.3.5 Sludge Treatment and Disposal

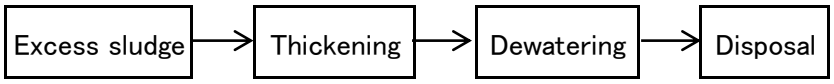
(1) Characteristics of Waste Sludge

Since the OD process has no primary settling tank, only waste activated sludge (WAS) is produced.

WAS contains mostly protein which is the main constituent of biomass. WAS from the OD process is aerobically stabilized because of the long SRT. Odour emission therefore is generally much less than primary sludge.

(2) Sludge Treatment

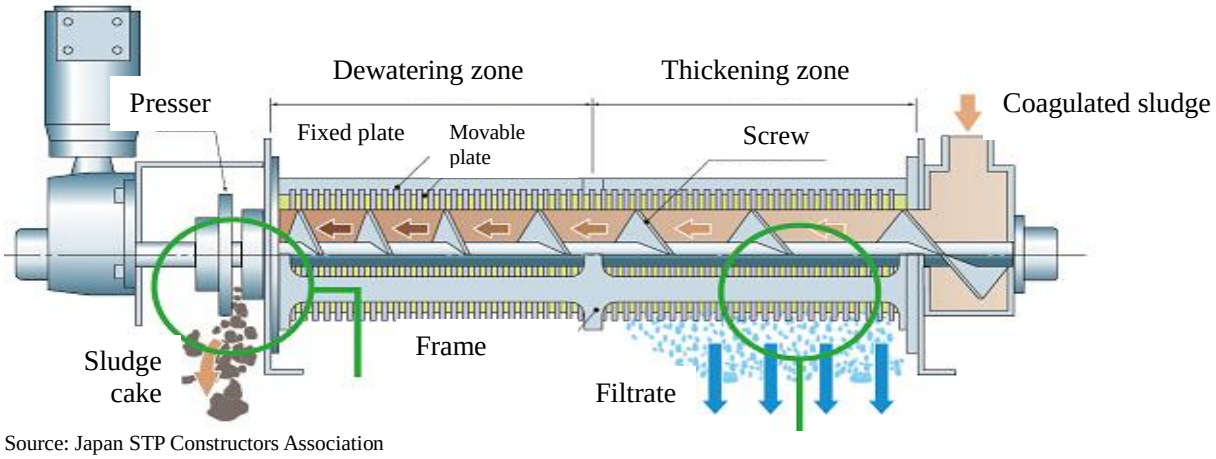
A typical sludge treatment process is shown in **Figure 4.3-6**. Excess sludge is thickened then dewatered. Thickening is carried out by gravity. Depending on the type of dewatering machine, thickening is sometimes omitted and excess sludge is dewatered directly. Anaerobic digestion is usually not used since WAS is not easily decomposed anaerobically.



Source: JET

Figure 4.3-6 Flow Schematic for Sludge Treatment

Filter belt press or screw press dewatering machines are commonly used. Both types of machine require sludge conditioning by polymer coagulant prior to dewatering. Screw press machines are becoming popular for the following reasons: 1) compact size supplied as a unit containing dewatering equipment, coagulation equipment, and control panel; 2) easy to operate, unmanned operation is possible; 3) direct dewatering of excess sludge without thickening is possible.



Source: Japan STP Constructors Association

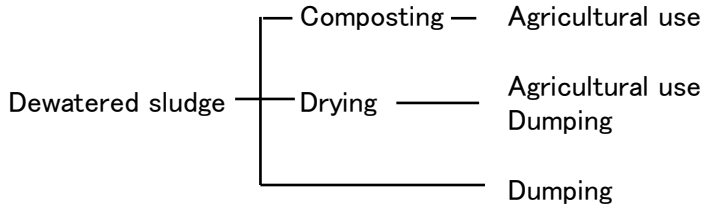
Figure 4.3-7 Diagram of Pressurized Screw Press

(3) Sludge Disposal

The quantity of waste sludge can be calculated by multiplying the amount of suspended solids removed

by 0.75. In general, SS removal efficiency of the OD process is 95%. Therefore, in the case of Nuwara Eliya, sludge produced at the daily maximum flow rate is 0.54 DSt/d (4,700× (160-8) ×0.75×10-6). Assuming the moisture content of dewatered sludge is 80%, the amount of the dewatered sludge will be 2.7 tons/day.

The options for the disposal of dewatered sludge are listed in **Figure 4.3-8**.

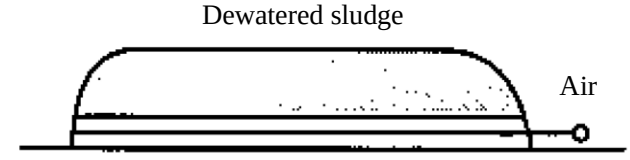


Source: JET

Figure 4.3-8 Sludge Disposal Options

Nitrogen and phosphorus in sewage sludge are essential nutrients for plant growth. The composting process breaks down the organic substances and matured compost has no offensive odour. During composting, fermentation temperature will rise to 80-90℃, destroying pathogenic bacteria in the process. Composting is preferable to drying and dumping because it recycles the nutrients and is also hygienic. Composted sludge can be used as fertilizer for tea plantations, since it has a high nitrogen content. However, strict quality control and education of users are essential.

There are various sludge composting processes. The simplest is pile composting, shown in **Figure 4.3-9**. Sludge is dewatered to a moisture content of around 60% by adding organic materials such as sawdust, rice hull, straw, bark, or composted sludge. The dewatered sludge is piled on a flat concrete bed. Air is supplied through a pipe or by periodic turnover using a shovel or tractor. It usually takes 10-14 days for the first stage fermentation. The second stage will take 1 to 3 months to produce matured compost.



Source: JET

Figure 4.3-9 Pile Composting

Sludge compost contains nitrogen and phosphorus but only a small amount of potassium. Composting with other organic wastes such as cow dung can increase the potassium content and thus the value of compost products.

If there are no agricultural activities in the area to use the composted sludge, dumping may be the only option. Some dump sites do not accept materials with more than 60% moisture content. Dewatered sludge usually at around 80% moisture content must be dried before dumping.

4.4 ON-SITE FACILITIES AND SEPTAGE MANAGEMENT

4.4.1 On-site Facilities

Nuwara Eliya MC is sparsely populated except for the central urban area. On-site septic tanks can provide effective wastewater treatment. Design, construction, and maintenance of septic tanks should comply with national standards (Sri Lanka Standard (SLS) 745 Part 2: 2009) so that their proper functioning can be maintained.

4.4.2 Septic Tanks

Septic tanks retain wastewater, allowing the solids to separate from the suspension and facilitate partial decomposition to reduce pollution load. A septic tank must be adequately sized to perform these functions properly.

The schematic of a typical septic tank is shown in **APPENDIX 6**. The tank should be waterproof and durable enough to withstand external soil load as well as internal water pressure. When the tank is placed under a driveway or parking area, the specifications must ensure the ability to withstand reasonable vehicle loads.

4.4.3 Septic Tank Operation & Maintenance

Periodic maintenance is important for the facility to function sustainably. Therefore, users and owners should be aware of the following precautions.

(i) Sludge Removal

A septic tank requires removal of sludge at regular intervals. When filled with sludge and scum, the tank should be partially cleaned, leaving about one-third to half of the sludge as a 100 to 150 mm layer of "seed sludge" to restart the treatment process. The sludge pumped from the tank is disposed of at the STP to be constructed.

(ii) Access Cover

An access cover is kept tightly shut to prevent other waste from entering the tank. When damaged, it should be repaired or replaced immediately.

(iii) Mosquitoes

To prevent mosquito breeding, the septic tank must be kept tightly closed. Vents must be covered with mosquito mesh and checked periodically. The mesh must be replaced, as required.

(iv) Blockage

Blockage is typically caused by solids clogging the inlet of the septic tank. Preventive measures should be taken. Solid matter should be cleared from the access cover, using a long and flexible stick.

CHAPTER 5 INSTITUTIONAL ARRANGEMENTS FOR IMPLEMENTATION

The implementation of sewerage systems requires planning, design, construction, and eventually operation and maintenance. Capacity development of staff from NWSDB, relevant regional support centres (RSCs), and MCs is needed to ensure required tasks are satisfactorily conducted at each level.

5.1 PROJECT IMPLEMENTATION AND MANAGEMENT

5.1.1 Examples of Implementation Structures in Sri Lanka

Table 5.1-1 shows the implementation structure of water and sewerage works in 6 municipalities. Some sewerage works are under implementation or at the planning stage.

Table 5.1-1 Organization of Water and Sewerage Works in 6 Municipalities

Area	Water works			Sewerage works			
	Ownership	Management	O&M	Ownership	Management	O&M	
						STP	Pipe
CMC	N	N	N	MC	MC	---	MC
Kandy	MC	MC	MC	MC	MC (undecided)	MC (undecided)	MC (undecided)
Ratmalana-Moratuwa	N	N	N	N	N	N	N
Ja-ela/Ekala	N	N	N	N	N	N	N
Hikkaduwa	N	N	N	N	N	N	N
Kataragama	N	N	N	N	N	N	N

(N: NWSDB)
Source: JET

Colombo MC (CMC) owns the sewerage works and operates and maintains the pumping stations and sewer networks, while the water works is owned and managed by NWSDB.

Kandy MC owns the water and sewerage works, but the O&M of STP will be out-sourced to NWSDB, while sewer pipe maintenance will be conducted by the MC.

The water and sewerage works in Ratmalana-Moratuwa, Ja-ela/Ekala, Hikkaduwa, and Kataragama, are owned and managed by NWSDB.

The ownership and the implementation structure of the sewerage works is determined by each municipality.

5.1.2 Public Works in Nuwara Eliya MC

Table 5.1-2 shows the water supply, solid waste collection and disposal, on-site sanitation, road construction/maintenance and storm-water management in the MC.

Table 5.1-2 Public Works in Nuwara Eliya MC

Water works	Responsible organization		MC Engineering department
	Works		O&M of intake/storage tank, distribution, billing and collection
	Type of tasks	Planning & Designing	no
		Construction	Implementing
		O&M	Implementing
	Financing sources		Service charge
	Tariff system		MC tariff system
	Staff	Engineer	1
		Technical officer	1
		Others	74
	Out-sourcing		no
Solid waste management	Responsible organization		MC Health department
	Works		
	Type of tasks	Planning & Designing	Implementing
		Construction	Implementing
		O&M	Implementing
	Financing sources		MC budget without any subsidy
	Service charge		Economic center 65,000 SLR/month
	Dumping site	Location	Moon Plain (owned by MC)
		Capacity	19,000m3 (Extent of the land 20 years)
	Collection	Method	
		Vehicles	Compactor 2, Tractor 4, Cart 20,
	Staff	Supervisor	1
		PHI	3
		Upper level labor	10
		Labors	90
	Out-sourcing		no
On-site sanitation	Responsible organization		MC Health department
	Type of tasks	Planning & Designing	no
		Construction	Implementing
		O&M	Implementing
	No. of septic tanks	At present	8,000
		Future	10,000
	Financing sources		Service charge, MC budget
	Services	Installation	Property /land owner or House holder
		Approval	MC PHI (public health inspector)
		Supervisor	MC PHI (public health inspector)
	Sludge removal	Frequency	2 times/year
		Procedure	By gully sucker dump to septage tank at Moon plain
		Sludge disposal site	Moons plain Sanitary land filling site(
	Service charge	Installation	By Property /land owner or House holder
		Sludge disposal	Tariff
	Staff	Supervisor	1
		PHI	3
		Upper level labor	14
		Labors	90
	Out-sourcing		no
Road construction and maintenance works	Responsible organization		MC Engineering department
	Works		E grade roads with in Council Limit
	Type of tasks	Planning & Designing	no
		Construction	Implementing
		O&M	no
	Financing sources		Mainly MC budget, PC and national level budget also is used.
	Staff	Engineer	1
		Technical officer	2
		Others	0
	Out-sourcing	Details	Compactor 2, Tractor 4, Cart 20,
		Type of contract	Construction/Rehabilitation
Storm water management	Responsible organization		MC Health department
	Works		Clearing of drains/Cleaning of blockages
	Type of tasks	Planning & Designing	no
		Construction	Implementing
		O&M	Implementing
	Existing drainage system		Open drain system
	Financing sources		MC budget
	Staff	Engineer	1
		Technical officer	4
		Others	40
	Out-sourcing		no

Source: MC

Except for road construction and maintenance, the MC carries out all the other public works services from planning to O&M without outsourcing. The water tariff covers the expenses for water supply and the MC budget and government subsidies are used to cover the costs of providing the other services.

5.1.3 Organizational Options for Implementing Sewerage Works

5 options are prepared for the implementation of sewerage works as shown in **Table 5.1-3**.

Table 5.1-3 Organizational Options for Implementing Sewerage Works

Activity	Option 1	Option 2	Option 3	Option 4	Option 5
Request of sewerage works	NWSDB	NWSDB	LA	LA	LA
Approval of sewerage works	MWSD	MWSD	MWSD ⇨ MLGPC	MWSD ⇨ MLGPC	MWSD ⇨ MLGPC
Budget Preparation	MWSD ⇨ NWSDB	MWSD ⇨ NWSDB	MLGPC ⇨ LA	MLGPC ⇨ LA	MLGPC ⇨ LA
Project Planning	NWSDB assisted by LA	NWSDB assisted by LA	NWSDB assisted by LA	NWSDB assisted by LA	NWSDB assisted by LA
Planning & Designing	NWSDB & C/C	NWSDB & C/C	NWSDB & C/C	NWSDB & C/C	NWSDB & C/C
Construction	P/C	P/C	P/C	P/C	P/C
Construction Supervision	NWSDB & C/C	NWSDB & C/C	NWSDB & C/C	NWSDB & C/C	NWSDB & C/C
Ownership of facilities	NWSDB	NWSDB	LA	LA	LA
O&M Sewer Networks	NWSDB	P/O supervised by NWSDB	LA	P/O supervised by LA	LA
O&M STP			NWSDB		
Loan Settlement	MWSD ⇨ NWSDB	MWSD ⇨ NWSDB	MLGPC ⇨ LA	MLGPC ⇨ LA	MLGPC ⇨ LA

Notations : 1. LA- Local Authority (MC, Urban Council(UC), Pradeshiya Sabha (PS))
2. NWSDB- National Water Supply & Drainage Board
3. MWSD- Ministry of Water Supply & Drainage
4. MLGPC- Ministry of Local Government & Provincial Councils
5. C/C- Appointed Consultants/Contractor
6. P/C- Private Contractor
7. P/O- Private Operator

Source: JET

In Options 1 and 2, the sewerage system is owned and managed by NWSDB, in one case the O&M is outsourced to the private sector.

In Options 3 and 4, the MC owns the system but O&M of the STP is outsourced either to NWSDB (Option 3), or to the private sector (Option 4),

In Option 5 the system is owned, operated, and maintained by MC .

In all five options, the planning, design, and construction is carried out by NWSDB because they are experienced with these tasks.

5.1.4 Preferred Implementation Structure for Sewerage Works

Since Nuwara Eliya MC already owns and manages its water supply system, the sewerage charge can be collected together with the water charge. The MC can also manage the customer service for all the public works efficiently under one office. However, it may be better to outsource to NWSDB since the MC would have to hire and train more engineers and labourers.

Therefore, Option 3 is the preferred implementation structure for the sewerage works in the Nuwara Eliya MC.

5.2 ORGANIZATION FOR IMPLEMENTATION

To organize the implementation of the sewerage system in Nuwara Eliya MC, the detailed roles of NWSDB, relevant RSC and MC must be defined. **Table 5.2-1** shows the roles for each party from planning to O&M for Option 3.

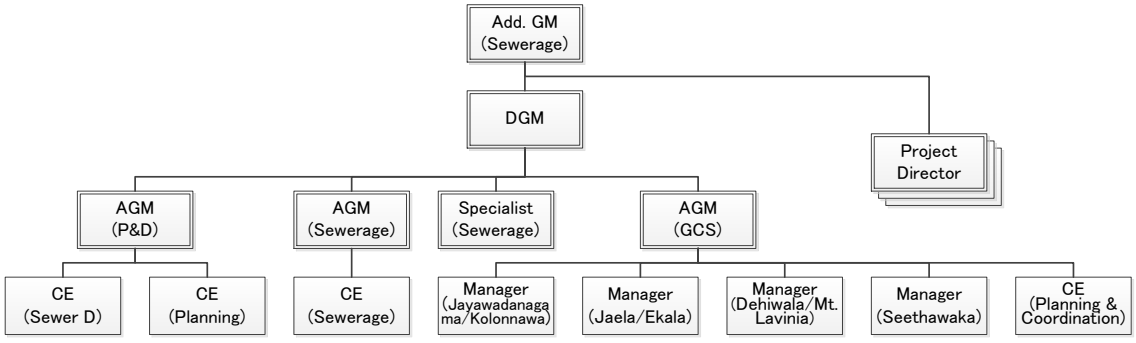
Table 5.2-1 Roles of NWSDB and MC at Various Project Implementation Stages

Option-3		Implementation Stage			
		Planning	Designing	Construction	O&M
NWSDB	Tasks	Supervision Decision of STP site and others	Supervision	Supervision	O&M of STP
	Staff	* Project Team	* PD under DGM * Staff in Project Management Units (PMU)	⇒	⇒
RSC	Tasks		Supporting project activities	⇒	Supporting O&M of STP
	Staff		* Manager in sewerage works	⇒	* Staff in STP * Staff for sewer networks
MC	Tasks	Supervision of planning works	Acquisition of STP site Supervision of designing works	Supervision of STP and sewer networks construction	Supervision of O&M of STP
	Staff	* Staff for tasks above	⇒	⇒	*Staff for supervision of sewerage works *Staff for sewer networks *Staff for house connection *Staff for monitoring environment etc. *Staff for public awareness *Staff for customer service

Source: JET

5.2.1 Organization of the NWSDB Sewerage Department

The organization of the NWSDB sewerage department is as shown in **Figure 5.2-1**. When the sewerage project is implemented, the engineering tasks in planning, design, construction and O&M will increase.

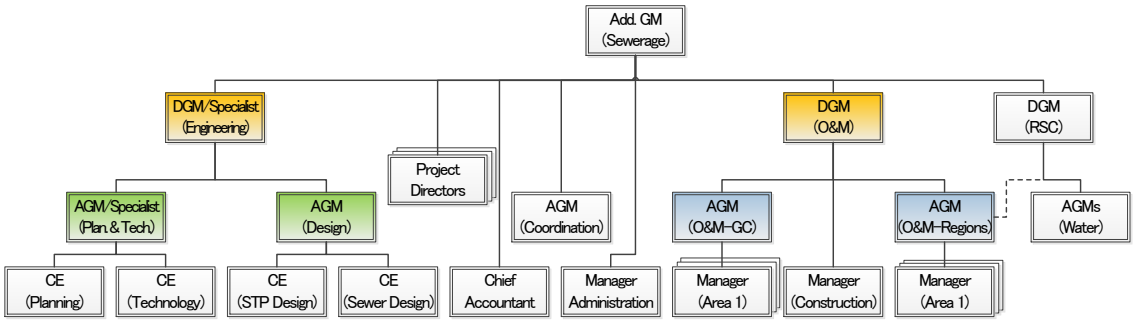


Source: JET

Figure 5.2-1 Organization of the NWSDB Sewerage Department

Some re-organization of the sewerage department must be made to cope with the increased tasks as shown in **Figure 5.2-2**.

The responsibilities of the Deputy General Manager (DGM) can be split into DGM/Specialist (Engineering) and DGM (O&M). Assistant General Manager (AGM) for planning and design (P&D) can be split into AGM (Plan & Tech.) and AGM (Design). AGM (O&M-Regionals) can be added to AGM (O&M-GC) to cope with the increased work load.

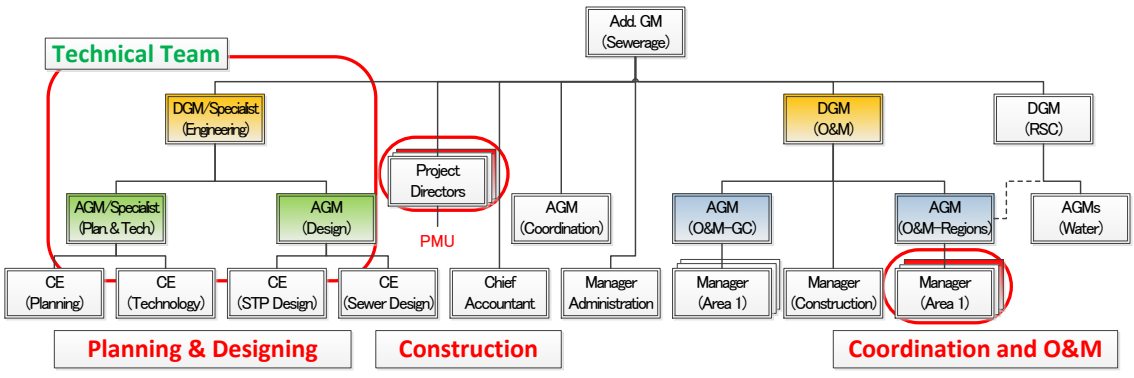


Source: JET

Figure 5.2-2 Proposed Re-organization of the NWSDB Sewerage Department

At the planning and design stage, NWSDB will establish a Technical Team, as shown in **Figure 5.2-3**, to work with the consultants. At the construction stage, a Project Director (PD) will be added under the Additional General Manager (Addl. GM) and a PMU for supervising the construction works will be established under the PD.

A Manager under the AGM (O&M-Regionals) will work with the RCS to coordinate the O&M of STP and sewer networks.



Source: JET

Figure 5.2-3 NWSDB Sewerage Department Responsibilities for Project Implementation

5.2.2 Organization of RSC Central

Nuwara Eliya MC owns and manages its water supply system with no involvement from RSC Central. For the sewerage system, the tasks from planning to O&M will be consigned to NWSDB and RSC Central will be involved.

A Manager in charge of the project will report to the AGM (O&M-Regionals) who will in turn report to the DGM (O&M). Because the RSC has little experience in sewerage works, technical support will be provided through AGM (O&M-Regionals). A unit will be formed under the Manager to work on O&M of STP.

5.2.3 Organization of Nuwara Eliya MC

Nuwara Eliya MC will manage the project, secure the sites for the STP and pumping stations, coordinate sewer network construction and house connections. The MC will operate and maintain sewer networks, supervise the O&M of STP, monitor effluent quality and nearby environment, conduct public outreach and promote sewerage service. Customer service for sewerage works will be implemented jointly with that of the other public services. **Table 5.2-2** shows the tasks and departments responsible for the delivery of the sewerage service.

Table 5.2-2 Sewerage System Tasks and Responsibilities

Stage	Task	Department in charge
Planning to Construction	Project management	Engineering Department
	Acquisition of STP and pumping stations site	
	Coordination for sewer networks construction	
	House connection	Health Department
O&M	O&M of sewer networks	
	Supervision of O&M of STP	
	Monitoring of STP effluent and nearby environment	
	Public awareness	
	Promotion of house connection	
	Customer service	

Source: JET

5.3 CAPACITY DEVELOPMENT

5.3.1 Securing Human Resources

(1) NWSDB

A PD and a PMU are required at the construction stage. A Manager reporting to the AGM (O&M-Regionals) and engineers, technical staff, drivers and labourers are needed to operate and maintain the facilities. Some staff can be transferred from existing sewerage and water supply operations to facilitate the start up. New staff will have to be hired to fill the vacancies left by the transfers.

As shown in **Table 5.3-1**, besides 13 national universities (most with faculties of civil, mechanical, electrical engineering, chemistry and environmental sciences), there are 8 technical colleges/high-schools. There will be many graduates who will have the required knowledge to join the work force in the sewerage sector.

Table 5.3-1 Faculties at National Universities and Technical Colleges/High Schools

University	Civil Works	Electrical	Mechanical	Chemistry	Environment
Colombo				✓	
Peradeniya	✓	✓	✓	✓	
Sri Jayewardenepura				✓	
Kelaniya				✓	
Moratuwa	✓	✓	✓	✓	
Jaffna	✓	✓	✓	✓	
Ruhuna	✓	✓	✓	✓	✓
Open University	✓	✓	✓	✓	✓
Eastern				✓	
South Eastern	✓	✓	✓		
Rajarata				✓	✓
Sabaragamuwa					
Wayamba		✓			
Uva Wellassa					
Visual & Performing Arts					
College/High school	Civil Works	Electrical	Mechanical	Chemistry	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

Satisfactory working conditions and compensation are important to keep staff motivated. As shown in **Table 5.3-2**, NWSDB salaries are higher than those of similar positions in the private sector. NWSDB has a decent promotion system and staff is motivated to perform well.

Table 5.3-2 Comparison of Salaries and Benefits between NWSDB and Private Sector

Grade		Staff of NWSDB		Staff of a private sector	
		Salary (LKR)	Benefits (in LKR)	Salary (LKR)	Benefits in (LKR)
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

(2) MC

The MC should implement the tasks shown in **Table 5.2-2**. Some staff can be transferred from water supply and other services. New staff must be hired to fill the vacancies left by the transfers. Peradeniya University in Kandy in the Central District will have graduates with the required knowledge.

5.3.2 Development of Human Resources

A lot of technical knowledge and experience is required from planning to O&M. Capacity development is very important especially when many new staff with almost no experience will be hired. Training seminars and OJT are necessary.

(1) NWSDB Training Centre

The Training Centre currently is not offering many technical programs on sewerage systems. As many staff will need training, this aspect of the Centre's curriculum will have to be enhanced. **Table 5.3-3** shows the programs that should be added.

Table 5.3-3 Required Training Programs for Sewerage Systems

Category	Title of the Program
Planning	Planning of Sewage Works
	Principle of Asset Management
Designing	Designing of Sewer System
	Jacking Method
	Rehabilitation of Pipe Networks
	Designing of STP
	Mechanical System Design in STP
	Electrical System Design in STP
O&M	Maintenance of Sewer System
	Operation of STP
	Maintenance of Mechanical System in STP
	Maintenance of Electrical System in STP
	Water Quality Management
	Commercial and Industrial Wastewater Management
Safety Management	On-site Safety management
Risk Management	On-site Risk Management

Source: JET

NWSDB staff as well as those from relevant MCs and private sector companies (if outsourcing is used) should participate in the training programs.

(2) On-the-Job Training (OJT)

OJT in the STP, at pumping stations, and sewer networks is necessary. Generally, the contractor will conduct OJT for staff of STP at commissioning. Staff should also be dispatched to other STPs for 6 months to a year to gain experience in maintenance and trouble-shooting.

5.3.3 Sewer Maintenance Equipment and Vehicles

Scheduled sewer cleaning is carried out regularly and at emergency situations. There should be adequate number of specialized machines and vehicles for the work. The Nuwara Eliya operation can start with the number of machines and vehicles other systems are using, as shown in **Table 5.3-4**. More can be added as the service area expands and as more maintenance is required.

Table 5.3-4 Sewer Maintenance Equipment & Vehicles Used at Existing Sewerage Systems

	Dehiwala – Mount Lavinia	Jayawadanagama - Kolonnawa	Ja-ela/Ekala
Gully/ Jetting Combined Machine	-	1	-
Gully Bowser	2	1 (with frequent breakdown)	1
Portable Jetting Machine	1	1 (with frequent breakdown)	-
Crane Truck	-	1 (with frequent breakdown)	-
High Pressure Jet Machine	1	1	1
High Pressure Water Spraying Machine	-	1	-

Source: JET

5.3.4 Customer Service

Nuwara Eliya MC is already managing customer service for water supply. When sewerage is added to their responsibilities, they will have to deal with and track customer complaints such as foul odour and clogged pipes. They can learn from other MCs where sewerage systems are already in operation.

5.4 CONSTRUCTION MANAGEMENT FOR THE PROJECT

The PMU established under the PD will oversee the activities during construction.

5.4.1 PMU

There will be 40 staff in the PMU, including engineers and labourers.

5.4.2 Project Office

It would be ideal to have the PMU office in the RSC. However, if this arrangement cannot be accommodated, the office can be set up near the project site. The office should be big enough to house the contractors as well. Another matter to bear in mind is the need to have enough parking for people who have to visit the project site.

CHAPTER 6 COST ESTIMATE AND PROCUREMENT

6.1 PROJECT COST

6.1.1 Construction and Project Costs

Construction cost is estimated based on NWSDB's "RATES 2016". The rates not contained in this schedule are calculated based on previous JICA projects and Pre-F/S reports in Sri Lanka. Construction cost is presented in **APPENDIX 7**.

Project cost is estimated based on the following conditions.

Construction cost	:	Estimated with price level at January, 2017
Consulting cost	:	Estimated with price level at January, 2017
Consulting period	:	2019～2024
Construction period	:	2021～2024
Administration cost	:	5%
Physical contingency	:	5%
Interest during construction	:	Construction：0.3% Consulting：0.01%
Front end fee	:	0.2%
Tax and duty	:	15%
Price escalation	:	Local currency : 3.8%, Foreign currency : 1.6%
Exchange rate	:	LKR 1 ＝JPY 0.77

Project cost is estimated at approximately 10.3 billion LKR (7.9 billion JPY), excluding tax and duty, as shown in **Table 6.1-1**. Details of the project cost estimate are presented in **APPENDIX 8**.

Table 6.1-1 Estimated Project Cost

		Amount		Total Amount	Total Amount
		L.C. (LKR)	F.C. (JPY)	LKR	JPY
1	Construction Cost				
	A Nuawra Eliya STP (Q=4,700m3/day)	786,161,039	758,016,000	1,770,597,403	1,363,360,000
	B Trunk Sewer & Pump Station	1,544,441,000	1,168,923,000	3,062,523,000	2,358,143,000
	C Branch Sewer & Pump Station	1,048,513,000	352,170,000	1,505,877,000	1,159,525,000
	D House Connection	477,500,000	0	477,500,000	367,675,000
	Sub-total of 1(A-D)	3,856,615,039	2,279,109,000	6,816,497,403	5,248,703,000
2	Administration cost	484,000,000	0	484,000,000	372,680,000
3	Consulting cost	374,000,000	682,000,000	1,259,714,000	969,980,000
4	Physical contingency for construction cost	239,000,000	125,000,000	401,338,000	309,030,000
5	Price escalation for construction cost	926,000,000	218,000,000	1,209,117,000	931,020,000
6	Land acquisition and compensation	-	-	-	-
7	Interest during construction	0	64,000,000	83,117,000	64,000,000
8	Front-end Fee	0	15,000,000	19,481,000	15,000,000
9	Tax and duty	1,753,000,000	0	1,753,000,000	1,349,810,000
	Sub-total of (2-9)	3,776,000,000	1,104,000,000	5,209,766,000	4,011,520,000
	Total including Tax and Duty	7,632,615,039	3,383,109,000	12,026,263,000	9,260,223,000
	Total excluding Tax and Duty	5,879,615,039	3,383,109,000	10,273,263,000	7,910,413,000
	Eligible Portion (1, 3, 4, 5 and 7)	5,395,615,039	3,368,109,000	9,769,783,000	7,522,733,000
	Non-Eligible Portion (2, 6, 8 and 9)	2,237,000,000	15,000,000	2,256,481,000	1,737,490,000

Source: JET

6.1.2 Operation and Maintenance (O&M) Cost

O&M cost is estimated based on the Ratmalana/Moratuwa sewerage system as shown in **Table 6.1-2**. It includes staff cost, utilities, chemical cost, repair expenses, installation cost, security and other expenses. The detailed estimate is presented in **APPENDIX 9**,

Table 6.1-2 Estimated O&M Cost

	Total Amount (LKR)	Total Amount (JPY)
Nuwara Eliya	67,127,000	51,850,000

Source: JET

6.2 PHASED CONSTRUCTION

The project can be implemented in one phase because it is relatively modest in scale, with a service area of 515 ha, 4,700 m^3/day capacity and cost of 10.3 billion LKR (7.9 billion JPY).

CHAPTER 7 FINANCING SEWERAGE PROJECT

7.1 FINANCIAL CONDITION OF NUWARA ELIYA MUNICIPAL COUNCIL

7.1.1 Financial Statements

Table 7.1-1, **Table 7.1-2**, and **Table 7.1-3** show the financial condition of Nuwara Eliya MC. Nuwara Eliya MC differs from most other MCs in that they record their business transactions in financial statements.

Revenue should cover total expenditures. Any surplus or deficit is rolled over to the next year. Similar to other MCs, Nuwara Eliya MC pays the salaries of central government employees working at the MC and gets reimbursed annually through a central to provincial government budgetary transfer, under "Revenue Grants" account (**Table 7.1-2**).

Table 7.1-1 Financial Balance Sheet for Nuwara Eliya MC

As of 31st December 2015

Unit: million LKR

Description	2014	2015
Assets		
Current Assets		
Cash and Cash Equivalent	23.537	57.442
Investments	8.263	6.617
Prepayments	2.840	3.542
Receivables	226.522	203.351
Stores in hand	17.171	23.468
Total	**278.333**	**294.420**
Non-Current Assets		
Fixed Assets	341.663	405.941
Total	**341.663**	**405.941**
Total Assets	**619.996**	**700.361**
Equity and Liabilities		
Current Liabilities		
Payables	31.187	80.747
Receipts in Advance	4.255	5.325
Deposits	34.204	38.113
Total	**69.646**	**124.185**
Non-Current Liabilities		
Loan Capital	65.352	60.262
Total	**65.352**	**60.262**
Net Assets/Equity		
Accumulated Fund (Municipal Fund)	137.808	106.319
Revenue Contribution for Capital	344.341	408.619
Reserves	2.846	0.976
Total	**484.995**	**515.914**
Total Equity & Liabilities	**619.993**	**700.361**

Source: 2015 Financial Statement, MC - Nuwara Eliya

Table 7.1-2 Revenue & Expenditure Statement for Nuwara Eliya MC
for the year ended 31st December 2015

Unit: million LKR

Description	2014	2015
Revenue		
Rates and Taxes	81.957	79.081
Rent	87.807	38.733
Licenses	16.771	17.773
Fees for Services	16.237	19.879
Warrant Cost & Fines	0.733	0.881
Other Revenue	70.016	85.719
Revenue Grants	100.395	239.688
Total Revenue	**373.916**	**481.754**
Expenditure		
Recurrent Expenditure		
Personal Emoluments	135.166	234.841
Travelling Expenditure	2.434	0.701
Supplies	83.913	62.252
Maintenance Expenditure	25.686	29.294
Services	25.183	25.106
Interest Payments	2.396	5.502
Transfers	5.928	3.190
Pensions, Retirement Benefits, and Gratuities & Other Recurrent Expenditure	2.366	1.450
Total Recurrent Expenditure	**283.072**	**362.336**
Capital Expenditure		
Capital Expenditure	72.141	112.078
Total Capital Expenditure	**72.141**	**112.078**
Total Recurrent & Capital Expenditure	**355.213**	**474.414**
Excess of Total Revenue over Total Expenditure	**18.703**	**7.340**

Source: 2015 Financial Statement, MC - Nuwara Eliya

Table 7.1-3 Cash Flow Statement for Nuwara Eliya MC
Year Ended 31st December 2015

Unit: million LKR

Description	2014	2015
Cash Flow from Operational Activities		
Total Cash Provided from Operations (a)	390.490	503.308
Total Cash disbursed to Operations (b)	364.804	462.003
Net Cash Flows from Operational Activities c=(a-b)	**25.686**	**41.305**
Cash Flow from Investment Activities		
Total Cash Provided from Investment Activities (d)	0.000	0.000
Total Cash disbursed to Investment (e)	4.925	7.403
Net Cash Flows from Investment Activities f=(d-e)	**-4.925**	**-7.403**
Cash Flows from Financing Activities		
Total Cash Provided from Financing Activities (g)	15.196	15.498
Total Cash disbursed to Financing Activities (h)	14.852	15.530
Net Cash Flows from Financing Activities i=(g-h)	0.344	-0.032
Net Movement in Cash j=c+f+i	**21.105**	**33.870**
Opening Cash Balance as at January 1st, 2015	2.432	23.537
Closing Cash Balance as at January 1st, 2015	23.537	57.407

Source: 2015 Financial Statement, MC - Nuwara Eliya

As shown in **Table 7.1-2**, Nuwara Eliya MC recorded annual surplus in 2014 and 2015 after reflecting salary reimbursement. **Table 7.1-1** shows the 2015 surplus at 106 million LKR; "Loan Capital" at 60 million LKR and large "Receivables" at 203 million LKR. The loan size is moderate and the receivables are not deemed as a serious problem. The MC maintains a positive cash balance which increased to 57 LKR million in 2015 (**Table 7.1-3**). Nuwara Eliya MC's financial performance is quite good.

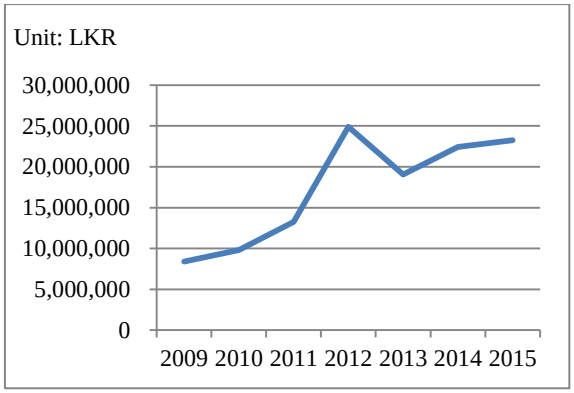
Tourism revenue (such as admission fees to Hakgala Botanical Garden, Gregory Lake and other attractions) is significant and on the rise, accounting for the MC's good financial condition. Tourism related revenue is recorded under "Other Revenue" in **Table 7.1-2** and **Table 7.1-4**, **Figure 7.1-1** and **Figure 7.1-2** show the trend of tourism revenue for the past years.

Table 7.1-4 Revenue from Admission Fees 2009-2015 for 3 Tourist Attractions

Unit: LKR

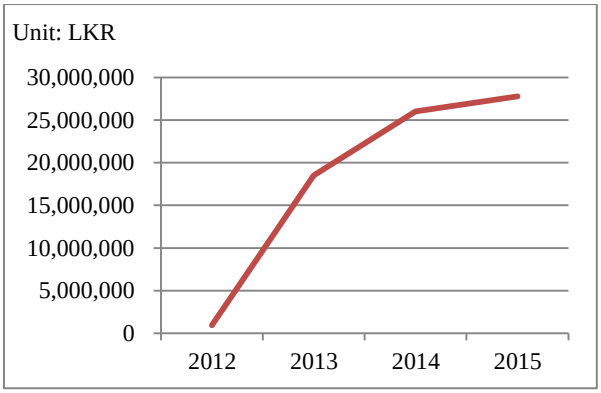
Year	Victoria Park	Gregory Lake	Moon Plane	Total
2009	8,410,108.00	0.00	0.00	8,410,108.00
2010	9,790,620.00	0.00	0.00	9,790,620.00
2011	13,256,281.00	0.00	0.00	13,256,281.00
2012	24,882,495.00	943,087.00	0.00	25,825,582.00
2013	19,061,080.00	18,511,380.00	0.00	37,572,460.00
2014	22,447,423.19	25,999,941.28	957,385.94	49,404,750.41
2015	23,262,657.15	27,777,986.63	4,142,991.12	55,183,634.90
Total	**121,110,664.34**	**73,232,394.91**	**5,100,377.06**	**199,443,436.31**

Source: Nuwara Eliya MC



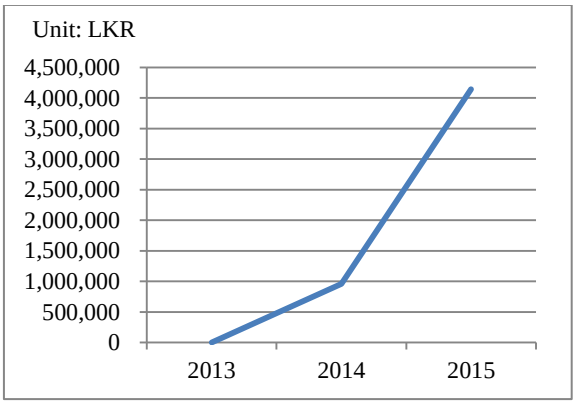
Source: Nuwara Eliya MC

Figure 7.1-1 Trend of Victoria Park Admission Revenue



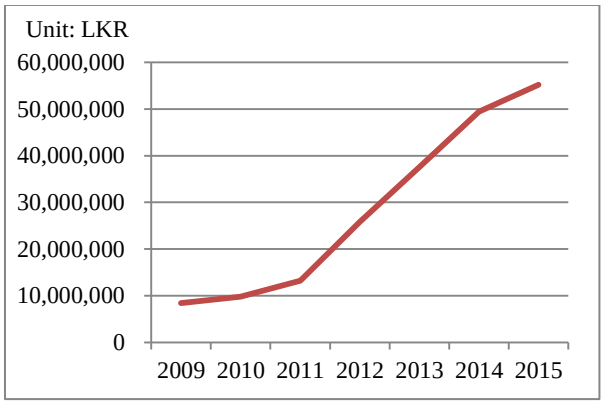
Source: Nuwara Eliya MC

Figure 7.1-2 Trend of Gregory Lake Admission Revenue



Source: Nuwara Eliya MC

Figure 7.1-3 Trend of Moon Plane Admission Revenue



Source: Nuwara Eliya MC

Figure 7.1-4 Trend of Total Admission Revenue

The financial performance of Nuwara Eliya MC shows that it has the capacity to operate and maintain the wastewater treatment facilities.

7.1.2 Financial Condition of the Water Supply Sector in Nuwara Eliya MC

Nuwara Eliya MC operates its own water supply service. The financial condition of the MC's water supply business can indicate how well its sewerage business will succeed. **Table 7.1-5** contains excerpts from 2015 statements, showing the breakdown of revenue and recurrent/capital expenditures, with a positive balance (Revenue – Recurrent & Capital Expenditure) of 6.65 million LKR. The water supply business generated 15% surplus. The O&M budget for water supply service can adequately cover the maintenance cost.

Table 7.1-5 2015 Income and Expenditures - Nuwara Eliya MC Water Supply

Unit: million LKR

Description		Water Services
1	**Revenue**	
	Rates and Taxes	37.161
	Rent	
	Licenses	
	Fees for Services	2.633
	Warrant Cost & Fines	0.010
	Other Revenue	0.325
	Revenue Grants	5.689
	Total Revenue	**45.818**
2	**Expenditure**	
2.1	**Recurrent Expenditure**	
	Personal Emoluments	26.109
	Travelling Expenditure	0.004
	Supplies & Requisites	8.485
	Repairs and Maintenance of Capital Assets	0.185
	Transportation Communication Utility & Other Services	4.364
	Interests, Payments, Dividends, and Bonuses	0.000
	Grants (Contributions and Subsidies)	0.021
	Pensions, Retirement Benefits, and Gratuities	0.002
	Total Recurrent Expenditure	**39.170**
2.2	**Capital Expenditure**	**0.000**
	Total Expenditure	**39.170**
3	**Balance (Revenue - Expenditure)**	**6.648**

Source: 2015 Financial Statement, MC - Nuwara Eliya

Table 7.1-6 and **Figure 7.1-5** show the total income and expenditures and annual profit from 2011 to 2015. Profit decreased for 2014 and 2015.

Table 7.1-6 Income and Expenditure Trend - Nuwara Eliya MC Water Supply

Unit: LKR

Year	2011	2012	2013	2014	2015
Total Income	37,341,246	42,947,978	48,254,748	48,409,342	45,817,393
Total Expenditure	22,170,105	24,273,554	22,524,305	29,398,238	39,169,338
Profit / Loss (-)	15,171,141	18,674,424	25,730,443	19,011,104	6,648,055

Source: 2015 Financial Statement, MC - Nuwara Eliya

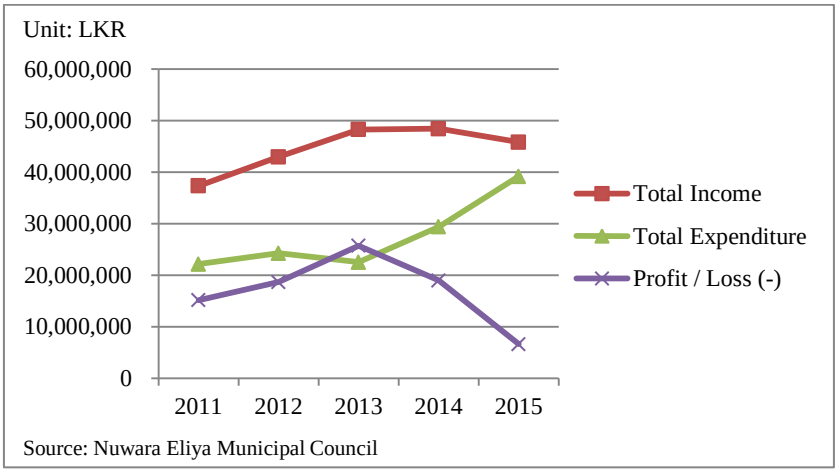


Figure 7.1-5 Income & Expenditure Trend - Nuwara Eliya MC Water Supply

The water supply business of Nuwara Eliya MC is running a surplus and is not a burden to the MC when sewage treatment is added to its responsibilities. The water supply sector may even have the financial capability to subsidize the sewerage sector if needed.

7.2 FINANCING SEWERAGE FACILITY CONSTRUCTION AND O&M

7.2.1 Construction, O&M and Replacement Costs

The Cabinet Memorandum "Regularizing Foreign Financing Mechanism in Relation to Water Supply and Sewerage Project", dated 26 January 2016, stipulates that the Treasury will bear 100% of the debt service (capital & interest) for sewerage projects.

As in most countries including Japan, the sewage tariff does not cover the full cost of construction, O&M, and future replacement. In many developing countries such as Malaysia, Thailand and Vietnam, it is difficult for the sewage tariff to cover even just the O&M costs because of the low willingness to pay. Therefore, for Sri Lanka, it is recommended that:

- 100% of the construction cost to be covered by the central government, i.e. 100% grant to NWSDB or MC.
- O&M costs shall be covered by the sewage tariff which will be increased gradually.
- small-scale replacements should be covered by NWSDB's or the MC's own budget, but large scale ones will be conducted as projects funded by the central government.

Therefore, the sewage tariff is structured to cover the only the O&M costs of the sewerage facilities.

7.2.2 Sewage Tariffs

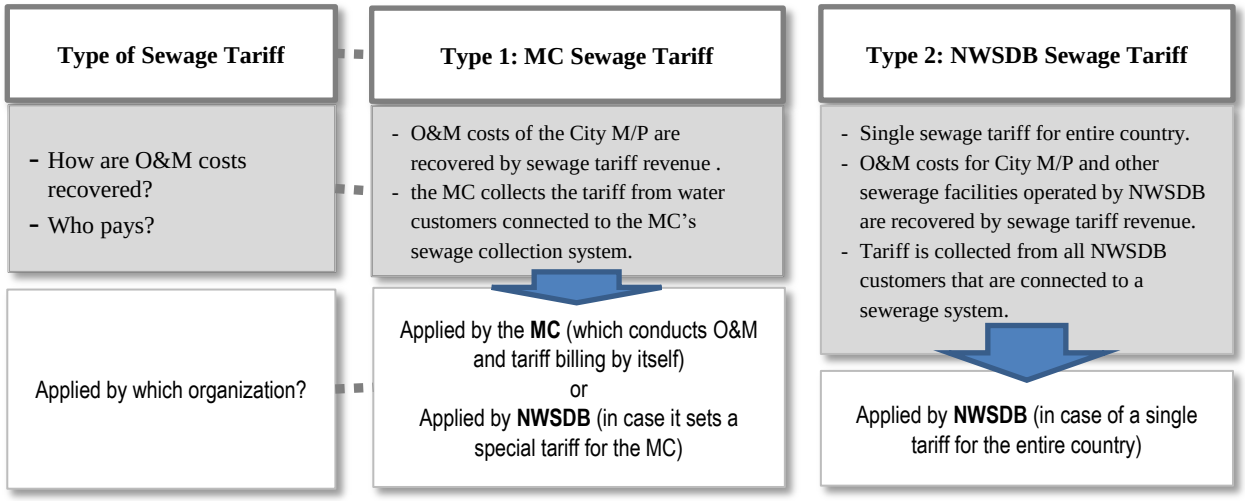
(1) Two Types of Proposed Tariffs

Two types of sewage tariffs are proposed to recover the full costs of O&M for sewerage systems:

- Type 1 recovers the O&M costs of the sewerage facilities that serve customers in the MC's sewer service area. This tariff would be used by MCs when they own, operate and maintain the

sewerage system or if NWSDB applies a project specific tariff to the MC instead of the Type 2 tariff.

- Type 2 is a uniform, nation-wide tariff, that would recover O&M costs of all sewerage facilities owned, operated and maintained by the NWSDB including those identified in the City M/P. (refer to **Figure 7.2-1**).



Source: JET

Figure 7.2-1 Difference Between Type 1 and Type 2 Sewage Tariff

(2) Tariff Calculation Methodology

The sewage tariff is calculated by dividing the estimated annual O&M costs (excluding depreciation and replacement) by total water consumption of the sewerage customers.

A profit margin is provided to set aside funds for small-scale replacements and contingencies such as unexpected disasters or sudden price hike of cost items. It is set at 10% of the O&M costs for Type 1 and 5% for Type 2 tariff. The higher rate reflects the much smaller budget for MCs compare to that of NWSDB.

Sewage charges will be added to the water bill. The sewage charge will be calculated by dividing the total O&M costs by the water consumption volume. Therefore, the sewage charge to each customer is proportional to amount of water they consume.

(3) Sewage Tariff Proposed by the Strategic M/P

The sewage tariff proposed by the Strategic M/P is calculated for NWSDB to recover all the O&M costs under current conditions. The tariff would be implemented with increments planned for 2019 and 2022 (Strategic M/P, Section 7.3.1). The sewage tariff to cover the O&M costs of each City M/P is calculated by considering that it can take up to ten years to reach full operational capacity.

When NWSDB is responsible for the O&M and billing on behalf of the MC, the sewage tariff proposed by the Strategic M/P should be implemented as planned. A tariff increase for each City M/P would be implemented after the STP is operating at full capacity (**Figure 7.2-2**).

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025
1st Tariff Raise of Strategic M/P			△						
2nd Tariff Raise of Strategic M/P						△			
3rd Tariff Raise of City M/P (if necessary)								△	

Source: JET

Figure 7.2-2 Implementation Schedule for Tariffs

When the MC is responsible for sewerage services, the sewage tariff can be implemented in one step. The timing can be at the discretion of the MC but it should be done before the facilities start to operate.

7.2.3 Assumptions for Calculating the Proposed Tariff

The following assumptions are used to calculate the sewage tariff in the City M/P:

- total volume of water consumed by customers is based on the Design Criteria
- price inflation is not reflected in the calculation. Inflation adjustment would be included in the calculation of an actual sewage tariff .
- customers are charged for connecting to the sewage collection system (as is the present practice)

7.2.4 Sewage Tariff Calculation

The following Tables show the Type 1 and Type 2 sewage tariff to cover the O&M cost of the proposed City M/P project. The calculated tariffs are a weighted average that is based on the total water consumption of domestic, commercial, and industrial customers.

(1) Type 1: MC does the O&M and the billing or NWSDB sets a special tariff for the MC

Table 7.2-1 Calculation of Type 1 Sewage Tariff for Nuwara Eliya MC

No.	Items	Unit	Description	Amount
1	Annual O&M costs	LKR/year	Total	67,126,267
2	Expected profit (10%) (=1x10%)	LKR/year	Total	6,712,627
3	**O&M costs with profit** (=1+2)	LKR/year	**Total**	**73,838,894**
4	Sewage Flow	m^3/day	Domestic Flow	1,834
		m^3/day	Non-Domestic Flow	1,376
		m^3/year	Total	1,171,650
5	Sewage Return Factor	%		80.0
6	**Water Consumption Volume** *1	m^3/year	**Total**	**1,464,563**
7	**Sewage Tariff** (=3/6)	LKR/m^3		**50.42**

Note: *1; Water consumption volume is calculated by dividing the estimated sewage flow by (Sewage return factor/100).
Source: JET

(2) Type 2: NWSDB National Sewage Tariff

Table 7.2-2 Calculation of Type 2 Sewage Tariff (3rd Increment) for Nuwara Eliya MC

Items	Unit	Description	Amount
Operating Expense	LKR	Existing (2015)*1	410,282,866
		New facilities (City M/P)*2	67,126,267
		Total	**477,409,133**
Income to be subtracted from Expense	LKR	Connection Charge	25,531,614
		P&D/Bowser *3	160,854,906
		Total	**186,386,520**
O&M costs after subtraction	LKR	**Total**	291,022,613
Expected Profit (5%)	LKR	**Total**	14,551,131
O/M costs after subtraction plus profit	LKR	**Total**	**305,573,744**
Water Consumption Volume of Sewerage Customers	m^3/year	Existing (2015)	6,240,008
		New facilities (City M/P)	1,464,563
		Total	**7,704,571**
Sewage Tariff	LKR/m^3	-	**39.66**

Note: *1; based on actual cost data for 2015 for O&M costs of the existing sewerage facilities with operational costs of head office,.
*2; For City M/P, based on maximum O&M costs at full capacity.
*3; based on a 3 year average, including contract service fee, planning and design service, and gully bowser (desludging septic tanks) revenue.
Source: prepared by JET, based on the data from NWSDB

If the City M/P is implemented, the NWSDB sewage tariff would be increased to 39.66/m^3 LKR. (third increase) when the STP operation reaches full capacity. The calculated tariff is a weighted average that is based on the total water consumption of domestic, commercial, and industrial customers.

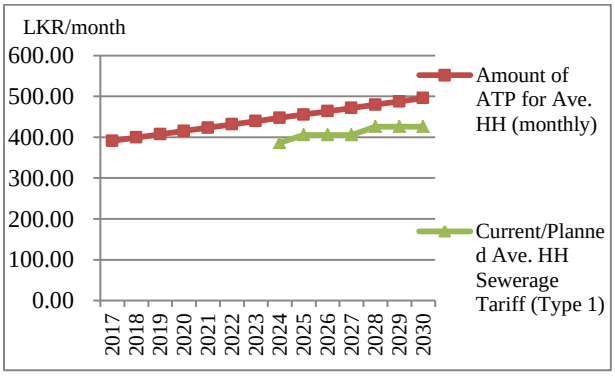
7.2.5 Ability to Pay

The following 3 assumptions are made in the analysis of household ATP sewerage charges:

- third tariff increase for City M/P is set for 2024
- trend of household income increase shall continue
- increase in sewage tariff for domestic, commercial and industrial customers should be the same. If the increase for commercial and industrial customers is higher than that of domestic customers, monthly charge for households should be set lower.

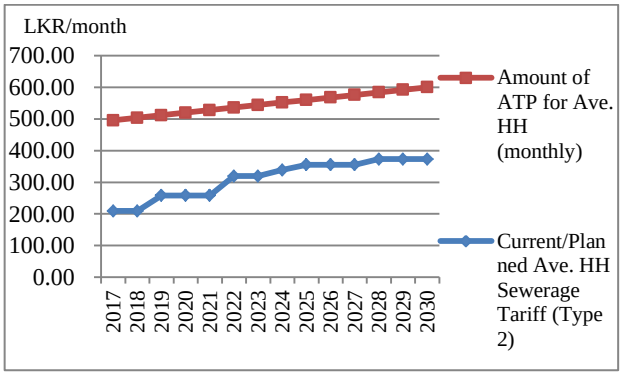
Figure 7.2-3 shows the monthly charge based on Type 1 sewage tariff and the ATP based on household income data of Nuwara Eliya District. **Figure 7.2-4** shows the monthly charge based on Type 2 sewage tariff for NWSDB and the ATP based on national average household income data.

ATP is set at 1% of average household income, based on International Bank for Reconstruction and Development (IBRD) WB estimate.



Note: ATP is estimated based on the District HH income data.
Source: JET

Figure 7.2-3 Comparison of Type 1 Sewage Tariff and Ability to Pay



Note: ATP is estimated by national average HH income data.
Source: JET

Figure 7.2-4 Comparison of Type 2 Sewage Tariff and Ability to Pay

The monthly household sewage charge (Type 1) is 86% to 89% of the ATP which is affordable but close to the threshold.

The monthly household sewage charge (Type 2) at 42% to 64% of the ATP, is affordable.

It is necessary to check the average household income level again using the latest income data before the actual tariff preparation.

7.2.6 Sewage Tariff Tables (Type 2 NWSDB)

The previous tariff calculation was based on a weighted average applied to all consumer categories. **Table 7.2-3** and **Table 7.2-4** are examples of how the sewage tariff (Type 2) can be calculated from the NWSDB water tariff tables. This method makes it easier to calculate and avoid charging a customer more for sewage than for water consumption. In this example, the domestic sewage tariff would be 50% of the water tariff and would be added to the water bill.

Table 7.2-3 Example of Domestic Sewage Tariff (for 2024)

Domestic Sewage Tariff = 50% of the following water supply tariffs

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: JET

Table 7.2-4 Example of Non-Domestic Sewage Tariff: (in 2024)

Non-domestic Sewage Tariff as a % of the following water supply tariffs:
- Commercial; 70%
- Government hospital; 70%
- Industries (SME); 150%
- Industries (non-SME & Govt. Institution) 150%

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: JET

Any future increase in water tariffs would result in a corresponding increase in the sewage tariff. The planning for water and sewage tariff revisions must be well-coordinated.

The third tariff increase should be implemented in 2024. By then the water supply tariff will have almost certainly been increased. In such a case, the percentages applied to the water tariff (50% of domestic water tariff in **Table 7.2-3**) would be lower.

7.3 FINACIAL PLAN CONCLUSIONS

A) Nuwara Eliya MC's financial performance is quite good and the MC has the capacity to operate and maintain the wastewater treatment facilities.
B) The water supply business has been reporting surpluses in the past and can cover some shortfall on the sewerage side when the sewerage system is implemented.
C) The following cost burden principle for sewerage service should be used in Sri Lanka:
   - central government should cover 100% of the construction cost, i.e.100% grant for NWSDB or MC.
   - sewage tariff should be calculated to cover O&M costs, with gradual future increases.
   - small-scale replacements should be covered by NWSDB's or the MC's own budget, but large scale ones should be funded as projects by the central government.
D) Type 1 sewage tariff is calculated to recover O&M costs from revenue collected from the customers in the MC area; Type 2 recovers the total O&M costs of the sewerage business of NWSDB including the O&M costs of City M/P, from revenue NWSDB collects from all its sewerage customers.
E) Type 1 unit sewage tariff for MC is estimated at 50.42/m^3 LKR.
F) Type 2 unit sewage tariff for NWSDB is estimated at 39.66/m^3 LKR.

G) Type 1 and 2 tariffs are within the ATP of households, i.e. the average household can afford the sewage charge. Type 1 sewage charge is just within the ATP. Type 2 sewage charge is about half of ATP.
H) The latest average household income data should be used for the tariff calculation.

CHAPTER 8 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

8.1 EXISTING CONDITIONS

Environmental and Social conditions in the Project area are presented in CHAPTER 2.

8.2 REGULATIONS AND ORGANIZATIONS RELEVANT TO ESC

Laws and regulations relevant to ESC at the national level, and organizations responsible for implementation, were reviewed in the Strategic Sewerage Master Plan (Section I of this Report). No regulations are found specific to or published by Nuwara Eliya MC relevant to the Project. National regulations described in the Strategic Sewerage Master Plan can be found in **APPENDIX 10**.

8.3 COMPARISON WITH JICA GUIDELINES

Comparison of Sri Lankan national regulations with those of JICA is given in **APPENDIX 11**.

8.4 INTERNATIONAL COMMITMENTS

The Government of Sri Lanka (GOSL) is party to several international agreements related to environment and human rights (see **APPENDIX 12**). Agreements specific to Nuwara Eliya MC could not be found.

8.5 ENVIRONMENTAL SCOPING

Scoping is defined as the process of identifying the content and extent of the environmental information to be submitted to the competent authority under the EIA procedure. Scoping is shown in **Table 8.5-1**.

Table 8.5-1 Environmental Scoping

Item	Evaluation		Reason
1 Air pollution	P/C	B-	Dust and exhaust gases are generated during construction.
	O	D	No impacts are expected during operation.
2 Water pollution	P/C	B-	Excavation and runoff will cause turbidity during construction.
	O	B+	Treatment of sewage and greywater will reduce water pollution.
3 Soil pollution	P/C	B-	Construction equipment and transfer of construction materials contribute to soil pollution.
	O	D	No impacts are expected during operation.
4 Waste	P/C	B-	Construction waste will be generated.
	O	B-	Sludge will be generated during operation of treatment facilities.
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.
	O	B-/B+	B-: Odour will be generated at the WWTP during operation. B+: Improved sewerage collection and environmental conditions will reduce offensive odours in the Project area.
8 Geographical features	P/C	B-	WWTP construction activities will alter features of the site and impact surrounding lands.
	O	B-	If found to be necessary, landslide prevention measures will alter features of the surrounding

Item	Evaluation		Reason
			land.
9 Bottom sediments	P/C	D	No impacts are expected during construction.
	O	B+	Reduction of waste water flow into Gregory Lake will reduce impacts and improve benthic conditions of water bodies.
10 Biota and ecosystems	P/C	C-	Impacts are unknown and require investigation. (Included in EIA)
	O	C+/C-	C+: Ecosystems will benefit from improved water quality. C-: Negative impacts of WWTP are unknown and need investigation.
10b Protected lands	P/C	C-	Forest reserves are located adjacent to and within the Project area and may be impacted. The extent of impact is unknown and requires investigation.
	O	C-	
11 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.
12 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.
13 Global warming	P/C	D	No impacts are expected during construction.
	O	D	No impacts are expected during operation.
14 Land acquisition	P/C	B-	Land for treatment plant, pumping stations, and sewerage lines will be required.
	O	D	No impacts are expected during operation.
15 Local economies	P/C	C+/C-	C+: Construction activities may increase in local employment and economic activities. C-: Construction activities may inconvenience local businesses.
	O	C+	Improved water environment will positively impact aquaculture and businesses (tourism etc)
16 Land use	P/C	C-	Land use patterns may be impacted by acquisition, resettlement, and construction of facilities.
	O	D	No additional impact caused by operation is expected.
17 Social institutions	P/C	D	No impacts are expected during construction.
	O	D	No impacts are expected during operation.
18 Existing social infrastructures and services	P/C	B-	Traffic disturbance will be caused by construction activities.
	O	B+	Infrastructure for sewerage collection and treatment will be created.
19 Poor (low income households)	P/C	C-	The poor and other socially vulnerable populations may be impacted by construction activities.
	O	C-	Impacts are unknown and require investigation.
19a Indigenous and ethnic populations	P/C	C-	The poor and other socially vulnerable populations may be impacted by construction activities.
	O	C-	Impacts are unknown and require investigation.
20 Misdistribution of benefits and damages	P/C	C-	Impacts are unknown and require investigation.
	O	C-	Impacts are unknown and require investigation.
21 Local conflicts of interest	P/C	C-	Impacts are unknown and require investigation.
	O	C-	Impacts are unknown and require investigation.
22 Gender	P/C	C-	Women may receive unequal economic opportunities during construction.
	O	C+	Women are expected to benefit from improved water environment.
23 Children's rights	P/C	C-	Child labour may occur during construction.
	O	C+	Children are expected to benefit from improved water environment.
24 Cultural heritage	P/C	C-	Construction activities may impact heritage sites.
	O	C+	C+: Improved water environment and sanitation facilities are expected to reduce negative impacts on heritage sites (especially during pilgrimage and festival periods).
24a Landscapes	P/C	B-	Construction activities will impact landscape in the Project area.
	O	B-	Newly constructed facilities will impact landscape in the Project area. Landslide prevention devices for the WWTP (if necessary) may also affect landscape.
25 Infectious diseases such as HIV/AIDS	P/C	B-	Influx of construction workers will increase risk of infectious diseases.
	O	B+	Improved sanitation services will decrease incidence of infectious diseases (especially during and following peak pilgrimage periods).

【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 / Negative
Source: JET

8.6 TOR FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS STUDY

8.6.1 Purpose

The purpose of the survey at this preparatory stage is to predict and assess the type and scale of possible project impacts to the natural and social environment.

8.6.2 Items to be Targeted and Evaluated in the Study

Items that receive A, B, or C ranking (**Table 8.5-1**) should be reviewed and evaluated. Other items identified as the survey proceeds should also be included.

8.6.3 Target Areas

The target areas are the proposed construction sites, and areas immediately surrounding the Project facilities.

8.6.4 Target Periods

Target periods are the stages of planning, execution, and operation of the constructed facilities.

8.6.5 Contents and Methods for ESC Study

The information to be collected and the typical countermeasures to be review are presented in **Table 8.6-1**.

Table 8.6-1 The ESC Study Associated with the Project

Item				Study/Countermeasure	Status
No.	Title	Evaluation			
01	Air Pollution	P/C	B-	Study: Air pollution standards, construction vehicles and methods. Method: Site survey, literature survey of regulations and standards.	M/P F/S
		O	D	N/A	N/A
02	Water Pollution	P/C	B-	Study: Water pollution standards, construction methods. Method: Site survey, literature survey of regulations and standards.	M/P F/S
		O	B+	Study: Water pollution standards, treatment methods, water quality, flow rates, pollution loads.	M/P
03	Soil Pollution	P/C	B-	Study: Soil pollution standards, prevention measures/construction methods, construction equipment Method: Site survey, literature survey of regulations and standards.	M/P F/S
		O	D	N/A	N/A
04	Waste	P/C	B-	Study: Waste management regulations/procedures, Collection and disposal methods, disposal site conditions. Method: Site surveys, hearing surveys of concerned parties.	Complete
		O	B-	Study: Sludge generation. Method: Treatment method.	F/S
05	Noise and Vibrations	P/C	B-	Study: Noise regulations, current condition, construction methods. Method: Site surveys, hearing surveys of concerned parties, noise measurement surveys.	Complete
		O	B-	Study: Treatment method and possible noise generation.	F/S
06	Ground Subsidence	P/C	C-	Study: Geographic conditions. Method: Geographic survey.	F/S
		O	C-		

07	Offensive Odours	P/C	D	N/A	N/A
		O	B-/B+	Study: Current odour conditions, treatment method. Method: Site surveys, hearing surveys of concerned parties.	M/P F/S
08	Geographical Features	P/C	B-	Study: Geographic conditions, construction method. Method: Geographical survey.	F/S
		O	B-	Study: Geographical conditions, landslide prevention methods. Method: Geographical survey.	F/S
09	Bottom Sediments	P/C	D	N/A	N/A
		O	B+	Study: Sediment conditions of water bodies. Method: Site surveys, literature surveys, water quality surveys.	F/S EIA
10	Biota and Ecosystems	P/C	C-	Study: Inventory of flora and fauna in the construction area. Method: Site survey, hearing survey of concerned parties	F/S EIA
		O	C+/C-		
10a	Protected lands	P/C	C-	Study: Status of protect lands, construction locations/methods. Method: Site survey, interview survey of concerned parties.	M/P F/S (EIA) D/D
		O	C-		
11	Water Usage	P/C	C-	Study: Water use practices of local communities, impacts of sewage treatment on water usage. Method: Site surveys, interview surveys of concerned parties.	M/P F/S
		O	C-		
12	Accidents	P/C	B-	Study: Construction/industrial safety regulations, traffic safety/accident prevention methods. Method: Site surveys, literature survey, interview surveys of concerned parties.	M/P F/S
		O	B-	Study: Industrial safety regulations. Method: Literature surveys.	M/P F/S
13	Global Warming	P/C	D	N/A	N/A
		O	D	N/A	N/A
14	Land Acquisition	P/C	B-	Study: Land requirements, acquisition procedures, compliance to JICA guidelines. Method: Site surveys, literature surveys, interview surveys of concerned parties.	M/P F/S (EIA)
		O	D	N/A	N/A
15	Local Economies	P/C	C+/C-	Study: Local economic environment, industries, markets. Relevant laws and regulations. Method: Site surveys, literature surveys, interview surveys of concerned parties.	M/P F/S
		O	C+		
16	Land Use	P/C	C-	Study: Land use practices of local communities. Method: Site surveys, interview surveys of concerned parties.	F/S
		O	D		
17	Social Institutions	P/C	D	N/A	N/A
		O	D	N/A	N/A
18	Existing Social Infrastructures and Services	P/C	B-	Study: Traffic patterns, location of important social infrastructure (schools, hospitals, religious institutions, etc) Method: Site survey, inventory survey, public consultation.	M/P F/S
		O	B+		
19	Poor (low income households)	P/C	C-	Study: Census/demographic data, economic status, and land use patterns of affected peoples. Method: Interview survey of concerned parties, relevant laws, and regulations.	M/P F/S (EIA)
		O	C-		
19a	Indigenous and ethnic population	P/C	C-	Study: Census/demographic data, economic status, and land use patterns of affected peoples. Method: Interview survey of concerned parties, relevant laws, and regulations.	M/P F/S (EIA)
		O	C-		
20	Misdistribution of benefits and damages	P/C	C-	Study: Social and economic conditions. Method: Interview surveys of concerned parties, public consultation.	M/P F/S
		O	C-		
21	Local Conflicts of interest	P/C	C-	Study: Risks and prevalence of conflicts of interest. Method: Interview surveys of concerned parties, public consultation.	M/P F/S
		O	C-		
22	Gender	P/C	C-	Study: Working conditions/statistics of women, gender equality policies. Method: Interview survey of concerned parties, relevant laws, and regulations.	M/P F/S (EIA)
		O	C+	Study: Health and working conditions of women.	M/P

				Method: Interview survey of concerned parties, data collection.	F/S (EIA)
23	Children's Rights	P/C	C-	Study: Child labour laws. Method: Interview survey of concerned parties, relevant laws, and regulations.	M/P F/S (EIA)
		O	C+	Study: Water borne diseases and children Method: Interview survey of concerned parties, data collection.	M/P F/S (EIA)
24	Cultural Heritage	P/C	C-	Study: Location of cultural heritage sites. Method: Site survey, location of registered heritage/historical sites, interview survey of concerned parties.	M/P F/S (EIA)
		O	C+	Study: Impacts of pollution on heritage sites. Method: Interview survey of concerned parties.	
24a	Landscapes	P/C	B-	Study: Location of parks, tourism sites, and other valuable sites, construction locations and methods. Method: Site survey, interview survey of concerned parties.	M/P F/S (EIA) D/D
		O	B-		
25	Infectious Diseases such as HIV/AIDS	P/C	B-	Study: Prevalence of AIDS/HIV and other infectious diseases, current prevention programs. Method: Data collection, interview surveys of concerned parties.	M/P F/S
		O	B+	Study: Prevalence of water borne and other environmental diseases. Method: Data collection, interview surveys of concerned parties	

Source: JET

8.6.6 Prediction and Evaluation of Potential Impacts

Prediction and evaluation of potential impacts should be conducted for items ranked A, B, or C in Section 8.5: Scoping.

Each item should be re-evaluated as the survey proceeds, and the scoping Table updated accordingly. Subsequently, items with A or B ranking should be evaluated in terms of the extent of the impact.

8.6.7 EMP and EMoP

When the Project causes foreseeable but unavoidable environmental impacts, EMP will identify how to mitigate the impacts, and EMoP will identify steps to be taken by relevant authorities to ensure that mitigation measures are effectively implemented. Execution plans, frequency of measures, lead organization, support for the organization, and budget should be provided for EMP and EMoP.

8.6.8 Stakeholder Consultation

Consultations with UNI and NGO were conducted at the start of the Project to understand the needs and attitudes in the area, and to confirm the relevance of the Project. Details on the meeting minutes are given in **APPENDIX 13**.The results of the ESC studies should be presented at stakeholder consultations, and the stakeholder feedback should be collected.

8.7 DRAFT EMP AND EMOP

Environmental and social considerations will be managed through EMP. EMP will be implemented through EMoP. EMP development is not appropriate at this stage. Draft versions of EMP and EMoP are presented in **APPENDIX 14**. They will be further developed as the Project proceeds and as more information becomes available.

8.8 SCHEDULE OF ESC ACTIVITIES

Surveys related to ESC will be conducted according to the schedule shown in **Figure 8.8-1**.

Stage	Period		ESC Expert	EIA Study	Target		Environmental Study	Remark
					Original	Selected		
Strategic MP	2016	Jan			335 local authorities (79)	(Approx.) 5 local authorities	Primary study	➢ Environmental policies, plans and programs ➢ National level research
		Feb	■					
		Mar						
		Apr						
5 Cities MP (Pre-F/S)		May	■		5 local authorities	2 local authorities	Preparation study for IEE/EIA	➢ Literature search ➢ Site survey
		Jun						
		Jul	■					
		Aug	■					
		Sep						
Feasibility Study (F/S)	2017	May		■	Nuwara Eliya MC (If selected for F/S)		EIA Study	➢ EMP(draft) ➢ Monitoring Plan(draft) ➢ EIA Report ➢ Resettlement Action Plan ➢ Stakeholder Meeting
		Jun	■	■				
		Jul		■				
		Aug		■				
		Sep	■	■				
		Oct		■				
		Nov	■	■				
		Dec		■				

Source: JET

Figure 8.8-1 Schedule for ESC Surveys

CHAPTER 9 CONCLUSION AND RECOMMENDATION

9.1 F/S IMPLEMENTATION

Land acquisition for the STP and disposal site is a very important aspect in implementing the sewerage project. The site for the wastewater treatment plant in Nuwara Eliya MC has been secured and the disposal site is in operation. [The latter was established under a pilot project as part of the Study on Improvement of Solid Waste Management in the Secondary Cities in Sri Lanka with Japan financial assistance.] Nuwara Eliya MC is well positioned to implement the construction of facilities immediately following the F/S. Therefore, Nuwara Eliya MC should be part of the F/S.

The MC explained that the candidate site is situated in a secondary forest and therefore, is not subject to conservation measures as for natural forests. This should be confirmed in writing when conducting the F/S survey.

9.2 RISK AND MITIGATION MEASURES

Table 9.2-1 lists the risks and mitigation measures associated with the implementation of the Project. Major risks include delays in land acquisition as well as increase in the construction cost such as the need to build an access road.

Table 9.2-1 Risks and Mitigation Measures

Risks	Mitigation Measures
Delay: due to the start of Pumping Stations and STP, if the identified lands are not acquired before the commencement of the project	Joint Coordinating Committee (JCC), UDA, NWSDB and other relevant agencies must take appropriate actions in a timely manner for clearing project sites before the construction.
Delay: due to the start of pumping stations and STP, if necessary approval for the EIA is not granted before the commencement of project	JCC, UDA, NWSDB and other relevant agencies must take appropriate actions in a timely manner to obtain the necessary approval before the construction
Cost Increase: if there are variances in cost for access road, building foundations and pipe trenching and bedding.	Soil test must be carried out to identify the soil conditions.
Low inflow: of sewage at the treatment plant if the development of the city is delayed.	NWSDB must make the appropriate stage wise sewerage development plan based on city development plan carried out by the local authority.

Source: JET

9.3 CONCLUSION AND RECOMMENDATIONS

The Nuwara Eliya Sewerage Project will have a significant positive impact on the preservation and improvement of Lake Gregory water quality. Lake Gregory is an important tourism asset of this internationally popular tourist city. Therefore, the project is of very high priority.

The locations for pumping stations are not yet identified. These locations and land requirement need to be determined at the F/S stage, so that sites can be acquired together with the STP site. The Project includes the construction of a bridge to access the STP. Excavation and grading the land belonging to the Forestry Bureau at the foot of a mountain is required. The F/S should include geological and other basic site investigations so that construction cost can be estimated accurately.

APPENDICES

APPENDICES

APPENDIX 1:Nuwara Eliya Waste Water Flow Calculation

Nuwara Eliya Wastewater Flow Forecast

Water consumption	120 lpcd
Domestic Waste Water /Water	80%
Non-Domestic ww/Domestic	75%
Infiltration	20%

1	Nuwara Eliya DSD		Population 2001	Population 2012	Population 2046	% covered	Population 2046 in covered area	Water consumption(cum/d)	Domestic Waste Water Flow (cum)	Non-Domestic Flow(cum/d)	Domestic + Non-Domestic Waste Water Flow (cum/d)	Infiltration (cum/d)	Total Waste Water Flow (cum/d)
1.1	535H	Havaeliya East	2327	2273	2273	85	1932	232	185	139	325	65	390
1.2	535L	NuwaraEliya West	2540	2481	2481	95	2357	283	226	170	396	79	475
1.3	535	Nuwara Eliya	1878	1290	1290	100	1290	155	124	93	217	43	260
1.4	535D	Nuwara Eliya Central	4712	4292	4292	90	3863	464	371	278	649	130	779
1.5	535G	Hawaeliya North	2686	2216	2216	100	2216	266	213	160	372	74	447
1.6	535F	Hawaeliya West	1888	2072	2363	100	2363	284	227	170	397	79	476
1.7	535C	Kelegala	1874	1829	1829	100	1829	219	176	132	307	61	369
1.8	535B	Kalukele	1131	1093	1093	65	710	85	68	51	119	24	143
		Sub Total 1	19036	17546	17837		16560	1987	1590	1192	2782	556	3338
2.1	535D	Nuwara Eliya Central	4712	4292	4292	10	429	52	41	31	72	14	87
2.2	535E	Sandathenna	2803	2816	2834	30	850	102	82	61	143	29	171
2.3	535A	Magasthota	1518	1408	1408	85	1197	144	115	86	201	40	241
		Sub Total 2	9033	8516	8534		2476	297	238	178	416	83	499
		TOTAL	28069	26062	26371		19036	2284	1827	1371	3198	640	3838

APPENDIX 2: Inflow Sewage Quality

Inflow sewage quality - Measured data of inflow sewage -

The planned inflow water quality values of Moratuwa/Rathmalana STP are considerably higher than the actual data.

		Raddolugama 1)	Maththegoda 1)	Hikkaduwa 1)	Moratuwa/ Rathmalana**	Ja-Ela/ Ekara***	Average	Design raw water quality	Moratuwa/Rathmalana (First stage planned values)	
pH at 26⁰C		6.7	6.4	7.0	6.6-8.5	-	6.7			pH at 26⁰C
Total Suspended Solids at 104⁰C	mg/l	163	90	139	232	-	156	160	458	Total Suspended Solids at 104⁰C
Chemical Oxygen Demand Total	mg/l	609	473	446	274	628	486	600	1057	Chemical Oxygen Demand Total
Chemical Oxygen Demand Soluble	mg/l	241	241	206	-	-	229	-	-	Chemical Oxygen Demand Soluble
Biochemical Oxygen Demand- 5Total	mg/l	383	247	240	87	187	229	240	355	Biochemical Oxygen Demand- 5Total
Biochemical Oxygen Demand- 5 Soluble	mg/l	159	116	149	-	-	141	-	-	Biochemical Oxygen Demand- 5 Soluble
Nitrate- Nitrogen and Nitrite Nitrogen	mg/l	2.3	2.5	5.7	1.0	-	2.9	-	-	Nitrate- Nitrogen and Nitrite Nitrogen
Ammoniacal Nitrogen	mg/l	26	28	24	14	-	23	-	-	Ammoniacal Nitrogen
Total Nitrogen	mg/l	39	34	33	42	-	37	45	55	Total Nitrogen
Total Phosphorous	mg/l	5.9	3.3	2.9	2.8	-	3.7	6	12	Total Phosphorous

1) Average values of the three measurements which were conducted from December 2016 to January 2017 (Annex 1)

**Data taken between October 2013 and February 2016

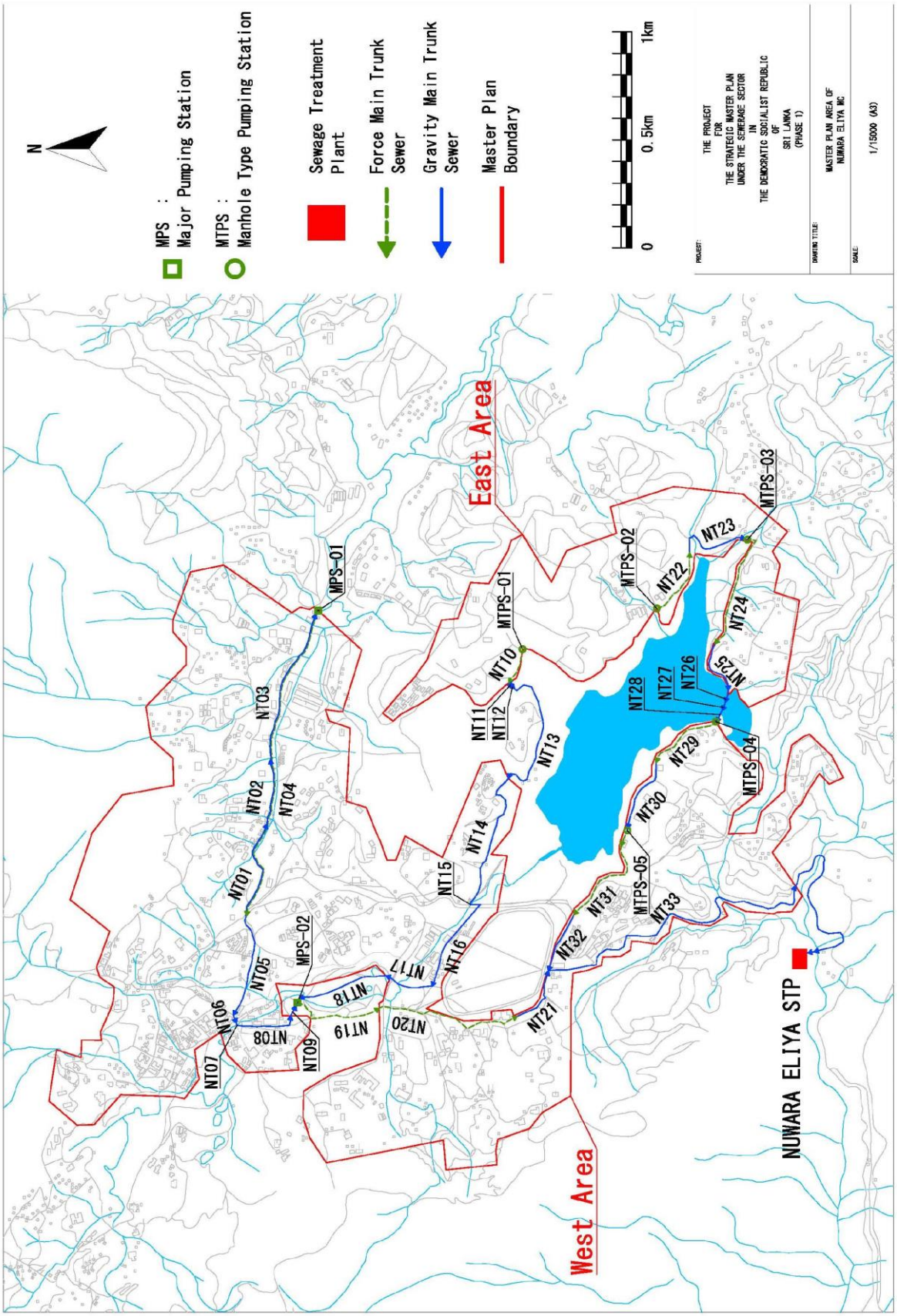
***Average of 1-year measurement

The Result of Sewage Analysis

		Raddolugama			Maththegoda			Hikkaduwa		
		23,24 Nov.2016	29,30 Nov.2016	5,6 Dec 2016	25,26 Nov.2016	1,2 Dec 2016	7,8 Dec 2016	27,28 Dec 2016	3,4 Dec 2016	9,10 Dec 2016
pH at 26^0C		6.6	6.93	6.7	6.2	6.9	6.2	7.3	6.42	7.4
Total Suspended Solids at 104^0C	mg/l	814*	115	211	54	115	100	59	165	194
Chemical Oxygen Demand Total	mg/l	752*	650	567	510	670	239	344	406	587
Chemical Oxygen Demand Soluble	mg/l	184*	261	220	312	330	80	206	201	212
Biochemical Oxygen Demand- 5Total	mg/l	669*	402	363	189	390	162	186	213	321
Biochemical Oxygen Demand- 5 Soluble	mg/l	99.8*	136	181	120	181	48	109	167	172
Nitrate- Nitrogen and Nitrite Nitrogen	mg/l	2.2	28*	2.4	2.5	1.4	3.5	1.2	13.7	2.2
Ammoniacal Nitrogen	mg/l	10	30	38	19	42	24	18	19	35
Total Nitrogen	mg/l	13	61	42	25	46	32	21	35	42
Total Phosphorous	mg/l	4	8.8	4.8	0.4	5.8	3.8	0.6	4.1	4.1

*JET considered values in gray as outliers and not used for the design.

APPENDIX 3:Draft Amendment of Tolerance Discharge Limits



SEWER DESIGN CALCULATIONS

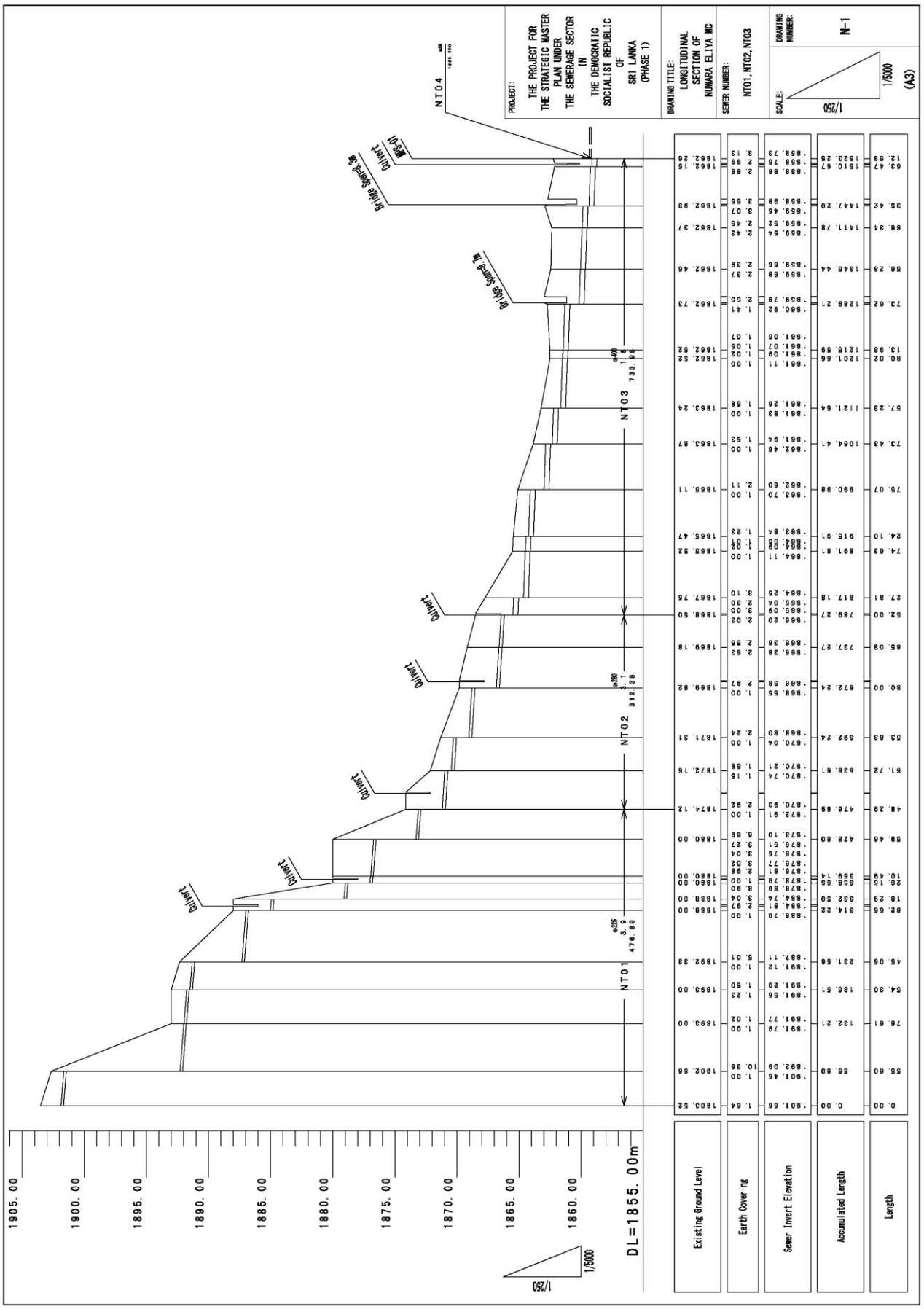
Master Plan Area: NuwaraEliya MC

Unit Sewer Water (m^3/s/ha): West Area 0.000246 / East Area 0.000160

Legend: ◎: Main Sewer

P_ 1

Line No.	Catchment Area: West Area Area (ha)	West Area Accumulated Area (ha)	East Area Area (ha)	East Area Accumulated Area (ha)	Total Area Accumulated Area (ha)	Accumulated Length (m)	Design Outflow: Sewer Water Outflow West Area (m^3/s)	East Area (m^3/s)	Point Input (m^3/s)	Total Outflow (m^3/s)	Design Sewer Line: Dia (Internal Diameter) (mm)	Slope (‰)	V (m/s)	Cap (m^3/s)	Existing Ground Level Upper/Lower (m)	Sewer Invert Elevation Upper/Lower (m)	Earth Covering Upper/Lower (m)	Note
NT01 ◎	26.76	26.76			26.76	477	0.007			0.007	HDPE ⊙ 225 (201)	3.90	0.65	0.021	1903.52 / 1874.12	1901.664 / 1872.907	1.64 / 1.00	
NT02 ◎	31.39	58.15			31.39 / 58.15	313 / 790	0.014			0.014	HDPE ⊙ 280 (250.2)	3.10	0.67	0.033	1874.12 / 1868.50	1870.934 / 1866.201	2.92 / 2.03	
NT03 ◎	73.29	131.44			73.29 / 131.44	734 / 1524	0.032			0.032	GRP ⊙ 400 (400)	1.80	0.70	0.088	1868.50 / 1862.26	1865.094 / 1858.727	3.00 / 3.13	To MPS-01
NT04 ◎		131.44			0.00 / 131.44	1524 / 3047	0.032			0.032	HDPE ⊙ 200 (178.6)	Force Main			1862.26 / 1903.52	1859.200 / 1902.329	2.87 / 1.00	From MPS-01
NT05 ◎	23.01	154.45			23.01 / 154.45	494 / 3540	0.038			0.038	GRP ⊙ 400 (400)	1.80	0.70	0.088	1903.52 / 1882.79	1896.245 / 1879.257	6.87 / 3.13	
NT06 ◎	46.27	200.72			46.27 / 200.72	49 / 3589	0.049			0.049	GRP ⊙ 450 (450)	1.70	0.74	0.118	1882.79 / 1880.84	1879.207 / 1879.105	3.13 / 1.28	
NT07 ◎		200.72			0.00 / 200.72	9 / 3597	0.049			0.049	HDPE ⊙ 280 (250.2)	Inverted Siphon			1880.84 / 1890.84	1875.600 / 1875.600	4.97 / 4.97	
NT08 ◎	8.62	209.34			8.62 / 209.34	283 / 3880	0.051			0.051	GRP ⊙ 450 (450)	1.70	0.74	0.118	1890.84 / 1881.31	1878.900 / 1878.320	1.48 / 2.53	
NT09 ◎		209.34			0.00 / 209.34	69 / 3948	0.051			0.051	GRP ⊙ 450 (450)	1.70	0.74	0.118	1881.31 / 1880.00	1878.300 / 1878.184	2.55 / 1.36	To MPS-02
NT10 ◎			35.38	35.38	35.38	173		0.006		0.006	HDPE ⊙ 110 (98)	Force Main			1885.08 / 1891.81	1882.300 / 1890.706	2.68 / 1.00	From MPTS-01
NT11 ◎				35.38	0.00 / 35.38	27 / 200		0.006		0.006	HDPE ⊙ 225 (201)	3.90	0.65	0.021	1891.81 / 1891.82	1890.597 / 1890.494	1.00 / 1.11	
NT12 ◎				35.38	0.00 / 35.38	14 / 213		0.006		0.006	HDPE ⊙ 110 (98)	Inverted Siphon			1891.82 / 1890.23	1886.216 / 1886.216	5.50 / 3.91	
NT13 ◎				35.38	0.00 / 35.38	660 / 873		0.006		0.006	HDPE ⊙ 225 (201)	3.90	0.65	0.021	1890.23 / 1882.81	1889.200 / 1881.426	0.82 / 1.17	
NT14 ◎	39.49	39.49		35.38	39.49 / 74.87	675 / 1547	0.010	0.006		0.015	HDPE ⊙ 280 (250.2)	3.10	0.67	0.033	1882.81 / 1877.37	1880.190 / 1875.721	2.35 / 1.38	
NT15 ◎		39.49		35.38	0.00 / 74.87	19 / 1566	0.010	0.006		0.015	HDPE ⊙ 180 (164.6)	Inverted Siphon			1877.37 / 1877.37	1873.300 / 1873.300	3.90 / 3.90	
NT16 ◎	6.48	45.97		35.38	6.48 / 81.35	482 / 2048	0.011	0.006		0.017	HDPE ⊙ 315 (281.8)	2.70	0.68	0.043	1877.37 / 1879.00	1875.500 / 1873.314	1.57 / 5.39	
NT17 ◎	85.02	130.99		35.38	85.02 / 166.37	230 / 2277	0.032	0.006		0.038	GRP ⊙ 400 (400)	1.80	0.70	0.088	1879.00 / 1877.43	1873.196 / 1872.703	5.40 / 4.32	
NT18 ◎		130.99		35.38	0.00 / 166.37	441 / 2717	0.032	0.006		0.038	GRP ⊙ 400 (400)	1.80	0.70	0.088	1877.43 / 1880.00	1872.683 / 1871.750	4.34 / 7.84	To MPS-02
NT19 ◎		340.33		35.38	0.00 / 375.71	440 / 4388	0.084	0.006		0.089	HDPE ⊙ 315 (281.8)	Force Main			1880.00 / 1878.24	1878.698 / 1876.443	1.00 / 1.50	From MPS-02
NT20 ◎		340.33		35.38	0.00 / 375.71	693 / 5081	0.084	0.006		0.089	HDPE ⊙ 315 (281.8)	Force Main			1878.24 / 1887.09	1876.941 / 1885.789	1.00 / 1.00	
NT21 ◎	5.85	346.18		35.38	5.85 / 381.56	292 / 5372	0.085	0.006		0.091	GRP ⊙ 600 (600)	1.20	0.75	0.213	1887.09 / 1882.16	1882.049 / 1880.395	4.43 / 1.16	To NT-33
NT22 ◎			24.51	24.51	24.51	326		0.004		0.004	HDPE ⊙ 110 (98)	Force Main			1881.47 / 1884.90	1880.362 / 1883.796	1.00 / 1.00	From MTPS-02
NT23 ◎			15.00	39.51	15.00 / 39.51	386 / 711		0.006		0.006	HDPE ⊙ 225 (201)	3.90	0.65	0.021	1884.90 / 1877.68	1880.823 / 1874.689	3.86 / 2.78	To MTPS-03
NT24 ◎			14.87	54.38	14.87 / 54.38	568 / 1279		0.009		0.009	HDPE ⊙ 110 (98)	Force Main			1877.68 / 1883.41	1876.575 / 1882.305	1.00 / 1.00	From MTPS-03
NT25 ◎			6.35	60.73	6.35 / 60.73	276 / 1555		0.010		0.010	HDPE ⊙ 225 (201)	3.90	0.65	0.021	1883.41 / 1876.30	1881.529 / 1875.087	1.67 / 1.00	
NT26 ◎				60.73	0.00 / 60.73	39 / 1593		0.010		0.010	HDPE ⊙ 225 (201)	3.90	0.65	0.021	1876.30 / 1876.51	1875.087 / 1874.936	1.00 / 1.36	
NT27 ◎				60.73	0.00 / 60.73	35 / 1627		0.010		0.010	HDPE ⊙ 140 (125)	Inverted Siphon			1876.51 / 1876.38	1871.990 / 1871.990	4.39 / 4.26	
NT28 ◎				60.73	0.00 / 60.73	75 / 1702		0.010		0.010	HDPE ⊙ 225 (201)	3.90	0.65	0.021	1876.38 / 1876.31	1874.400 / 1874.089	1.77 / 2.01	To MTPS-04
NT29 ◎	7.16	7.16		60.73	7.16 / 67.89	359 / 2060	0.002	0.010		0.011	HDPE ⊙ 110 (98)	Force Main			1876.31 / 1881.83	1875.205 / 1880.726	1.00 / 1.00	From MTPS-04
NT30 ◎	8.65	15.81		60.73	8.65 / 76.54	364 / 2423	0.004	0.010		0.014	HDPE ⊙ 280 (250.2)	3.10	0.67	0.033	1881.83 / 1878.89	1879.938 / 1875.443	1.63 / 3.18	To MTPS-05
NT31 ◎	7.40	23.21		60.73	7.40 / 83.94	546 / 2969	0.006	0.010		0.015	HDPE ⊙ 140 (125)	Force Main			1878.89 / 1884.19	1875.324 / 1883.057	3.43 / 1.00	From MTPS-05
NT32 ◎	2.59	25.80		60.73	2.59 / 86.53	288 / 3257	0.006	0.010		0.016	HDPE ⊙ 280 (250.2)	3.10	0.67	0.033	1884.19 / 1882.16	1882.871 / 1880.894	1.05 / 1.00	
NT33 ◎	46.91	418.89		96.11	46.91 / 515.00	2398 / 7769	0.103	0.015		0.118	GRP ⊙ 700 (700)	1.00	0.76	0.293	1882.16 / 1780.00	1878.618 / 1774.273	2.83 / 5.02	To STP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NTO2
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1900.00
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1885.00
1880.00
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1/250
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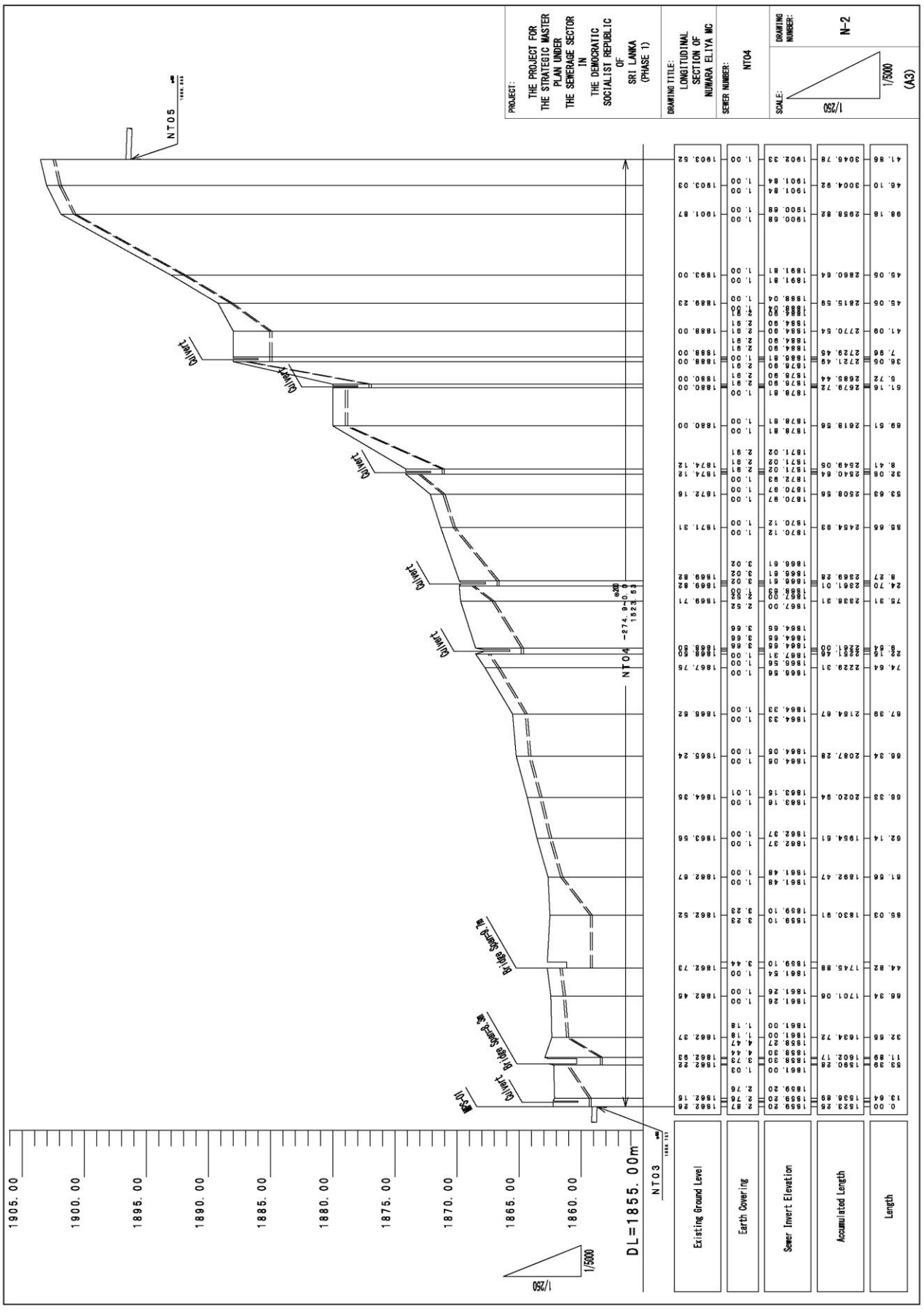
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length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1/5000
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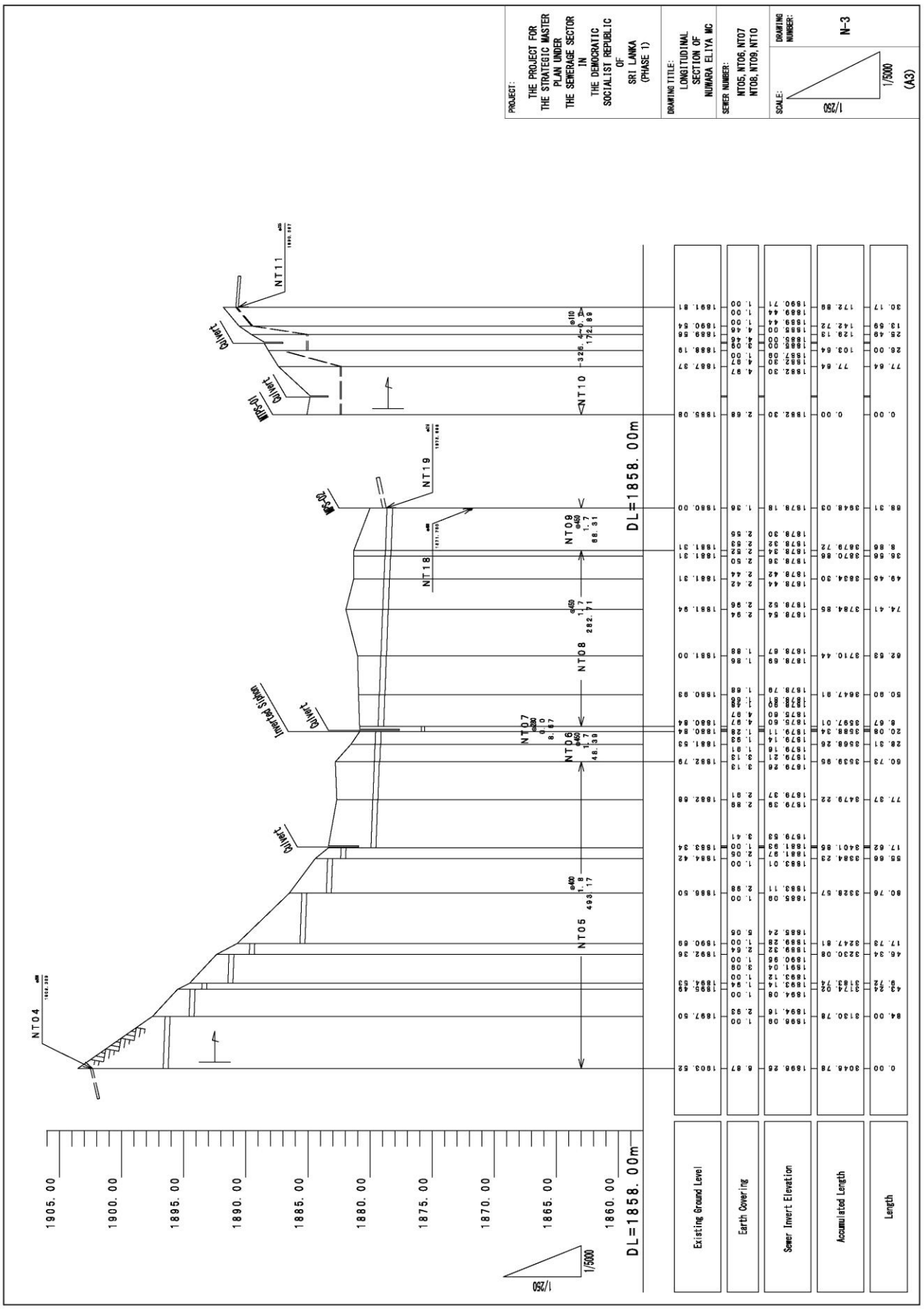
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length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(A3)
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NT06
NT07
NT08
NT09
NT10
NT11
NT18
NT19
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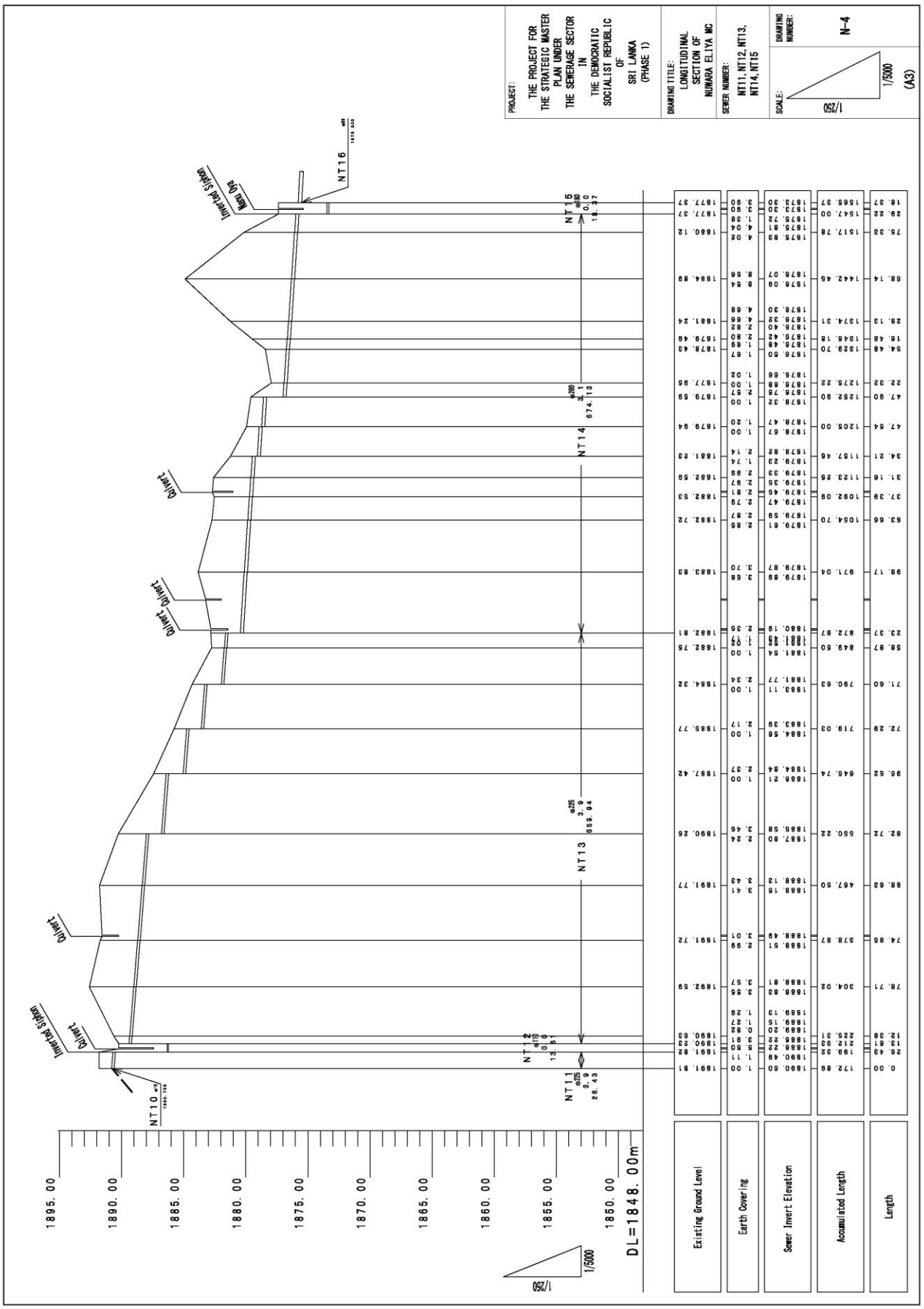
Length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1/250
1/5000
(A3)
NT16
NT15
NT14
NT13
NT12
NT11
NT10
Manhole
Inverted Siphon
Outfall
1895.00
1890.00
1885.00
1880.00
1875.00
1870.00
1865.00
1860.00
1855.00
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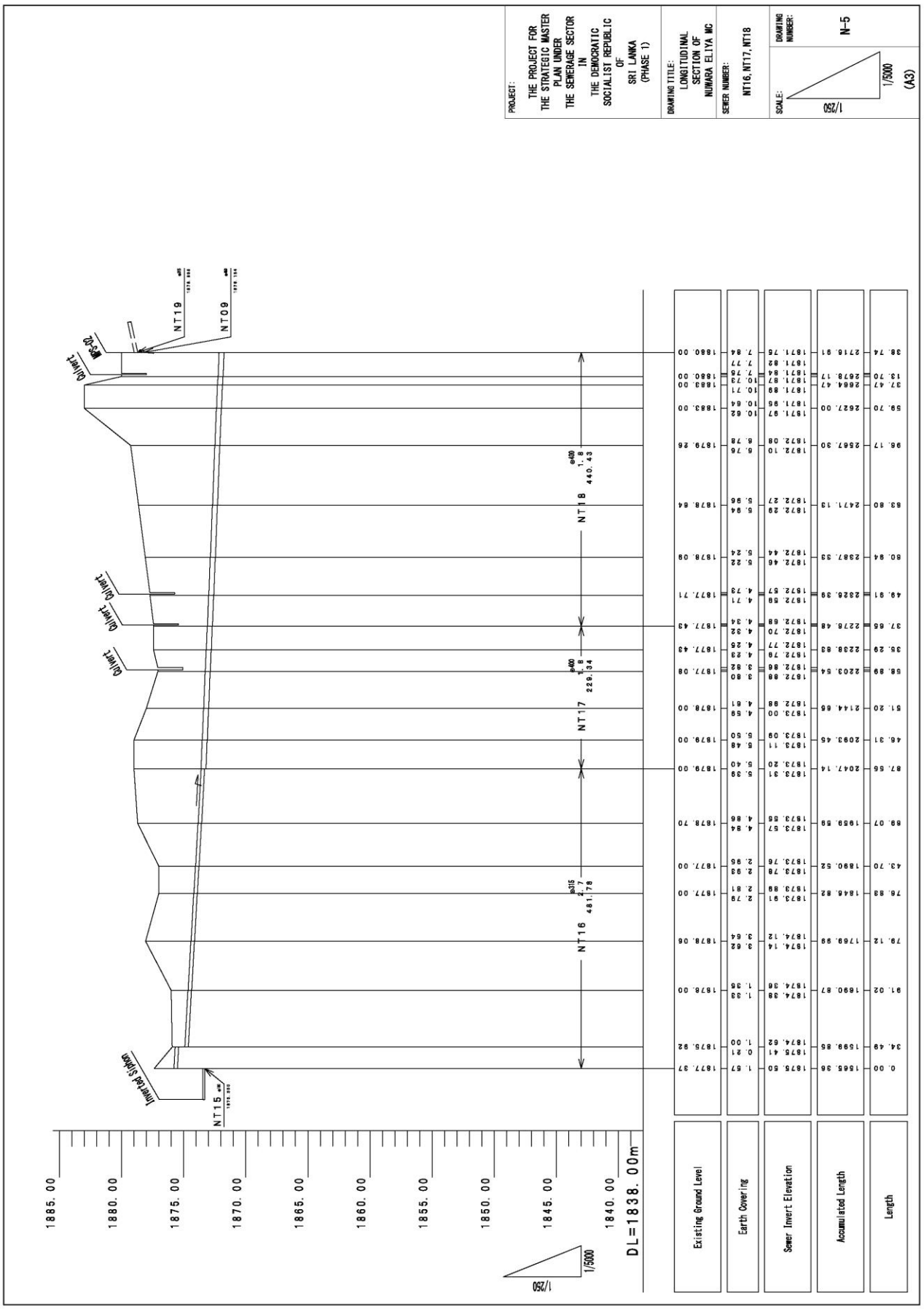
DL=1848.00m
1/250
1/5000
Existing Ground Level
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length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1/5000
(A3)
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NT18
NT17
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NT15
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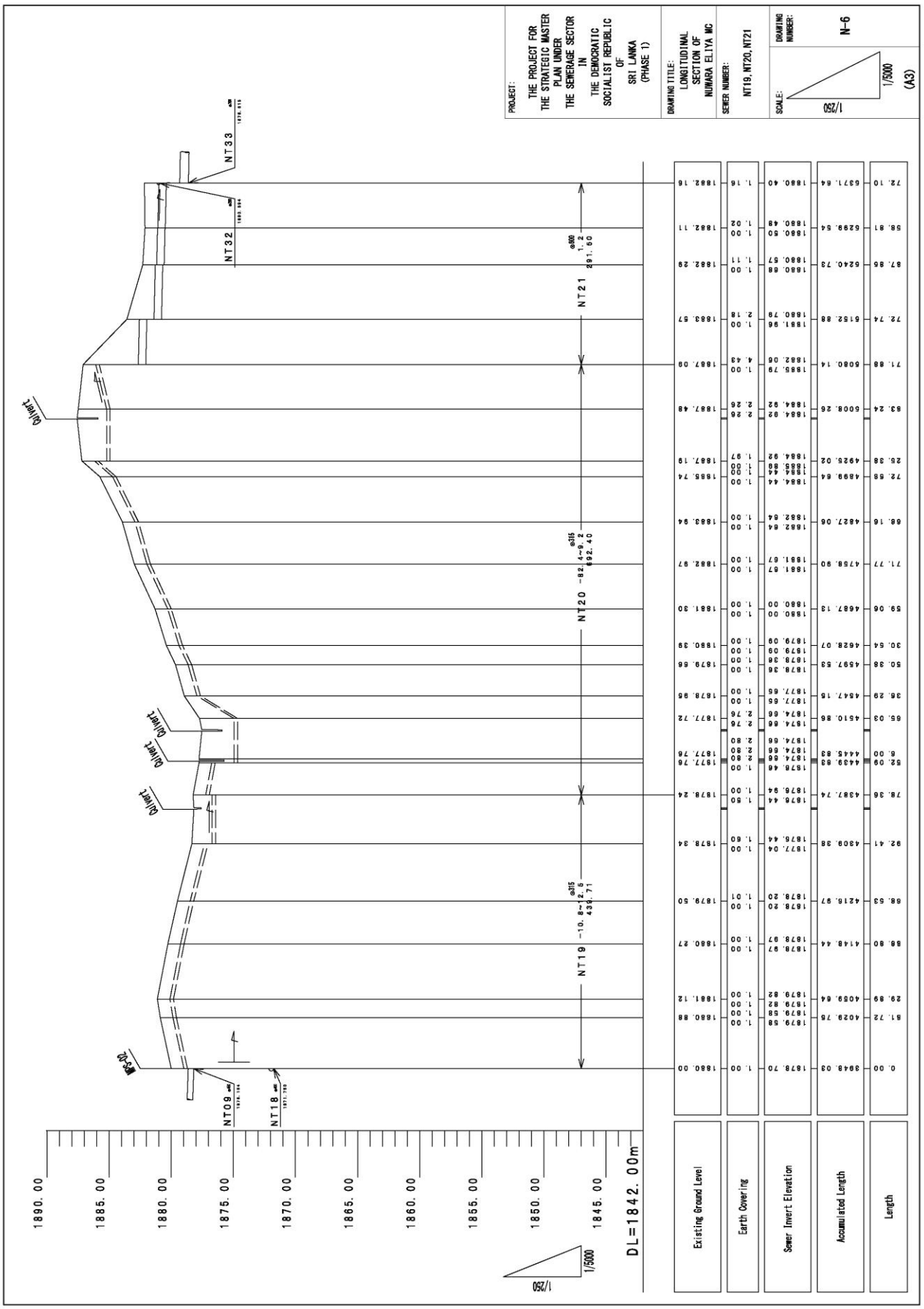
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length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NT32
NT21
NT20
NT19
NT09
NT18
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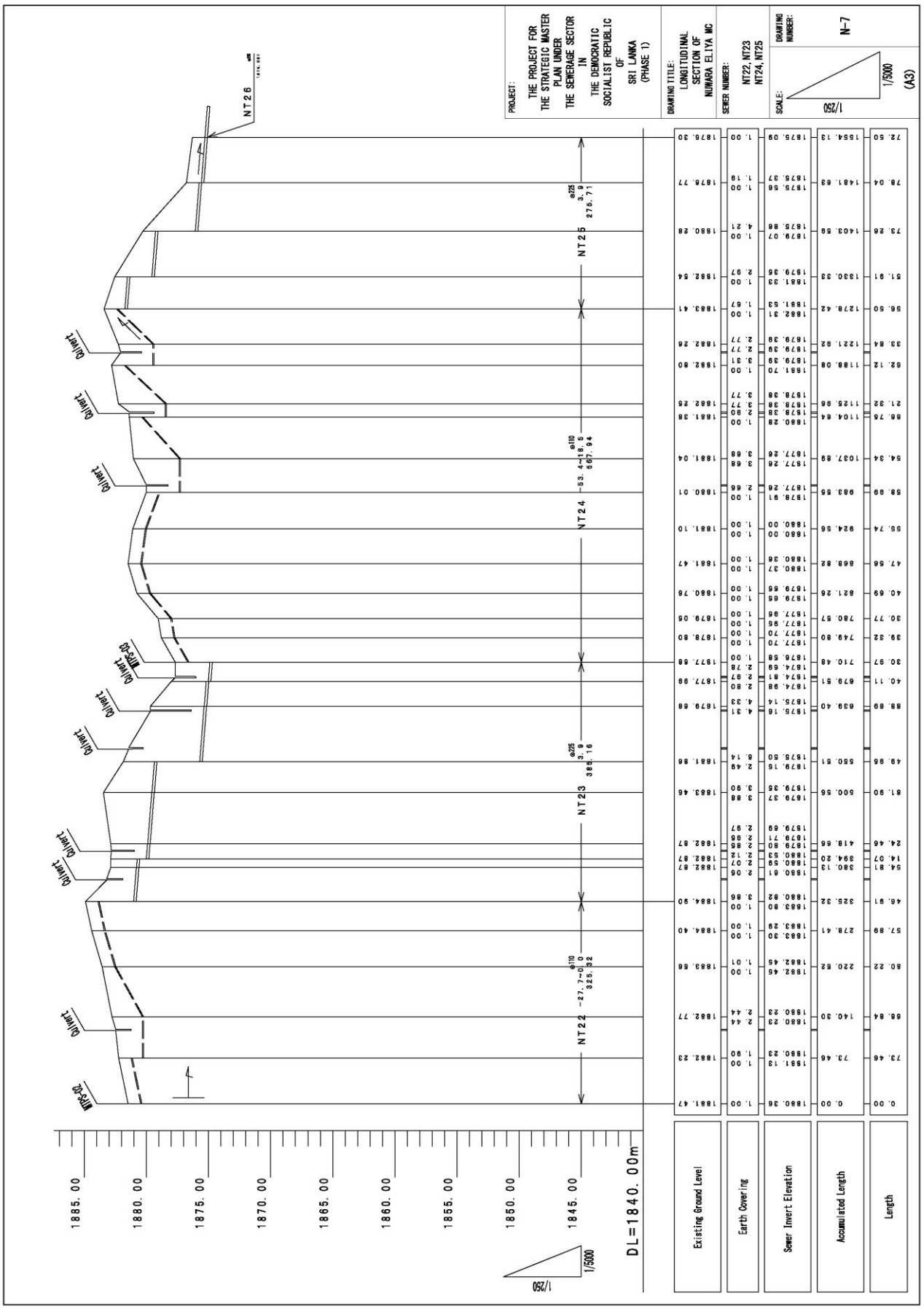
DL+2M
DL=1842.00m
1890.00
1885.00
1880.00
1875.00
1870.00
1865.00
1860.00
1855.00
1850.00
1845.00
1/5000
1/250
Existing Ground Level
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length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1/250
NT26
NT25
NT24
NT23
NT22
MH5-20
Existing Ground Level
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length
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1885.00
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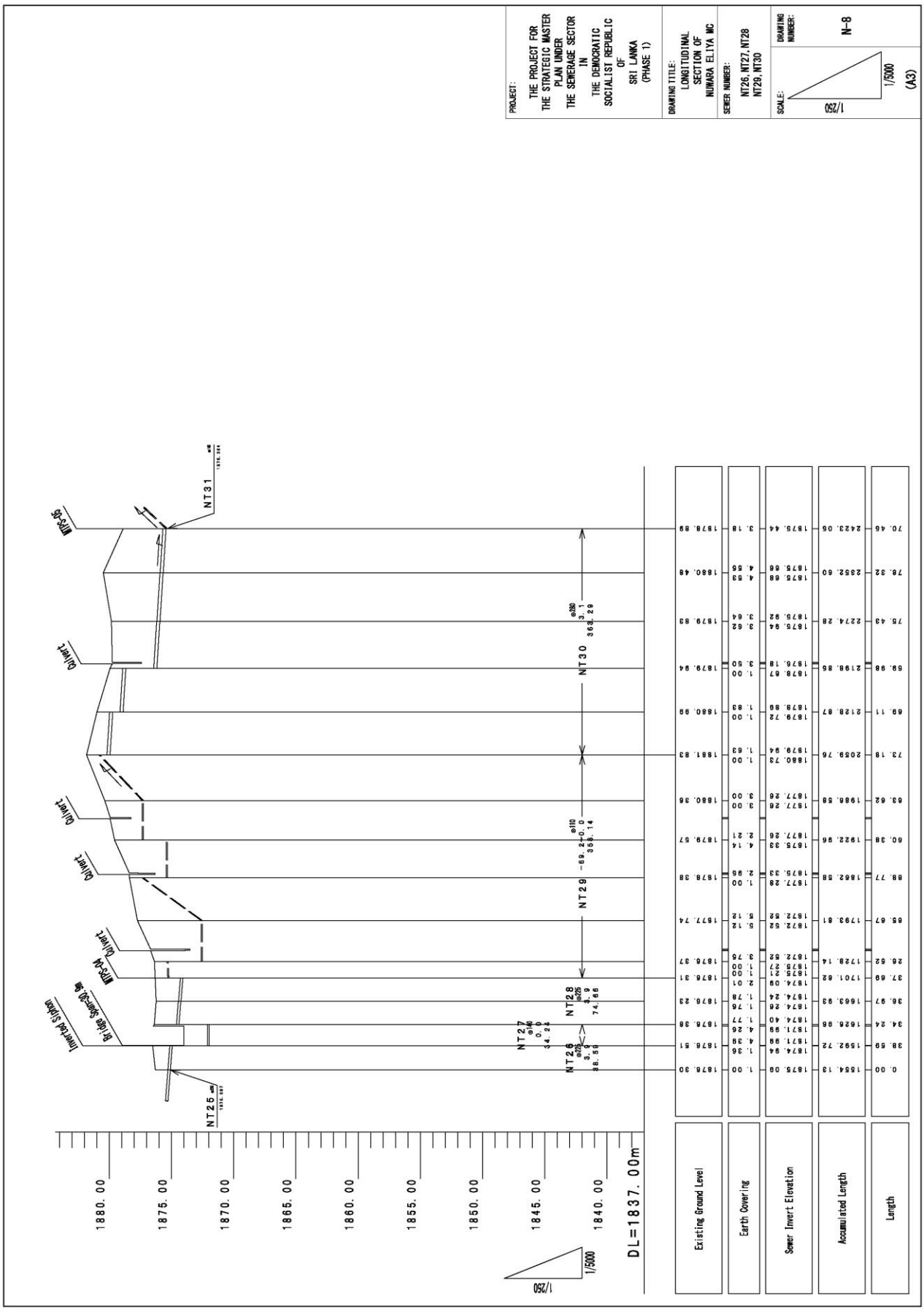
1/5000
1/250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1/250
1/5000
(A3)
DRAWING NUMBER:
N-8
NT31
NT30
NT29
NT28
NT27
NT26
MH'S-05
MH'S-04
MH'S-03
Outlet
Inlet
Existing Ground Level
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length
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1845.00
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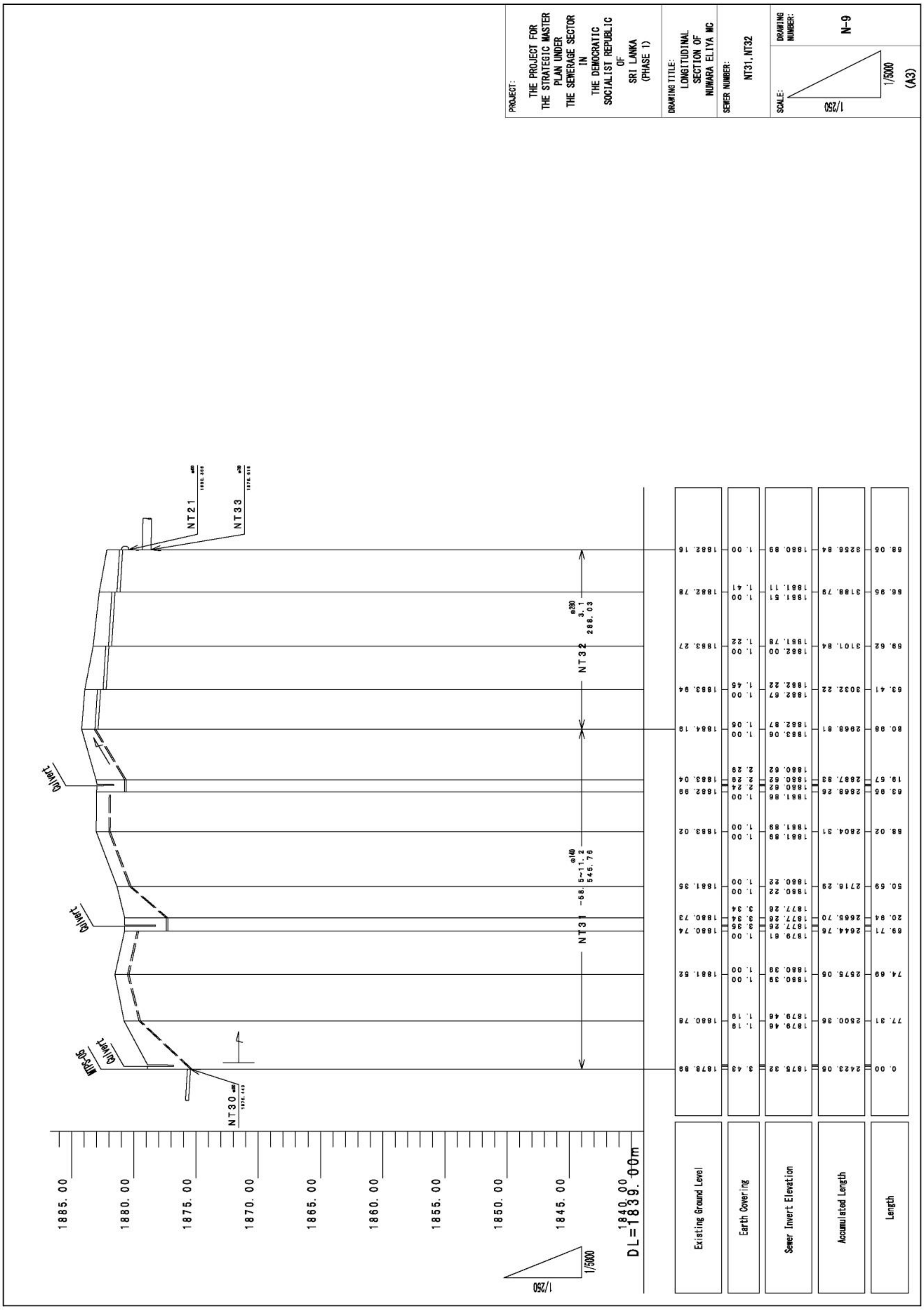
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1/250
1/5000
(A3)
DRAWING NUMBER:
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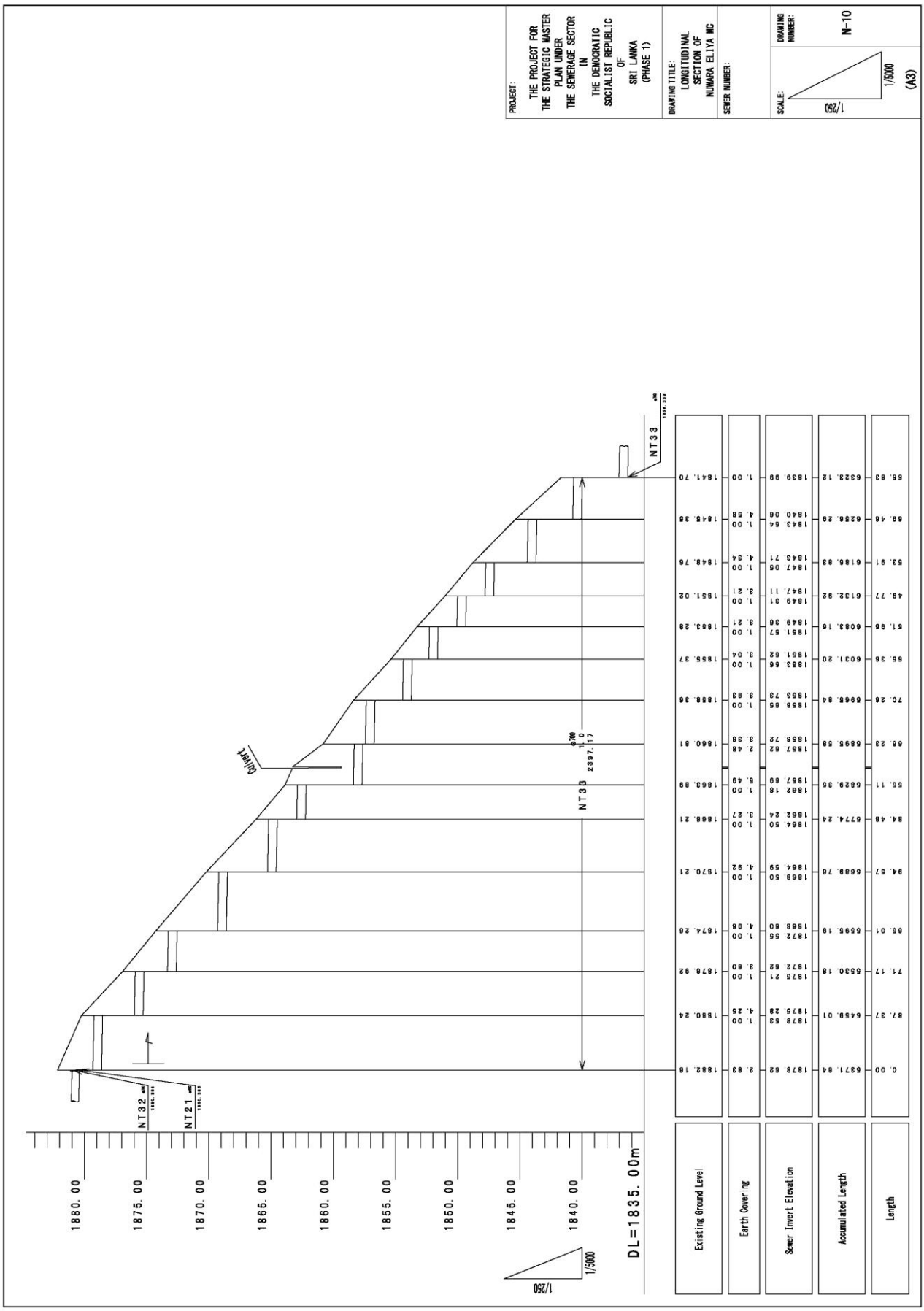
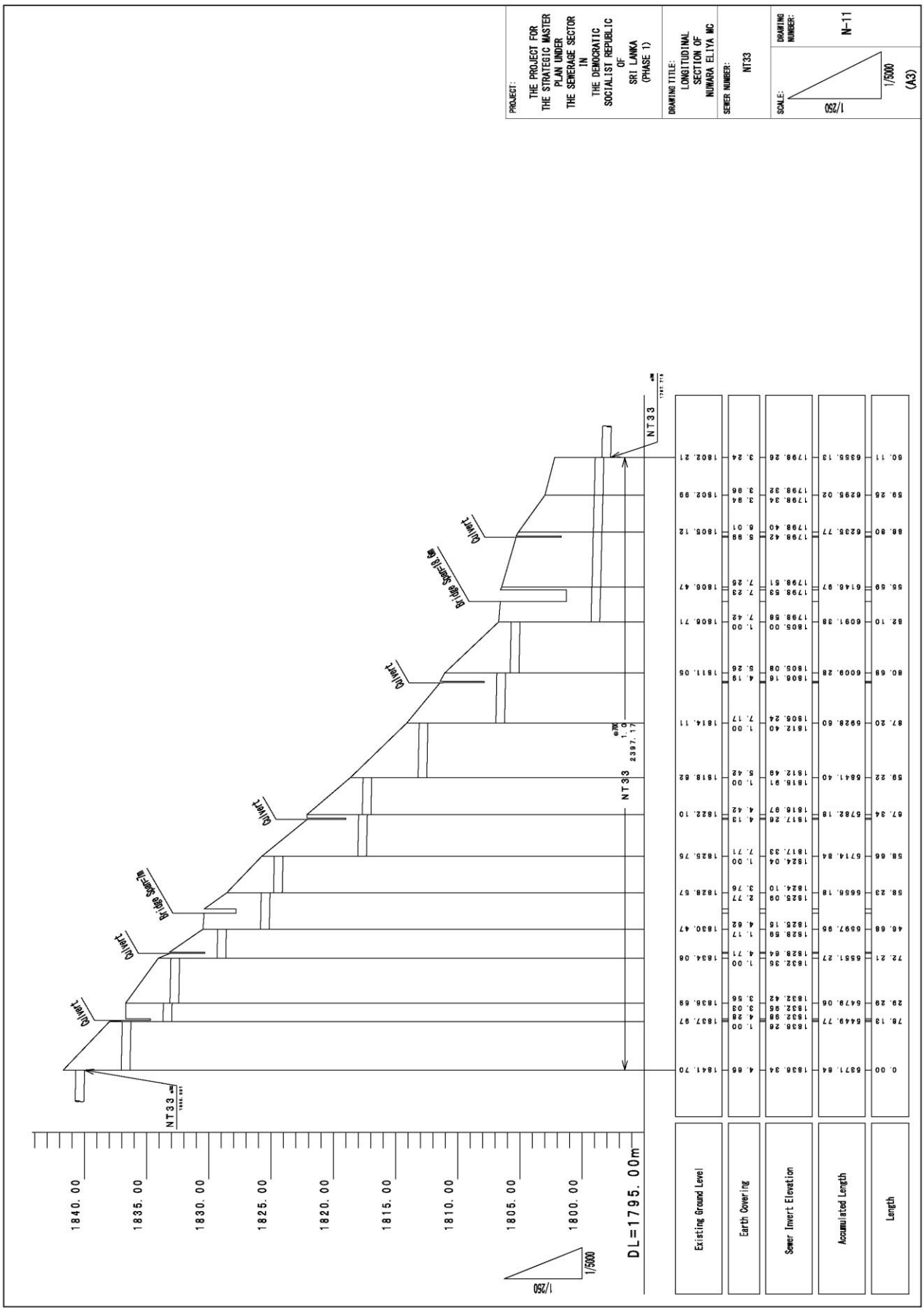
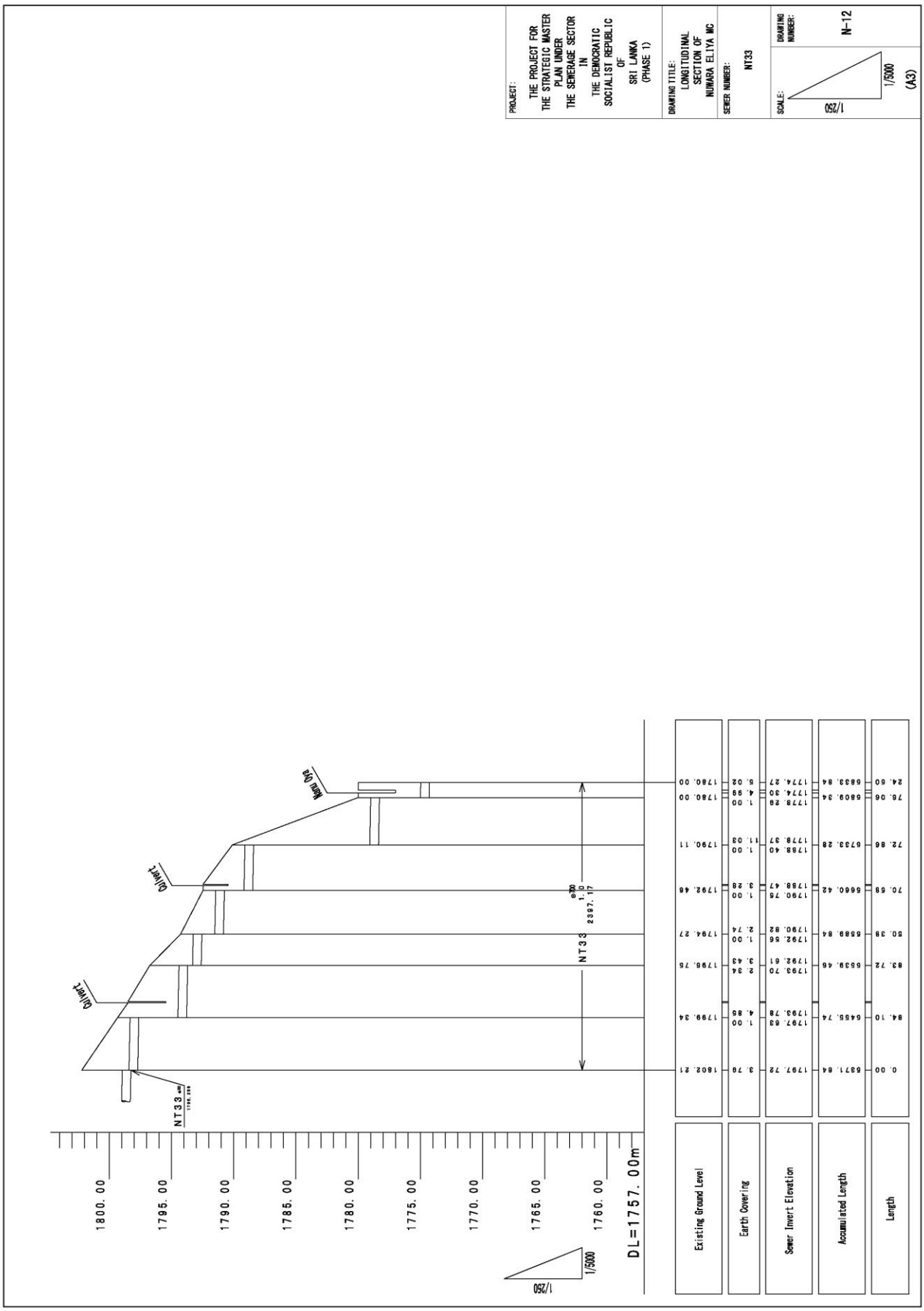
MTPS-05
Culvert
NT30
NT21
NT33
NT31 -58.5~11.2 545.76
NT32 3.1 288.03
Existing Ground Level
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length


PROJECT:
THE PROJECT FOR THE STRATEGIC MASTER PLAN UNDER THE SEWERAGE SECTOR IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA (PHASE 1)
DRAWING TITLE:
LONGITUDINAL SECTION OF NUWARA ELIYA MC
SEWER NUMBER:
DRAWING NUMBER:
N-10
SCALE:
1/250
1/5000
(A3)
NT33
NT32
NT21
DL=1835.00m
1880.00
1875.00
1870.00
1865.00
1860.00
1855.00
1850.00
1845.00
1840.00
Existing Ground Level
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length


PROJECT:
THE PROJECT FOR THE STRATEGIC MASTER PLAN UNDER THE SEWERAGE SECTOR IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA (PHASE 1)
DRAWING TITLE:
LONGITUDINAL SECTION OF NUWARA ELIYA MC
SEWER NUMBER:
NT33
DRAWING NUMBER:
N-11
SCALE:
1/250
1/5000
(A3)
NT33
NT33
DL=1795.00m
1840.00
1835.00
1830.00
1825.00
1820.00
1815.00
1810.00
1805.00
1800.00
Existing Ground Level
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length


PROJECT:
THE PROJECT FOR THE STRATEGIC MASTER PLAN UNDER THE SEWERAGE SECTOR IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA (PHASE 1)
DRAWING TITLE:
LONGITUDINAL SECTION OF NUWARA ELIYA MC
SEWER NUMBER:
NT33
DRAWING NUMBER:
N-12
SCALE:
1/250
1/5000
(A3)
Main Drain
Outlet
Outlet
NT33
NT33
DL=1757.00m
1800.00
1795.00
1790.00
1785.00
1780.00
1775.00
1770.00
1765.00
1760.00
Existing Ground Level
Earth Covering
Sewer Invert Elevation
Accumulated Length
Length

APPENDIX 4: Draft Amendment of Tolerance Discharge Limits

Schedule III

Tolerance limit values for the discharge of wastewaters or effluents (industrial / domestic) from a prescribed activity into the inland surface waters

No.	*Parameter*	*Unit, type of limit*	*Tolerance limit values for Inland surface waters*
1.	Total suspended solids	mg/1, max.	50
2.	Total dissolved solids	mg/1, max.	1000
3.	pH at ambient temperature	-	6.0 – 8.5
4.	Biochemical oxygen demand (BOD_5 in 5 days at 20^0 C)	mg/1,max.	30
5.	Temperature at the point of discharge	^{0}C, max.	Ambient water temperature ± 5 or 40 whichever is lesser
6.	Oils and greases	mg/1,max.	10
7.	Phenols (as C_6H_5OH)	mg/1,max.	1.0
8.	Chemical oxygen demand (COD)	mg/1,max.	250
9.	Colour (Maximum spectral absorption coefficient)	Wave length range 436 nm, (Yellow range) 525 nm, (Red range) 620 nm, (blue range)	 $7m^{-1}$ $5m^{-1}$ $3m^{-1}$
10.	Dissolved phosphates (as P)	mg/1,max.	5

11.	Total Kjeldhal nitrogen (as N)	mg/1,max.	150
12.	Ammoniacal nitrogen (as N)	mg/1,max.	50
13.	Nitrate (as N)	mg/1,max.	10
14.	Cyanide (as CN)	mg/1,max.	0.05
15.	Total residual chlorine (as Cl_2)	mg/1,max.	0.5
16.	Chlorides (as Cl)	mg/1,max.	400
17.	Fluorides (as F)	mg/1,max.	2.0
18.	Sulphides (as S)	mg/1,max.	0.5
19.	Arsenic, total (as As)	mg/1,max.	0.05
20.	Cadmium, total (as Cd)	mg/1,max.	0.03
21.	Chromium, total (as Cr)	mg/1,max.	0.05
22.	Chromium, hexavalent (as Cr^{6+})	mg/1,max.	0.01
23.	Copper, total (as Cu)	mg/1,max.	0.05
24.	Iron, total (as Fe)	mg/1,max.	3.0
25.	Lead, total (as Pb)	mg/1,max.	0.05
26.	Mercury, total (as Hg)	mg/1,max.	0.001
27.	Nickel, total (as Ni)	mg/1,max.	0.2
28.	Selenium, total(as Se)	mg/1,max.	0.05
29.	Zinc, total (as Zn)	mg/1,max.	2.0
30.	Silver, total (as Ag)	mg/1,max.	0.035
31.	Pesticides (Total)	mg/1,max.	0.005
32.	Surfactants (Total)	mg/l, max.	5.0
33.	Faecal coliform	MPN/100ml, max.	150

34.	Sulphates (as S)	mg/l, max.	250
35.	Radio Active Material:		
	(a) Alpha emitters	micro curie/ml, max	10^{-8}
	(b) Beta emitters	micro curie/ml, max	10^{-7}

Note 1: All efforts should be made to remove unpleasant odour as practicable as possible.

Note 2: These limit values are based on the premise that for inland surface water the dilution factor may be at least 1:8. In an event where the dilution factor is found to be less, the limit values in the Schedule should be adjusted on a proportional basis so as to give rise to more stringent limit values.

Note 3: The above mentioned general standards and criteria should cease to apply with regard to a particular industry when industry specific standards and criteria are stipulated for that industry.

APPENDIX 5: Land Confirmation for STP

CPC/NE/MC/WW/2016/ (JAICA)

நுவரஎலிய நாகரிக கொமிஸாரிஸ்
நுவரெலியா மாநகர சபை ஆணையாளர
THE MUNICIPAL COMMISSIONER
NUWARA ELIYA
காரியாலய அலுவலகம் Office } 052-2222274 / 052-2222275
ෆැක්ස් பெக்ஸ் Fax } 052-2222274
නිවස வாசஸ்தலம் Residence } 052-2222371
ඊ-මේල් மின் அஞ்சல் E-mail } mcne76@yahoo.com
වෙබ් வலை Web } www.nuwaraeliya.mc.gov.lk

මගේ අංකය எனது இல. My No. .....
ඔබේ අංකය உமது இல. Your No. .....

නාගරික කාර්යාලය
நகர சபை அலுவலகம்
The Municipal Office

2016.09.20

දිනය .....

නුවරඑළිය நுவரெலியா Nuwara - Eliya

Team Leader,
The Project for the Strategic Master Plan under
Sewerage Sector in Democratic Socialist of Sri Lanka,
Team Leader Office,
No. 25, Sangabho Mawatha, Borupana Road,
Ratmalana.

Dear Sir,

Confirmation on the Land Availability for the Construction of a sewerage Treatment Plant for Nuwara Eliya MC Area.

This has reference to your letter No: TL-PSMPSS/Muni.Commissioner-Nuwara Eliya/ 0052 and dated 01st September 2016 regarding the above subject.

02. First of all I have to thank you for selecting our city as one of the five important cities for "Strategic Master Plan under Sewerage Sector" and we hopefully waiting for "Detail Feasibility Study".

03. The proposed STP Site for Nuwara Eliya city is located at right bank side of Nanu-oya stream and next to Pedro Tea Plantation area at Black pool, Nanu-oya, and Hatton – Nuwara Eliya main road.

04. We are now almost above 50% of the acquisition procedure for above STP site.

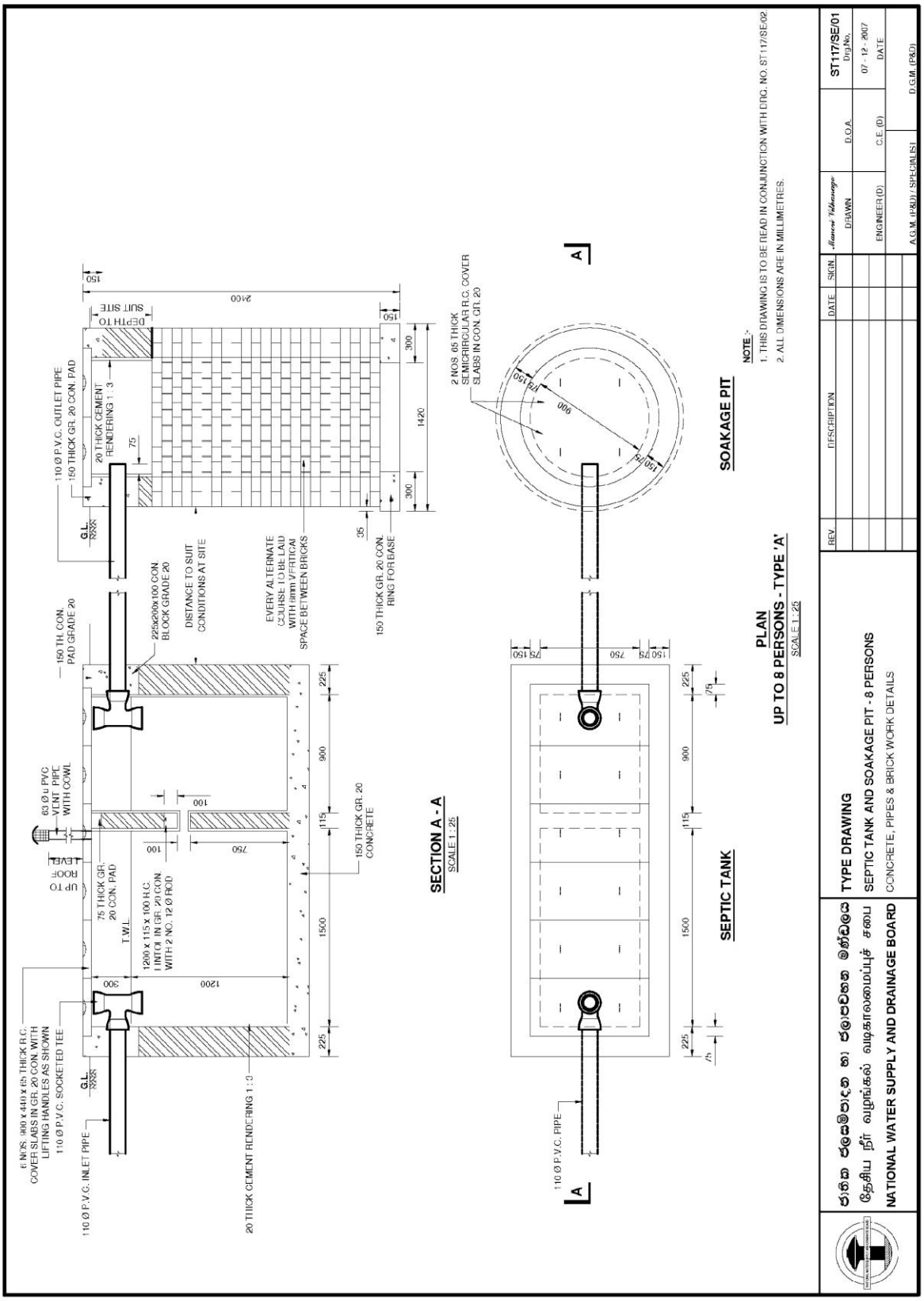
05. Therefore, I can confirm our council can acquire the proposed STP site without any difficulties for sewerage project.

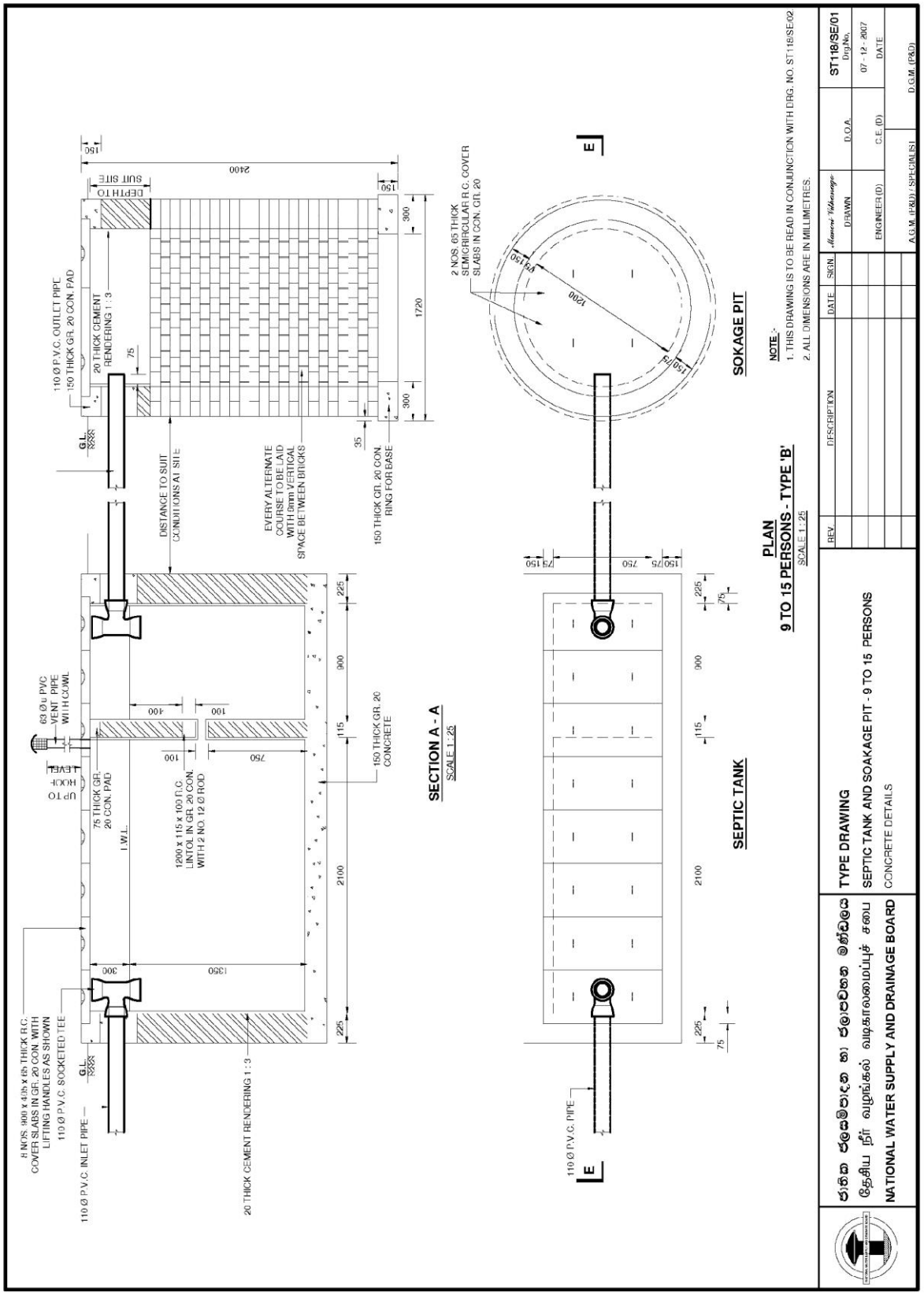
Thank you.
Yours Faithfully,

R.M.K.R.B. Rathnayake,
Municipal Commissioner,
Municipal Council – Nuwara Eliya.

R.M.K.R.B. Rathnayake
Municipal Commissioner
Municipal Council
Nuwara Eliya.

APPENDIX 6: General Layout of Septic Tank




PLAN
9 TO 15 PERSONS - TYPE 'B'
SCALE 1:25
SOKAGE PIT
SEPTIC TANK
SECTION A - A
SCALE 1:25
NOTE :-
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRG. NO. ST116/SE/02
2. ALL DIMENSIONS ARE IN MILLIMETRES.
TYPE DRAWING
SEPTIC TANK AND SOAKAGE PIT - 9 TO 15 PERSONS
CONCRETE DETAILS
NATIONAL WATER SUPPLY AND DRAINAGE BOARD
ST118/SE/01
07 - 12 - 2007
D.G.M. (P&D)

APPENDIX 7: Regulations and Organizations Related to ESC

Nuwara Eliya Master Plan Area = 515 ha

1USD= 145 LKR
1USD= 112 YEN
1LKR 0.770 YEN

	Item Description	Spec	Unit	Quantity	Unit Price		Amount		Total Amount	Total Amount
					L.C.	F.C.	L.C.	F.C.		
					LKR	JPY	LKR	JPY	LKR	JPY
1	**Construction Cost**									
A	**STP**									
A1	**STP**									
	Nuwara Eliya STP (Q=4,700m3/day)	About 2400 USD/m3	Ls	1			656,290,909	758,016,000	1,640,727,273	1,263,360,000
	Access Road		Ls	1			129,870,130	0	129,870,130	100,000,000
	Sub-total of A						**786,161,039**	**758,016,000**	**1,770,597,403**	**1,363,360,000**
B										
B1	**Trunk Sewer**									
	Supply and install of HDPE OD225	Depth : not exceeding 1.5m	m	273	2,800	3,800	763,000	1,036,000	2,108,000	1,624,000
	Supply and install of HDPE OD225	Depth : not exceeding 2.0m	m	144	3,900	4,200	563,000	607,000	1,351,000	1,041,000
	Supply and install of HDPE OD225	Depth : not exceeding 2.5m	m	255	4,400	4,200	1,120,000	1,069,000	2,508,000	1,931,000
	Supply and install of HDPE OD225	Depth : not exceeding 3.0m	m	129	5,400	4,500	695,000	579,000	1,447,000	1,114,000
	Supply and install of HDPE OD225	Depth : not exceeding 3.5m	m	356	5,500	4,500	1,959,000	1,602,000	4,040,000	3,110,000
	Supply and install of HDPE OD225	Depth : not exceeding 4.0m	m	340	6,400	4,800	2,177,000	1,633,000	4,298,000	3,309,000
	Supply and install of HDPE OD225	Depth : not exceeding 4.5m	m	118	6,500	4,800	768,000	567,000	1,504,000	1,158,000
	Supply and install of HDPE OD280	Depth : not exceeding 1.5m	m	336	2,900	5,700	974,000	1,915,000	3,461,000	2,665,000
	Supply and install of HDPE OD280	Depth : not exceeding 2.0m	m	247	4,100	6,000	1,014,000	1,483,000	2,940,000	2,264,000
	Supply and install of HDPE OD280	Depth : not exceeding 2.5m	m	128	4,400	6,000	561,000	765,000	1,555,000	1,197,000
	Supply and install of HDPE OD280	Depth : not exceeding 3.0m	m	320	5,400	6,300	1,730,000	2,018,000	4,351,000	3,350,000
	Supply and install of HDPE OD280	Depth : not exceeding 4.0m	m	257	6,400	6,600	1,646,000	1,698,000	3,851,000	2,965,000
	Supply and install of HDPE OD280	Depth : not exceeding 4.5m	m	29	6,500	6,600	190,000	193,000	441,000	339,000
	Supply and install of HDPE OD315	Depth : not exceeding 1.5m	m	91	2,900	6,900	264,000	628,000	1,080,000	831,000
	Supply and install of HDPE OD315	Depth : not exceeding 2.0m	m	34	4,100	7,200	141,000	248,000	463,000	357,000
	Supply and install of HDPE OD315	Depth : not exceeding 3.0m	m	44	5,400	7,600	236,000	332,000	667,000	514,000
	Supply and install of HDPE OD315	Depth : not exceeding 4.0m	m	156	6,400	7,900	998,000	1,232,000	2,598,000	2,000,000
	Supply and install of GRP/FRP ND400	Depth : not exceeding 1.5m	m	187	3,800	22,700	710,000	4,239,000	6,215,000	4,786,000
	Supply and install of GRP/FRP ND400	Depth : not exceeding 2.0m	m	147	4,900	23,000	720,000	3,380,000	5,110,000	3,934,000
	Supply and install of GRP/FRP ND400	Depth : not exceeding 2.5m	m	157	7,300	23,000	1,149,000	3,620,000	5,850,000	4,505,000
	Supply and install of GRP/FRP ND400	Depth : not exceeding 3.0m	m	173	8,500	23,400	1,469,000	4,045,000	6,722,000	5,176,000
	Supply and install of GRP/FRP ND400	Depth : not exceeding 3.5m	m	335	8,700	23,400	2,914,000	7,839,000	13,095,000	10,083,000
	Supply and install of GRP/FRP ND400	Depth : not exceeding 4.0m	m	63	9,800	23,700	622,000	1,504,000	2,575,000	1,983,000
	Supply and install of GRP/FRP ND400	Depth : not exceeding 4.5m	m	73	10,100	23,700	737,000	1,729,000	2,982,000	2,296,000
	Supply and install of GRP/FRP ND450	Depth : not exceeding 2.0m	m	134	6,500	28,800	868,000	3,845,000	5,862,000	4,513,000
	Supply and install of GRP/FRP ND450	Depth : not exceeding 2.5m	m	37	9,300	28,800	340,000	1,053,000	1,708,000	1,315,000
	Supply and install of GRP/FRP ND450	Depth : not exceeding 3.0m	m	201	10,900	29,200	2,191,000	5,870,000	9,814,000	7,557,000
	Supply and install of GRP/FRP ND450	Depth : not exceeding 3.5m	m	28	11,100	29,200	314,000	827,000	1,388,000	1,069,000
	Supply and install of GRP/FRP ND600	Depth : not exceeding 1.5m	m	131	6,400	34,000	838,000	4,451,000	6,619,000	5,096,000
	Supply and install of GRP/FRP ND600	Depth : not exceeding 2.5m	m	88	12,000	34,500	1,054,000	3,031,000	4,990,000	3,843,000
	Supply and install of GRP/FRP ND600	Depth : not exceeding 4.5m	m	73	16,200	35,300	1,178,000	2,568,000	4,513,000	3,475,000
	Supply and install of GRP/FRP ND700	Depth : not exceeding 3.0m	m	158	19,000	44,200	3,001,000	6,981,000	12,067,000	9,292,000
	Supply and install of GRP/FRP ND700	Depth : not exceeding 3.5m	m	404	21,300	44,800	8,610,000	18,110,000	32,129,000	24,740,000
	Supply and install of GRP/FRP ND700	Depth : not exceeding 4.0m	m	405	19,700	44,200	7,987,000	17,921,000	31,261,000	24,071,000
	Supply and install of GRP/FRP ND700	Depth : not exceeding 4.5m	m	229	20,200	44,200	4,629,000	10,128,000	17,782,000	13,692,000
	Supply and install of HDPE OD110	Depth : not exceeding 1.5m	m	508	600	1,000	305,000	508,000	965,000	743,000
	Supply and install of HDPE OD110	Depth : not exceeding 2.5m	m	147	1,700	1,000	250,000	147,000	441,000	340,000
	Supply and install of HDPE OD110	Depth : not exceeding 3.0m	m	193	1,700	1,000	329,000	193,000	580,000	446,000
	Supply and install of HDPE OD110	Depth : not exceeding 3.5m	m	34	1,800	1,000	61,000	34,000	105,000	81,000
	Supply and install of HDPE OD110	Depth : not exceeding 4.0m	m	205	1,900	1,000	389,000	205,000	655,000	505,000
	Supply and install of HDPE OD110	Depth : not exceeding 4.5m	m	99	2,000	1,000	199,000	99,000	328,000	252,000
	Supply and install of HDPE OD140	Depth : not exceeding 1.5m	m	296	600	1,500	178,000	445,000	756,000	582,000
	Supply and install of HDPE OD140	Depth : not exceeding 2.5m	m	101	1,700	1,500	171,000	151,000	367,000	283,000
	Supply and install of HDPE OD140	Depth : not exceeding 3.5m	m	149	1,800	1,500	268,000	223,000	558,000	429,000
	Supply and install of HDPE OD140	Depth : not exceeding 4.5m	m	34	2,000	1,500	68,000	51,000	134,000	103,000
	Supply and install of HDPE OD180	Depth : not exceeding 4.0m	m	18	1,800	2,500	33,000	46,000	93,000	71,000
	Supply and install of HDPE OD200	Depth : not exceeding 1.5m	m	848	800	3,300	679,000	2,799,000	4,314,000	3,322,000
	Supply and install of HDPE OD200	Depth : not exceeding 3.0m	m	306	1,700	3,300	519,000	1,008,000	1,828,000	1,408,000
	Supply and install of HDPE OD200	Depth : not exceeding 3.5m	m	241	1,700	3,300	409,000	794,000	1,440,000	1,109,000
	Supply and install of HDPE OD200	Depth : not exceeding 4.0m	m	85	1,800	3,300	153,000	280,000	517,000	398,000
	Supply and install of HDPE OD200	Depth : not exceeding 4.5m	m	44	1,900	3,300	84,000	147,000	275,000	212,000
	Supply and install of HDPE OD315	Depth : not exceeding 1.5m	m	791	1,000	7,700	791,000	6,093,000	8,704,000	6,702,000
	Supply and install of HDPE OD315	Depth : not exceeding 2.0m	m	78	1,300	7,700	102,000	603,000	885,000	682,000
	Supply and install of HDPE OD315	Depth : not exceeding 2.5m	m	155	1,600	7,700	248,000	1,194,000	1,799,000	1,385,000
	Supply and install of HDPE OD315	Depth : not exceeding 3.0m	m	107	1,600	7,700	172,000	826,000	1,245,000	958,000
	Supply and install of HDPE OD225(PJ)	Depth : not exceeding 10m	m	323	30,700	233,849	9,904,000	75,440,000	107,878,000	83,066,000
	Supply and install of HDPE OD280(PJ)	Depth : not exceeding 10m	m	320	31,200	235,697	9,996,000	75,510,000	108,061,000	83,207,000
	Supply and install of HDPE OD315(PJ)	Depth : not exceeding 10m	m	157	31,500	236,929	4,934,000	37,108,000	53,126,000	40,907,000
	Supply and install of GRP/FRP ND400(PJ)	Depth : not exceeding 10m	m	762	35,600	275,814	27,113,000	210,057,000	299,914,000	230,934,000
	Supply and install of GRP/FRP ND700(PJ)	Depth : not exceeding 10m	m	1,200	40,600	479,710	48,736,000	575,839,000	796,579,000	613,366,000
	Supply and install of HDPE OD110(PJ)	Depth : not exceeding 10m	m	252	30,200	231,770	7,601,000	58,334,000	83,359,000	64,187,000
	Supply and install of HDPE OD280(PJ)	Depth : not exceeding 10m	m	9	31,200	235,697	271,000	2,043,000	2,924,000	2,252,000
	Temporary road reinstatementAsphalt concete	Add 10% of pipeline(W=1.2)	m2	18,140	2,000	0	36,280,000	0	36,280,000	27,936,000
	Permanent road reinstatementAsphalt concete	Add 10% of pipeline(W=1.2)	m2	18,140	4,910	0	89,068,000	0	89,068,000	68,582,000
B2	**Pump Station**									
	Manhole Type Pumping Station		pc	5	22,000,000	0	110,000,000	0	110,000,000	84,700,000
	Major Pumping Station		pc	2	570,000,000	0	1,140,000,000	0	1,140,000,000	877,800,000
	Sub-total of B						**1,544,441,000**	**1,168,923,000**	**3,062,523,000**	**2,358,143,000**
C	**Branch Sewer**									
C1										
	Supply and install of HDPE OD225	Depth : not exceeding 2.5m	m	77,250	4,400	4,200	339,900,000	324,450,000	761,264,000	586,173,000
	Temporary road reinstatementAsphalt concete	Add 10% of pipeline(W=1.2)	m2	101,970	2,000	0	203,940,000	0	203,940,000	157,034,000
	Permanent road reinstatementAsphalt concete	Add 10% of pipeline(W=1.2)	m2	101,970	4,910	0	500,673,000	0	500,673,000	385,518,000
	Manhole Type Pump		pc	4	1,000,000	6,930,000	4,000,000	27,720,000	40,000,000	30,800,000
	Sub-total of C						**1,048,513,000**	**352,170,000**	**1,505,877,000**	**1,159,525,000**
D	**House Connection**									
D1										
	House Connection		HH	4,775	100,000	0	477,500,000	0	477,500,000	367,675,000
	Sub-total of D						**477,500,000**	**0**	**477,500,000**	**367,675,000**
	Sub-total of 1						**3,856,615,039**	**2,279,109,000**	**6,816,497,403**	**5,248,703,000**
2	Administration cost						484,000,000	0	484,000,000	372,680,000
3	Consulting cost						374,000,000	682,000,000	1,259,714,000	969,980,000
4	Physical contingency for construction cost						239,000,000	125,000,000	401,338,000	309,030,000
5	Price escalation for construction cost						926,000,000	218,000,000	1,209,117,000	931,020,000
6	Land acquisition and compensation									
7	Interest during construction						0	64,000,000	83,117,000	64,000,000
8	Front-end Fee						0	15,000,000	19,481,000	15,000,000
9	Tax and duty						1,753,000,000	0	1,753,000,000	1,349,810,000
	Sub-total of (2-9)						**3,776,000,000**	**1,104,000,000**	**5,209,766,000**	**4,011,520,000**
	Total including Tax and Duty						**7,632,615,039**	**3,383,109,000**	**12,026,263,000**	**9,260,223,000**
	Total excluding Tax and Duty						**5,879,615,039**	**3,383,109,000**	**10,273,263,000**	**7,910,413,000**
	Eligible Portion (1, 3, 4, 5 and 7)						**5,395,615,039**	**3,368,109,000**	**9,769,783,000**	**7,522,733,000**
	Non-Eligible Portion (2, 6, 8 and 9)						**2,237,000,000**	**15,000,000**	**2,256,481,000**	**1,737,490,000**

APPENDIX 8: Detail of Annual Fund Requirement

Annual Fund Requirement of Nuwara Eliya MC

Base Year for Cost Estimation:	Jan, 2017			FC & Total:	million JPY
Exchange Rates	LKR = JPY	0.77		LC :	million LKR
Price Escalation:	FC: 1.6%	LC:	3.8%		
Physical Contingency	5%				
Physical Contingency for Consultant	5%				

Annual Fund Requirement of Nuwara Eliya MC

Item	Total			2017			2018			2019		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION												
Ⅰ) Procurement / Construction	2,622	5,021	6,488	0	0	0	0	0	0	0	0	0
STP	758	786	1,363	0	0	0	0	0	0	0	0	0
Trunk Sewer	1,169	1,544	2,358	0	0	0	0	0	0	0	0	0
Branch Sewer	352	1,049	1,160	0	0	0	0	0	0	0	0	0
House Connection	0	478	368	0	0	0	0	0	0	0	0	0
Base cost for JICA financing	2,279	3,857	5,249	0	0	0	0	0	0	0	0	0
Price escalation	218	926	931	0	0	0	0	0	0	0	0	0
Physical contingency	125	239	309	0	0	0	0	0	0	0	0	0
Ⅱ) Consulting services	682	374	970	0	0	0	0	0	0	160	78	220
Base cost	608	302	841	0	0	0	0	0	0	148	69	201
Price escalation	42	54	83	0	0	0	0	0	0	5	5	9
Physical contingency	32	18	46	0	0	0	0	0	0	8	4	10
Total (Ⅰ + Ⅱ)	3,304	5,395	7,459	0	0	0	0	0	0	160	78	220
B. NON ELIGIBLE PORTION												
a Procurement / Construction	0	0	0	0	0	0	0	0	0	0	0	0
Base cost for JICA financing	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0
b Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0
Base cost	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0
c Administration cost	0	484	373	0	0	0	0	0	0	0	14	11
d VAT	0	1,453	1,119	0	0	0	0	0	0	0	43	33
e Import Tax	0	300	231	0	0	0	0	0	0	0	15	11
Total (a+b+c+d+e)	0	2,238	1,723	0	0	0	0	0	0	0	72	55
TOTAL (A+B)	3,304	7,633	9,182	0	0	0	0	0	0	160	150	276
C. Interest during Construction	64	0	64	0	0	0	0	0	0	0	0	0
Interest during Construction(Const.)	63	0	63	0	0	0	0	0	0	0	0	0
Interest during Construction (Consul.)	1	0	1	0	0	0	0	0	0	0	0	0
D. Front End Fee	15	0	15	0	0	0	0	0	0	15	0	15
GRAND TOTAL (A+B+C+D)	3,383	7,633	9,261	0	0	0	0	0	0	175	150	291
E. JICA finance portion incl. IDC (A + C)	3,368	5,395	7,522	0	0	0	0	0	0	160	78	220

Item	2020			2021			2022			2023		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION												
Ⅰ) Procurement / Construction	0	0	0	455	839	1,102	666	1,255	1,632	677	1,302	1,680
STP	0	0	0	135	140	243	195	202	351	195	202	351
Trunk Sewer	0	0	0	209	276	421	301	397	606	301	397	606
Branch Sewer	0	0	0	63	187	207	91	270	298	91	270	298
House Connection	0	0	0	0	85	66	0	123	95	0	123	95
Base cost for JICA financing	0	0	0	407	689	937	586	992	1,350	586	992	1,350
Price escalation	0	0	0	27	111	112	48	203	205	59	249	250
Physical contingency	0	0	0	22	40	52	32	60	78	32	62	80
Ⅱ) Consulting services	134	56	177	88	45	122	95	67	147	100	69	153
Base cost	122	48	159	78	37	106	84	53	124	86	53	127
Price escalation	6	6	10	5	6	10	7	11	15	9	13	19
Physical contingency	6	3	8	4	2	6	5	3	7	5	3	7
Total (Ⅰ + Ⅱ)	134	56	177	543	884	1,224	761	1,322	1,779	777	1,372	1,833
B. NON ELIGIBLE PORTION												
a Procurement / Construction	0	0	0	0	0	0	0	0	0	0	0	0
Base cost for JICA financing	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0
b Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0
Base cost	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0
c Administration cost	0	12	9	0	79	61	0	116	89	0	119	92
d VAT	0	35	27	0	238	184	0	347	267	0	357	275
e Import Tax	0	12	9	0	49	38	0	69	53	0	71	54
Total (a+b+c+d+e)	0	58	45	0	367	283	0	531	409	0	547	421
TOTAL (A+B)	134	114	222	543	1,251	1,506	761	1,853	2,188	777	1,918	2,254
C. Interest during Construction	0	0	0	3	0	3	8	0	8	13	0	13
Interest during Construction(Const.)	0	0	0	3	0	3	8	0	8	13	0	13
Interest during Construction (Consul.)	0	0	0	0	0	0	0	0	0	0	0	0
D. Front End Fee	0	0	0	0	0	0	0	0	0	0	0	0
GRAND TOTAL (A+B+C+D)	134	114	222	546	1,251	1,510	770	1,853	2,196	790	1,918	2,267
E. JICA finance portion incl. IDC (A + C)	134	56	177	546	884	1,227	770	1,322	1,787	790	1,372	1,846

Item	2024			2025			2026			2027		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION												
Ⅰ) Procurement / Construction	688	1,352	1,729	136	273	346	0	0	0	0	0	0
STP	195	202	351	38	39	68	0	0	0	0	0	0
Trunk Sewer	301	397	606	58	77	118	0	0	0	0	0	0
Branch Sewer	91	270	298	18	52	58	0	0	0	0	0	0
House Connection	0	123	95	0	24	18	0	0	0	0	0	0
Base cost for JICA financing	586	992	1,350	114	193	262	0	0	0	0	0	0
Price escalation	69	296	297	15	67	67	0	0	0	0	0	0
Physical contingency	33	64	82	6	13	16	0	0	0	0	0	0
Ⅱ) Consulting services	106	59	151	0	0	0	0	0	0	0	0	0
Base cost	90	43	123	0	0	0	0	0	0	0	0	0
Price escalation	11	13	21	0	0	0	0	0	0	0	0	0
Physical contingency	5	3	7	0	0	0	0	0	0	0	0	0
Total (Ⅰ + Ⅱ)	793	1,411	1,880	136	273	346	0	0	0	0	0	0
B. NON ELIGIBLE PORTION												
a Procurement / Construction	0	0	0	0	0	0	0	0	0	0	0	0
Base cost for JICA financing	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0
b Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0
Base cost	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0
c Administration cost	0	122	94	0	22	17	0	0	0	0	0	0
d VAT	0	366	282	0	67	52	0	0	0	0	0	0
e Import Tax	0	72	56	0	12	10	0	0	0	0	0	0
Total (a+b+c+d+e)	0	560	431	0	102	79	0	0	0	0	0	0
TOTAL (A+B)	793	1,972	2,311	136	375	425	0	0	0	0	0	0
C. Interest during Construction	19	0	19	20	0	20	0	0	0	0	0	0
Interest during Construction(Const.)	19	0	19	20	0	20	0	0	0	0	0	0
Interest during Construction (Consul.)	0	0	0	0	0	0	0	0	0	0	0	0
D. Front End Fee	0	0	0	0	0	0	0	0	0	0	0	0
GRAND TOTAL (A+B+C+D)	812	1,972	2,330	156	375	444	0	0	0	0	0	0
E. JICA finance portion incl. IDC (A + C)	812	1,411	1,898	156	273	366	0	0	0	0	0	0

APPENDIX 9: Breakdown of Operating Expenditure

Moratuwa Ratmalana - 8119

Type of Expenditure	Moratuwa Ratmalana WWTP	Moratuwa Ratmalana Distribution Network	Moratuwa (Soysapura)	Total
Salary			21,586,000.00	21,586,000.00
Utility Cost	9,460,008.00	3,300,000.00	103,000.00	12,863,008.00
Chemical Cost	383,000.00	-		383,000.00
Repair and Maintanance Cost	810,050.00	142,950.00	1,271,000.00	2,224,000.00
Establishment Cost	862,000.00	-	1,115,000.00	1,977,000.00
Security and Rent Cost	1,162,000.00	2,324,000.00	1,121,000.00	4,607,000.00
Total	**12,677,058.00**	**5,766,950.00**	**25,196,000.00**	**43,640,008.00**

Soysapura — Treatment Plant and Network
Present, Inflow, 5000m3/d (RS/m3/d/year) — 39.13 LKR/m3/day
Capacity, 17000m3/d (RS/m3/d/year)

			Total Amount (LKR)
Sri Jayawardanapura Kotte MC	35000	m3/d -> 35000 x 39.13 x 365 =	499,876,455
Anuradhapura MC	14000	m3/d -> 1400 x 39.13 x 365 =	199,950,582
Badulla MC	4000	m3/d -> 4000 x 39.13 x 365 =	57,128,738
Nuwara Eliya MC	4700	m3/d -> 4700 x 39.13 x 365 =	67,126,267
Dehiwala-Mt Lavinia MC	20000	m3/d -> 20000 x 39.13 x 365 =	285,643,689

APPENDIX 10: Regulations and Organizations Related to ESC

In Sri Lanka, various environmental legislations and standards are in force pertaining to wastewater collection, treatment, and disposal practices in order to safeguard the environment. It should be noted that many number of statutes exist which deal with this subject directly or indirectly. The most important legislations and standards are;

- National Environmental Act No. 47 of 1980 and No. 56 of 1988 and its amendments
- Tolerance limits for the discharge of industrial waste in to inland surface waters
- Tolerance limits for industrial effluents discharged on land for irrigation purpose
- Tolerance limits for industrial and domestic effluents discharged into marine coastal areas
- Tolerance limits for discharge of effluents into public sewers with central treatment plants
- Hazardous Waste Disposal
- Air Quality and Offensive Odor
- Noise and Vibration
- Marine Pollution Prevention Act no 59 of 1981
- Coast Conservation Act No. 57 of 1981 amended by Act No 64 of 1988 and its amendments
- Flood Protection Ordinance No 4 of 1924
- Land development Ordinance of 1935
- Nuisance Ordinance No. 15 of 1862 as amended by act No 57 of 1946
- State Land Ordinance No 8 of 1947
- Soil Conservation Act No 25 of 1951
- Urban Development Authority Law No 41 of 1978
- Mahaweli Authority of Sri Lanka Act No 23 of 1979
- Municipal Councils Ordinance No 29 of 1947 amended by act no 61 of 1981
- Fauna and Flora Protection Ordinance No 2 of 1987
- Agrarian Services Act No 58 of 1979 amended by Act No. 4 of 1991
- Irrigation Ordinance No 32 of 1946, amended by No 48 of 1968 and by No 13 of 1994
- Forest Ordinance No 16 of 1907 as amended by Act No 23 of 1995

1.1 Approvals Required for a Sewerage Project

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)
Approval of CEA under EIA regulations is required for the implementation of any "Prescribed Project" and valid Environmental Protection License (EPL) is required to discharge effluents in to 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 carryout construction activities of the 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 to lay pipelines along provincial or national roads, the approval of PRDA or RDA is required.

Department of Archaeology

It is the state agency responsible for conservation of archaeological artefacts and structures of historical interest whether lying or hidden beneath the surface of the ground or in any water/lake. Any development project on such land will have to be permitted by the Director General of Archaeology.

The Forest Department
The Forest Department in its role as statutory custodian of state forests and lands and the plantation of new forests, has been vested with powers so as to not granting permission for any development activity within any land declared, proposed or defined under the Forest Ordinance.

The Department of Wild Life Conservation
The Department of Wild Life Conservation has been vested with the powers as to not grant permission for development projects which are proposed to be located within, or within a 1 mile radius of National Reserves declared under the Fauna and Flora Protection Ordinance without carrying out EIA.

Department of Agrarian Development
Filling of any paddy cultivation land is envisaged for the construction of sewerage treatment plants, laying of pipelines or related structures, approval of the Department, of Agrarian Development is required.

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.

1.2 EIA Procedure Under NEA

Environmental Impact Assessment (EIA) is the general process of finding the impacts on natural and social environments and proposing preventive or minimising measures to enhance positive impacts. The broader legal framework for the EIA process in Sri Lanka was laid down by the amendments made to NEA in 1988 through the National Environmental (Amendment) Act No. 56 of 1988. The provision relating to EIA is contained in Part IV C of the National Environmental Act. Regulations pertaining to this process are published in Government Gazette Extraordinary No.772/72 dated 24th June 1993 and in several subsequent amendments. The procedure stipulated in the Act for the approval of projects provides for the submission of two types of reports: Initial Environmental Examination (IEE) report or EIA report. Such reports are required in respect of "prescribed projects" included in EIA regulations.

The EIA process is implemented through designated Project Approving Agencies (PAAs). A list of line ministries and agencies that are designated as PAAs is depicted in Government Gazette (Extra Ordinary) No. 859/14 dated February 13, 1995. The PAA's are basically responsible for the administration of the EIA process under NEA, which includes but not limited to:

- Subject all prescribed projects to IEE/EIA requirements
- Ensure and guide proper scoping process for IEEs/EIAs
- Draft Term of Reference (ToR) for IEEs/EIAs
- Establish, conduct and participate in Technical Evaluation and reviews during and after IEE/EIA report preparation
- Ensure public notification of availability of EIA for public review
- Evaluate the comments received from the public and other agencies
- Establish appropriate mitigatory measures and ensure that they are incorporated in the approval conditions
- Ensure implementation of the conditions through effective monitoring
- Obtain concurrence of the CEA prior to taking decision on the EIA report.

In order to obtain environmental approval for a prescribed project, the project proponent should submit either an Initial Environmental Examination (IEE) report or an EIA report as required by the PAA. Determination of whether an IEE or EIA is required for a proposed prescribed project is based on an assessment of the likely significance of the impacts of the proposed project on the environment. EIAs, rather than IEEs, are required for prescribed projects that are likely to have significant impacts. Determination of Significance is

based on the consideration of both context and intensity of the potential impacts.

In the event that an EIA is required, the PAA in consultation with CEA is responsible for subjecting the preliminary information submitted by the project proponent to environmental scoping, in order to set the Terms of Reference (TOR) for the EIA within 30 days from the date of acknowledging receipt of the preliminary information. The TOR is prepared by a scoping committee comprising experts in the relevant field, appointed by the PAA. In developing the TOR, the EIA regulations provide for the PAA to consider the views of state agencies and the public.

Upon submission of the EIA report by the project proponent, the PAA is required to determine whether issues referred to in the TOR have been addressed and notify the proponent of any inadequacies within 14 days. In the event any inadequacies are identified, the project proponent is required to make necessary amendments and resubmit the report. Once accepted, in addition to the EIA being forwarded to the CEA by the PAA, notice is also placed in a national newspaper published daily in Sinhala, Tamil and English languages inviting the public to make written comments, if any, to the PAA within 30 days from the date of first appearance of the notice. According to the legislation, public consultation is mandatory is only at this stage of the EIA process. Informal consultation with Non-Governmental Organisations (NGOs), interested groups and civil society may occur during early stages of environmental studies depending on the type of project and public interest in the project. The notification would specify the times and places at which the EIA would be available to the public. As a minimum the report would be available at the CEA, PAA and in appropriate government agencies in the project area. The environmental regulations have provisions for public hearings on the project although it is not mandatory. The PAA can use its discretion and hold a public hearing if it would be in the interest of the public. The PAA is required to forward all comments, either written or raised during any public hearing, to the project proponent for review and response within 6 days of completion of the public comment period. The project proponent is required to respond to all such comments in writing to the PAA.

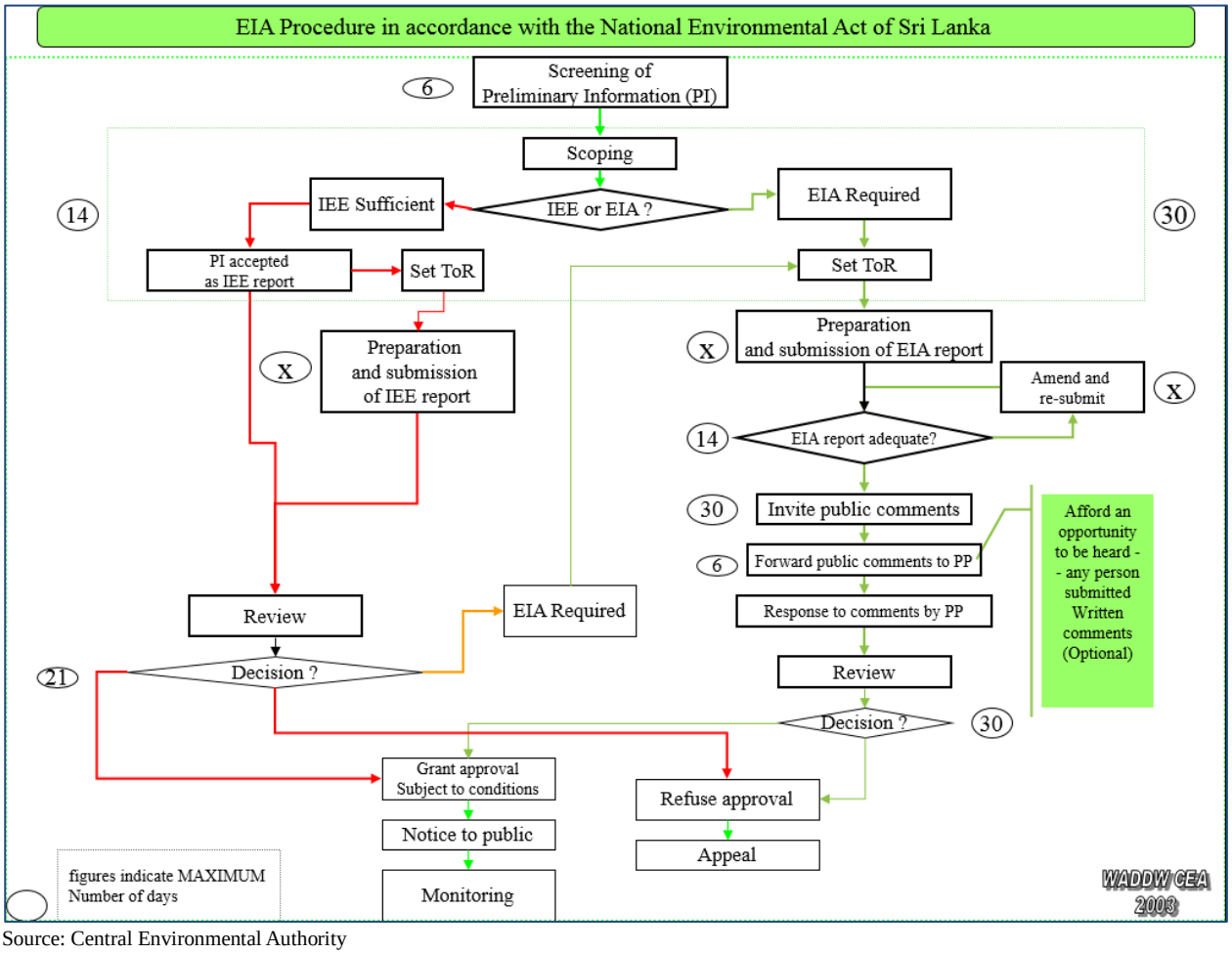
The Technical Evaluation Committee (TEC) appointed by the PAA would then evaluate the EIA and require the project proponent to respond to any queries raised by the TEC. The TEC would also evaluate the adequacy of the project proponent's response to any comments raised during the public comments period. Upon completion of the evaluation of the TEC, the PAA with the concurrence of the CEA would either grant approval for the implementation of the proposed project subject to specified conditions or refuse approval for implementation of the project, with reasons for doing so. This decision must be made within 30 days of the receipt of responses from the project proponent. The PAA is required to specify a period within which the approved project should be completed. In the event the proponent is unable to complete the project within the specified period, written permission for an extension has to be obtained from the PAA, 30 days prior to the expiration date.

Upon review of the preliminary information provided by the project proponent (PP), if the PAA determines that the project would have no long-term adverse environmental impacts, an initial environmental examination (IEE) would be considered adequate. Under such circumstances, the proponent will be required to submit a detailed IEE for review and approval by the PAA. The IEE will identify potential environmental and social issues and the complexity of possible remedial actions. Upon reviewing the IEE, if the TEC identifies any substantial environmental issues that may arise as a result of the proposed project, the proponent will be required to undertake a detailed EIA. The IEE review process is similar to the EIA review process, except for the level of detail and analysis involved, which is proportionate to the anticipated environmental and social impacts. The IEE is not required by law to be opened for the public for comments and does not go through the public consultation process.

Projects Subject to EIA

According to the EIA regulations, "Sewerage Treatment" is not a prescribed activity requiring an IEE/EIA. However, "Laying of gas and liquid (excluding water) transfer pipelines of length exceeding 1 kilometre" is a prescriber activity. However, any project or undertaking irrespective of their magnitude, if located partly or wholly within an environmental sensitive area, will become a prescribed project requiring approval under the EIA regulations. Environmental sensitive areas are defined as;

- Any erodible area declared under the Soil Conservation Act (1951, 1953);
- Any Flood Area declared under the Flood Protection Ordinance (1924, 1955) and any Flood Protection Area declared under the Sri Lanka Land Reclamation and Development Corporation Act (1968, 1982);
- Any reservation beyond the Full Supply Level of a reservoir;
- Any archaeological reserve, ancient or protected monument as defined or declared under the Antiquities Ordinance (1965);
- Any area declared under the Botanic Gardens Ordinance (1928, 1973);
- Areas within, or less than 100m from the boundaries of any area declared under the National Heritage and Wilderness Act (1988): the Forest Ordinance;
- Areas within, or less than 100m from the boundaries of any area declared as a Sanctuary under the Fauna and Flora Protection Ordinance (1937);
- Areas within, or less than 100m from the high flood level contour of a public lake as defined by the Crown Lands Ordinance (1947, 1949, 1956) including those declared under Section 71 of the Ordinance;
- Areas 60m or less from the bank of a public stream as defined in the Crown Lands Ordinance, with a width of more than 25m at any point.



Source: Central Environmental Authority

Figure: Procedure for obtaining Environmental Clearance

APPENDIX 11: Comparison with JICA Guidelines

Comparison with JICA Guidelines

There are some gaps between the current Sri Lankan Regulations and JICA Guideline, but they are rather insignificant. The governmental laws pay less attention to the social impacts than JICA Guidelines. Thus, the preparing of the Resettlement Action Plan (RAP) is not mandatory. The 30 day term for public comment that the government stipulates differs greatly from the recommended 120-day JICA policy. Although JICA's guidelines suggest that the project proponents should disclose information related to it, under the Sri Lanka's legislation, the responsibility of information disclosure is incurred not by the project proponent but by the PAA.

Comparison of JICA and Sri Lankan Policies and Guidelines

Item	JICA Guidelines	Sri Lankan Policies and Regulations
EIA / IEE Process	At the scoping stage and EIA draft report stage, the project proponent has to hold stakeholder meetings in the area to explain the contents. The comments should be reflected in the plan. EIA reports / RAP will be disclosed 120 days prior to concluding the agreement documents.	Stakeholders are provided an opportunity to comment in the scoping stage. The stakeholders are usually related governmental organizations (not local community/general public). The stakeholders and public can submit queries and comments on the EIA draft report. The comments should be addressed in the final report. EIA reports will be opened for 30 days for public comments.
Environmental Checklist	A check list is provided for each sector. These items should be included in the EIA report.	The PAA shall prepare terms of reference for an EIA. No specific checklist is provided.
Involuntary Resettlement Process	The project proponent is obliged to prepare a RAP. If number of resettled household is small (e.g. one household), the RAP can be simplified one. The RAP is prepared as part of the EIA Report.	In case that the number of resettled households is 20 or more, the NIRP requires a RAP.
Compensation for land resettlement	Full replacement cost must be applied as much as possible.	The Land Acquisition Act (LAA) provides for the payment of compensation on the basis of "market value" which is defined as the "amount which the land might be expected to have realized if sold by a willing seller in the open market as a separate entity". The National Involuntary Resettlement Policy (NIRP) recommends that compensation for loss of land, structures, other assets and income should be based on full replacement cost and should be paid promptly together with transaction costs.
Compensation for non-registered residents	All residents before the cut-off-date are eligible.	The LAA does not have any provisions on this issue. The NIRP recommends that affected persons who do not have documented title to land should receive fair and just treatment.
Grievance redress mechanism	The project proponent is obliged to have a grievance redness mechanism.	The LAA provides a limited grievance redress mechanism whereby certain grievances of the affected persons relating to compensation can be referred to the Board of Review established under the LAA. The NIRP recommends the establishment of an internal monitoring system by project executing agencies to monitor the implementation of RAPs and handling of grievances. Grievances redress mechanism formally instituted by the project authorities with the support of the Divisional Secretaries of the project area.

APPENDIX 12: International Commitments related to ESC

International Commitments

A list of Environment-related International Conventions, Protocols, and Treaties is given in Table.

Table: 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)
15	Convention on Conservation of Migratory Species (Bonn, 1979)

APPENDIX 13: Record of Consultation with Public and Authorities

Record of Meeting/Discussion

Date:	02/05/2016	**Time**:	from	10:30	to	12:00	
Venue:	CEA Director of EIA office						

Attendants

Name	Position	Department/Organization
Name		
Kanthi De Silva	Director of EIA	CEA
JICA Experts (Name)		
Koji KIMURA	Deputy Team Leader	JET
Yudai TADAKI	Environmental and Social Consid.	JET
Ranjith Warusamana	Deputy Team Leater (Local expert)	JET (Local expert)
Ms. KPP Dharmasena	Chief Engineerg (P&D - Sewerage)	NWSDB

Main Subject:
1. Verify CEA requirments for environmental and social studies at each stage of the project
2. Acquire documentation/guidelines related to requirements

Topic	Contents of Discussion	Conclusion
1	By JET: General introduction of current project (Presented: IC/R presentation). JET understanding is environmental studies are required at each stage, as follows 1) National M/P: SEA required 2) Priority Cities M/P: IEE required 3) F/S for final two cities: EIA or IEE required.	
2	CEA response: SEA is not required for any stage. SEA is performed generally to determine the type of project to select. Since the current project is already defined as a sewerage project, no study is required. Furthermore, any environmental evaluation undertaken at this stage will not be considered or accepted as an SEA by CEA. There is no law or procedure for SEA.	
3	Requirements for IEE/EIA: IEE/EIA will NOT be required at the Cities M/P stage. EIA will be required for approval of the F/S for each of the selected cities. The TOR for the EIA can be issued based on the Project Proposal submitted to CEA at the the Cities M/P stage for preparation of coming EIA for the F/S.	
4	Minitry of Land is responsible for the Resettlement Action Plan.	
	Documents: SEA for water reources and irrigation development in Sri Lanka, TOR	

Actions to be taken	by Whom	until When

Date:

Record of Meeting/Discussion

Date:	02/11/2016	**Time**:	from	15:30	to	16:30	
Venue:	CEJ office						

Attendants

Name	Position	Department/Organization
Name		
Mr. Hemantha Withanage	Executive director	CEJ
JICA Experts (Name)		
Koji KIMURA	Deputy Team Leader	JET
Yudai TADAKI	Environmental and Social Consid.	JET
WADD Wijesooriya	Director	EMAC
Buddhika De Silva	Director	EMAC

Main Subject:
1. To make known the JET's intention to perform M/P for the Project, and its contents.
2. To collect thoughts and opinions regarding the Project and apply them for its implementation

Topic	Contents of Discussion	Conclusion
1	By JET: General introduction of current project (Presented: IC/R presentation).	
2	CEJ: Kaduwela may be an interesting location for sewerage project. a) High domestic sewerage needs: direct dumping of domestic sewerage to Kelani River, complaints of itchiness and reactions to bathing in river, etc b) Highly industrialized: industrial effluent and solid waste in Kelani river c) Water treatment plant located downstream is affected by pollution at Kaduwela. Many other water and land pollution issues were discussed	
3	CEJ and JET will further consult each other as the Project progresses.	
4		
	Documents: Kelani River Edatabase.pdf Content-Kelani River industrial pollution 2015 Kelani River industrial pollution	

Actions to be taken	by Whom	until When

Date:

Record of Meeting/Discussion

Date:	02/11/2016	**Time**:	from	14:00	to	15:00	
Venue:	Office of Professor Jayathunge, Faculty of Science, University of Colombo						

Attendants

Name	Position	Department/Organization
Name		
Prof. Amaramalee Jayathunge	Prof. Zoology	Faculty of Science, University of Colombo
JICA Experts (Name)		
Koji KIMURA	Deputy Team Leader	JET
Yudai TADAKI	Environmental and Social Consid.	JET
WADD Wijesooriya	Director	EMAC
Buddhika De Silva	Director	EMAC

Main Subject:
1. To make known the JET's intention to perform M/P for the Project, and its contents.
2. To collect thoughts and opinions regarding the Project and apply them for its implementation

Topic	Contents of Discussion	Conclusion
1	By JET: General introduction of current project (Presented: IC/R presentation).	
2	Prof. Jayathunge's response: Odor issues should be controlled. The extent of industrial and medical waste water included in the study, or treated at the waste water treatment plant should be discussed.	
3	Prof. Jayathunge will be leaving the department due to retirement. She will appoint others to participate in the consultations, from chemistry and biology backgrounds.	
4		

Actions to be taken	by Whom	until When

Date:

APPENDIX 14: Draft EMP and EMoP

Mitigation Measures

Mitigation measures proposed with respect to the stages of: (i) planning and design (ii) construction and (iii) operation is given in Table 1.

Table 1: Environmental Impact – Mitigation Matrix

Environmental Impact / Issue	Mitigation Measure	Implementing Organization	Responsible Organization
Planning and Design Phase			
Site Selection	▪ Site selection process shall avoid land acquisition and involuntary resettlement where possible, including impacts on vulnerable persons. ▪ Locate sewage pipelines within the right of ways of roads to eliminate acquisition of new land. ▪ Avoid locating sewage pumping stations and wet wells within close proximity of any inhabited areas, sensitive sites such as hospitals, schools, temples, etc. to minimize nuisance impacts from odor, rodents, etc. as much as possible	Consultant/ NWSDB	NWSDB
Overall Environmental Management	▪ An Environmental Management Plan shall be prepared and implemented.	Consultant/ NWSDB	NWSDB
Discharge standards	▪ The design will specify the guidelines for the proper handling and disposal of waste to predetermined authorized disposal sites;	Consultant/ NWSDB	NWSDB
Archaeological resources	▪ Consult the relevant records of national and/or local archaeological agencies regarding the archaeological potential of proposed sites of STP, pumping stations, and main sewers, to ensure that these are located in areas where there is a low risk of chance finds.	Consultant/ NWSDB	NWSDB
Public utilities	▪ Telephone lines, electric poles and wires, and water pipes (old) existing within right-of-way (ROW) require shifting without disruption to services.	Consultant/ NWSDB	NWSDB
Traffic	▪ In order to limit the disruption to the neighborhood and traffic flow, coordinate with NWSDB to provide guidance to the organization of construction works. ▪ The design will specify the handling and transportation of construction materials and equipment.	Consultant/ NWSDB	NWSDB
Safety	▪ The design will include guidelines for site safety which will include specific requirements for physical division (fence), where necessary, of the construction site from passing pedestrians, children at play, vehicles, and any other people at risk. ▪ The design will include guidelines for workers' safety on site and the safety of visitors. Bills of quantities and technical description of works will include needed safety equipment.	Consultant/ NWSDB	NWSDB
Construction Phase			
Soil erosion and sedimentation	▪ Careful planning of construction activities that lead to heavy erosion, to avoid heavy rainy seasons ▪ Remove waste soil as soon as it is excavated, by loading directly onto trucks; ▪ The work, permanent or temporary shall consist of measures to control soil erosion, sedimentation and water pollution. Typical measures include the use of berms, dikes, sediment basins, fiber mats, mulches, grasses, slope drains and other devices. ▪ Adequate compaction of filled surfaces on completion and progressive re-vegetation of all disturbed areas as quickly as possible ▪ Protection of drainage channels with berms (i.e. ridge or embankment bordering channel) to prevent overspill ▪ Sedimentation traps will be constructed to reduce suspended solids before water is discharged to water bodies where applicable. ▪ All debris and residual spoil material including any excess earth will be disposed only at designated locations. ▪ The debris and spoil material will be disposed in such a manner that (i) watercourses and drainage paths are not blocked; (ii) the disposed material will not be washed away by floods and (iii) will not be a nuisance to the public.	Contractor	Consultant/ NWSDB

Environmental Impact / Issue	Mitigation Measure	Implementing Organization	Responsible Organization
Transport of earth material	▪ Vehicles will be properly maintained to ensure the good running conditions and those which are not in suitable condition will be replaced. ▪ Provide covers during transportation	Contractor	Consultant/ NWSDB
Dust Control	▪ Enclosing or covering the construction site in order to control the dust dispersion. ▪ Protecting stockpiles from water and wind erosion; ▪ Using a water truck for dust suppression on all exposed areas ▪ Establishing and enforcing vehicle speed limits to minimize dust generation; ▪ Use tarpaulins to cover loose material when transported to and from the site. ▪ Locating stockpiles away from sensitive receptors; ▪ Loaded haul trucks travelling to and from the site having loads leveled to avoid spillage; ▪ Carrying out progressive rehabilitation of cleared land;	Contractor	Consultant/ NWSDB
Burrow pits	▪ Eligible contractor/s who are operating burrow pits with necessary approvals / permits, will only be selected. ▪ Noise, dust and related safety issues during loading, transportation and unloading will be controlled to meet` the standards and norms	Contractor	Consultant/ NWSDB
Construction Waste Disposal	▪ System to collect waste cement slurry will be provided to avoid contamination of drainage paths. ▪ Wastewater from washing of equipment used for concrete mixing and transporting of concrete will be disposed safely. ▪ All discarded and used oil and grease will be collected, stored and disposed (reuse / sell). ▪ All potentially water polluting chemicals and oils will be stored (a) at locations sufficiently away from watercourses and storm water drainage paths and (b) in a manner that would minimize chances of spillage. ▪ Minimize the oil and chemical spillages during operation and properly maintain the equipment and machinery. ▪ Debris and spoil will be disposed of only to designated places in such a manner that (i) waterways and drainage paths are not blocked, and (ii) the disposed material will not be washed away by heavy storm water flows.	Contractor	Consultant/ NWSDB
Drainage issues	▪ STP site should be located on the high ground to avoid water ingress ▪ Natural drain paths should not be disturbed during any construction activity	Contractor	Consultant/ NWSDB
Noise and vibration	▪ Temporary noise barriers / screens will be placed. ▪ All construction work will be carried out during day time as much as possible and work will be stopped after 6 pm. ▪ Workers involved in high noise generating activities (such as compacting, concrete/cement mixing operations using the mixers) and handling high noise generating machinery and equipment will be provided with ear plugs or mufflers. ▪ To the extent possible, attempts will be made to use equipment and machinery that produce low noise levels ▪ Proper and regular maintenance and/or servicing of equipment and machinery will be carried out.	Contractor	Consultant/ NWS&DB
	Operational phase		
Impacts on Water Resources	▪ Prevent seepage of polluted water to the ground by applying suitable lining for the ponds, raise the levels of the site and the tanks etc as applicable. ▪ Establish the STP on a sufficient high ground to avoid the flood impact. ▪ Avoid spillages of septage during operation – specially during unloading - and take precautionary measures to prevent mixing septage with storm water drainage system. ▪ As a precautionary step, it is proposed to monitor the ground water quality in the area. ▪ Ensure the disposal of treated effluent to a reed bed (artificial wet-land) with species which suit the climatic and	NWS&DB / MC	NWS&DB / MC / Consultant

Environmental Impact / Issue	Mitigation Measure	Implementing Organization	Responsible Organization
	coastal conditions of the area. ▪ Ensure the necessary effluent quality for disposal to inland waters		
Odor from STP	▪ Shielding of the unloading bay to an extend to prevent odorous gases being blown away by the wind ▪ Hydraulic arrangements that would minimize agitation of sewage during the release to the treatment system ▪ Keeping much of the screen channel close to prevent release of gases to air ▪ Establish and properly maintain a thick green belt along the STP site and pumping station where applicable.	NWS&DB / MMC	MMC / NWSDB
Sludge disposal	▪ Use dewatered sludge as fertilizer. ▪ It is recommended that the sludge be disposed at suitable site such as coconut land or suitable plantation land or through burial in to dug pits.	NWS&DB / MMC	MMC / NWSDB

DRAFT ENVIRONMENTAL MONITORING PLAN

Objective Of Environmental Monitoring Plan
In order to fulfil the following objectives an appropriate Environmental Monitoring Programme (EMoP) will be carried out.

- Check the implementation of mitigatory measures to ensure whether they are in conformity with the requirements
- Ensure that the impact does not exceed legal standards
- Provide timely warnings of potential environmental damages

The EMoP characterizes the proposed mitigation and monitoring actions as a set of tasks. In the EMoP the specific responsibilities on task implementation on the project proponent, the contractor(s), and the regulatory agency (agencies) are assigned. These tasks should be implemented within a specified time/period by the agency responsible and as per the specifications set out in the EMoP.

Environmental monitoring committee
The monitoring programme will be undertaken by a committee and all relevant line agencies, local government bodies and interested parties shall take part in the monitoring activities. An Environmental Monitoring Committee (EMC) consisting of the members from the following agencies shall be set up by CEA.

- Central Environmental Authority
- Municipal Council
- National Water Supply and Drainage Board
- Divisional Secretariat
- RDHS and Anuradhapura General Hospital
- Irrigation Department
- Archaeological Department
- Road Development Authority
- Provincial Road Development Authority
- Sri Lanka Railway
- Department of Forest Conservation
- Department of Wildlife Conservation
- Any other agency deemed necessary by the EMC

Outline of 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 mitigatory measures suggested are properly implemented and they are effective in achieving the objectives of environmental protection. Outline of the Environmental Monitoring Plan is presented in Table 2.

One important aspect of monitoring should be to assess the effectiveness of the mitigation measures suggested, where they are found lacking, appropriate new actions to mitigate any adverse effects should be undertaken. This requires measurements of selected environmental parameters at identified locations and a summary of the measurement schedule proposed is given in Table 3.

Table 2: Outline of the Environmental Monitoring Plan

Activity	Expected Negative Impact	Mitigation measures	Responsible for Mitigation	Responsible for Monitoring	Parameters to be monitored	Location	Frequency
Pre-construction stage	Cutting of trees	Permits to be obtained for cutting trees. Cut down of branches wherever possible, rather than cutting the whole tree	Contractor	MC / NWSDB	Number of trees in the project area	Project sites	Before commencing
	Burrowing of earth	Approvals to be obtained	Contractor	MC / NWSDB	Field reports and observations	Project sites	Before commencing
Construction stage	Damages to existing roads	Excavation should be done after studying the design drawings	Contractor	MC / NWSDB	Field reports and observations	Project sites	Once every two months
	Traffic congestion	Implement a proper traffic management plan. Use sign boards and barricaes	Contractor	MC / NWSDB	Field reports and observations	Project sites	Weekly
	Generation of dust	Systemic watering on excavated soil	Contractor	MC / NWSDB	Field reports and observations	Project sites	Once every two weeks
		Using a tarpaulin cover while transporting the materials such as sand, cement and excavated soil	Suppliers	MC / NWSDB	Field report and complaints if any	Off the project site	Weekly
		Taking measures to minimize the dust when loading and unloading the materials	Contractor	MC / NWSDB	Field report and complaints if any	Project site	Weekly
	Increased noise level	Machinery should not produce a noise level above 75db. Relevant equipment should be used to monitor the noise levels	Contractor	MC / NWSDB	Noise reports and complaints if any	Project site	Daily
	Waste generation and camping on the location	Solid waste generated should be disposed properly and removed to appropriate disposal yards	Contractor	MC / NWSDB	Field reports	Project site	Once every three months
	Impacts on existing habitats	No endemic or endangered species are damaged. Cutting of tree should be compensated by planting of more trees around the area	Contractor	MC / NWSDB	Field reports	Project site	Once every six months
Operation and maintenance stage	Sludge generation	Collecting sludge in an underground chamber and proper disposal of it	MC / NWSDB	MC / NWSDB	Maintenance report	Project area	Daily
	Possible negative impacts on water quality and quantity	Water quality and quantity tests to be carried out regularly	MC / NWSDB	MC / NWSDB	Field reports	Project site	Once every month

Table 3: Environmental Monitoring Schedule

Aspect	Parameter	Method	Stage	Frequency	Responsibility	Location
Noise level	Day and Night time Noise level (dB)	Portable noise meter (range 0-120 dB(A))	Pre-construction	Once (Baseline measurement)	Contractor / NWSDB / EMC	At STP site boundary; Sensitive locations along the sewer network; Selected pumping stations;
			Construction	Once a year	Contractor / NWSDB / EMC	
			Operation	Yearly; On complaints	NWSDB / EMC	
Air quality / Odour	SO_2, NO_2, CO, PM_{10}, SPM	Spectrometric method; High volume sampling and Gravimetric analysis	Pre-construction	Once (Baseline measurement)	Contractor / NWSDB / EMC	At STP site; Sensitive locations along the sewer network; Selected pumping stations;
			Construction	Two times	Contractor / NWSDB / EMC	
			Operation	Yearly; On complaints	NWSDB / EMC	
Water Quality	EC, TSS, DO, BOD, COD, pH, Oil and grease, E-coli	Portable water quality meter, Spectrometric method	Pre-construction	Once (Baseline measurement)	Contractor / NWSDB / EMC	Malwathu Oya near STP site - (i) upstream and (ii) downstream; Streams at sensitive locations along the sewer network; Streams at selected pumping stations;
			Construction	Two times	Contractor / NWSDB / EMC	
			Operation	Yearly; On complaints	NWSDB / EMC	