INTER-AMERICAN DEVELOPMENT BANK

TRINIDAD & TOBAGO WASTEWATER INFRASTRUCTURE REHABILITATION PROGRAM (TT-L1018): ORPHAN WWTPs IN THE MALONEY SEWERAGE REGION

ENVIRONMENTAL AND SOCIAL ANALYSIS AND OUTLINE ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

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PREPARED BY

George Krishna Sammy, Ph.D., R.Eng., FAPETT,
Environmental Engineer

gksammy@mail.tt

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EXECUTIVE SUMMARY

The Inter-American Development Bank (IADB) is preparing a Wastewater Infrastructure Improvement Program (TT-L1018) for Trinidad & Tobago, the general objective of which is to improve the environmental conditions in Trinidad & Tobago, by decreasing the uncontrolled discharge of untreated wastewater into the environment. This Environmental and Social Analysis (ESA) and outline Environmental and Social Management Plan (ESMP) form part of that Program, and are specific to eight WWTPs in the Maloney Sewerage Region: Maloney, Bregon Park, Lynton Gardens, Lillian Heights, La Florissante, Santa Monica Gardens, La Resource and Timberland.

The Maloney WWTP is presently operated by the Water and Sewerage Authority, but one of the two treatment trains is reported to be inoperable. Recent test results show that the effluent quality is non-compliant with the requirements of the Water Pollution Rules with regard to dissolved oxygen and faecal coliforms. The other 8 plants have been abandoned and are inoperable, and are considered to be "orphan" WWTPs.

Proposed Interventions

The Maloney WWTP will be rehabilitated and expanded to accommodate the flows originally treated by the seven smaller WWTPs, as well as provision for future growth. The upgraded Maloney WWTP will utilize some of the structures at the existing Maloney Gardens WWTP, and expand upon these. In addition, the following works are proposed:

- The Bregon Park, Lynton Gardens, Lillian Heights, La Florissante and Timberland WWTPs will be decommissioned and converted to sewage lift stations.

- A new system of sewer mains will be constructed to convey waste water from these plants to the Maloney WWTP.

- Flow from the existing lift stations at Santa Monica and La Resource will also be routed into the new sewer mains.

Regulatory Framework

Three agencies will have jurisdiction over the interventions described above:

- The Water and Sewerage Authority (WASA),
- The Environmental Management Authority (EMA), and
- The Inter-American Development Bank (IADB).

WASA will be responsible for approving the upgrading and expansion works at the Maloney WWTP, and will own and operate the full system on commissioning. The EMA has several rules which will apply to this project: the Certificate of Environmental Clearance (CEC) Rules, the Water Pollution Rules, the Noise Pollution Rules, and the draft Air Pollution Rules. The project must also conform to the IADB's Environmental and Safeguards Policy and (if there is acquisition of land for the project) the IADB's Involuntary Resettlement Policy.

The EMA requested an EIA for a major part of this project, and has issued CEC 1469/2006 to WASA. This CEC covers the proposed upgrade and expansion works at the Maloney WWTP, as well as the replacement of the orphan WWTPs at Lynton Gardens, Lillian Heights, La Florissante, Santa Monica Gardens and La Resource with sewage lift stations. However, this CEC does not cover replacement of the orphan WWTPs at Bregon Park and Timberland with sewage lift stations, so an Additional CEC will be required to cover those works. It is not expected that an EIA will be required for the Additional CEC, since the type of work envisaged is the same as at the other orphan WWTPs, which was included in the EIA submitted earlier.

Based on the Design Effluent Criteria, WASA will be required to submit an application for Source Registration under the Water Pollution Rules for the upgraded and expanded Maloney WWTP. However, the Design Effluent Criteria conform to the permitted levels under the Water Pollution Rules, so it is not expected that WASA will have to apply for a Permit under these Rules.

Construction noise is exempt under the Noise Pollution Control Rules during the daytime. However, if the contractor proposes to undertake work at night an application for a Noise Variation must be submitted. As part of that application, background noise levels must be established in the areas where night work is proposed.

This project is classified as Category B under the IADB's Environmental and Safeguards Policy. Such projects require Environmental and Social Analysis as well as an Environmental and Social Management Plan. Both those requirements are satisfied by this report and appendices.

Environmental Setting

A limited program of water quality sampling and testing was conducted by WASA in July 2011. The results of that program showed that the quality of raw sewage was somewhat lower than the typical values for weak domestic waste water quoted in an internationally-recognized sanitary engineering textbook. There was evidence of altered water quality between the upstream and downstream sampling locations at Bregon Park WWTP and Lynton Gardens WWTP, but less so at Lillian Heights WWTP and La Florissante WWTP. The following are summaries of other key aspects of the environmental setting:

- All eight WWTPs are situated on the Northern Gravels Aquifer, an unconfined aquifer which is extensively pumped for water supply throughout North Trinidad.

- The receiving streams for these WWTPs are all tributaries of the Caroni River. Flow rates in these rivers vary seasonally, with higher flow in the wet season and lower flow in the dry season. However, there is some recharge of the rivers from the river bed gravels during the dry season, so there is generally a continuous base flow throughout the dry season.

- All eight WWTPs are situated within developed areas where the original vegetation has been cleared and the vegetation presently at the sites is secondary growth of little ecological significance.

- Discharges from these WWTPs flow into tributaries of the Caroni River, which in turn outfalls into the Caroni Swamp, which is the largest mangrove wetland in Trinidad & Tobago and has been declared a RAMSAR site.

- Over the past three decades, lands in the wider vicinity of the Maloney Sewerage Region have been intensively converted from agriculture to housing.

Impacts and Mitigation

The expected benefit of this project is a reduction in contaminant releases to surface and ground water. Short-term economic benefits are also expected during the construction phase.

Potential adverse impacts relate to:

- Contamination of Surface and Ground Water,
- Soil Contamination,
- Impaired Air Quality,
- Noise,
- Health Issues,
- Obstructed Access,
- Traffic Congestion,
- Construction Safety Issues, and
- Waste Disposal Issues.

Possible mitigation measures have been indentified to address each of these concerns.

Two economic impacts have been discussed based on recent projects in Trinidad & Tobago: Land Acquisition issues and the potential for reduction in Property Values. However, neither of these is relevant to this project.

With regard to climate change, the projected sea level is not expected to affect these facilities. However, during extreme dry seasons, streamflow will be reduced to the base flow for extended periods, and dilution of the treated effluent will be significantly reduced, leading to somewhat higher ambient concentrations of contaminants in the streams after mixing.

Natural hazards of concern in Trinidad & Tobago are earthquakes and tropical cyclones. Both of these can be addressed in the design of the facilities by identifying appropriate acceleration values for earthquake-proof design, appropriate wind speeds for structural design and appropriate rainfall intensities for drainage design.

The limited water sampling and testing program undertaken by WASA for this project confirms that present discharges from the orphan WWTPs violate the Water Pollution Rules. Contaminated soil and water are also present at these sites, which constitutes another potential liability.

Monitoring

Water quality monitoring will include in-stream monitoring above and below the outfall points at the Maloney WWTP as well as at the seven orphan WWTPs. When the upgraded and expanded Maloney WWTP is commissioned, effluent samples will also be tested. Samples of effluent and from the streams will be tested for pH, Temperature, Total Residual Chlorine, Dissolved Oxygen, 5-day Biological Oxygen Demand, Chemical Oxygen Demand, Total Suspended Solids, Ammoniacal Nitrogen, Total Phosphorus, Total Oil & Grease and Faecal Coliforms.

The Contractor's Health, Safety and Environmental (HSE) Performance will be monitored by HSE Inspectors on the Supervising Engineer's team who will be assigned full-time to the project.

Management Plans

An outline Environmental and Social Management Plan has been prepared for this project, and this will be finalized during the design stage. Other management plans to be prepared include a Road Traffic Management Plan, an Emergency Prevention and Response Plan, and a Quality Assurance Project Plan.

Public Participation

As part of the EIA originally submitted for CEC 1469/2006, public meetings were held at the Maloney Indoor Sport Arena on November 18 and 26, 2008. It is expected that the EMA will request additional public meetings as part of the application for the Additional CEC to cover works at Bregon Park WWTP and Timberland WWTP. In addition, it is recommended that WASA should consult with key stakeholders within three months after the approval of funding by the IADB.

WASA Capability

It is envisaged that WASA's Environmental and Regulatory Compliance Department (ERCD) will be assigned the following environmental tasks on this project:

- Preparing the Application for an Additional CEC for Works at Bregon Park and Timberland,
- Organizing and Hosting Public Meetings, and
- Advertising the Start of Construction.

This Department is considered capable of undertaking these work items.

Despite the fact that the ERCD is also capable of undertaking additional tasks, it is recommended that:

- reviewing WASA's sampling and testing procedures, recommending improvements and providing training should be the responsibility of a specialist hired by WASA under this project.
- finalizing the ESMP should be the responsibility of the environmental professionals on the Design Engineer's team,
- the preparation of the Road Traffic Management Plan and the Emergency Prevention and Response Plan should be prepared by the Contractor,

< the preparation of the QAPP should be assigned to an independent consultant.

It appears that WASA's Laboratory is capable of all of the sampling required for this project, and for undertaking all of the required testing except for Ammoniacal Nitrogen, Total Phosphorus and Oil & Grease. These three tests are available at local commercial laboratories. Provision should be made under this project for increasing the budget of the WASA Laboratory to cover the cost of this sampling and testing.

Contract Requirements

It is expected that WASA will contract three firms to undertake different aspects of this work: a Design Engineer, a Supervising Engineer and a Contractor. CEC 1469/2006 should be made a part of all three contracts with a requirement that the all relevant clauses be complied with. The Additional CEC for works at Bregon Park and Timberland and the finalized ESMP should be made a part of the Supervising Engineer's contract and the Contractor's contract.

The Scope of Work for the Design Engineer should include Contamination Studies at all seven orphan WWTP sites, finalizing the ESMP, and determining appropriate acceleration for earthquake resistant design, tropical cyclone wind speed for structural design and tropical cyclone rainfall intensity for drainage design.

The Scope of Work for the Contractor should include the preparation of a Road Traffic Management Plan and an Emergency Prevention and Response Plan.

Cost Estimates

Cost estimates are provided for a wide range of environmental requirements of this project. In summary, the annual costs are estimated as follows:

2012	$TT 944,600.00
2013	$TT 1,034,600.00
2014	$TT 1,019,600.00
2015	$TT 199,600.00
2016	$TT 199,700.00
TOTAL	$TT 3,398,000.00

These estimates do not include the cost of implementing most of the mitigation measures, since those measures are construction "good-practices" which will not be priced separately. Instead, they will be included in the rates charged for different construction activities.

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GLOSSARY

WORD	MEANING
Central Sewerage System	A collection system which transports sewage from individual households to a Wastewater Treatment Plant for treatment.
Certificate of Environmental Clearance	An environmental permit issued by the Environmental Management Authority to allow the implementation of projects which involve one or several Designated Activities.
Chlorine Contact Chamber	That part of a water or wastewater treatment plant where effluent is disinfected by chlorine, normally at the end of the treatment process.
Complete Mixing Aeration	An aerobic Wastewater Treatment Process where there are uniform characteristics throughout the reactor.
Designated Activities	A number of activities defined by the Environmental Management Authority for which a Certificate of Environmental Clearance (CEC) must be obtained prior to project implementation.
El Niño / Southern Oscillation	A coupled variation in climate between a recurrent pattern of positive sea-surface temperature anomalies in the Equatorial Pacific (*El Niño*) and the associated global pattern in sea-level pressure (*Southern Oscillation*).
Extended Aeration	An adaptation of the activated sludge wastewater treatment process which us characterized by low organic loading and long aeration time.
Force Main	A sewer where sewage flows under pressure (as opposed to flow under gravity in normal sewers).
Headworks	The front end of a wastewater treatment plant where sewage is received.
Infrastructure	The basic facilities, services, and installations needed for the functioning of a community or society, including water supply and wastewater collection and treatment.
Sewage Lift Station	A pump station which transfers sewage under pressure to a force main (pressure sewer).
Personal Protective Equipment	Specialized clothing or equipment worn by employees for protection against health and safety hazards.
Septage	The sludge produced in individual on-lot wastewater disposal systems, principally septic tanks and cesspits.
Tropical Cyclone	The general term for non-frontal storms that form over warm tropical oceans. In the Atlantic Basin, Tropical Cyclones that sustain wind speeds of 119km/hr or more for at least 1 minute are termed Hurricanes according to the revised Saffir-Simpson Hurricane Wind Scale.
Unconfined Aquifer	an aquifer in which the water table is open to the atmosphere through permeable overlying material.
Wet Well	A chamber which is used for collecting liquid, and to which the suction pipe of a pump is attached.

ACRONYMS

ACRONYM	MEANING
BOD_5	5-day Biological Oxygen Demand
COD	Chemical Oxygen Demand
COPE	Council of Presidents of the Environment
CSO	Central Statistical Office
CT	Constant Transfer
dB	Decibel
dBA	Decibel (A-weighted)
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
EMA	Environmental Management Authority
ENSO	El Niño / Southern Oscillation
ERCD	WASA's Environmental and Regulatory Compliance Department
EPRP	Emergency Prevention and Response Plan
ESA	Environmental and Social Assessment
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organisation
GCM	General Circulation Model
HEM	Hexane Extractable Material
IADB	Inter-American Development Bank
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate and Society
NH_3-N	Ammoniacal Nitrogen
OSHA	Occupational Health and Safety Agency
PPE	Personal Protective Equipment
ROW	Right of Way
RTMP	Road Traffic Management Plan
T&TEC	Trinidad & Tobago Electricity Commission
TCPD	Town and Country Planning Division
TO&G	Total Oil and Grease
TSS	Total Suspended Solids
TSTT	Telecommunication Service of Trinidad &Tobago
TTMS	Trinidad & Tobago Meteorological Services
UNDP	United Nations Development Program
WASA	Water and Sewerage Authority
WRA	Water Resources Agency
WWTP	Waste Water Treatment Plant

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August 02, 2011

1 INTRODUCTION

1.1 Context and Layout of Report

The Inter-American Development Bank (IADB) is preparing a Wastewater Infrastructure Rehabilitation Program (TT-L1018) for Trinidad & Tobago. The general objective of the proposed program is to improve the environmental conditions in Trinidad & Tobago, by decreasing the uncontrolled discharge of untreated wastewater into the environment. The specific objective is to improve the existing wastewater management services in priority areas, through:

(i) the takeover, refurbishment, upgrade and eventual integration, or decommissioning, of malfunctioning wastewater treatment facilities in T&T, and

(ii) the strengthening of WASA operational and maintenance performance.

This consultancy to prepare an Environmental and Social Analysis (ESA) and an Environmental and Social Management Plan (ESMP) for this Program was undertaken in compliance with a letter-agreement dated June 03, 2011, between the Inter-American Development Bank (IADB) and Dr. George Krishna Sammy. This report is specific to the proposed works in the Maloney Sewerage Region, but also serves as a model for the proposed works in the Couva Sewerage Region. This report is specific to the proposed works in the Maloney Sewerage Region, but also serves as a model for the proposed works in the Couva Sewerage Region

This report consists of nine chapters and two appendices. The remainder of this introductory chapter provides the background to this assignment, discusses the Multiple-Works Approach and the ranking of interventions, and indicates the scope of the study and its objectives. Chapter 2 describes the proposed works to be taken in the Maloney Sewerage Region, and Chapter 3 lists laws, regulations and policies that would govern these works.

Chapter 4 describes the project setting, including the physical, biological and human environments. Chapter 5 identifies potential impacts of this project, listing benefits as well as adverse impacts. This chapter also includes a classification of the project under the IADB system, discusses the expected effects of climate change on the predicted impacts, and identifies natural hazards and liability issues. Chapter 6 provides information on mitigation of adverse impacts, monitoring and management plans for the environmental aspects of this project.

Chapter 7 discusses public participation that was undertaken as part of an earlier EIA for this project, and recommends additional public and stakeholder involvement in the project. Chapter 8 is a discussion of WASA's capability to undertake certain aspects of the environmental requirements for this project and a listing of Contract Requirements. Finally, Chapter 9 provides cost estimates.

1.2 Background

Central municipal wastewater collection and treatment in Trinidad & Tobago was introduced in 1962, in the City of Port of Spain and the Boroughs of San Fernando and Arima. Since then, the wastewater collection and treatment infrastructure has expanded to approximately 560 km of pipeline and 243 wastewater facilities both in Trinidad and in Tobago. However, it is estimated that only 30% of Trinidad & Tobago's population is presently serviced by wastewater systems, with the remaining 70% being serviced by septic tanks and pit latrines.

Over the last five decades, population growth and housing developments have not been matched with adequate expansion of central sewerage systems. As a result, the Water and Sewerage Authority (WASA), on behalf of the Government of Trinidad & Tobago, instituted a policy that each new housing development larger than 40 houses would require sewerage and a wastewater treatment plant (WWTP). The intent was to allow WASA sufficient time to expand its central sewerage systems to accommodate these developments, after which the treatment plants at individual developments would be decommissioned. As a result, the WWTPs built for individual developments were package-type plants.

To date WASA's central sewerage systems have not been expanded as anticipated, and the package-type plants, approximately 200 in total, have not been closed or integrated into a centralized wastewater management system. The majority of these plants, most located in Trinidad, have since malfunctioned or have been abandoned. Effluents from these facilities (consisting of poorly treated or untreated sewage) are often discharged into water courses (some of which are upstream of water intakes), posing health and environmental risks and increasing the costs of potable water treatment. The disposal of untreated sewage into rivers and coastal waters also has the potential to impact the quality of aquatic life and / or to pose an economic threat to the tourism sector.

In 2004, WASA was mandated by the Cabinet of the Government of Trinidad & Tobago to assume responsibility for all WWTPs and to integrate them into WASA's existing wastewater system. This IADB program will assist WASA in carrying out that mandate for a limited number of WWTPs.

1.3 Multiple-Works Approach

This project will follow a multiple-works approach, which can be used when the interventions within a program are similar in nature, but independent from one another. Using this approach, a representative sample of the interventions is identified (in this case, the works in the Maloney Sewerage Region – see Section 2.3, below) and future interventions in other sewerage regions will be identified in due course based on specific criteria and specifications (see Section 1.4), including environmental and social criteria.

1.4 Ranking of Interventions

Trinidad & Tobago is divided into 30 sewerage regions; 25 in Trinidad and 5 in Tobago. These were ranked for priority interventions based on specific criteria agreed between WASA, the Ministry of Public Utilities (MPU) and the IADB.

The criteria used in this ranking were as follows:

- Whether WWTPs are located upstream of a water treatment plant (WTP) intake or in an area with groundwater reserves.
- Whether the area served is densely populated.
- Feasibility of integration of WWTPs into larger centralized systems.
- Whether WWTPs are upstream of areas where river water is used for irrigation.
- Geotechnical considerations.
- Economic criteria (cost of the intervention compared to the potential for user payments).
- Whether there are public beaches and/or recreational areas downstream of the WWTPs.
- Potential for expansion.
- Whether raw sewage is overflowing onto footpaths and roadways.
- Legal Status of WWTPs and ease of takeover by WASA.
- Social acceptability (odours, noises, truck movement, etc).
- Sustainability of interventions (would improved plants be required after integration / regionalization?).

- Sludge handling capacity (current and future).

- Reduction of base river flows (i.e., minimum ecological flow).

In addition to the ranking of interventions, a Project Risk Management Workshop was held in May, 2011. This included representatives of a number of organizations, such as WASA, the IADB, the Regulated Industries Commission (RIC), the Environmental Management Authority (EMA) and the Ministry of Public Utilities (MPU).

1.5 Scope of Study

The highest-ranked sewerage regions selected for possible inclusion in this program were Maloney, Couva and San Fernando. This report is specific to the Maloney Sewerage Region situated in North Trinidad (see Figure 1-1). There are eight WWTPs included in this project: Maloney, Bregon Park, Lynton Gardens, Lillian Heights, La Florissante, Santa Monica Gardens, La Resource and Timberland.

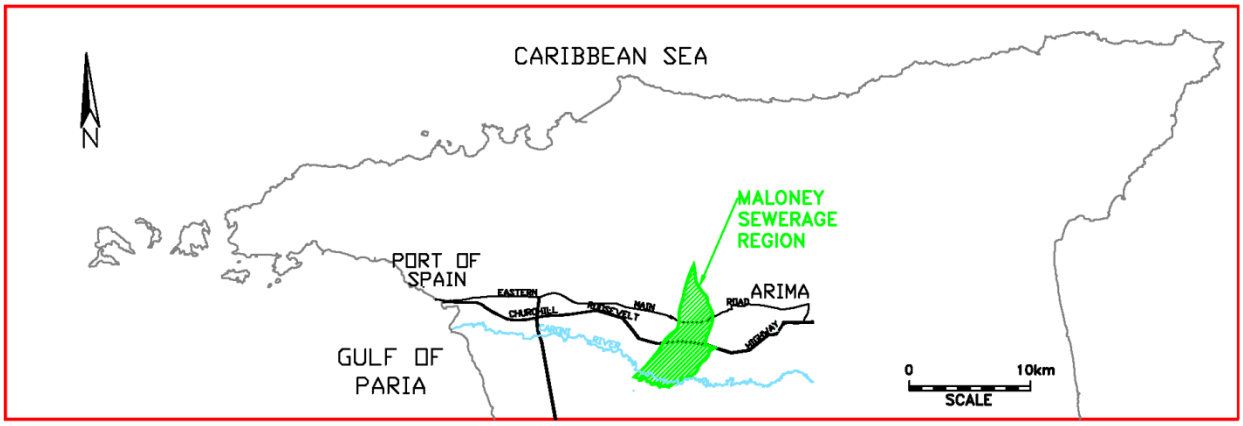

FIGURE 1-1: LOCATION OF THE MALONEY SEWERAGE REGION

1.6 Objectives of the ESA

Objectives of this Environmental and Social Analysis include:

- Assess environmental and social potential impacts, risks, and mitigation requirements.
- Assess compliance with applicable IADB Bank environmental and social policies.
- Assess compliance with the applicable environmental, social, health & safety, and labour legal requirements in Trinidad & Tobago.
- Prepare an Outline Environmental and Social Management Plan (ESMP).
- Assess WASA's capacity to mitigate and monitor environmental, social, health & safety and labour aspects.
- Assist WASA in disclosure and public consultation activities and propose future disclosure and public consultation actions.
- Assess potential issues of liabilities due to past contamination.

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2 PROJECT DESCRIPTION

This chapter describes proposed interventions in the Maloney Sewerage Region (see Figure 1-1) under IDB Loan TT-L1018. In addition to the Maloney WWTP, the Maloney Sewerage Region includes seven smaller sewerage systems (see Figure 2-1):

- Bregon Park,
- Lynton Gardens,
- Lillian Heights,
- La Florissante,
- Santa Monica Gardens,
- La Resource, and
- Timberland.

This chapter begins by describing the present condition of the Maloney WWTP and the Orphan WWTPs, describes the proposed interventions, and finally provides a conceptual schedule.

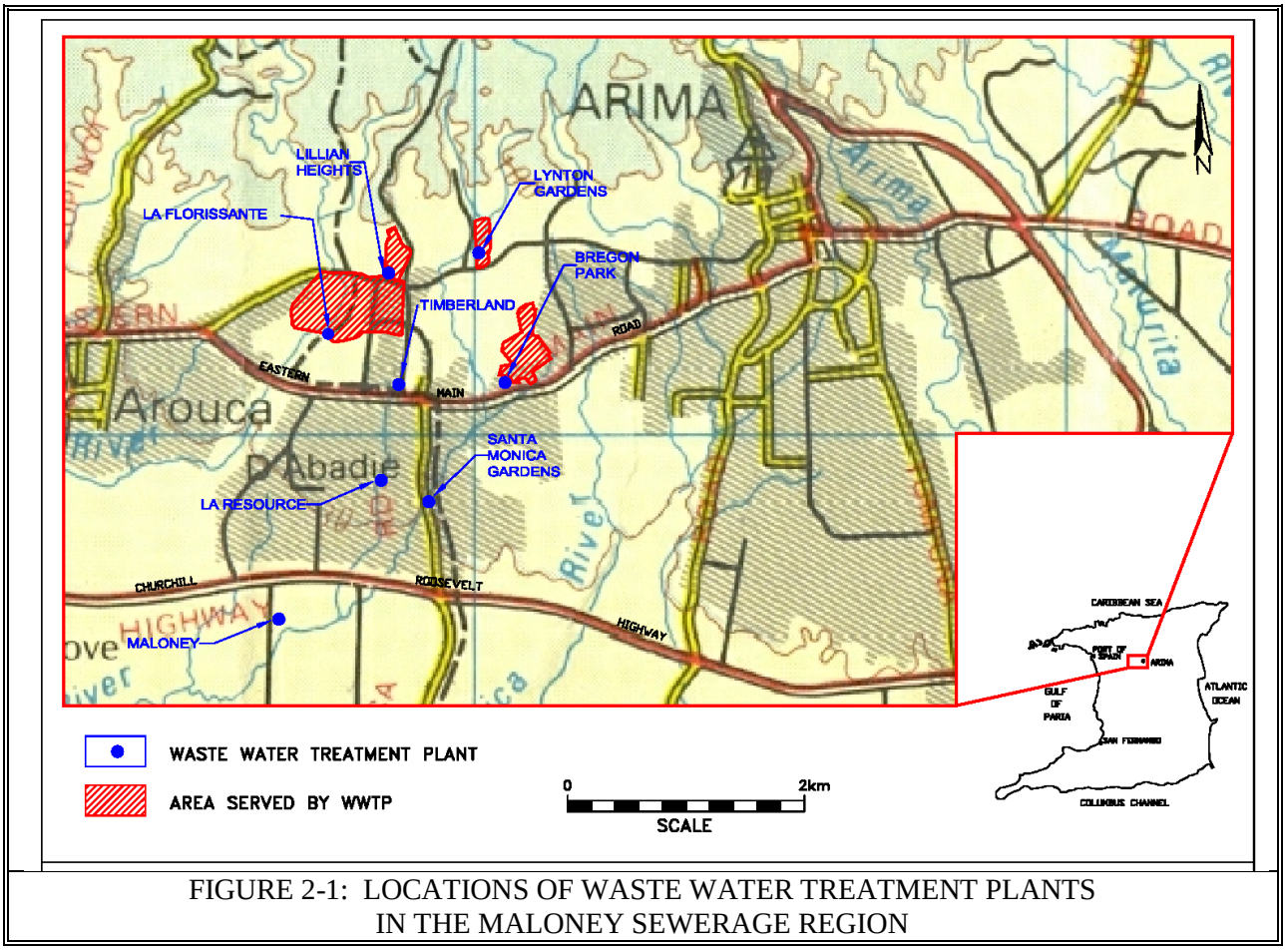

FIGURE 2-1: LOCATIONS OF WASTE WATER TREATMENT PLANTS IN THE MALONEY SEWERAGE REGION

2.1 Maloney WWTP

2.1.1 Process Trains

The existing Maloney WWTP includes two extended aeration treatment trains, shown in Photographs 2-1 and 2-1. During a site visit on August 4, 2011, WASA staff indicated that the original treatment train was inoperable.

PHOTOGRAPH 2-1: ORIGINAL TREATMENT TRAIN AT THE MALONEY WWTP (2007) (SOURCE: GENIVAR CONDITION ASSESSMENT REPORT)

PHOTOGRAPH 2-2: NEW TREATMENT TRAIN AT THE MALONEY WWTP (2007) (SOURCE: GENIVAR CONDITION ASSESSMENT REPORT)

2.1.2 Effluent Quality

Samples of the effluent from the existing Maloney WWTP were sampled on August 5, 8 and 11, 2011, and the average results are shown in Table 2-1, along with the permitted levels of the respective parameters in the Water Pollution Rules (see Section 3.2.3). This effluent is non-compliant with the permitted levels for Dissolved Oxygen and Faecal Coliforms.

TABLE 2-1: MEASURED EFFLUENT QUALITY FROM EXISTING MALONEY WWTP

PARAMETER	AVERAGE QUALITY OF EFFLUENT FROM MALONEY WWTP	PERMITTED LEVELS UNDER THE WATER POLLUTION RULES
pH	7.2 to 7.4	between 6 and 9
Dissolved Oxygen (DO)	2 mg/L	more than 4 mg/L
Biological Oxygen Demand (BOD_5)	19.7 mg/L	less than 30 mg/L
Chemical Oxygen Demand (COD)	39 mg/L	less than 250 mg/L
Total Suspended Solids (TSS)	34 mg/L	less than 50 mg/L
Faecal Coliforms	310,000 cfu/100 ml	less than 400 cfu/100 ml

2.2 Present Condition of Orphan WWTPs

The descriptions in this section are a combination of information from the 2007 Genivar Condition Assessment Report (Wastewater) for the North Central Zone and field observations on July 01, 2011 and July 14, 2011. The Genivar Condition Assessment was undertaken as part of their assignment for the Development of a Water & Wastewater Master Plan & Policy for Trinidad & Tobago. In summary, the seven smaller WWTPs have been abandoned and are non-functional as at July 14, 2011.

2.2.1 Bregon Park

According to the Genivar Condition Assessment Report, the Bregon Park WWTP is a privately owned package-type complete mixing aeration plant. It was originally built to serve 94 lots in the surrounding development. In 2007, it appeared that plant had been abandoned for many years; with only a square concrete tank with a concrete surface aerator bridge remaining on site. The tank was in very poor condition showing erosion, cracks, and an overgrowth of vegetation (see Photograph 2-3). By 2011, the situation had deteriorated further, with even more vegetation overgrowing the concrete structure (see Photographs 2-4 and 2-5).

PHOTOGRAPH 2-3: CONCRETE WWTP AT BREGON PARK (2007)
(SOURCE: GENIVAR CONDITION ASSESSMENT REPORT)

PHOTOGRAPH 2-4: OVERGROWN WWTP AT BREGON PARK (2011)

PHOTOGRAPH 2-5: OVERGROWN WWTP AT BREGON PARK (2011)

2.2.2 Lynton Gardens

According to the Genivar Condition Assessment Report, the Lynton Gardens WWTP is a privately owned package-type extended aeration plant, which was built to serve 58 lots in the surrounding development. In 2007, it appeared that this plant had been abandoned for some time. As a result, domestic sewage was overflowing into an onsite stormwater drainage ditch. There were two circular concrete tanks, each of which accommodated a donut aeration chamber and a centre radial flow clarifier with a platform and handrails. The concrete tanks were in poor condition, showing erosion with cracks and an overgrowth of vegetation. The chlorine contact chamber and sludge drying bed were both overgrown with vegetation, but the control building still appeared to be in fair condition. By 2011, all components of the plant, including the control building appeared to be in a state of disrepair (see Photograph 2-6).

PHOTOGRAPH 2-6: CONCRETE WWTP AT LYNTON GARDENS (2011)

2.2.3 Lillian Heights

According to the Genivar Condition Assessment Report, the Lillian Heights WWTP is a privately owned extended aeration package-type plant, built to service the Nello Suite Development. In 2007, it appeared that this plant had been abandoned for some time. There was one abandoned circular metal tank in bad condition (metal panels showing obvious signs of corrosion) (see Photograph 2-7) and an abandoned control building with broken vent blocks and concrete block walls, and with no door. By 2011, the situation had considerably worsened, with the entire tank engulfed in vines and other vegetation (see Photograph 2-8).

PHOTOGRAPH 2-7: ABANDONED WWTP AT LILLIAN HEIGHTS (2007)
(SOURCE: GENIVAR CONDITION ASSESSMENT REPORT)

PHOTOGRAPH 2-8: OVERGROWN WWTP AT LILLIAN HEIGHTS (2011)

2.2.4 La Florissante

The sewerage system at La Florissante is more complex than the other three systems, since it includes two sewage lift stations (see Photographs 2-9 and 2-10). Neither of these lift stations is operable, thus sewage entering the wet wells overflows into adjacent surface drains.

PHOTOGRAPH 2-9: ABANDONED SEWAGE LIFT STATION (EAST OF RIVER) AT LA FLORISSANTE (2011)

PHOTOGRAPH 2-10: ABANDONED SEWAGE LIFT STATION (WEST OF RIVER) AT LA FLORISSANTE (2011)

According to the Genivar Condition Assessment Report, the La Florissante WWTP is a privately owned package-type Constant Transfer (CT) extended aeration system which was constructed in 1981 to serve the La Florissante development area. In 2007, it appeared that this plant had been

abandoned some time ago. This remains the same in 2011 (see Photograph 2-11) and in addition, field observations revealed the presence of overflowing raw sewage on the compound.

PHOTOGRAPH 2-11: ABANDONED STEEL TANK WWTP AT LA FLORISSANTE (2011)

2.2.5 Santa Monica

According to the Genivar Condition Assessment Report, the Santa Monica Gardens WWTP is a privately owned package-type extended aeration system which was built to serve 135 lots. In 2007, it appeared that this plant had been abandoned for some time and the influent domestic sewage was overflowing to a tributary of the Oropuna River directly from inlet manhole. There was one rectangular concrete tank in poor condition showing erosion, cracks, and an overgrowth of vegetation. The situation was essentially the same in 2011 (see Photographs 2-12 and 2-13). As a result, WASA is in the process of building a new sewage lift station to pump the inflowing domestic sewage to the Maloney WWTP.

PHOTOGRAPH 2-10: VEGETATION IN THE SANTA MONICA WWTP (2012)

PHOTOGRAPH 2-11: VEGETATION IN THE SANTA MONICA WWTP (2013)

2.2.6 La Resource

According to the Genivar Condition Assessment Report, the La Resource WWTP is a privately owned package-type Constant Transfer (CT) extended aeration system which was built to serve 150 lots. In 2007, it appeared that this plant had recently been abandoned, and the influent domestic sewage was overflowing into a tributary of the Oropuna River. There was one rectangular concrete tank in fair condition with some erosion and cracks. By 2011 WASA had diverted flow from the lift station to the Maloney WWTP and the tank was overgrown with duckweed and shrubs (see Photograph 2-14).

PHOTOGRAPH 2-14: WWTP AT LA RESOURCE (2011)

2.2.7 Timberland

This WWTP was not included in the Genivar Condition Assessment Report. It The Timberland WWTP consists of a rectangular concrete tank, built to serve the adjacent development (much of which still remains as undeveloped lots). In 2011, the plant appeared to be abandoned and there was domestic sewage overflowing from the last manhole of the sewerage system onto the roadway (see Photograph 2-15).

PHOTOGRAPH 2-15: TIMBERLAND WWTP (2011)

2.3 Proposed Changes

The proposed changes to the sewerage systems in the Maloney Sewerage Region upstream of the Maloney WWTP are described below. This section begins with a discussion of the rehabilitation and expansion of the Maloney WWTP, and then describes other proposed works.

2.3.1 Maloney WWTP

The Maloney WWTP will be rehabilitated and expanded to accommodate the flows originally treated by the seven smaller WWTPs, as well as provision for future growth. The upgraded Maloney WWTP will utilize some of the structures at the existing Maloney Gardens WWTP, and expand upon these.

The proposed rehabilitation and expansion works are as follows:

- Three new raw sewerage pumps,
- One new wet well,
- One new mechanical fine screen,
- Two new vortex grit chambers,
- Two new aeration tanks with nitrification,
- Two new secondary clarifiers,
- Retrofitting existing aeration tanks to sludge digestion tanks,
- Three new blowers (2 for aeration tanks and 1 for sludge digestion),
- One new sludge thickening system,
- One new Motor Control Centre,
- One new Ultra-Violet disinfection system,
- One new standby generator,
- Four new sludge drying beds,
- Extension of existing access roads to the headworks, sludge drying beds and secondary treatment,
- Rehabilitation of existing buildings, and
- Provision for a plant-wide flushing water system.

According to the EIA for the upgrade and expansion of this WWTP, the design effluent criteria are as shown in Table 2-2.

TABLE 2-2: DESIGN EFFLUENT CRITERIA FOR MALONEY WWTP

WATER POLLUTANT (Parameter or Substance)	PERMITTED LEVEL FOR DISCHARGE INTO INLAND SURFACE WATER
pH	between 6 and 9
Dissolved Oxygen (DO)	more than 4 mg/L
Biological Oxygen Demand (BOD_5)	less than 20 mg/L
Chemical Oxygen Demand (COD)	less than 250 mg/L
Total Suspended Solids (TSS)	less than 20 mg/L
Ammoniacal Nitrogen (as NH_3-N)	less than 10 mg/L
Total Nitrogen (N)	less than 10 mg/L
Total Phosphorus (P)	less than 5 mg/L
Total Residual Chlorine	less than 1 mg/L
Total Oil & Grease (TO&G), or n-Hexane Extractable Material (HEM)	less than 10 mg/L
Faecal Coliforms	less than 100 cfu/100 ml

2.3.2 Other Proposed Works

In addition to the works at the Maloney WWTP, the following additional works are proposed:

- The Bregon Park, Lynton Gardens, Lillian Heights, La Florissante and Timberland WWTPs will be decommissioned and converted to sewage lift stations.
- A new system of sewer mains will be constructed to convey waste water from these plants to the Maloney WWTP (see Figure 2-2).
- Flow from the existing lift stations at Santa Monica and La Resource will also be routed into the new sewer mains.

To effect the changes listed above, the following additional work items will be necessary:

- Removal and disposal of faecal matter from tanks and wet wells at all WWTPs,
- Removal, treatment and proper disposal of overflowed faecal matter,
- Sanitizing, demolishing and disposal of concrete,
- Sanitizing, dismantling and disposal of steel, and
- Demolishing and disposal of pump houses and control panels.

2.4 Conceptual Schedule

The IADB has indicated that the implementation of this project will extend over 5 years. Based on this, a conceptual schedule is shown in the following bar chart:

PHASE OF PROJECT	2012				2013				2014				2015				2016			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Design of Works and Regulatory Approvals																				
Tendering and Construction																				
Commissioning and Initial Operation																				

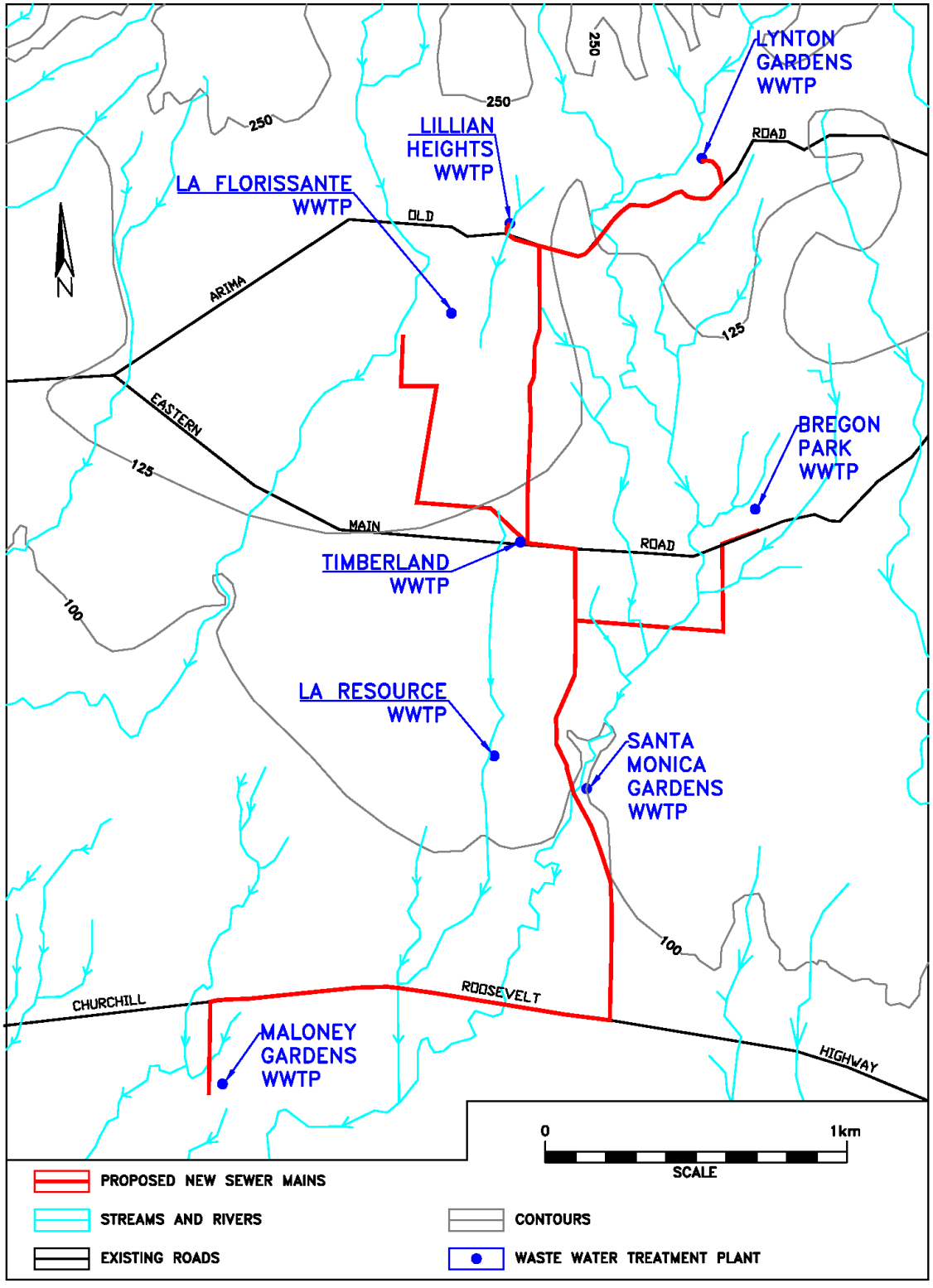

FIGURE 2-2: PROPOSED NEW SEWER MAINS

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3 INSTITUTIONAL AND LEGAL FRAMEWORK

Three agencies will have jurisdiction over the interventions described in Chapter 2:

- The Water and Sewerage Authority,
- The Environmental Management Authority and
- The Inter-American Development Bank.

This chapter provides information on regulations of these three organizations which relate to this project. The final section discusses an international protocol to which Trinidad & Tobago is signatory.

3.1 The Water and Sewerage Authority (WASA)

This section discusses the Water and Sewerage Act and the Approval of Wastewater Treatment Plants.

3.1.1 Water and Sewerage Act, 1965

The enabling legislation of WASA is the Water and Sewerage Act which was first enacted in 1965 and subsequently amended. Part IV of the Act is specific to sewerage, and the following clauses are relevant to this program:

- Under Clause 62(b), WASA is responsible for constructing and developing sewerage works as it considers necessary and expedient. Clause 64 amplifies the powers of the Authority regarding the construction and development of sewerage works, and it is empowered to hire contractors to undertake such works.
- Under Clause 66(i), WASA may instruct that households be connected to the sewerage system, provided such houses have a water connection and are within 150 feet of the sewer.

3.1.2 Approval of WWTPs

WASA's general procedure for the approval of wastewater treatment may be summarized as follows:

1. The Developer applies for approval of a building development, and submits to WASA copies of the Town and Country Planning Division's outline approval, location / site map, topographical map, cadastral survey showing layout of lots, and drawing showing proposed infrastructure in relation to existing infrastructure.

2. WASA does a wastewater feasibility investigation, where three options are considered: on-lot system (septic tank and soak away), integration into existing system, or stand alone package WWTP.

3. If a WWTP is required, the Applicant submits designs of both the plant and the proposed sewage collection system. WASA evaluates these designs, and if satisfactory final approval is granted.

4. The Applicant begins construction of the WWTP and WASA inspects work done during each construction phase (as per construction schedule) to ensure compliance with designs and approval granted.

5. On satisfactory completion of the WWTP, the Applicant is granted a completion certificate.

For the upgraded and expanded WWTP at Maloney, the approval process from Items 3 to 5 (above) must be followed. This is particularly important in this case since WASA will ultimately be the owner and operator of the upgraded and expanded Maloney WWTP. As such, their review of the designs would extend beyond the normal process considerations to items of maintenance and operability.

3.2 Environmental Management Authority (EMA)

The enabling legislation for the EMA is the Environmental Management Act, 2000. The first sub-section hereunder summarizes pertinent aspects of the Act relative to the functions of the EMA. The remaining three sub-sections address four pieces of subsidiary legislation which are relevant to this program:

< The Certificate of Environmental Clearance Rules,

< The Water Pollution Rules,

< The Noise Pollution Rules, and

< The draft Air Pollution Rules.

3.2.1 The Environmental Management Act

The Environmental Management Act empowers the EMA to undertake the following:

< Develop and establish national environmental standards and criteria {Clause 16(f)},

- Monitor compliance with the standards, criteria and programmes relating to the environment {Clause 16(g)}, and

- Take all appropriate action for the prevention and control of pollution and conservation of the environment {Clause 16(h)}.

Under Clause 26, the Minister with responsibility for the Environment may make Rules, subject to negative resolution of Parliament. Under Clause 27, drafts of the rules must be submitted for public comment. The rules to be discussed in the following sub-sections were made in conformity to these clauses.

3.2.2 Certificate of Environmental Clearance Rules

This section discusses the requirement for a CEC for this project, the CEC process, the CEC which has already been obtained, and the need for an additional CEC for certain aspects of this project.

3.2.2.1 CEC Requirement and Process

Under the Certificate of Environmental Clearance (CEC) Rules 2001, a CEC is required if a development activity or project includes one or several of the Designated Activities listed in the Certificate of Environmental Clearance (Designated Activities) Order, 2001. The works proposed in the Maloney Sewerage Region include two Designated Activities:

40	**Establishment of water distribution systems**	(a) The establishment, modification, expansion, decommissioning or abandonment (inclusive of associated works) of pipeline distribution systems for the delivery of potable, process water or sewage.
		(b) The laying of water and sewage mains (inclusive of associated works) along an existing or a new right of way for distances of more than 1 kilometre during a two-year period.
42	**Establishment of waste water or sewage treatment facilities**	The establishment, modification, expansion, decommissioning or abandonment (inclusive of associated works) of a waste water or sewage treatment facility.

Based on this, the works proposed in the Maloney Sewerage Region are subject to the CEC Rules.

3.2.2.2 CEC Process

The CEC process as described in the Certificate of Environmental Clearance Rules, 2001, may be summarized as follows:

i WASA submits an application for a CEC on the prescribed form to the EMA.

ii Within 10 working days, the EMA Acknowledges receipt of the Application, and indicates whether:
(a) the development does not require a CEC; or
(b) additional information is needed to complete the Application; or
(c) the development requires a CEC, but an Environmental Impact Assessment (EIA) is not required; or
(d) an EIA is required in support of the CEC Application.

Under Item (b), the EMA will issue its determination within 30 working days of receiving the requested additional information.

Under Item (c), the EMA will issue its determination of the CEC Application within 30 working days.

Under Item (d), the EMA will request an EIA if, in their view, there could be significant environmental impacts arising from the proposed activity.

iii If an EIA is required, the EMA will prepare draft Terms of Reference (TOR) for the EIA and submit these to the developer within 21 working days.

iv Within 28 days of receiving the draft TOR, WASA (and / or its consultant) has a responsibility to consult with interested stakeholders on the draft TOR, and may request amendments arising from these consultations. The EMA will consider the request for amendments, and will issue final TOR within 10 working days.

v WASA commissions the EIA, and submits the report to the EMA upon completion. The EMA will issue its determination of the CEC Application within 80 working days of receiving the EIA. This includes a 30-day period for public comment.

The decision on whether an EIA is required for any particular development is at the sole discretion of the EMA. However, based on experience on earlier projects, it is considered likely that an EIA will be required for the proposed works in the Maloney Sewerage Region.

3.2.2.3 Existing CEC

An application for a Certificate of Environmental Clearance (CEC) for upgrades and expansion in the Maloney and Malabar Sewerage Regions was submitted to the Environmental Management Authority (EMA) in April 2006, in accordance with the CEC Rules 2001. The EMA determined that the application required an Environmental Impact Assessment (EIA), and Final Terms of Reference (TOR) dated August 03, 2006 were issued.
Rapid Environmental Assessments (2003) Limited prepared an EIA (REAL, 2009) in conformity with the Final TOR, and that was submitted to the EMA. The scope of that EIA included upgrade and expansion of the Maloney WWTP, installation of sewer mains, and replacement of the La Florissante, La Resource, Lillian Heights, Lynton Gardens and Santa Monica WWTPs with sewage lift stations. Following a review of the EIA by the EMA and the provision of additional information as requested by the EMA, CEC 1469/2006 was issued on August 05,

2010. This CEC becomes invalid if the activity is not commenced within 3 years of the date of issue.

CEC 1469/2006 must be attached to the Contracts of the Design Engineer, the Supervising Engineer and the Contractor, with a stipulation that all relevant clauses must be complied with. In addition, the Contract of the Contractor should stipulate that the Contractor is required to prepare the Road Traffic Management Plan and the Emergency Prevention and Response Plan for the project (see Section 6.4).

3.2.2.4 Additional CEC

Clause i (b) of CEC 1469/2006 states that the CEC only validates activities included in the scope of work submitted with the CEC Application. As noted in Section 3.2.2.3, above, that scope of work did not include the replacement of the Bregon Park and Timberland WWTPs with sewage lift stations. On several occasions in the recent past (for example, CEC 2481/2008), the EMA has requested a separate CEC Application in order to approve additional work on project that already has a CEC. Based on this, it is expected that WASA will be required to submit a separate CEC Application for the replacement of the Bregon Park and Timberland WWTPs with sewage lift stations.

Even though the decision on whether an EIA is required for any particular development is at the sole discretion of the EMA, it is not expected that an EIA will be requested for the additional CEC. The type of work envisaged at the Bregon Park and Timberland WWTPs is essentially the same as approved for the La Florissante, La Resource, Lillian Heights, Lynton Gardens and Santa Monica WWTPs. The environmental concerns associated with this work were identified in the EIA for the Maloney and Malabar WWTPs, and mitigation measures listed. There should therefore be no need to repeat that analysis in the form of a new EIA.

3.2.3 Water Pollution Rules

The Water Pollution Rules 2001 (amended 2006) are now in force in Trinidad & Tobago, and sewerage facilities are specifically listed as Registrable Facilities under these rules. As a result, the upgraded and expanded WWTP at Maloney must be designed to conform to those Rules.

Schedule 1 of these Rules is a Register of Water Pollutants. In this Register, a number of substances / parameters are defined as pollutants if they exceed the stated limits. A number of recent CECs list the substances / parameters which are relevant to WWTPs, and the concentration at which each of these is considered a pollutant is listed in Table 3-1. The design effluent criteria for the upgraded and expanded Maloney WWTP are also shown in this table.

TABLE 3-1: DEFINITION OF POLLUTANTS FROM A WWTP

WATER POLLUTANT (Parameter or Substance)	CONCENTRATION AT WHICH SUBSTANCE IS DEFINED AS A POLLUTANT	DESIGN EFFLUENT CRITERIA FOR MALONEY WWTP
pH	less than 6 or more than 9	between 6 and 9
Dissolved Oxygen (DO)	less than 4 mg/L	more than 4 mg/L
Biological Oxygen Demand (BOD_5)	more than 10 mg/L	less than 20 mg/L
Chemical Oxygen Demand (COD)	more than 60 mg/L	less than 250 mg/L
Total Suspended Solids (TSS)	more than 15 mg/L	less than 20 mg/L
Ammoniacal Nitrogen (as NH_3-N)	more than 0.01 mg/L	less than 10 mg/L
Total Phosphorus (P)	more than 0.1 mg/L	less than 5 mg/L
Total Oil & Grease (TO&G), or n-Hexane Extractable Material (HEM)	more than 10 mg/L	less than 10 mg/L
Faecal Coliforms	more than 100 cfu/100 ml	less than 100 cfu/100 ml

Under Clause 4(1) of these Rules, a person or organization who intends to release from a registrable facility a water pollutant that is likely to cause harm to human health or the environment is required to submit a Source Application at least 45 working days before the intended release. After reviewing the information submitted with the Source Application, the EMA will issue a Registration Certificate if it determines that the Applicant is releasing a Water Pollutant.

CEC 1469/2006 (see Section 3.2.2.3) requires that WASA should submit a Source Application (an application to register a facility as a source of the release of a water pollutant) at least 45 days prior to the release to the environment. This requirement conforms to the requirements of the Water Pollution Rules, since 5-day Biological Oxygen Demand, Chemical Oxygen Demand, Total Suspended Solids, Ammoniacal Nitrogen and Total Phosphorus will all be defined as pollutants in the concentrations shown in the design effluent criteria (see Table 3-1). However,

this application for Source Registration will be made on the basis of the Design Effluent Criteria, since actual test results for the effluent will not be available 45 days prior to the start of release of effluent.

In addition to the concentrations which define pollution, the Rules also set Permitted Levels for discharges, based on the receiving water body. For the upgraded and expanded WWTP at Maloney, the receiving water bodies are inland surface waters, so the permitted limits would be as listed in Table 3-2.

TABLE 3-2: PERMITTED LEVELS FOR DISCHARGES FROM A WWTP

PARAMETER	PERMITTED LEVELS UNDER THE WATER POLLUTION RULES	DESIGN EFFLUENT CRITERIA FOR MALONY WWTP
pH	between 6 and 9	between 6 and 9
Dissolved Oxygen (DO)	more than 4 mg/L	more than 4 mg/L
Biological Oxygen Demand (BOD_5)	less than 30 mg/L	less than 20 mg/L
Chemical Oxygen Demand (COD)	less than 250 mg/L	less than 250 mg/L
Total Suspended Solids (TSS)	less than 50 mg/L	less than 20 mg/L
Ammoniacal Nitrogen (as NH_3-N)	less than 10 mg/L	less than 10 mg/L
Total Phosphorus (P)	less than 5 mg/L	less than 5 mg/L
Total Oil & Grease (TO&G), or n-Hexane Extractable Material (HEM)	less than 10 mg/L	less than 10 mg/L
Faecal Coliforms	less than 400 cfu/100 ml	less than 100 cfu/100 ml

Under Clause 8(1) of the Rules, if a person or organization releases a water pollutant into the environment that is in excess of the Permitted Level, and is likely to cause harm to human health and the environment, the EMA may, at any time, notify that person to apply for a Permit. This will not be necessary for the upgraded and expanded Maloney WWTP, since the design effluent criteria for all parameters will conform to these permissible limits.

3.2.4 Noise Pollution Control Rules

The Noise Pollution Control Rules 2001 set limits to the level of noise that can be emitted from any facility in Trinidad & Tobago, depending on the type of area in which the facility is located, or which noise from the facility affects. The seven WWTPs to be replaced with sewage lift stations and the upgraded and expanded WWTP at Maloney are all situated in the General Area.

They must therefore be designed to conform to the following limits:

Daytime Limits - On Mondays to Sundays of every week from 8:00 am to 8:00 pm on each day –

(a) the sound pressure level when measured as equivalent continuous sound pressure level shall not be more than 5 dBA above the background sound pressure level; and

(b) the sound pressure level when measured as instantaneous unweighted peak sound pressure level shall not exceed 120 dB (peak).

Notwithstanding the above, no person shall emit or cause to be emitted any sound that causes the sound pressure level when measured as the equivalent continuous sound pressure level to exceed 80 dBA.

Night-time Limits - On Mondays to Sundays of every week from 8:00 pm to 8:00 am on each day –

(a) the sound pressure level when measured as equivalent continuous sound pressure level shall not be more than 5 dBA above the background sound pressure level; and

(b) the sound pressure level when measured as instantaneous unweighted peak sound pressure level shall not exceed 115 dB (peak).

Notwithstanding the above, no person shall emit or cause to be emitted any sound that causes the sound pressure level when measured as the equivalent continuous sound pressure level to exceed 65 dBA.

To determine compliance with these limits, it will be necessary to establish pre-existing baseline noise levels at each location before the start of operation of the upgraded and expanded WWTP at Maloney and the new sewage lift stations.

Clause 7(k) of the Rules exempts construction activity carried out between the hours of 7:00 am and 7:00 pm on the same day. However, work outside these hours (during the night) is subject to the limits described above. In addition, Clause 9(i) of the Rules specify that a person who proposes to conduct an activity or event which will cause sound in excess of the prescribed standards must apply for a Noise Variation. Therefore, if the contractor schedules work between the hours of 7:00 pm on one day and 7:00 am on the following day, he must apply for a Noise Variation under the Noise Pollution Control Rules. Again, it will be necessary to establish baseline noise levels for this application.

3.2.5 Draft Air Pollution Rules

The EMA has issued draft Air Pollution Rules (2008) for public comment, and it is possible that these will come into force before the upgraded and expanded WWTP at Maloney is

commissioned. It is therefore prudent to design this WWTP so that their emissions do not result in ambient air quality that exceeds the maximum permissible levels in Table 3-3.

TABLE 3-3: AMBIENT AIR QUALITY PERMISSIBLE LIMITS

COMPOUND / SUBSTANCE	SHORT-TERM MAXIMUM PERMISSIBLE LEVEL		LONG-TERM MAXIMUM PERMISSIBLE LEVEL	
	MAXIMUM PERMISSIBLE LEVEL	AVERAGING TIME	MAXIMUM PERMISSIBLE LEVEL	AVERAGING TIME
Total Suspended Particulates (TSP)	150 µg/m^3	24 hours	--	--
Carbon Monoxide (CO)	100,000 µg/m^3	15 minutes	--	--
	60,000 µg/m^3	30 minutes	--	--
	30,000 µg/m^3	1 hour	--	--
	10,000 µg/m^3	8 hours	--	--
Nitrogen Dioxide (NO_2)	200 µg/m^3	1 hour	40 µg/m^3	1 year
Sulphur Dioxide (SO_2)	500 µg/m^3	10 minutes	50 µg/m^3	1 year
	125 µg/m^3	24 hours	--	--
Ammonia (NH_3)	3,600 µg/m^3	30 minutes	---	---
Chlorine (Cl) and its Compounds	300 µg/m^3	30 minutes	---	---
Hydrogen Sulphide (H_2S)	30 µg/m^3	30 minutes	--	--

3.3 Inter-American Development Bank

Two operational policies of the Bank may be applicable to this project:

- Environmental and Safeguards Policy, and
- Involuntary Resettlement Policy.

3.3.1 Environmental and Safeguards Policy

This section describes the classification of projects under the IADB's Environmental and Safeguards Policy (dated January 19, 2006), and then summarizes relevant aspects of that Policy.

3.3.1.1 Classification of Projects

The Policy provides for the classification of projects into three categories:

Category A includes any operation that is likely to cause significant negative environmental and associated social impacts, or have profound implications affecting natural resources. These operations will require an environmental assessment (EA), Environmental Impact Assessment (EIA) or a Strategic Environmental Assessment (SEA). Category "A" operations are considered high safeguard risk.

Category B includes operations that are likely to cause mostly local and short-term negative environmental and associated social impacts and for which effective mitigation measures are readily available. These operations will normally require an environmental and/or social analysis and an environmental and social management plan (ESMP).

Category C includes operations that are likely to cause minimal or no negative environmental and associated social impacts. These operations do not require an environmental or social analysis beyond the screening and scoping analysis for determining the classification. However, where relevant, these operations will establish safeguard, or monitoring requirements.

The classification of this project will be addressed in Section 5.4.

3.3.1.2 Summary of Relevant Requirements

Table 3-4 lists aspects of the Policy that will apply to this project. As will be seen, all requirements are addressed in specific sections of this report.

TABLE 3-4: RELEVANT REQUIREMENTS OF THE IADB ENVIRONMENTAL AND SAFEGUARDS POLICY

CLAUSE IN IADB POLICY	REQUIREMENT	RELEVANCE TO THIS PROJECT
4.17	All Bank-financed operations will be screened and classified according to their potential environmental impacts.	As will be explained in Section 5.4, this project is classified Category B, requiring an ESA and ESMP. This document satisfies those requirements.
4.18	The Bank will identify and manage other risk factors that may affect the environmental sustainability of its operations.	Trinidad is subject to earthquakes and tropical cyclones, as will be discussed in Section 5.6.
4.19	The preparation of environmental assessments and associated management plans and their implementation are the responsibility of the Borrower.	As was explained in Section 3.2.2, above, an EIA has been prepared and a CEC received for the majority of this project. However, certain aspects were not included in that EIA and CEC.
4.20	Category "A": and "B" operations will require consultations with affected parties and consideration of their views.	As will be explained in Chapter 7, public consultation meetings were held as part of the EIA. Due to the time which has elapsed since those meetings, further consultation is recommended.
4.25	Bank-financed operations should avoid adverse impacts to the environment and human health and safety occurring from the production, procurement, use, and disposal of hazardous material.	Concerns related to faecally-contaminated materials will be discussed in Section 5.7.2.
4.28	Bank-financed operations will include as appropriate, measures to prevent, reduce or eliminate pollution emanating from their activities.	This project is aimed at pollution prevention by eliminating the discharge of untreated or poorly treated sewage. Other measures to reduce pollution will be discussed in Chapter 6.

3.3.2 Involuntary Resettlement Policy

If it is necessary to acquire land for any of the works under this project, the IADB's Operational Policy (OP-710), Involuntary Resettlement - Operational Policy and Background Paper will apply. According to this Operational Policy, operations which may require resettlement must be evaluated and prepared according to two fundamental principles:

1. Every effort must be made to avoid or minimize the need for involuntary resettlement. A thorough analysis of project alternatives must be carried out in order to identify solutions that are economically and technically feasible while eliminating or minimizing the need for involuntary resettlement. Particular attention must be given to socio-cultural considerations, such as any cultural or religious significance of the land.

2. When displacement is unavoidable, a resettlement plan must be prepared to ensure that the affected people receive fair and adequate compensation and rehabilitation.

3.4 Protocol concerning Pollution from Land-Based Sources

Under the Protocol concerning Pollution from Land-based Sources and Activities to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, Parties are required to take appropriate measures to prevent, reduce and control pollution of the Convention area from land-based sources and activities; using for this purpose the best practicable means at its disposal and in accordance with its capabilities.

The Protocol defines "Class II Waters" as waters that are less sensitive to the impacts of domestic wastewater and to which humans or living resources are not exposed. Since the effluent from the proposed Maloney WWTP will flow into a tributary of the Caroni River and will be subject to significant dilution before being discharged into the sea, the receiving water falls into this category.

Limits set on the quality of domestic wastewater that is discharged into Class II Waters are listed in Table 3-5, with limits from the Water Pollution Rules (see Section 3.2.3) also provided for comparison. It will be noted that all limits under the Water Pollution Rules are significantly more stringent than the limits for Class II Waters, so compliance with the Water Pollution Rules automatically achieves compliance with the Protocol.

TABLE 3-5: LIMITS ON QUALITY OF DOMESTIC WASTEWATER DISCHARGED INTO CLASS II WATERS

PARAMETER	LIMITS TO DISCHARGE INTO CLASS II WATERS	LIMITS TO DISCHARGE INTO INLAND SURFACE WATER IN THE WATER POLLUTION RULES
Total Suspended Solids (mg/L)	150	50
Biological Oxygen Demand (BOD_5)	150	30
pH	5 to 10	6 to 9
Fats, Oil and Grease (mg/L)	50	10
Floatables	not visible	n/a

4 PROJECT SETTING

This chapter describes the environmental setting of the eight WWTPs, under the following headings:

- The Physical Environment,
- The Biological Environment, and
- The Human Environment.

4.1 The Physical Environment

On this program, key aspects of the physical environment are:

- Climate,
- Topography,
- Groundwater,
- Streamflow, and
- Water Quality.

4.1.1 Climate

This sub-section provides a general description of the climate in Trinidad & Tobago, and more specific information on rainfall, and wind speed and direction.

4.1.1.1 General Description

Trinidad & Tobago experiences a tropical climate with two seasonal regimes per year: a dry season which extends from January to May, and a wet season which extends from June to November (Burton, 1999). The periods May / June and December / January are usually considered as the transitional periods between both seasons and may exhibit dry or wet season conditions or a combination of both. The specific characteristics exhibited in these months vary from year to year.

Every 2 to 4 years (Bigg, 2003), the globe is affected by the weather phenomenon referred to as the El Nino / Southern Oscillation (ENSO), and this also affects the Caribbean region generally and Trinidad & Tobago in particular. The ENSO phenomenon has two phases; positive (La Niña) and negative (El Niño). During the negative ENSO phases conditions in the Caribbean region tend to be “dry and warm” while in the positive phase, conditions tend to be “cool and wet” (IRI, 2007).

Meteorological data collected at the Trinidad & Tobago Meteorological Services (TTMS) in Piarco is taken to be representative of the entire island's average weather conditions. For this assessment of the climate of Trinidad; and more specifically the Maloney Sewerage Region, rainfall from the TTMS will be used as reference points for the climatology of the area.

4.1.1.2 Rainfall

Figure 4-1 is an excerpt from the isohyetal map of Trinidad for the period 1911 to 1985 prepared by the Water Resources Agency (WRA, 1990), and this shows that all four WWTPs are situated in a zone where the annual rainfall ranges from 2000mm to 2200mm

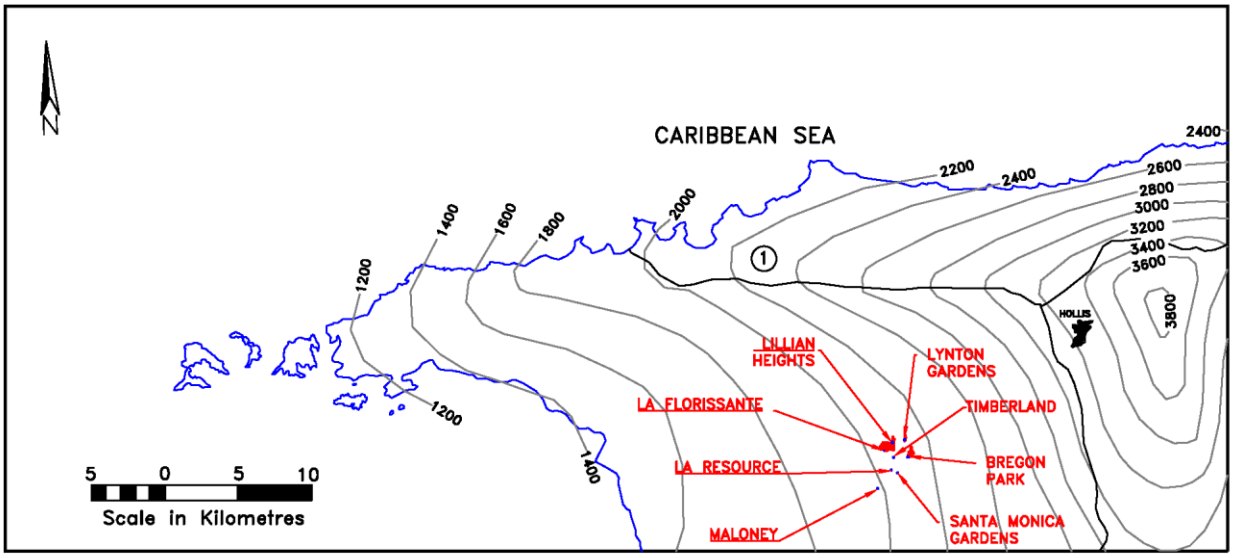

FIGURE 4-1: ISOHYETAL MAP OF NORTHWEST TRINIDAD
FOR THE PERIOD 1911 TO 1985
(SOURCE: WATER RESOURCES AGENCY, 1990)

The dry season is characterised by relatively low rainfall while the wet season is characterised by relatively high rainfall. There is also a short dry spell which occurs in the wet season, sometime during the months of September and / or October and lasting for about two weeks, locally known as the "Petite Careme" (WRA, 1990, FAO, 2000)

4.1.1.3 Winds

The Caribbean region is dominated by strong and persistent easterly winds, known as the "Trade Winds" (McGregor and Nieuwolf, 1998). Wind data recorded at Piarco International Airport is generally relevant to the sites of the four WWTPs, and the wind rose in Figure 4-2 represents records from the period 1995 to 2004. This shows wind direction predominantly ranging from the northeast to east-southeast. In general wind speeds are higher in the dry season than in the wet season.

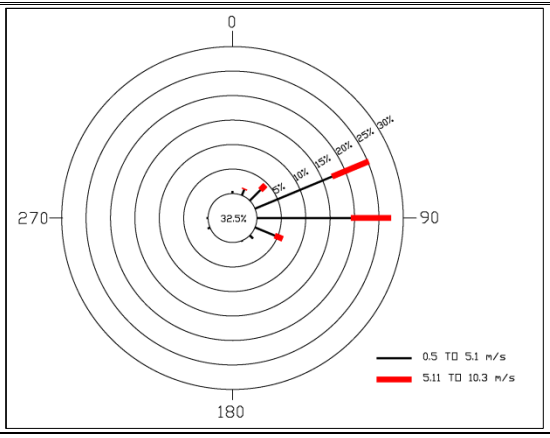

FIGURE 4-2: WIND ROSE FOR PIARCO FOR THE PERIOD 1995 TO 2004
(DATA SOURCE: TRINIDAD & TOBAGO METEORLOGICAL SERVICES, PIARCO)

4.1.1.4 Tropical Cyclones

Trinidad has typically experienced fewer hurricanes than islands further north. Figure 4-3 shows four tropical cyclones which have made land fall on the island and one that skirted the northeast coast since 1851:

- Tropical Storm #7 (1986),
- Tropical Storm Alma (1974),
- Tropical Storm Fran (1990),
- Tropical Storm Bret (1993), and
- Hurricane Isiodore (2002) which was a Tropical Depression when it made landfall.

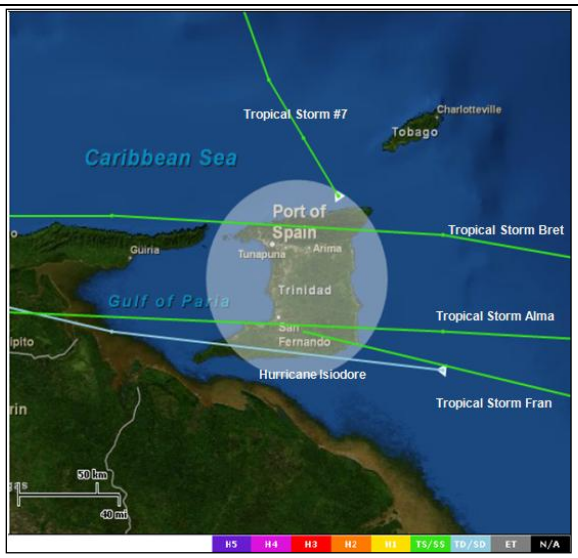

FIGURE 4-3: TROPICAL CYCLONES OVER TRINIDAD SINCE 1851
(SOURCE: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION)

4.1.2 Topography

All eight WWTPs service residential developments in the foothills of the Northern Range (see Figure 4-4). The WWTPs at Bregon Park, Lynton Gardens, Lillian Heights, Santa Monica Gardens, La Resource and Timberland are all situated at the lowest end of the respective developments, allowing flow by gravity sewers. The arrangement at La Florissante is different, with the WWTP situated at a higher elevation than many of the houses. As noted in Section 2.2.4, the sewerage system at La Florissante originally included two sewage lift stations plus force mains (pressure sewers) to convey sewage to the WWTP. However these lift stations are now in a state of disrepair.

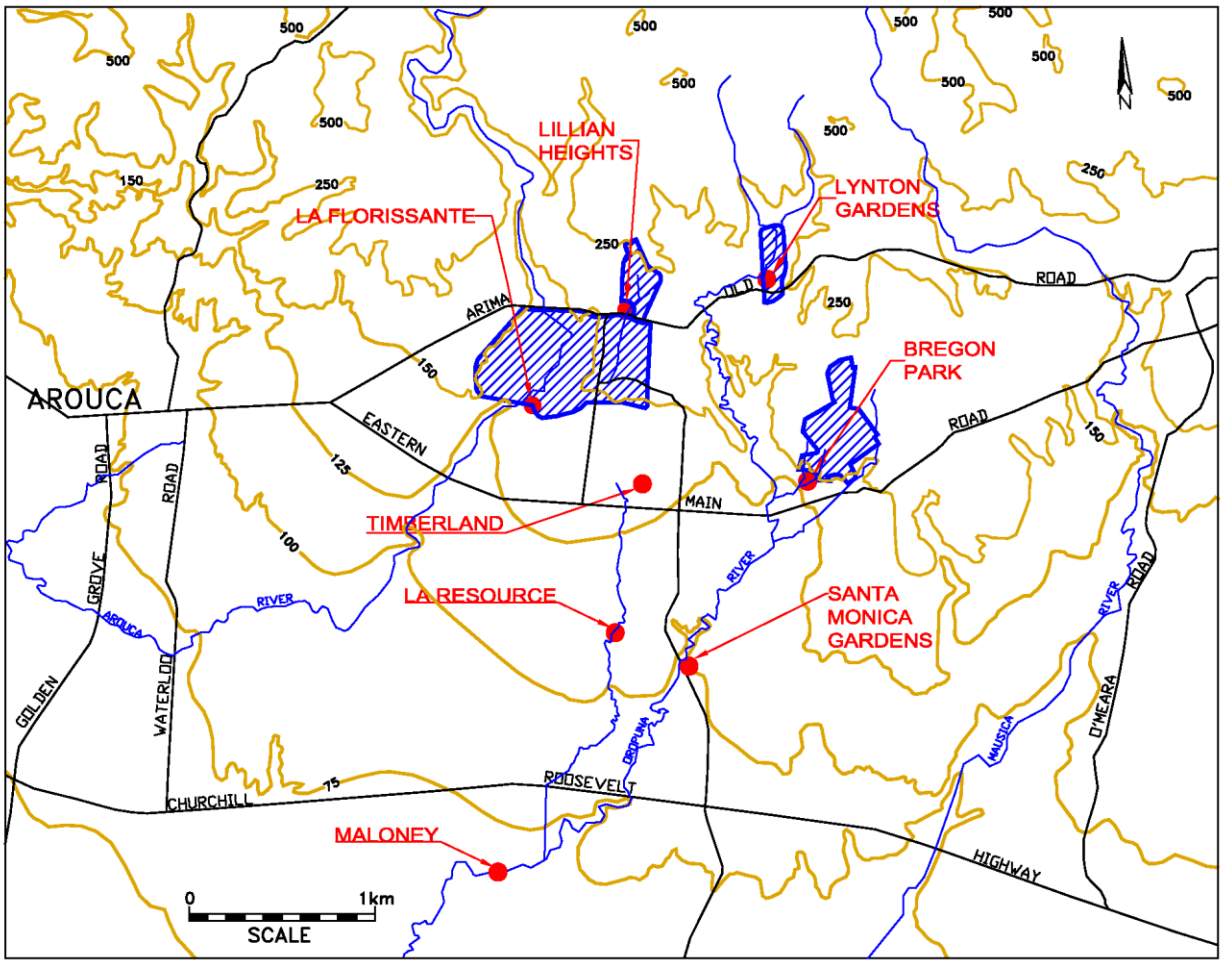

FIGURE 4-4: TOPOGRAPHY IN THE WIDER VICINITY

4.1.3 Ground Water

All eight WWTPs are situated on the Northern Gravels Aquifer (see Figure 4-5), an unconfined aquifer which is extensively pumped for water supply throughout North Trinidad. According to the Water Resources Agency (1990), the Northern Gravels Aquifer consists of Piedmont gravel-fans formed by rivers and streams emerging from the steep Northern Range onto the gentle Caroni Plain. The aquifer consists of a series of interbedded gravel, sand, silt and clay deposits along the southern foot of the Northern Range. The Arouca Wellfield is one of the wellfields which extract ground water from this aquifer for public water supply, and the Arouca No. 7 well is relatively close to the La Florissante WWTP.

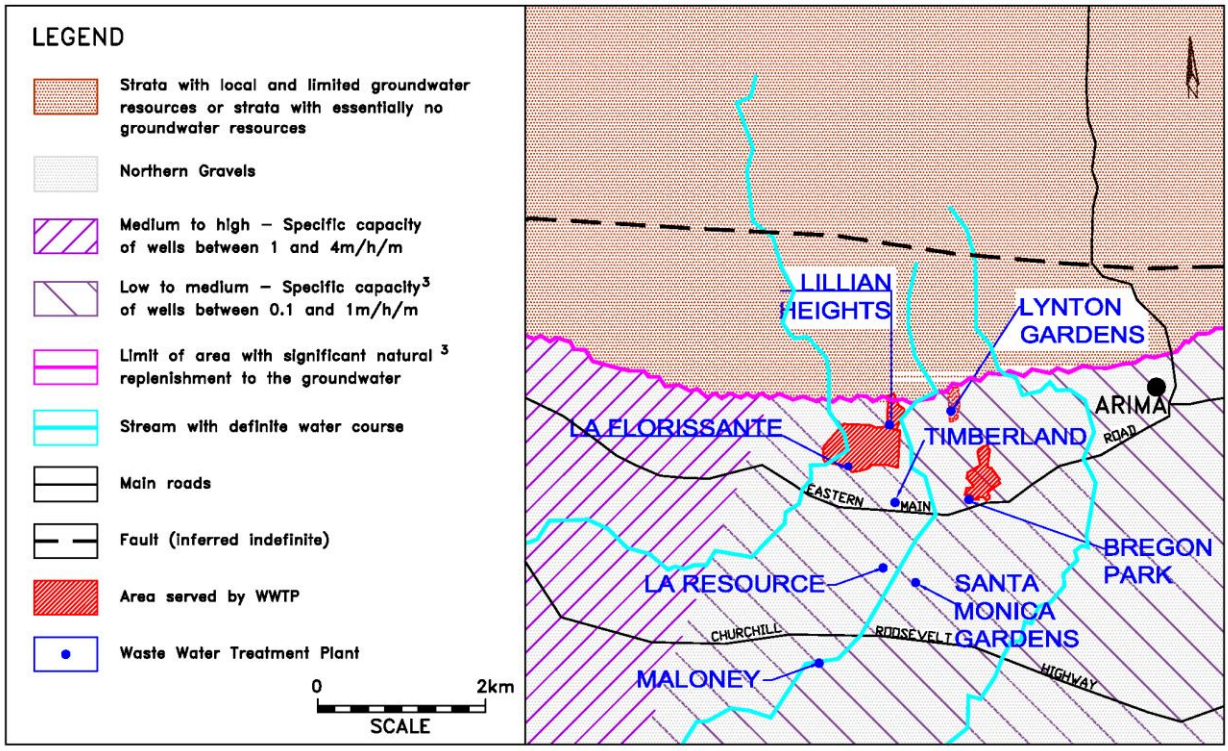

FIGURE 4-5: AQUIFER IN THE WIDER VICINITY
(SOURCE: HYDROGEOLOGICAL MAP OF TRINIDAD PREPARED BY THE WATER RESOURCES AGENCY)

4.1.4 Streamflow

The receiving streams for these WWTPs are all tributaries of the Caroni River (see Figure 4-6). The Arouca River receives discharges from both Lillian Heights and La Florissante, while the the Oropuna River receives discharges from Bregon Park, Lynton Gardens, Timberland, La Resource and Santa Monica Gardens. The confluence of the Oropuna River and the Arouca River is about 2 km upstream of the outfall to the Caroni River and the Arouca River outfalls into the Caroni River about 5 km downstream of the Kelly Weir.

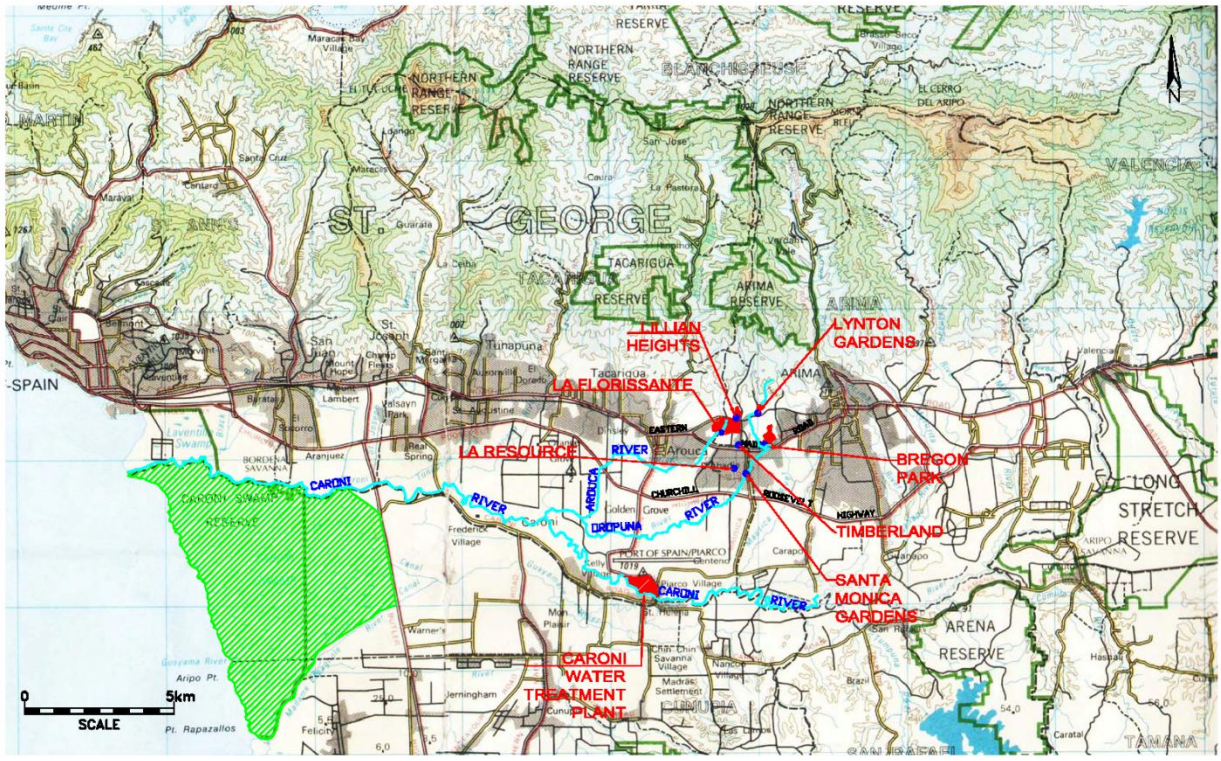

FIGURE 4-6: RIVERS FROM THE WWTPs TO THE CARONI RIVER

Flow rates in these rivers vary seasonally, with higher flow in the wet season and lower flow in the dry season. However, there is some recharge of the rivers from the river bed gravels during the dry season, so there is generally a continuous base flow throughout the dry season.

4.1.5 Water Quality

The results of a limited program of water quality sampling and testing, conducted by WASA in July 2011, are shown in Appendix A. The key findings of this program are as follows.

4.1.5.1 Raw Sewage

The quality of raw sewage samples collected on this assignment is summarized in Table 4-1. The average values for TSS, COD, BOD_5 and Faecal Coliforms are all somewhat lower than the typical values for weak domestic waste water quoted in Metcalf & Eddy (1991). Based on these results, it may be concluded that the legal owners of these WWTPs are in clear violation of the Water Pollution Rules (see Section 3.2.3), both for a failure to register as a Source of Water Pollution and for exceeding the permitted levels with regard to Total Dissolved Solids, Dissolved Oxygen, 5-day Biological Oxygen Demand and Faecal Coliform.

TABLE 4-1: AVERAGE RAW SEWAGE CONCENTRATIONS

PARAMETER	NUMBER OF SAMPLES	AVERAGE CONCENTRATIONS	PERMITTED LEVELS UNDER THE WATER POLLUTION RULES
Temperature (°C)	6	29.0	
pH	6	6.7 to 7.4	between 6 and 9
TSS (mg/L)	6	65.5	less than 50 mg/L
DO (mg/L)	6	0.7	more than 4 mg/L
COD (mg/L)	3	166.3	less than 250 mg/L
BOD_5 (mg/L)	6	70.3	less than 30 mg/L
Faecal Coliform (cfu/100mls)	3	370,000	less than 400

4.1.5.2 Bregon Park WWTP

There is evidence of altered water quality between the upstream and downstream sampling locations at Bregon Park WWTP. Specifically, there is an increase in average TSS (32.3 mg/L to 52.3 mg/L), average BOD_5 (0.5 mg/L to 15.7 mg/L) and average Faecal Coliforms (1,987 cfu/100ml to 436,667 cfu/100ml). There is also a corresponding decrease in DO (7 mg/L to 2.3 mg/L).

4.1.5.3 Lynton Gardens WWTP

There is also evidence of altered water quality between the upstream and downstream sampling locations at Lynton Gardens WWTP. Specifically, there is an increase in average TSS (18.7 mg/L to 34.3 mg/L), average BOD_5 (1.7 mg/L to 5.3 mg/L). The increase in average Faecal Coliforms (58,667 cfu/100ml to 79,733 cfu/100ml) was less pronounced than at Bregon Park. The decrease in DO (7.3 mg/L to 6 mg/L) was also less pronounced.

4.1.5.4 Lillian Heights WWTP

There is very little evidence of altered water quality between the upstream and downstream sampling locations at Lillian Heights WWTP. Specifically, there is almost no change average BOD_5 (8.0 mg/L to 7.0 mg/L), average Faecal Coliforms (34,733 cfu/100ml to 31,133 cfu/100ml) and average DO (6.3 mg/L to 6 mg/L). At this location, the average TSS decreased (39.3 mg/L to 21.7 mg/L) from upstream to downstream.

4.1.5.5 La Florissante WWTP

The only strong evidence of altered water quality between the upstream and downstream sampling locations at La Florissante WWTP was an increase in average Faecal Coliforms (2,267 cfu/100ml to 105,000 cfu/100ml). There was also a small increase in average TSS decreased (24 mg/L to 32.7 mg/L). There was no significant change in average DO (8 mg/L to 7.3 mg/L), and average BOD_5 decreased (12 mg/L to 5.7 mg/L) from upstream to downstream.

4.1.5.6 Other Parameters

With regard to other parameters which were measured on stream water samples:

- Temperatures ranged from 26.3^{o}C to 28.7^{o}C, as expected for streams of this size in Trinidad & Tobago

- pH values ranged between 5.5 and 9.1, with all three lowest values being measured in the Bregon Park WWTP receiving stream.

- No trends could be discerned from the COD results.

4.2 The Biological Environment

All eight WWTPs are situated within developed areas, where the original vegetation has been cleared and the vegetation presently at the sites (see Photographs 2-5, 2-6, 2-8 and 2-10) is secondary growth of little ecological significance.

As noted in Section 4.1.4, discharges from these WWTPs flow into tributaries of the Caroni River, which in turn outfalls into the Caroni Swamp (see Figure 4-6). The Caroni swamp is the largest mangrove wetland in Trinidad & Tobago, consisting of 5611 hectares of land (Forestry Division, 2002). In 1987, the Caroni Swamp was declared a Prohibited Area under the Forests Act. (Legal Notice #141 of 1987). In October 1991 the swamp was approved by Cabinet as a RAMSAR site.
The swamp is ecologically diverse, consisting of marshes, mangrove swamp, brackish and saline lagoons, and tidal mudflats. It provides a variety of habitats, thus supporting a rich biodiversity. It provides nutrients and protection in addition to being a nursery for marine and freshwater species. The approximate distance by river from the seven WWTPs to the Caroni Swamp is between 15 km and 22 km.

4.3 The Human Environment

On this program, key aspects of the physical environment are:

- Population,
- Land Use,
- Road Network, and
- Water Supply.

4.3.1 Population

Population data in Trinidad & Tobago is published on the basis of Enumeration Districts and communities (CSO 2002). The major population centre in the wider vicinity is the Borough of Arima to the east. All eight housing developments are situated in the Tunapuna / Piarco Regional Corporation. Four of these communities are situated as follows:

- Bregon Park is situated within the Cleaver Road community,
- Lynton Gardens and Lillian Heights are situated within the La Resource community,
- La Florissante is situated within the community of La Florissante.

Note that the communities listed above do not correspond to the areas served by each of the WWTPs. Other large communities in the wider vicinity are D'Abadie and Arouca. Table 4-2 lists the population, number of households, number of businesses and number of institutions in each community, as of the 2000 census (the latest data which is available). This data is typical of a built-up area.

TABLE 4-2: COMMUNITY STATISTICS

COMMUNITY	POPULATION	NUMBER OF HOUSEHOLDS	NUMBER OF BUSINESSES	NUMBER OF INSTITUTION
Arima	32,278	8,400	1,464	9
Cleaver Road	461	126	8	0
La Resource	1,223	291	26	0
La Florissante	1,395	402	8	0
D'Abadie	4,703	1,296	145	0
Arouca	12,074	2,884	307	7

4.3.2 Land Use

Over the past three decades, lands in the wider vicinity have been intensively converted from agriculture to housing. Before 1980, this area had only a few in-depth settlements: Arima, D'Abadie and Arouca (TCPD, 1982). The remaining built development was mainly ribbon-type development along major and other roads. With regard to four of the housing developments of interest:

- La Florissante was a coconut plantation,
- Lillian Heights and Lynton Gardens were largely forested, and
- Bregon Park was a mix of small crop agriculture and forest.

Since that time, many housing developments have been built in this area. These include large Government-funded developments (such as Bon Air and Maloney) and large Private Sector developments (such as La Florissante).

The following discussion traces land use along the receiving streams from the WWTPs to their outfall into the Caroni River (see Section 4.1.4 and Figure 4-6).

The Arouca River receives discharges from both Lillian Heights and La Florissante.

- From Arima Old Road, across the Eastern Main Road to Golden Grove Road this river flows through built-up areas with some small crop farming on undeveloped plots of land.
- Between Golden Grove Road and the Churchill Roosevelt Highway, it flows through commercial and high-end housing areas, and also alongside a Golf Course which appears to extract water for irrigation.
- From the Churchill Roosevelt Highway to the confluence with the Caroni River, this river flows through abandoned cane fields.

The Oropuna River receives discharges from Bregon Park, Lynton Gardens, Timberland, La Resource and Santa Monica Gardens.

- From Arima Old Road, across the Eastern Main Road to the Churchill Roosevelt River this river flows through built-up areas with some small crop farming on undeveloped plots of land.

- Between the Churchill Roosevelt Highway and Golden Grove Road, it flows through an undeveloped area which is reserved for the expansion of The Piarco International Airport.

- From Golden Grove Road to the confluence with the Arouca River, this river flows through abandoned cane fields.

4.3.3 Road Network

The Eastern Main Road is one of the main roadways between Port of Spain and Arima, and provides access to the four developments:

- Access to Bregon Park and Timberland is directly off the Eastern Main Road,

- Access to La Resource is from the Eastern Main Road via La Resource Road South,

- Access to Lillian Heights and Lynton Gardens is from the Eastern Main Road via Arima Old Road,

- Access to Santa Monica Gardens is off Mausica Road, and

- Access to La Florissante is from the Eastern Main Road via either Arima Old Road or La Resource Road.

The Eastern Main Road is a heavily-trafficked main artery. Arima Old Road, Mausica Road and La Resource Road are minor roads, with the first two carrying somewhat more traffic than the last. The movement of large vehicles along any of these roads is likely to cause traffic congestion. Arima Old Road and La Resource Road are relatively narrow and will accommodate only one-way traffic if there is construction within the roadway (for sewer installation).

4.3.4 Water Supply

There are two sources of water for the public water supply in the wider vicinity: the Arouca Wellfield and the Caroni Water Treatment Plant. As noted in Section 4.1.3, all seven existing WWTPs are located over the Northern Gravels Aquifer, which is presently pumped for the public supply. This is an unconfined aquifer, with low to medium specific conductivity in the area of these WWTPs.

The second facility for public water supply is the Caroni Water Treatment Plant, which supplies more than half of Trinidad's potable water. This plant pumps water directly from the Caroni River during both seasons, with the natural flow being supplemented during the dry season with releases from the Arena Reservoir. Pumping is from a pool created by the Kelly Weir, so discharges into the Caroni River upstream of this weir will affect the quality of raw water entering the Caroni Water Treatment Plant, while discharges downstream of the Kelly Weir will not affect raw water quality.

5 IDENTIFICATION OF POTENTIAL IMPACTS

This chapter discusses:

- the expected Benefit of the proposed works in the Maloney Sewerage Region,
- potential Adverse Impacts associated with each phase of the work,
- potential Economic Impacts,
- Classification of this Project,
- Climate Change and how it may affect the long-term potential impact of this project,
- Natural Hazards, and
- Liability Issues.

5.1 Benefit

The expected benefit of this project is a reduction in contaminant releases to surface and ground water. Table 5-1 shows the average concentrations of contaminants in raw sewage measured on this assignment and the design effluent criteria. Using the average concentrations as typical, treatment of the raw sewage to the quality envisaged in the design effluent criteria will achieve:

- A 7-fold increase in dissolved oxygen,
- A 71% decrease in 5-day BOD,
- A 54% decrease in TSS, and
- A 99.9% decrease in faecal coliform.

TABLE 5-1: QUALITY OF RAW SEWAGE

WATER CONTAMINANT	AVERAGE VALUES MEASURED ON THIS PROJECT	DESIGN EFFLUENT CRITERIA
pH	6.7 - 7.4	between 6 and 9
Dissolved Oxygen (DO)	0.7	more than 4 mg/L
Biological Oxygen Demand (BOD_5)	70.3	less than 20 mg/L
Chemical Oxygen Demand (COD)	166.3	less than 250 mg/L
Total Suspended Solids (TSS)	65.5	less than 30 mg/L
Faecal Coliforms	370,000	less than 400 cfu/100 ml

Another potential benefit of a project of this kind relates to economic gains during construction. These include:

- Contracts awarded to local (Trinidad & Tobago) contractors and subcontractors,
- Employment of skilled and unskilled local workers,
- Purchase of locally-produced construction material, and
- Supply of food, etc, to construction workers by local area residents.

5.2 Adverse Impacts

The potential adverse impacts of this project are listed in Table 5-2, showing the various tasks on the project during which each impact may arise. The table also differentiates between potential major and minor concerns. The potential adverse impacts are discussed in the following sub-sections.

TABLE 5-2: POTENTIAL ADVERSE IMPACTS OF THE PROJECT

POTENTIAL ADVERSE IMPACT	TASK			
	DISMANTLING / DEMOLITION	INSTALL SEWERS	INSTALL LIFT STATIONS	REFURBISH / EXPAND MALONEY WWTP
Contamination of Water	Maj	Maj	Min	Maj
Soil Contamination	Min	Min	Min	Min
Impaired Air Quality	Min	Maj	Min	Min
Noise	Maj	Min	Min	Min
Health Issues	Maj	n / a	n / a	Maj
Obstructed Access	n / a	Maj	n / a	n / a
Traffic Congestion	Min	Maj	Min	Min
Construction Safety Issues	Maj	Min	Min	Min
Waste Disposal Issues	Maj	Min	Min	Min
Maj = Potential Major Impact, Min = Potential Minor Impact, n / a = not applicable				

5.2.1 Contamination of Water

Liquids and sludges presently in the seven smaller WWTPs must be removed before they are dismantled / demolished. In the case of Maloney WWTP, liquids and sludges will have to be removed from some of the tanks before refurbishment work can proceed. In addition, areas where raw sewage has overflowed must also be cleaned up as part of the demolition exercise.

Improper disposal of such liquids, sludges and contaminated soil can result in contamination of surface water. This concern relates to the demolition / dismantling of the seven WWTPs, and to the refurbishment / expansion works at Maloney WWTP, and is considered to be major due to the type of contamination that may occur.

A second water contamination issue relates to silty runoff which may arise from water which is being pumped out of trenches excavated for the installation of sewers. This can be considered a major concern due to the high concentration of silt in such water.

Silty runoff may also arise from erosion of cleared areas. This concern is applicable to all four tasks, but is considered to be minor since only a relatively small area will be cleared at each site.

Finally surface water may be contaminated by spills and leaks of hydrocarbons (fuels and lubricants) from construction equipment. This concern is also applicable to all four tasks, but is considered to be minor given normal construction practices in Trinidad & Tobago.

5.2.2 Soil Contamination

Spills and leaks of hydrocarbons (fuels and lubricants) from construction equipment may also contaminate soil on the sites. This concern is applicable to all four tasks, but is considered to be minor given normal construction practices in Trinidad & Tobago.

5.2.3 Impaired Air Quality

Construction works can result in air emissions from the:

- dust from traffic along the roads or within the site,
- dust from cleared areas and sand stockpiles, and
- (to a lesser extent) exhaust fumes from construction equipment.

These types of emissions can arise during all four tasks on this project. It is considered to be a major concern during the installation of sewers, because this task will extend over a wide area. It is considered to be a minor concern during the remaining three tasks, due to the relatively small areas involved.

5.2.4 Noise

Dismantling / demolition works will likely involve the use of jack-hammers or similar equipment used to break up concrete structures, so this concern is considered to be major. In contrast, noise emissions from the other tasks will result from:

- other construction equipment used on the site; and
- trucks and low-boys used to transport equipment and material to and from the site.

The concern for the remaining tasks is considered to be minor.

5.2.5 Health Issues

Health issues can arise from the handling of faecal matter, with recent overflows from the collection system likely to be more hazardous to health than liquids and sludges that have been in the abandoned WWTPs for several years.

Exposure of workers involved in the removal of this matter is the greatest concern, but the public may also be exposed if the liquids and sludges are improperly disposed or if there are spills during transport. This concern relates to the demolition / dismantling of the seven WWTPs, and to the refurbishment / expansion works at Maloney WWTP. It is considered to be major due to the health risk to workers and the general public.

5.2.6 Obstruction of Access

Since the sewers will be installed within or alongside existing roads, access to individual lots may be temporarily obstructed during construction. This concern relates only to the installation of sewers, but is considered to be major due to the level of inconvenience that property owners and occupiers will face.

5.2.7 Traffic Congestion

Traffic congestion will arise due to the temporary narrowing of the roadway to facilitate installation of the sewers, and this will be experienced along all of the roadways earmarked for the laying of sewers. This is considered to be a major concern, due to the level of inconvenience to road users.

For all tasks, traffic congestion may arise from trucks and low-boys used to transport equipment and material to and from the site. This concern is more pronounced on narrower roads such as the internal roads in Santa Monica and La Resource, but is also relevant to traffic along La Resource Road or Arima Old Road. This is considered to be a minor concern on the three tasks other than the installation of sewers, due to the relatively low level of traffic that will be necessary.

5.2.8 Construction Safety Issues

Construction safety concerns are threefold:

- Safety of workers during construction,
- Injury to the public if they wander onto the site, and
- Hazards associated with trucks transporting equipment and material to and from the site.

Worker safety is a general concern during construction work. It is especially so during the demolition of concrete structures, where jack hammers or similar tools may be used. In addition, hazards may arise on site from falling debris. Worker safety issues on this task are therefore considered to be a major concern.

For all tasks, the public are exposed to danger if they wander onto the construction site. However, with proper fencing and security, this concern is reduced to a minimum. Road safety concerns can also be effectively addressed by proper training of drivers and safe loading of vehicles. This is therefore considered to be a minor concern on the three tasks other than the demolition of the seven smaller WWTPs.

5.2.9 Waste Disposal Issues

Provision must be made for proper disposal of liquids, sludges and contaminated soil removed from the sites of the WWTPs as well as rubble from the demolition of the concrete structures and scrap metal from tanks, roofs, etc. Given the need for special disposal procedures for faecally-contaminated matter, this is considered to be a major concern, and it applies to the demolition / dismantling of the seven WWTPs, as well as the refurbishment / expansion works at Maloney WWTP.

For the other tasks, normal construction rubble will have to be disposed of, and this is considered to be a minor concern.

5.3 Economic Impacts

Two adverse economic impacts have been discussed on recent projects in Trinidad & Tobago, and these are discussed here for completeness:

- Land Acquisition Issues, and
- Reduced Property Values.

5.3.1 Land Acquisition Issues

Land acquisition has proved to be a contentious issue on several recent development projects in Trinidad & Tobago. Based on the information provided by WASA, it does not appear that land acquisition will be required for this project. However, if land acquisition does prove to be necessary, it must be done in conformity with the provisions of Operational Policy (OP-710), Involuntary Resettlement -Operational Policy and Background Paper. According to this Operational Policy, operations which may require resettlement will be evaluated and prepared according to two fundamental principles:

1. Every effort must be made to avoid or minimize the need for involuntary resettlement. A thorough analysis of project alternatives must be carried out in order to identify solutions that are economically and technically feasible while eliminating or minimizing the need for involuntary resettlement. Particular attention must be given to socio-cultural considerations, such as any cultural or religious significance of the land.

2. When displacement is unavoidable, a resettlement plan must be prepared to ensure that the affected people receive fair and adequate compensation and rehabilitation.

5.3.2 Reduced Property Values

On recent projects in Trinidad & Tobago and elsewhere in the West Indies, loss of property value due to the construction of crematoriums or industries in close proximity has also been raised as a concern. If a WWTP were to be constructed on a new site, it would be expected that this concern may be raised by adjacent landowners. However, the construction of sewage lift stations on seven sites already occupied by abandoned WWTPs, or the refurbishment / expansion works at the existing Maloney WWTP is not the type of development which would potentially lower the value of adjacent property.

5.4 Classification of this Project

The classification of operations under the IADB Environmental and Safeguards Compliance Policy was described in Section 3.3.1.1. Under that classification system, this project is classified as **Category B.** That is, it is likely to cause mostly local and short-term negative environmental and associated social impacts, and effective mitigation measures are readily available. Category B operations normally require an environmental and/or social analysis, according to and focusing on, specific issues; and an environmental and social management plan (ESMP). This Environmental and Social Analysis (ESA) Report, and the outline ESMP in Appendix B are intended to satisfy those requirements.

5.5 Climate Change

Climate change refers to a statistically significant variation in either the mean state of the climate or in its natural variability, persisting for an extended period, typically decades or longer (O'Hare, Sweeney and Wilby, 2005 and IPCC, 2007). Due to the complexity of climate studies and the large number of variables and interactions which play a role in changing the climate, predictions of these changes have been extremely difficult. To aid in these predictions, extremely complex General Circulation Models (GCM's) have been used to determine possible trends in climate change under various scenarios of physical, biological, chemical and anthropogenic changes and / or effects. This section gives an overview of climate change predictions for Trinidad & Tobago, and then relates these predicted changes to the potential environmental impacts of this project.

5.5.1 Climate Change Predictions

The United Nations Development Program (UNDP, 2008) has established Climate Change Country Profiles for the globe. The Trinidad & Tobago country profile describes the following observed trends in climate change since 1960:

- < There has been an increase in the mean annual temperature by around 0.6°C, at an average rate of 0.13°C per decade

- < The decrease in mean annual rainfall has been fractional and thus statistically insignificant. However, there has been a large change in mean monthly rainfall during the wet season months of June, July and August. On average, monthly precipitation during these months has decreased by 6.1mm per decade.

The Intergovernmental Panel on Climate Change (IPCC) has made several predictions for the Caribbean Region:

- < There is an expected temperature increase of 1.4°C to 3.2°C in 100 years with a median of 2.0°C. The IPCC has thus stated that the region is likely to experience warming during this century.

- < There is a 100% chance that extreme warm seasons will be experienced

- < There is an expected percentage change in precipitation of -39% to 11% in 100 years with a median of -12%. The IPCC has thus stated that the region is likely to experience a decrease in precipitation during this century.

- < There is a 3% chance that extreme wet seasons will be experienced and a 39% chance that extreme dry seasons will be experienced.

- There is a projected rise in sea level of 0.23m to 0.47m by the end of this century, with a mean of 0.35m.

Note should be made that there have been many uncertainties and variations in different model predictions for Tropical Cyclones. This has resulted in the IPCC stating that there is no clear picture with respect to regional changes in frequency and movement however there is an expected increase in intensity of Tropical Cyclones.

5.5.2 Altered Impacts

The works proposed under this program will be constructed over the next 5 years or sooner, so climate change is not expected to alter the potential impacts during the construction phase. With regard to the operation phase:

- The Maloney Sewerage Area is well inland and the Maloney WWTP, the proposed seven sewage lift stations and the new sewer mains are all more than 8 m (25 feet) above sea level. As a result, the projected sea level of 0.23m to 0.47m by the end of this century is not expected to affect these facilities.

- During extreme dry seasons (projected with a 39% chance of occurrence), streamflow will be reduced to the base flow (see Section 4.1.4) for extended periods. During such periods, dilution of the treated effluent will be significantly reduced, leading to somewhat higher ambient concentrations of contaminants in the streams after mixing.

5.6 Natural Hazards

Two natural hazards of concern in Trinidad are:

- Earthquakes, and

- Tropical Cyclones.

5.6.1 Earthquakes

Shepherd et al (2003) describe Trinidad as being located in a complex, seismically active zone. Figure 5-1 shows the epicentres of crustal earthquakes in and around North Trinidad for the period 1977 to 1988. Shepherd et al concluded that there is no correlation between these earthquakes and the El Pilar Fault System which runs just south of the Northern Range. The earthquake history of North Trinidad makes it important that all structures should be designed to resist expected acceleration. This is a special concern for the design of tanks, where there the contained liquid will also accelerate.

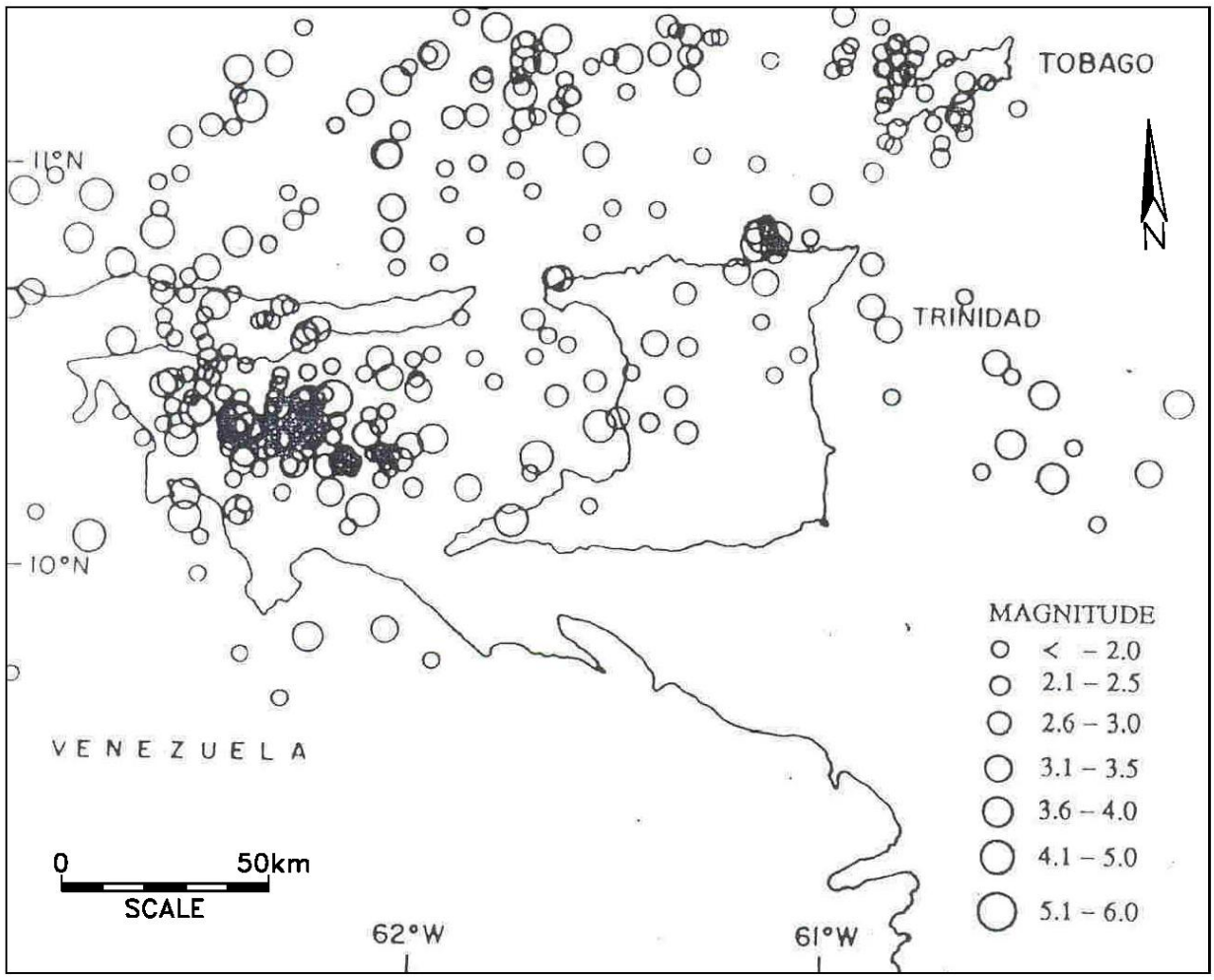

FIGURE 5-1: DISTRIBUTION OF SHALLOW (< 34 km) EARTHQUAKES IN TRINIDAD FROM AUGUST 1977 TO SEPTEMBER 1988
(SOURCE: SHEPHERD AND ASPINAL, 1983)

On previous projects, earthquake-resistant design has been to Zone 3 of the United States' Uniform Building Code, but it will be necessary for the designer of the upgraded and expanded WWTP at Maloney to determine the appropriate acceleration for earthquake resistant design.

5.6.2 Tropical Cyclones

The history of tropical cyclones affecting North Trinidad was discussed in Section 4.1.1. It will be necessary for the designer of the upgraded and expanded WWTP at Maloney to determine the appropriate wind speeds for design of structures and the appropriate rainfall intensities for the design of drainage.

5.7 Liability Issues

Two potential liability issues have been identified on this project:

- Violations under the Water Pollution Rules, and
- Contaminated Water and Soil.

5.7.1 Violations of the Water Pollution Rules

As indicated in Section 4.1.5.1, the legal owners of the WWTPs in the Maloney Sewerage Region are presently in violation of the Water Pollution Rules because:

- They have not applied for Source Registration, and
- They have not requested a Permit to release a water pollutant into the receiving environment outside the permissible level.

The Environmental Management Act, 2000, sets out the procedure for compliance and enforcement as follows:

- EMA issues a Notice of Violation which specifies the nature of the violation and may request modifications to the activity giving rise to the violation.
- If the matter in the Notice of Violation is not satisfactorily explained or otherwise resolved, the EMA issues an Administrative Order. This will direct the person to
  - Cease and desist from the violation (immediately or by a specified date),
  - Immediately remedy any environmental conditions or damage,
  - Undertake an Investigation and / or
  - Perform monitoring.
- EMA may make an Administrative Civil Assessment which may include:
  - Compensation for actual costs incurred by the EMA,
  - Compensation for damage to the environment,
  - Damages for any economic benefit which the person may have enjoyed as a result of the violation, and / or
  - A penalty for failure to comply with the applicable environmental requirements.
- EMA makes an application for enforcement to the Environmental Commission.

At the present time, the liability for these violations applies to the legal owners of the WWTPs. When WASA takes over these WWTPs, they will also assume this liability until the new system is implemented. It would therefore be prudent to advise the EMA that WASA is taking over these orphan facilities for the purpose of upgrading the system, and to seek a moratorium on enforcement while the improvement works are in progress.

5.7.2 Contaminated Water and Soil

As noted in Section 4.1.5.1, these WWTPs are discharging raw sewage into the environment, resulting in contamination of the receiving water and contaminated soil on the site. This raises public health issues in the surrounding communities as well as worker health issues during the improvement works, both of which may result in liability. Public health issues would be included in any Administrative Civil Assessment which is calculated by the EMA (see Section 5.7.1). Worker health issues will be addressed in the mitigation measures in Section 6.1, below.

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6 MITIGATION, MANAGEMENT AND MONITORING

This chapter discusses:

- Mitigation Measures that may be applied to reduce (or where possible, eliminate) adverse impacts,
- Monitoring of Water Quality,
- the outline Environmental and Social Management Plan for these works, and
- Other Management Plans for this project.

6.1 Mitigation Measures

Table 6-1 summarizes mitigation measures which may be used to reduce (or, where possible, eliminate) adverse impacts arising from this project.

TABLE 6-1: POSSIBLE MITIGATION MEASURES

POTENTIAL ADVERSE IMPACT	POSSIBLE MITIGATION MEASURES
Contamination of Water by Faecal Matter	< Test water and sludge in the abandoned WWTPs and soil contaminated by recent overflows prior to commencement of demolition / dismantling work, and < Where test results show faecal contamination, arrange for removal to an appropriate wastewater treatment plant or a septage facility for treatment and disposal.
Contamination of Water by Sediment	< Conduct site preparation work only in areas that are required for the project, < Provide temporary drains during the pre-construction phase to control run-off, < Keep material stored on site to a minimum, < Confine temporary stockpiles of cleared material using wooden “cribs” (or other means such as geofabric screens on stakes) around the perimeter. These should be removed after the material in the stockpile has been used or removed from the site, < Install siltation traps (using either hard or soft solutions) within drains to trap silt before it enters any watercourse outside of the site, < Where mains and force-mains are constructed by open-cut parallel to watercourses, place topsoil and backfill material on the opposite side of the trench from the river, < Use topsoil and backfill material to backfill the trench as soon as practical after the installation of mains and force-mains are completed, and < Re-instate the mains and force-mains ROW to ensure proper drainage and re-vegetation, as soon as practical, following installation and backfilling.
Contamination of Water by	< Identify specific sites for fuelling and servicing (refuelling of vehicles within a minimum of 30.5 m from surface water bodies will be avoided),

POTENTIAL ADVERSE IMPACT	POSSIBLE MITIGATION MEASURES
Hydrocarbon Spills or Leaks	< Provide impermeable bunds around fuel storage tanks, < Store chemicals and fuels in bunded areas of adequate capacity, < Promptly clean up spills and remove all soil which may become contaminated during the course of construction to a bioremediation cell for treatment (on-site remediation may be considered if the volumes are small), < Re-fuel vehicles and equipment in bunded areas, < Dispose of spent chemical and fuel containers in a proper and timely manner, < Use of appropriate pumps and nozzles for refuelling activities, < Place disconnected hoses in containers to prevent residual fuel spills, < Provide ongoing maintenance of vehicles and machinery to ensure no leakage from equipment, < Minimize spills during construction by "good practice" construction techniques such as use of appropriate containers, avoiding overfilling, etc., and < Avoid "hosing down" of spills and construction material. Instead, use dry clean up and mopping up techniques as appropriate.
Contamination of Soil by Hydrocarbon Spills or Leaks	As for contamination of water by hydrocarbon spills or leaks.
Impaired Air Quality by Dust from Traffic on Roads or Within the Site	< Cover all transport vehicles moving granular material to and from the site (with tarpaulins, etc.) to prevent dust emissions, < Wash truck tyres prior to leaving the work site, < Enforce traffic speed regulations within the construction zone as speeding along roads can contribute to dust emissions, < Clean up areas on which dirt or debris are deposited by vehicles working on this project, and < Optimize and control pre-construction and construction traffic.
Impaired Air Quality by Dust from Cleared Areas or Stockpiles	< Clear only area needed for construction, < Wet cleared area, < When handling fine grain granular material, avoid letting them fall from high above the ground to minimize dust generation and dispersion, < Keep stockpiles to a minimum and use as soon as practical, and < Protect stockpiled fine grain granular material from wind action by covering them with tarpaulins when not used or store aggregates in bins or silos.
Impaired Air Quality by Exhaust Fumes from Vehicles and Equipment	< Perform vehicle inspections and maintenance, < Maintain internal combustion engines, < Use suitable emission controls, and < Optimise the use of equipment and vehicles (control and minimize vehicle movements).
Noise	< Restrict dismantling / demolition activities to daytime hours (7:00 am to 7:00 pm), to the extent practical, < Restrict transportation of sewer pipe and construction rubble to daytime at non-peak hours, < If construction must take place at night, apply for a noise variation from the

POTENTIAL ADVERSE IMPACT	POSSIBLE MITIGATION MEASURES
	EMA, < Ensure that vehicles have appropriate noise suppression equipment (mufflers), and < Regularly inspect and properly maintain all vehicles.
Health Issues associated with Handling and Transport of Faecal Matter	< Ensure that Contractors submit a Health and Safety Plan for approval by supervising engineer, < Undertake job hazard analyses and relevant safety training, < Ensure that workers undertake training in handling and transport of faecal matter, and < Require the use of appropriate PPE.
Obstruction of Access	< Obey all traffic safety and road closure regulations, < Off-road traffic outside of designated areas shall be prohibited, < Prohibit unauthorized public use of work site areas and non-public access roads, and < Leave gaps in rows of spoil to coincide with access tracks and obvious walkways.
Traffic Congestion	< Prepare a Traffic Management Plan in consultation with the Police Service and the Traffic Management Branch, < Designate areas for off-loading, away from roads, < Schedule the transport of sewer sections, other materials and equipment to avoid peak traffic hours, < Train truck drivers in defensive driving, < Avoid the use of long convoys or trucks, < Arrange for police outriders to accompany particularly large loads, < Use designated areas for off-loading, away from roads, and < Repair all roads, bridges or culverts which are damaged as a direct result of transportation activities for this project.
Construction Safety Issues – Worker Safety	< Undertake job hazard analyses and relevant safety training, < Ensure that Contractors submit an Emergency Plan for approval by OSH Agency, < Ensure that workers undertake training in handling hazardous materials (faecal matter), < Appoint an on-site Safety Co-ordinator, < Undertake weekly safety meetings and daily safety toolbox meetings, < Require the use of appropriate PPE, < Develop a detailed on-site First Aid Plan, < Provide training in First Aid / CPR to all personnel on the site Emergency Response Team, < Respond promptly to injuries, when required, and < Stabilize the injured party, and transfer to an off-site health facility if necessary.
Construction Safety Issues – Public Entering the Site	< Proper marking and policing of sewer trenches to avoid accidents, < Consult with the Police Service in the affected areas, < Arrange for 24-hour security guards, < Ensure that members of the public are not permitted in the construction zone,

POTENTIAL ADVERSE IMPACT	POSSIBLE MITIGATION MEASURES
	< Issue advisories and public announcements to inform residents of demolition / construction activities, < Develop a detailed on-site First Aid Plan, < Provide training in First Aid / CPR to all personnel on the site Emergency Response Team, < Respond promptly to injuries, when required, and < Stabilize the injured party, and transfer to an off-site health facility if necessary.
Construction Safety Issues – Road Traffic	< Issue advisories and public announcements to inform residents of transportation of sewer pipes and construction rubble, < Comply with Highways Act, the Motor Vehicles and Road Traffic Act, < Ensure drivers working on the project comply with road rules and are trained in defensive driving, and < Designate areas for off-loading, away from roads.
Waste Disposal Issues – Faecal Matter	< Ensure that workers undertake training in handling and transport of faecal matter, and < Arrange for safe removal of faecal matter to an appropriate treatment plant or a septage facility for treatment and disposal.
Waste Disposal Issues – Construction Rubble	< Arrange for safe removal of construction rubble to an appropriate landfill or other disposal site.

6.2 Monitoring of Water Quality

CEC 1469/2006 specifies two regimes of water quality monitoring:

- Effluent Quality Monitoring, and
- In-Steam Water Quality Monitoring.

The details of these monitoring programs will be developed in the Quality Assurance Project Program (QAPP) which must be prepared to satisfy the requirement in Clause ii (ggg) of CEC 1469/2006. However, quality control on sampling and testing is discussed in the final sub-section, below.

6.2.1 Effluent Quality Monitoring

Clause ii (hhh) of CEC 1469/2006 specifies sampling the effluent of the upgraded and expanded Maloney WWTP after the first seven days of the commissioning, and once per week for the lifespan of the WWTP. It is expected that the sampling will be done by WASA personnel. These samples are to be tested for:

- pH,
- Temperature,
- Total Residual Chlorine,
- Dissolved Oxygen,
- 5-day Biological Oxygen Demand,
- Chemical Oxygen Demand,
- Total Suspended Solids,
- Ammoniacal Nitrogen,
- Total Phosphorus,
- Total Oil and Grease or n-Hexane Extractable Material, and
- Faecal Coliforms.

At each sampling event, the rate of outflow is also to be measured. In preparation for the limited sampling and testing program described in Appendix A, WASA indicated that their laboratory did not offer the following tests:

- Ammoniacal Nitrogen,
- Total Phosphorus, and
- Total Oil and Grease or n-Hexane Extractable Material.

Arrangements would therefore either have to be made to upgrade the WASA laboratory to offer those tests, or to have those tests done at a commercial local testing laboratory. Examples of

local laboratories with the capability to undertake the full range of tests listed above are Analytic Technologies Limited, Ecotox and Kaizen.

6.2.2 In-Steam Water Quality Monitoring

The following documents the in-stream sampling and testing program specified for the expanded and upgraded Maloney WWTP in CEC 1469/2006, and recommends a similar in-stream sampling and testing program for the orphan WWTPs.

6.2.2.1 Maloney WWTP

Clause ii (nnn) of CEC 1469/2006 specifies sampling the receiving stream upstream and downstream of the point of effluent discharge at the upgraded and expanded Maloney WWTP. Such sampling is to be conducted four times per year; twice in the dry season (February and May) and twice in the wet season (August and November). Sampling locations would be selected approximately 100 m upstream and 100 m downstream, based on accessibility.

Assuming that the IADB approves this loan by the end of 2011, it is recommended that the in-stream sampling and testing should begin in February 2012. On this program:

- Test results collected during the design phase of this project will provide a water quality baseline reflective of the effluent from the present WWTP.

- Test results collected during the construction phase of this project will indicate water quality resulting from construction discharges.

- Finally, test results collected after commissioning will reflect the performance of the upgraded and expanded Maloney WWTP.

The duration of this testing program is not spelled out in the CEC, but it may be assumed that the in-stream monitoring at the Maloney WWTP will extend for the lifespan of the WWTP (as for the effluent monitoring program – see Section 6.2.1, above).

The test parameters are not spelled out in the CEC, but it may be assumed that the parameters listed in Section 6.2.1 will also be tested for in the In-Stream Water Monitoring Program. The limitations to the testing capability of the WASA Laboratory described in Section 6.2.1, above, are also applicable here.

6.2.2.2 Orphan Plants

CEC 1469/2006 does not specify in-stream sampling and testing at any of the seven orphan WWTPs which will be replaced with sewage lift stations. Notwithstanding, it is recommended that an in-stream monitoring program similar to the one described above for the Maloney WWTP be undertaken at each of the seven orphan WWTPs. This program will serve to document the improvement in water quality which is the major expected benefit of this project (see Section

5.1). The limited sampling and testing program described in Appendix A, is quite similar to the proposed In-Stream, but it was undertaken only at four orphan WWTPs: Bregon Park, Lynton Gardens, Lillian Heights and La Florissante. As such, this will have to be expanded to include Santa Monica Gardens, Timberland and La Resource.

For this recommended program at the orphan WWTPs, sampling will also be conducted four times per year; twice in the dry season (February and May) and twice in the wet season (August and November). Sampling locations will be the same as described in Appendix A for Bregon Park, Lynton Gardens, Lillian Heights and La Florissante. Additional sampling locations will be selected approximately 100 m upstream and 100 m downstream of the plants at Santa Monica, Timberland and La Resource, based on accessibility.

Again assuming that the IADB approves this loan by the end of 2011, it is recommended that the in-stream sampling and testing program at the seven orphan WWTPs should begin in February 2012. As before:

- Test results collected during the design phase of this project will provide a water quality baseline reflective of the effluent from the present WWTP.

- Test results collected during the construction phase of this project will indicate water quality resulting from construction discharges.

- Test results collected after commissioning will reflect the performance of the upgraded and expanded Maloney WWTP.

Unlike the in-stream monitoring at the Maloney WWTP, there is no need to extend the program at the orphan WWTPs into the long term. Instead, this program should be schedule for a period of two years (8 monitoring events) after the sewage lift station is brought into service at each location. This will provide sufficient data to document the improvement in river water quality associated with this project.

6.2.3 Quality Control

Two quality control measures are recommended on this project:

- A review of WASA's Sampling and Testing Procedures, and

- A QAPP for the operational phase of the project.

6.2.3.1 Review of WASA's Sampling and Testing Procedures

As part of the overall program (including works at Maloney Sewerage Region, San Fernando Sewerage Region and Couva Sewerage Region), a considerable amount of sampling and testing will be undertaken by WASA personnel. This presents an opportunity to add value to WASA's laboratory facilities by reviewing sampling and testing procedures and recommending improvements. It is therefore recommended that a specialist in this area of expertise should be hired to undertake this work as soon as practical after the decision by the IADB to fund this program.

6.2.3.2 Quality Assurance Project Plan

Clause (ii)(ggg) of CEC 1469/2006 stipulates that a Quality Assurance Project Plan (QAPP) be prepared to cover all operational monitoring requirements at the new Maloney WWTP. This will detail standard operating procedures for sampling, holding and testing, competency of personnel and quality control measures. This may be prepared by WASA's Environmental and Regulatory Compliance Department, or by a consultant hired by WASA. Given the specialized nature of this work, it would likely be more efficient for WASA to hire a consultant to undertake this work.

6.3 Environmental and Social Management Plan

An outline Environmental and Social Management Plan (ESMP) for this project is included in Appendix B. This consists of:

- An introduction which outlines the scope of the plan and describes the management structure.
- A description of the proposed works,
- A discussion of personnel, training and toolbox meetings,
- Guidelines for internal and external communication
- HSE procedures during construction,
- HSE procedures during operation,
- A listing of related plans, and
- Auditing and Management review.

Development of this outline ESMP into its final form may be undertaken by WASA's Environmental and Regulatory Compliance Department, by an environmental consultant on the

Design Engineer's team or by hired by an environmental consultant hired directly by WASA (see Chapter 8).

6.4 Other Plans

CEC 1469/2006 specifies that a number of management plans be prepared and submitted to the EMA, and Table 6-2 lists those will supplement the ESMP described in Section 6.3, above. Even though WASA will retain overall responsibility for the timely submission of these plans, some would be more effectively prepared by the Contractor. Table 6-2 also indicates which party would best assume responsibility for preparing each plan.

The first two Plans are considered a normal part of the Contractor's planning, and so would best be prepared by the Contractor. The QAPP is a specialized document, and it is recommended that WASA hire a consultant to prepare it. The expanded Scope of Work for that consultant was presented in Section 6.2.3.1.

TABLE 6-2: OTHER MANAGEMENT PLANS

PLAN	CLAUSE IN CEC 1469/2006	INTENT	RESPONSIBLE FOR PREPARING
Road Traffic Management Plan	(ii) (c)	Minimize traffic congestion, accident risk, dust and noise associated with traffic to and from the project sites.	Contractor
Emergency Prevention and Response Plan	(iii) (b)	Response procedures to natural hazards (tropical cyclones or earthquakes) and site emergencies, with incident reporting procedures.	Contractor
Quality Assurance Project Plan	(ii) (ggg)	Detail standard operating procedures and other requirements for all operation-phase monitoring requirements. Also, review of WASA's sampling and testing procedures and training.	Consultant

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7 PUBLIC PARTICIPATION

This chapter summarizes public meetings which were carried out as part of the EIA for the Malabar and Maloney WWTPs (see Section 3.2.2.3), recommends further stakeholder meetings, and summarizes community outreach requirements of CEC 1469/2006.

7.1 Public Meetings

Public Meetings were held as part of the EIA, as shown in Table 7-1.

TABLE 7-1: PUBLIC MEETINGS FOR THE EIA

DATE	VENUE
Tuesday November 18, 2008	The Maloney Indoor Sport Arena
Tuesday November 26, 2008	The Maloney Indoor Sport Arena

The EIA reports that, overall, residents and other stakeholders were in support of the proposed project. The main problems identified at the Maloney WWTP were a pungent smell in the area and the poor quality of the water. These problems can be rectified by the refurbishment and expansion of the Maloney WWTP. Other concerns raised by residents and stakeholders were associated with other likely potential impacts such as disruption of the roads, increase in traffic, increase in dust and air pollutants. Finally, residents were concerned about costs associated with the project which they may incur.

7.2 Stakeholder Meetings

Approximately three years have elapsed since the Public Meetings listed in Section 7.1. It is therefore recommended that WASA should consult with key stakeholders again, within three months of the approval of funding by the IADB. It is not recommended that these meetings be held prior to loan approval, since in the past stakeholders have objected to repeated meetings before the developer could indicate that the project was fully approved.

This stage of consultation should include:

- The Tunapuna Piarco Regional Corporation,
- The Highways Division, Ministry of Works,
- The Drainage Division, Ministry of Works,
- The Trinidad & Tobago Electricity Commission (T&TEC),
- Telecommunication Services of Trinidad & Tobago (TSTT), and
- Environmental Groups represented in the Council of Presidents for the Environment (COPE).

Traditionally, a separate meeting is held with the Regional Corporation at their meeting room, on a day and time which is convenient to the majority of representatives. The other stakeholders may be invited to one meeting, or may be met individually.

The purpose of these meetings will be:

- to introduce the project,
- to seek specific information (such as the location of utilities which may conflict with the works), and
- to hear concerns so that they may be addressed in the design and implementation of the project.

7.3 Requirements of the Existing CEC

CEC 1469/2006 includes a number of requirements for WASA to interact with the public prior to and during the construction of this project. These are summarized in Table 7-2.

TABLE 7-2: PUBLIC OUTREACH REQUIREMENTS IN CEC 1469/2006

SUMMARY OF REQUIREMENT	CEC CLAUSE
Consult and co-ordinate project activities with other entities that own / operate / maintain underground drains, cables and pipelines in the area.	i (g)
Publish Advisory Notices in at least two local newspapers.	ii (d)
Notify residents, communities and businesses two weeks prior to the commencement of works.	ii (e)
Designate a Community Relations Officer.	iii (d)

7.4 Requirements for the Additional CEC

As noted in Section 3.2.2.4,an Additional CEC will be required to incorporate into this project the replacement of the Bregon Park and Timberland WWTPs with sewage lift stations. Public consultation is a requirement for obtaining a CEC, whether or not an EIA is required. The following sub-sections describe the form of the consultation in each case.

7.4.1 When an EIA is not Required

On recent projects where an EIA has not been required, the EMA has requested evidence of consultation with neighbours. This has taken the form of distributing fliers concerning the project and inviting feedback, or hosting meetings with neighbours to introduce and discuss the project and receive concerns. The results of the consultation are then documented in a report

which is submitted to the EMA. The request for evidence of consultation with neighbours normally comes as "a request for additional information", and the CEC is not granted until the EMA has received and reviewed the report on the consultation.

7.4.2 When an EIA is Required

If an EIA is required for the additional CEC for works at Bregon Park and Timberland (see Section 3.2.2.4), the requirement for public consultation will be stipulated in the Terms of Reference (see Section 3.2.2). This requirement is normally set out in some detail. Overall, the EMA requires that public engagement in the EIA process should be accessible, transparent, accountable, and flexible, should provide for certainty, and should be conducted with integrity.

On a recent project, the Applicant was required to facilitate a minimum of two public meetings with the potentially affected communities / stakeholders; the first to be held to introduce the project and the second to present the findings of the EIA. At each meeting the Applicant was required to ensure that experts who worked on the EIA as well as representatives from the Applicant's company were available to respond to questions and concerns related to their respective fields.

The listing of stakeholders to be invited to public meetings normally includes:

- The Parliamentary Representative(s) for the potentially impacted area,
- The Municipal and Regional Corporations in the potentially impacted area,
- Government Ministries / Departments / Statutory Authorities,
- Environmental experts,
- Community-based organisations, environmental and other non-governmental organisations,
- Service and Utility companies operating in the vicinity,
- Other business interests that can be affected by the project, and
- The general public.

The following guidelines for the public consultations are also normally included in the Terms of Reference:

<u>Venue and Date</u>

- The public consultations shall be hosted at locations that are easily accessible to the communities that can be directly affected by the project.

- The venues must have the capacity for at least one hundred attendees.

- Meetings shall be held at a time that is best suited for maximized attendance.

Advertising

- The public meetings shall be advertised in at least one national newspaper at least one week before the date of the meeting, with the advertisements occupying at least one quarter of a page.

- Flyers should be placed at popular stops within the communities (gas stations, supermarkets, banks and drugstores).

- Letters should be sent to those stakeholders who may not reside in the affected communities.

Handout Material

At least two weeks prior to each meeting, an appropriate number of copies of a printed summary of the project must be distributed to the relevant communities.

Meeting Format

During the first meeting, the proponent or representative(s) of the proponent shall give a clear and concise synopsis of the proposed project, including:

- Introduction of the Organization proposing to implement the project,

- The precise location of the project,

- The activities to be undertaken by the proponent, and

- An overview of the environmental studies to be conducted as part of the EIA.

The second meeting will present the findings of the EIA, including potential impacts and risks as well as measures to mitigate or reduce such impacts and risks. Information should be graphic, concise and clear and designed in a manner that would elicit participation. The schedule should allow stakeholders time for assessment of the information presented and submission of concerns.

At each meeting the floor must be opened for comments / questions, which may be appropriately managed in the interest of time and in an effort to extract the salient points. All comments / questions from the meeting(s) will be submitted as script and attached in an appendix of the EIA Report.

8 WASA CAPABILITY AND CONTRACT REQUIREMENTS

This chapter discusses WASA's capability to manage the environmental and social requirements described earlier in this report, and summarizes specific requirements to be included in the Contracts for this project.

8.1 WASA Capability

This section discusses the capability of two departments of WASA to undertake selected environmental requirements on this project:

- the Environmental and Regulatory Compliance Department, and
- the Laboratory.

8.1.1 Environmental and Regulatory Compliance Department

WASA's Environmental and Regulatory Compliance Department (ERCD) consists of the following personnel:

- Manager,
- Assistant Manager,
- Corporate Development Officer,
- 2 Management Assistants, and
- Engineer Apprentice Trainee.

The current holders of each of those posts all have Bachelor's degrees, and three have postgraduate qualifications.

It is envisaged that the ERCD will be assigned the following environmental work items on this project:

- Preparing the Application foran Additional CEC for Works at Bregon Park and Timberland,
- Organizing and Hosting Public Meetings, and
- Advertising the Start of Construction.

This Department is considered capable of undertaking these work items.

The ERCD is also capable of undertaking the following:

- Finalizing the Environmental and Social Management Plan (ESMP),
- Preparing a Road Traffic Management Plan,
- Preparing an Emergency Prevention and Response Plan, and
- Preparing a QAPP.

However, it is recommended that finalizing the ESMP should be the responsibility of the environmental professionals on the Design Engineer's team, since they would have better access to the specifics of the project design. In like manner, the preparation of the Road Traffic Management Plan and the Emergency Prevention and Response Plan should be prepared by the Contractor since these are integral to his work. Finally, the preparation of the QAPP would be most efficient if assigned to an independent consultant.

This ESA also recommends that the opportunity be taken to review and upgrade WASA's sampling and laboratory operations, including an element of training (see Section 6.2.3.1). It does not appear that the ERCD has in-house competence to undertake this work. In addition, the use of an outside specialist would bring a desirable degree of independence to the review process.

8.1.2 Laboratory

It appears that WASA's Laboratory is capable of all of the sampling required for this project, and for undertaking all of the required testing except for Ammoniacal Nitrogen, Total Phosphorus and Oil & Grease. These three tests are available at local commercial laboratories (see Section 6.2.1). The review of WASA's sampling and laboratory procedures and training which is recommended as part of the QAPP will serve as a quality improvement effort for the WASA Laboratory.

It is considered unlikely that the sampling and testing required for this project can be accommodated under the present budget of the laboratory. This is a fairly large program, which would cost over $TT 1 million over 5 years if contracted to commercial laboratories. Provision should therefore be made under this project for increasing the budget of the WASA Laboratory to cover the cost of this sampling and testing.

8.2 Contract Requirements

It is expected that WASA will contract three firms to undertake different aspects of this work (see Appendix B): a Design Engineer, a Supervising Engineer and a Contractor. Recommendations for items to be included in these contracts are presented below.

8.2.1 Design Engineer's Contract

The following items are recommended to be included in WASA's contract with the Design Engineer:

- CEC 1469/2006 should be made a part of the contract with a requirement that the Design Engineer conform to all relevant clauses.

- Contamination Studies at all 7 orphan WWTP sites should be included in the Design Engineer's Scope of Work, with a view to quantifying the nature and extent of any contamination, recommending appropriate PPE for workers on the site, and determining the best method of treatment and disposal.

- This ESA Report, including the outline ESMP, should be made available to the Design Engineer as a reference document.

- Finalizing the ESMP should be included in the Design Engineer's Scope of Work

- Determining appropriate acceleration for earthquake resistant design, tropical cyclone wind speed for structural design and tropical cyclone rainfall intensity for drainage design should be included in the Design Engineer's Scope of Work.

8.2.2 Supervising Engineer's Contract

The following items are recommended to be included in WASA's contract with the Supervising Engineer:

- CEC 1469/2006 should be made a part of the contract with a requirement that the Supervising Engineer conform to all relevant clauses.

- The Additional CEC for works at Bregon Park and Timberland WWTPs should also be made a part of the contract with a requirement that the Supervising Engineer conform to all relevant clauses.

- The finalized ESMP should be made part of the contract with a requirement that the Supervising Engineer follow to the procedures therein.

8.2.3 Contractor's Contract

The following items are recommended to be included in WASA's contract with the Contractor:

- CEC 1469/2006 should be made a part of the contract with a requirement that the Contractor conform to all relevant clauses.

- The Additional CEC for works at Bregon Park and Timberland WWTPs should also be made a part of the contract with a requirement that the Contractor conform to all relevant clauses.

- The preparation of a Road Traffic Management Plan and an Emergency Prevention and Response Plan should be included in the Contractor's Scope of Work.

- The finalized ESMP should be made part of the contract with a requirement that the Contractor follow to the procedures therein.

9 COST ESTIMATES

This chapter provides cost estimates for various items listed in the previous chapters. The final section is a summary of costs by project phase. Throughout this chapter, the costs are estimated from recent cost of similar work items, and from unit rates for commercial firms to undertake the work.

9.1 CEC Requirements, Management Plans, etc

In this section cost estimates are provided for:

- An Additional CEC for Works at Bregon Park and Timberland,
- Review of WASA's Sampling and Testing Procedures,
- Public Meetings,
- Finalizing the Environmental and Social Management Plan (ESMP),
- Preparing a Road Traffic Management Plan,
- Preparing an Emergency Prevention and Response Plan,
- Advertising the Start of Construction, and
- Preparing a QAPP.

9.1.1 Additional CEC

As indicated in Section 3.2.2.4, a CEC must be obtained for the proposed works at Bregon Park and Timberland. The application may be prepared by WASA's Environmental and Regulatory Compliance Department or by a consultant, and is likely to be submitted in the third quarter of 2012, after the preliminary design for the project has been completed. The cost of having a consultant prepare and submit the application for the Additional CEC, inclusive of the $TT 500.00 application fee, is estimated at $TT 25,000.00. This amount will be included in WASA's in-house budget for this project.

9.1.2 Review of WASA's Sampling and Testing Procedures

As indicated in Section 6.2.3.1, an extensive program of sampling and testing will be undertaken by WASA on this program in the Maloney, San Fernando and Couva Sewerage Regions. This provides an opportunity to review and upgrade the sampling and testing procedure of the WASA Lab.

The specialist for this review can be sourced locally. For example, Premier Quality Services Limited (PQSL - the training and consultancy subsidiary of the Trinidad & Tobago Bureau of Standards) has confirmed their competence and availability to undertake work of this kind. It is recommended that this work be undertaken early in the life of the project (First Quarter, 2011). The estimated cost of this work (review, recommendations and training) is $TT 90,000.00. This amount will be included in the project budget for hiring the Sampling and Testing Specialist.

9.1.3 Public Meetings

As noted in Section 7.4, the EMA is expected to request public meetings as part of the Additional CEC Application, whether or not an EIA is requested. Costs associated with those meetings include newspaper advertisements, rental of a venue, provision of a public address system in the hall, recording and transcribing the discussions and refreshments. These meetings are likely to be held in the third quarter of 2011, and the estimated cost of hosting one public meeting is $TT 45,000.00. This amount will be included in WASA's in-house budget for this project.

9.1.4 Finalizing the ESMP

The ESMP will be finalized close to the end of the design phase of the project, when full designs are available for the various project elements. This is likely to be during the fourth quarter of 2012. It is recommended that the final ESMP be prepared by the environmental specialist on the Design Engineer's team (see Section 8.1.1). The cost of having the environmental specialist prepare the final ESMP, is estimated at $TT 50,000.00. This amount will be included in the Design Engineer's contract.

9.1.5 Road Traffic Management Plan

CEC 1469/2006 stipulates that a Road Traffic Management Plan (RTMP) must be submitted to the EMA at least 2 weeks prior to the commencement of works. Therefore, this plan is likely to be prepared in the second quarter of 2013. As indicated in Section 6.4, this plan is best prepared by the Contractor, or by a traffic management specialist hired by the Contractor. The cost of having a traffic management specialist prepare the RTMP, is estimated at $TT 45,000.00. This amount will be included in the Contractor's contract.

9.1.6 Emergency Prevention and Response Plan

CEC 1469/2006 stipulates that an Emergency Prevention and Response Plan (EPRP) must be developed prior to the commencement of works. Therefore, this plan is likely to be prepared in the second quarter of 2013. As indicated in Section 6.4, this plan is best prepared by the Contractor, or by a H & S specialist hired by the Contractor. The cost of having an H & S specialist prepare the EPRP, is estimated at $TT 90,000.00. This amount will be included in the Contractor's contract.

9.1.7 Advertising the Start of Construction

As noted in Section 7.3, WASA is required to advertise the start of construction by placing advertisements in at least two newspapers, and by placing fliers in potentially affected communities. This will need to be done in the first quarter of 2013, and the cost two advertisements plus the printing and distribution of fliers is estimated at $TT 35,000.00. This amount will be included in WASA's in-house budget for this project.

9.1.8 Quality Assurance Project Plan

CEC 1469/2006 stipulates that a Quality Assurance Project Plan (QAPP) must be submitted to the EMA at least 90 working days prior to the commissioning of the upgraded and expanded Maloney WWTP. Therefore, this plan is likely to be prepared in the fourth quarter of 2014. As indicated in Section 6.4, this plan is best prepared by a consultant hired by WASA. The cost of having a consultant prepare the QAPP is estimated at $TT 52,000.00. This amount will be included in the project budget for hiring the QAPP Consultant.

9.2 Mitigation Measures

Implementing the mitigation measures listed in Section 6.1 will be the responsibility of the Contractor, verified by the Supervising Engineer. For the most part, the mitigation measures are construction "good-practices" which will not be priced separately. Instead, the cost of such measures will be included in the rates charged for different construction activities.

However, there are two items which can be separately priced:

- Contamination Surveys at the 7 Orphan Plants, and
- Noise Baseline Studies.

9.2.1 Contamination Surveys

In Section 6.1 it is recommended that contamination surveys be undertaken at the abandoned plants prior to the commencement of demolition / dismantling work. Such surveys will quantify the nature and volume of contaminated material present at each site, and will assist in determining appropriate PPE for workers and also the best disposal site. It is recommended that this work be undertaken by the Design Engineer, perhaps in the second quarter of 2012. The cost of the contamination survey at each of the seven orphan WWTP sites is estimated at $TT 50,000.00. This amount would be included in the Design Engineer's contract.

9.2.2 Noise Baseline Studies

Baseline noise studies must be undertaken during the design phase of this project, and may also be undertaken during the construction phase.

9.2.2.1 Design Phase

As indicated in Section 3.2.4, these facilities are situated in the General Area where the allowable limits are stated in reference to background noise levels. In order to determine allowable noise levels at the lift stations and WWTPs, the Design Engineer must monitor ambient noise levels in the area of each of these facilities. The EMA normally stipulates that noise monitoring at any location should be done on three locations over a 2-week period. Such monitoring is likely to be undertaken in the second quarter of 2012, and the cost of a noise monitoring study at one location is estimated at $TT 20,000.00. This amount will be included in the Design Engineer's contract.

9.2.2.2 Construction Phase

Also as stated in Section 3.2.4, the Contractor must seek a Noise Variation to undertake construction work during the night. The Contractor may decide to re-establish baseline noise levels shortly before the submission of the Application for a Noise Variation. The exact timing of any potential night work is not known at this time, but it may be assumed that such work will be scheduled later in the construction period – say the first quarter of 2014. As before, the cost of a noise monitoring study at one location is estimated at $TT 20,000.00. This amount will be included in the Contractor's contract.

9.3 Monitoring

In this section provides cost estimates for:

- HSE Inspector on the Supervising Engineer's Team,
- In-Stream Water Quality Monitoring, and
- WWTP Effluent Quality Monitoring.

9.3.1 HSE Inspector

On projects of this type, it is now standard practice in Trinidad & Tobago to have a Health, Safety and Environment Inspector on the Supervising Engineer's Team assigned full-time to the project. This HSE Inspector is assigned for the full construction period. The estimated quarterly charging rate for such an Inspector, based on presence on site 10 hours per day and 6 days per week is $TT 170,000.00. This amount will be included in the Supervising Engineer's contract.

9.3.2 In-Stream Water Quality Monitoring

As indicated in Section 6.2.2, in-stream monitoring upstream and downstream of the upgraded and expanded Maloney WWTP is stipulated in CEC 1469/2006, and similar in-stream monitoring is also recommended at the seven orphan WWTPs. The estimated cost of this monitoring per sampling event is shown in Table 9-1. This amount will be included in WASA's in-house budget for this project.

TABLE 9-1: COST OF IN-STREAM MONITORING

ITEM	UNIT	NUMBER	RATE	AMOUNT
Sampling Crew	days	2	$2,000.00	$4,000.00
Laboratory Testing	per sample	16	$2,525.00	$40,400.00
Report	each	1	$500.00	$500.00
TOTAL COST PER SAMPLING EVENT				**$44,900.00**

9.3.3 WWTP Effluent Monitoring

As indicated in Section 6.2.1, monitoring of the effluent from the upgraded and expanded Maloney WWTP is stipulated in CEC 1469/2006. The estimated cost of this monitoring per sampling event (including flow estimation) is shown in Table 9-2. This amount will be included in WASA's in-house budget for this project.

TABLE 9-2: COST OF WWTP EFFLUENT MONITORING

ITEM	UNIT	NUMBER	RATE	AMOUNT
Sampling Crew	days	1	$2,000.00	$2,000.00
Laboratory Testing	per sample	1	$2,525.00	$2,525.00
Report	each	1	$500.00	$500.00
TOTAL COST PER SAMPLING EVENT				**$5,025.00**

9.4 Summary of Costs

Table 9-3 provides a summary of estimated costs by project phase.

TABLE 9-3: SUMMARY OF COSTS OF ENVIRONMENTAL REQUIREMENTS

YEAR / QUARTER	PROJECT PHASE	ITEM	ESTIMATED COST ($TT)
2012 Quarter 1	Design	Review of WASA Laboratory's Sampling and	$90,000.00

YEAR / QUARTER	PROJECT PHASE	ITEM	ESTIMATED COST ($TT)
		Testing Procedures	
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	134,900.00
2012 Quarter 2	Design	In-Stream Monitoring	$44,900.00
		Baseline Noise Monitoring at 8 Locations	$160,000.00
		Quarterly Sub-Total	$204,900.00
2012 Quarter 3	Design	Prepare and Submit CEC Application	$25,000.00
		Host two Public Meetings	90,000.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$159,900.00
2012 Quarter 4	Design	In-Stream Monitoring	$44,900.00
		Contamination Surveys at 7 Orphan WWTP Sites	$350,000.00
		Finalize the Environmental and Social Management Plan	$50,000.00
		Quarterly Sub-Total	$444,900.00
		Annual Total for 2012	**$944,600.00**
2013 Quarter 1	Construction	Prepare Road Traffic Management Plan	$45,000.00
		Prepare Emergency Prevention and Response Plan	$95,000.00
		Advertising the Start of Construction	$35,000.00
		HSE Inspector	$170,000.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$389,900.00
2013 Quarter 2	Construction	HSE Inspector	$170,000.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$214,900.00
2013 Quarter 3	Construction	HSE Inspector	$170,000.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$214,900.00
2013 Quarter 4	Construction	HSE Inspector	$170,000.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$214,900.00
		Annual Total for 2013	**$1,034,600.00**
2014 Quarter 1	Construction	HSE Inspector	$170,000.00

YEAR / QUARTER	PROJECT PHASE	ITEM	ESTIMATED COST ($TT)
		Baseline Noise Monitoring at 8 Locations	$160,000.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$374,900.00
2014 Quarter 2	Construction	HSE Inspector	$170,000.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$214,900.00
2014 Quarter 3	Construction	HSE Inspector	$170,000.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$214,900.00
2014 Quarter 4	Construction	HSE Inspector	$170,000.00
		In-Stream Monitoring	$44,900.00
		Prepare a Quality Assurance Project Plan	$52,000.00
		Quarterly Sub-Total	$214,900.00
		Annual Total for 2014	**$1,019,600.00**
2015 Quarter 1	Operation	WWTP Effluent Monitoring	$5,025.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$49,925.00
2015 Quarter 2	Operation	WWTP Effluent Monitoring	$5,025.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$49,925.00
2015 Quarter 3	Operation	WWTP Effluent Monitoring	$5,025.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$49,925.00
2015 Quarter 4	Operation	WWTP Effluent Monitoring	$5,025.00
		In-Stream Monitoring	$44,900.00
		Quarterly Sub-Total	$49,925.00
		Annual Total for 2015	**$199,700.00**
2016 Quarter 1	Operation	In-Stream Monitoring	$44,900.00
		WWTP Effluent Monitoring	$5,025.00
		Quarterly Sub-Total	$49,925.00
2016 Quarter 2	Operation	In-Stream Monitoring	$44,900.00
		WWTP Effluent Monitoring	$5,025.00
		Quarterly Sub-Total	$49,925.00
2016 Quarter 3	Operation	In-Stream Monitoring	$44,900.00
		WWTP Effluent Monitoring	$5,025.00

YEAR / QUARTER	PROJECT PHASE	ITEM	ESTIMATED COST ($TT)
		Quarterly Sub-Total	$49,925.00
2016 Quarter 4	Operation	In-Stream Monitoring	$44,900.00
		WWTP Effluent Monitoring	$5,025.00
		Quarterly Sub-Total	$49,925.00
		Annual Total for 2016	**$199,700.00**

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TRINIDAD & TOBAGO WASTEWATER INFRASTRUCTURE REHABILITATION PROGRAM (TT-L1018): ORPHAN WWTPs IN THE MALONEY SEWERAGE REGION

ENVIRONMENTAL AND SOCIAL ANALYSIS

APPENDIX A: WATER QUALITY RESULTS

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APPENDIX A: WATER QUALITY RESULTS

A.1 INTRODUCTION

A.1.1 Scope

This appendix reports the results of water quality sampling and testing undertaken by the Water and Sewerage Authority (WASA) as part of the Environmental and Social Analysis for improvement works at wastewater treatment plants in the Maloney Sewerage Region.

A.1.2 Layout of Appendix

This Appendix consists of 4 sections. The remainder of this introductory section describes the Maloney Sewerage Region, and Section 2 is a Method Statement. Section 3 presents and discusses the water quality results, and Section 4 is a Summary of Findings.

A.1.3 The Maloney Sewerage Region

The Maloney Sewerage Region includes the Maloney Waste Water Treatment Plant (WWTP) as well as seven smaller WWTPs (see Figure A-1):

- Bregon Park,
- Lynton Gardens,
- Lillian Heights,
- La Florissante,
- Santa Monica Gardens,
- La Resource, and
- Timberland.

As part of this assignment, WASA sampled and tested water from the streams (and raw sewage where accessible) at the Bregon Park, Lynton Gardens, Lillian Heights and La Florissante WWTPs.

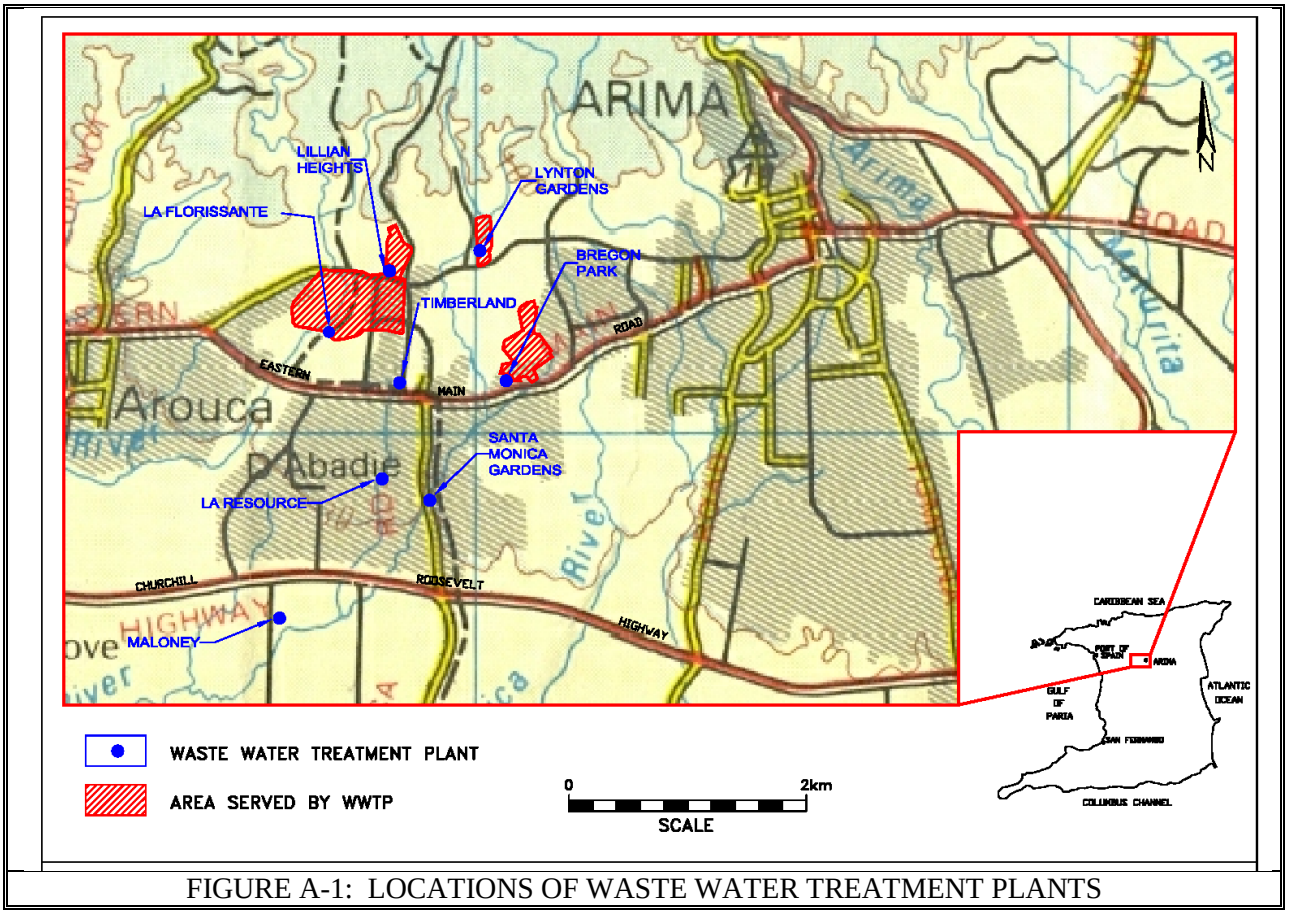

FIGURE A-1: LOCATIONS OF WASTE WATER TREATMENT PLANTS

A.2 METHOD STATEMENT

This chapter discusses the selection of sampling locations and dates, and provides information on the lab testing.

A.2.1 Sampling Locations and Dates

Sampling locations were agreed between WASA Staff and Dr. George Sammy, based on accessibility. The rationale for each of the sampling locations is discussed below, and the approximate GPS Co-ordinates of each sampling location is provided in the last sub-section. Samples were taken at Bregon Park, Lynton Gardens, Lillian Heights and La Florissante WWTPs on July 4, 6 and 13, 2011, and at Maloney WWTP on August 5, 8 and 11, 2011.

A.2.1.1 Maloney WWTP

Of the two treatment trains at the Maloney WWTP, it was reported that only one was operable in August 2011. Effluent from both trains is discharged to a common manhole, and is then piped to a surface drain which flows approximately 200 m to the Oropuna River (the receiving stream). Samples were taken in the common manhole, approximately 100 m south of the plant in the surface drain, approximately 200 m upstream of the point of discharge into the River, and approximately 50 m downstream of that point of discharge.

A.2.1.2 Bregon Park

No effluent nor raw sewage overflow was noted at the abandoned Bregon Park WWTP. Water samples were therefore taken from the receiving stream approximately 300 m upstream and 200 m downstream of the WWTP.

A.2.1.3 Lynton Gardens

At this abandoned WWTP, raw sewage overflow as noted on the site. This was sampled for testing. In addition, water samples were taken from the receiving stream approximately 40 m upstream and 80 m downstream of the WWTP.

A.2.1.4 Lillian Heights

No effluent nor raw sewage overflow was noted at the abandoned Lillian Heights WWTP. Water samples were therefore taken from the receiving drain approximately 25 m upstream and 25 m downstream of the WWTP. The downstream location was beyond the confluence with another drain, and so represented mixed water from the WWTP site and from other areas.

A.2.1.5 La Florissante

At this abandoned WWTP, raw sewage overflow as noted on the site. This was sampled for testing. In addition, water samples were taken from the receiving stream at three locations. The location furthest upstream was in an area of agricultural activity, approximately 750 m upstream of the WWTP. The second upstream location receives runoff from the La Florissante development as well as other housing along Arima Old Road. This is located approximately 750 m upstream of the WWTP. The final sampling point is located approximately 150 m downstream of the WWTP.

A.2.1.6 GPS Co-ordinates

Table A-1 lists approximate GPS co-ordinates for each sampling location. These were recorded using a Garmin GPSMAP 76CSx handheld unit.

TABLE A-1: APPROXIMATE GPS CO-ORDINATES FOR SAMPLE LOCATIONS.

WWTP	LOCATION	NORTHING	EASTING
Maloney	Upstream	1,173,288	683,460
	Common Manhole	1,173,720	683,335
	Surface Drain	1,173,481	683,278
	Downsteam	1,173,204	683,233
Bregon Park	Upstream	1,175,820	685,524
	Downstream	1,175,540	685,390
Lynton Gardens	Upstream	1,176,797	685,298
	On site	1,176,776	685,310
	Downstream	1,176,751	685,258
Lillian Heights	Upstream	1,176,554	684,526
	Downstream	1,176,514	684,497
La Florissante	Far Upstream	1,176,544	684,054
	Upstream	1,176,340	684,158
	On site	1,176,024	684,027
	Downstream	1,176,022	683,888

A.2.2 Laboratory Testing

Samples were tested for temperature on site. The samples were then taken to the WASA Lab and tested for the following parameters:

- pH,
- Total Suspended Solids,
- Dissolved Oxygen,
- Chemical Oxygen Demand,
- 5-day Biological Oxygen Demand, and
- Faecal Coliforms.

A.3 MALONEY WWTP: RESULTS AND DISCUSSION

This section presents and describes the results of tests done on samples from the Maloney WWTP.

A.3.1 Raw Sewage

The quality of raw sewage entering the Maloney WWTP is shown in Table A.2.

TABLE A-2: RAW SEWAGE QUALITY

PARAMETER	SAMPLE TAKEN AUG 5, 2011	SAMPLE TAKEN AUG 8, 2011	SAMPLE TAKEN AUG 11, 2011	AVERAGE
Temperature (^{o}C)	30	28	30	29.3
pH	7.5	7.3	7.5	---
TSS (mg/L)	304	114	108	175.3
Dissolved Oxygen (mg/L)	0	0	0	0
BOD (mg/L)	514	168	141	274.3

A.3.1 Raw Sewage

The effluent and stream results obtained for the Maloney WWTP are presented in Table A.3, and these are discussed below.

TABLE A-3: RESULTS FOR MALONEY WWTP

DATE	UPSTREAM IN Oropuna RIVER	EFFLUENT FROM COMMON MANHOLE	SURFACE DRAIN	DOWNSTREAM IN *** RIVER
Temperature (^{o}C)				
August 5, 2011	28	30	30	28
August 8, 2011	28	28	30	28
August 11, 2011	28	30	30	29
Average	28	29.3	30	28.3
pH				
August 5, 2011	7.2	7.2	7.3	7.2
August 8, 2011	7.2	7.4	7.4	7.3
August 11, 2011	7.2	7.2	7.4	7.3

DATE	UPSTREAM IN Oropuna RIVER	EFFLUENT FROM COMMON MANHOLE	SURFACE DRAIN	DOWNSTREAM IN *** RIVER
Total Suspended Solids (mg/L)				
August 5, 2011	13	35	49	36
August 8, 2011	6	45	38	34
August 11, 2011	5	19	37	32
Average	8	33	41.3	34
Dissolved Oxygen (mg/L)				
August 5, 2011	3	4	2	3
August 8, 2011	4	1	1	1
August 11, 2011	4	4	1	2
Average	3.7	3	1.3	2
Chemical Oxygen Demand (mg/L)				
August 5, 2011	30	59	60	36
August 8, 2011	18	96	80	41
August 11, 2011	22	35	58	40
Average	23.3	63.3	66	39
Biological Oxygen Demand (mg/L)				
August 5, 2011	6	27	26	14
August 8, 2011	9	42	49	27
August 11, 2011	1	19	36	18
Average	5.3	29.3	37	19.7
Faecal Coliforms (mg/L)				
August 5, 2011	12,000	195,000	175,000	360,000
August 8, 2011	2,200	1,300,000	660,000	370,000
August 11, 2011	20,000	630,000	620,000	200,000
Average	11,400	708,333	485,000	310,000

In summary:

- Temperatures and pH values were all in the range expected for effluent and receiving streams in Trinidad & Tobago.

- Average Total Suspended Solids (TSS), Chemical Oxygen Demand (COD) and 5-day Biological Oxygen Demand (BOD_5) values downstream were consistently higher than corresponding values upstream, which is consistent with the discharge of moderate levels of TSS, COD and BOD from the WWTP.

< Faecal Coliform values upstream were consistently lower than downstream, which is consistent with the discharge of high levels of Faecal Coliforms from the WWTP.

A.4 ORPHAN WWTPs: RESULTS AND DISCUSSION

This chapter presents and discusses the test results obtained form the Orphan WWTPs, by parameter.

A.4.1 Temperature

The recorded temperatures are summarized in Table A-4. Average temperatures in the receiving streams ranged from of raw sewage sampled at ranged from 26.3 °C to 28.7 °C, which is as expected for streams of this size in Trinidad & Tobago. Average temperatures of the raw sewage collected at Lynton Gardens and La Florissante were 28.7 °C and 29.3 °C, respectively. These were a little higher than the temperatures in the streams, likely because of the shallower water courses from which the raw sewage samples were taken, which would be heated more by the sun.

TABLE A-4: TEMPERATURE (°C) RESULTS

DATE	FAR UPSTREAM	UPSTREAM	RAW	DOWNSTREAM
Bregon Park				
July 4, 2011	--	27.0	--	28.0
July 6, 2011	--	26.0	--	26.0
July 13, 2011	--	26.0	--	27.0
Average	--	26.3	--	27.0
Lynton Gardens				
July 4, 2011	--	28.0	29.0	28.0
July 6, 2011	--	26.0	28.0	26.0
July 13, 2011	--	27.0	29.0	27.0
Average	--	27.0	28.7	27.0
Lillian Heights				
July 4, 2011	--	32.0	--	31.0
July 6, 2011	--	26.0	--	26.0
July 13, 2011	--	28.0	--	28.0
Average	--	28.7	--	28.3
La Florissante				
July 4, 2011	27.0	28.0	32.0	29.0
July 6, 2011	26.0	26.0	28.0	26.0
July 13, 2011	26.0	26.0	28.0	27.0

Average	26.3	26.7	29.3	27.3

A.4.2 pH

The recorded pH values are summarized in Table A-6. The pH values in the streams ranged between 5.5 and 9.1, the lowest values all being measured upstream and downstream of the Bregon Park WWTP. The recorded pH values in the raw sewage collected at Lynton Gardens and La Florissante ranged from 6.7 to 7.4.

TABLE A-5: pH RESULTS

DATE	FAR UPSTREAM	UPSTREAM	RAW	DOWNSTREAM
Bregon Park				
July 4, 2011	--	5.5	--	6.7
July 6, 2011	--	5.6	--	6.8
July 13, 2011	--	5.8	--	6.9
Lynton Gardens				
July 4, 2011	--	6.9	6.7	7.0
July 6, 2011	--	7.0	6.8	7.1
July 13, 2011	--	7.0	7.0	7.2
Lillian Heights				
July 4, 2011	--	9.1	--	7.5
July 6, 2011	--	7.9	--	7.6
July 13, 2011	--	8.1	--	7.7
La Florissante				
July 4, 2011	8.4	8.0	7.2	7.5
July 6, 2011	7.5	7.2	7.0	7.1
July 13, 2011	7.8	7.6	7.4	7.6

A.4.3 Total Suspended Solids

The measured values of Total Suspended Solids (TSS) are summarized in Table A-6. Average TSS values in the streams ranged from 18.7 mg/L to 52.3 mg/L. In all cases except Lillian Heights, the average TSS upstream was lower than the average TSS downstream, suggesting that sewage is entering the streams and contributing solids. As expected, the average TSS in raw sewage samples was higher than the upstream values in the corresponding receiving streams: 74 mg/L as compared to 18.7 mg/L at Lynton Gardens and 57 mg/L as compared to 24 mg/L at La Florissante.

TABLE A-6: TSS (mg/L) RESULTS

DATE	FAR UPSTREAM	UPSTREAM	RAW	DOWNSTREAM
Bregon Park				
July 4, 2011	--	8.0	--	13.0
July 6, 2011	--	75.0	--	130.0
July 13, 2011	--	14.0	--	14.0
Average	--	32.3	--	52.3
Lynton Gardens				
July 4, 2011	--	6.0	140.0	14.0
July 6, 2011	--	43.0	47.0	82.0
July 13, 2011	--	7.0	35.0	7.0
Average	--	18.7	74.0	34.3
Lillian Heights				
July 4, 2011	--	34.0	--	26.0
July 6, 2011	--	41.0	--	15.0
July 13, 2011	--	43.0	--	24.0
Average	--	39.3	--	21.7
La Florissante				
July 4, 2011	20.0	5.0	88.0	19.0
July 6, 2011	48.0	57.0	33.0	72.0
July 13, 2011	5.0	10.0	50.0	7.0
Average	24.3	24.0	57.0	32.7

A.4.4 Dissolved Oxygen

The measured values of Dissolved Oxygen (DO) are summarized in Table A-7. Average DO values in the streams ranged from 2.3 mg/L to 8.0 mg/L. In all cases the average DO upstream was higher than the average DO downstream. As expected, the average DO in raw sewage samples taken were very low, with no DO being measured at Lynton Gardens WWTP while at La Florissante WWTP an average of 1.3 mg/L was measured.

TABLE A-7: DO (mg/L) RESULTS

DATE	FAR UPSTREAM	UPSTREAM	RAW	DOWNSTREAM
Bregon Park				
July 4, 2011	--	7.0	--	1.0
July 6, 2011	--	7.0	--	6.0
July 13, 2011	--	7.0	--	0.0
Average	--	7.0	--	2.3
Lynton Gardens				
July 4, 2011	--	7.0	0.0	5.0
July 6, 2011	--	8.0	0.0	8.0
July 13, 2011	--	7.0	0.0	5.0
Average	--	7.3	0.0	6.0
Lillian Heights				
July 4, 2011	--	7.0	--	6.0
July 6, 2011	--	8.0	--	8.0
July 13, 2011	--	4.0	--	4.0
Average	--	6.3	--	6.0
La Florissante				
July 4, 2011	8.0	8.0	0.0	8.0
July 6, 2011	8.0	8.0	0.0	7.0
July 13, 2011	8.0	8.0	4.0	7.0
Average	8.0	8.0	1.3	7.3

A.4.5 Chemical Oxygen Demand

The measured values of the Chemical Oxygen Demand (COD) are summarized in Table A-8. Average COD values for the streams ranged from 11.0 mg/L to 129.7 mg/L. In all cases except La Florissante, the average COD upstream was higher than the average COD downstream. The average COD for the raw sewage sample taken at Lynton Gardens was 166.3 mg/L.

TABLE A-8: COD (mg/L) RESULTS

DATE	FAR UPSTREAM	UPSTREAM	RAW	DOWNSTREAM
Bregon Park				
July 4, 2011	--	17.0	--	46.0
July 6, 2011	--	46.0	--	47.0
July 13, 2011	--	134.0	--	60.0
Average	--	65.7	--	51.0
Lynton Gardens				
July 4, 2011	--	6.0	371.0	7.0
July 6, 2011	--	29.0	119.0	53.0
July 13, 2011	--	146.0	9.0	23.0
Average	--	60.3	166.3	27.7
Lillian Heights				
July 4, 2011	--	104.0	--	53.0
July 6, 2011	--	54.0	--	43.0
July 13, 2011	--	231.0	--	104.0
Average	--	129.7	--	66.7
La Florissante				
July 4, 2011	2.0	14.0	--	8.0
July 6, 2011	22.0	23.0	--	27.0
July 13, 2011	10.0	11.0	--	14.0
Average	11.3	16.0	--	16.3

A.4.6 5-day Biological Oxygen Demand

The measured values of the 5-day Biological Oxygen Demand (BOD_5) are summarized in Table A-9. Average BOD_5 values for the streams ranged from 0.5 mg/L to 15.7 mg/L. The average BOD_5 measured in raw sewage samples at Lynton Gardens and La Florissante was 79.3 mg/L and 61.3 mg/L respectively and, as expected, these values were much higher than any of the values measured in the corresponding receiving streams.

TABLE A-9: 5-DAY BOD (mg/L) RESULTS

DATE	FAR UPSTREAM	UPSTREAM	RAW	DOWNSTREAM
Bregon Park				
July 4, 2011	--	0.0	--	10.0
July 6, 2011	--	1.0	--	8.0
July 13, 2011	--	--	--	29.0
Average	--	0.5	--	15.7
Lynton Gardens				
July 4, 2011	--	1.0	81.0	4.0
July 6, 2011	--	3.0	71.0	5.0
July 13, 2011	--	1.0	86.0	7.0
Average	--	1.7	79.3	5.3
Lillian Heights				
July 4, 2011	--	8.0	--	9.0
July 6, 2011	--	6.0	--	5.0
July 13, 2011	--	10.0	--	7.0
Average	--	8.0	--	7.0
La Florissante				
July 4, 2011	0.0	0.0	76.0	5.0
July 6, 2011	1.0	24.0	53.0	5.0
July 13, 2011	--	--	55.0	7.0
Average	0.5	12.0	61.3	5.7

A.4.7 Faecal Coliform

The measured values of Faecal Coliforms are summarized in Table A-10. Average Faecal Coliform values in the streams ranged from 1,400 Cfu/100mls to 436,667 Cfu/100mls. In all cases except for Lillian Heights, the average values of Faecal Coliform measured upstream were much lower than downstream average values. At Lillian Heights, upstream and downstream average values were of the same order of magnitude. The average Faecal Coliforms in the raw sewage sample taken at Lynton Gardens was 370,000 Cfu/100mls.

TABLE A-10: FAECAL COLIFORMS (cfu/100mls) RESULTS

DATE	FAR UPSTREAM	UPSTREAM	RAW	DOWNSTREAM
Bregon Park				
July 4, 2011	--	420	--	200,000
July 6, 2011	--	5,500	--	250,000
July 13, 2011	--	40	--	860,000
Average	--	1987	--	436,667
Lynton Gardens				
July 4, 2011	--	119,000	200,000	196,000
July 6, 2011	--	7,000	860,000	200
July 13, 2011	--	50,000	50,000	43,000
Average	--	58,667	370,000	79,733
Lillian Heights				
July 4, 2011	--	74,000	--	89,000
July 6, 2011	--	200	--	1,400
July 13, 2011	--	30,000	--	3,000
Average	--	34,733	--	31,133
La Florissante				
July 4, 2011	--	4,700	--	108,000
July 6, 2011	2,400	500	--	25,000
July 13, 2011	400	1,600	--	182,000
Average	1,400	2,267	--	105,000

A.5 SUMMARY OF FINDINGS

This section gives an overview of the findings of this limited water sampling and testing program.

A.5.1 Raw Sewage

The quality of raw sewage samples collected on this assignment is summarized in Table A-11. The average values for TSS, COD, BOD_5 and Faecal Coliforms are all somewhat lower than the typical values for weak domestic waste water quoted in Metcalf & Eddy (1991).

TABLE A-11: AVERAGE RAW SEWAGE CONCENTRATIONS

PARAMETER	AVERAGE READING	NUMBER OF SAMPLES
Temperature (°C)	29.1	9
pH	6.7 to 7.5	9
TSS (mg/L)	102.1	9
DO (mg/L)	0.5	9
COD (mg/L)	166.3	3
BOD_5 (mg/L)	138.3	9
Faecal Coliform (cfu/100mls)	370,000	3

A.5.2 Bregon Park WWTP

There is evidence of altered water quality between the upstream and downstream sampling locations at Bregon Park WWTP. Specifically, there is an increase in average TSS (32.3 mg/L to 52.3 mg/L), average BOD_5 (0.5 mg/L to 15.7 mg/L) and average Faecal Coliforms (1,987 cfu/100ml to 436,667 cfu/100ml). There is also a corresponding decrease in DO (7 mg/L to 2.3 mg/L).

A.5.3 Lynton Gardens WWTP

There is also evidence of altered water quality between the upstream and downstream sampling locations at Lynton Gardens WWTP. Specifically, there is an increase in average TSS (18.7 mg/L to 34.3 mg/L), average BOD_5 (1.7 mg/L to 5.3 mg/L). The increase in average Faecal Coliforms (58,667 cfu/100ml to 79,733 cfu/100ml) was less pronounced than at Bregon Park. The decrease in DO (7.3 mg/L to 6 mg/L) was also less pronounced.

A.5.4 Lillian Heights WWTP

There is very little evidence of altered water quality between the upstream and downstream sampling locations at Lillian Heights WWTP. Specifically, there is almost no change average BOD_5 (8.0 mg/L to 7.0 mg/L), average Faecal Coliforms (34,733 cfu/100ml to 31,133 cfu/100ml) and average DO (6.3 mg/L to 6 mg/L). At this location, the average TSS decreased (39.3 mg/L to 21.7 mg/L) from upstream to downstream.

A.5.5 La Florissante WWTP

The only strong evidence of altered water quality between the upstream and downstream sampling locations at La Florissante WWTP was an increase in average Faecal Coliforms (2,267 cfu/100ml to 105,000 cfu/100ml). There was also a small increase in average TSS decreased (24 mg/L to 32.7 mg/L). There was no significant change in average DO (8 mg/L to 7.3 mg/L), and average BOD_5 decreased (12 mg/L to 5.7 mg/L) from upstream to downstream.

A.5.6 Other Parameters

With regard to other parameters which were measured on stream water samples:

- Temperatures ranged from 26.3 °C to 28.7 °C, as expected for streams of this size in Trinidad & Tobago

- pH values ranged between 5.5 and 9.1, with all three lowest values being measured in the Bregon Park WWTP receiving stream.

- No trends could be discerned from the COD results.

TRINIDAD & TOBAGO WASTEWATER INFRASTRUCTURE REHABILITATION PROGRAM (TT-L1018): ORPHAN WWTPs IN THE MALONEY SEWERAGE REGION

ENVIRONMENTAL AND SOCIAL ANALYSIS

APPENDIX B: OUTLINE ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

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APPENDIX B: OUTLINE ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

B.1 INTRODUCTION

B.1.1 Scope

This Outline Environmental and Social Management Plan (ESMP) has been prepared for both the construction and the operation phases of the proposed works within the Maloney Sewerage Region. This document is an outline only, and is not intended for implementation in its present form. It must be amplified, finalized, reviewed and approved before it can be implemented.

B.1.2 Layout of Report

This Outline ESMP consists of 8 chapters. The remainder of this introductory chapter describes the management structure for this project, and Chapter 2 is a summary description of the proposed works. Chapter 3 addresses personnel, training and toolbox meetings, and Chapter 4 concerns communications. Chapters 5 and 6 include procedures for addressing environmental, health and safety issues during the construction and operation phases of the project, respectively. Finally, Chapter 7 lists related plans and Chapter 8 discusses auditing and management review.

B.1.3 Management Structure

Key agencies on this project are:

- The Water and Sewerage Authority,
- The Inter-American Development Bank,
- The Design Engineer,
- The Supervising Engineer,
- The Contractor,
- The Environmental Management Authority, and
- The Occupational Safety and Health Agency.

The organization chart for this project is shown in Figure B-1, and the various agencies are introduced below.

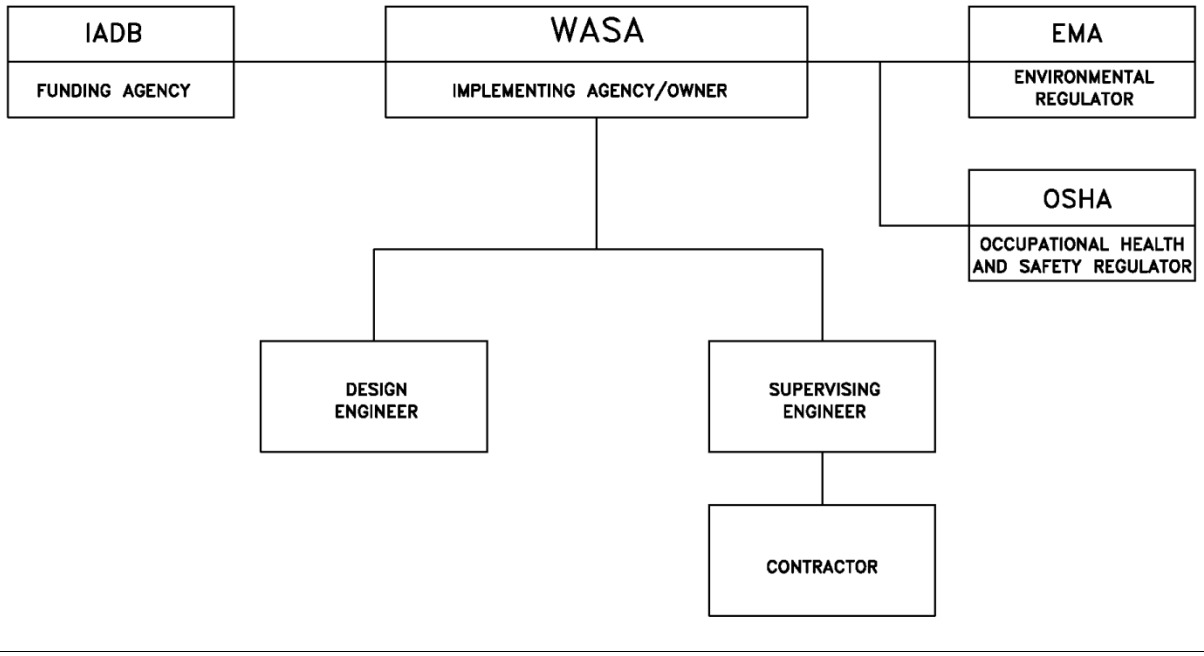

FIGURE B-1: PROJECT ORGANIZATION CHART

B.A.3.1 The Water and Sewerage Authority

The Water and Sewerage Authority (WASA) was created under the Water and Sewerage Act, 1965. It has overall responsibility for the production and distribution of potable water for the public supply. WASA is also responsible for constructing and developing sewerage works as it considers necessary and expedient. On this project WASA will function as the implementing agency for the proposed works, and will then assume ownership and responsibility for operation of the new system. It is expected that WASA will assign a Project Manager to this project.

B.1.3.2 The Inter-American Development Bank

The Inter-American Development Bank (IADB) is the funding agency for this project. They will review all aspects of the project to ensure compliance with Bank policies. The IADB will also approve the hiring of the design engineer, the supervising engineer and the contractor for this work.

B.1.3.3 The Design Engineer

WASA, with the approval of the IADB, will hire a Design Engineer to design the proposed works and prepare Contract Documents and Drawings.

B.1.3.4 The Supervising Enginee

r

WASA, with the approval of the IADB, will also hire a Supervising Engineer to oversee the construction of the works. In the past, the practice was to hire the Design Engineer to undertake the functions of the Supervising Engineer, but more recently the practice has been to hire a different firm as Supervising Engineer. The Supervising Engineer's team will include Resident Engineers, Clerks-of-Works and Health, Safety and Environment (HSE) Inspectors.

B.1.3.5 The Contractor

WASA will invite tenders for the construction of these works on the basis of Contract Documents and Drawings prepared by the Design Engineer (see Section 1.3.2, above). WASA, with the approval of the IADB, will then select a contractor for these works. The Contractor's site staff will include a Liaison Officer to receive complaints, comments and queries from the public.

B.1.3.6 The Environmental Management Authority

The Environmental Management Authority (EMA) is the environmental regulatory authority in Trinidad & Tobago. As such, they will oversee environmental performance throughout the life of this project, both during construction and during operation. Specifically, they will receive and process applications for CECs, Noise Variations, Registration under the Water Pollution Rules, etc. They will also take enforcement action where there are non-compliances with Environmental Rules or CEC conditions.

B.1.3.7 The Occupational Safety and Health Agency

The Occupational Safety and Health Agency (OSHA) is the regulatory agency for worker health and safety in Trinidad & Tobago. As such, they will oversee worker health and safety throughout the life of this project, both during construction and during operation. Specifically, they will receive and review Risk Assessments and Occupational Safety and Health Management Plans, as well as accident reports, etc. They will also take enforcement action where there are violations of the OSH Act.

B.2 PROJECT DESCRIPTION

This chapter will describe the proposed interventions in the Maloney Sewerage Region under IDB Loan TT-L1018, in the format set out below. These works will involve the Maloney Waste Water Treatment Plant as well as seven smaller sewerage systems: Bregon Park, Lynton Gardens, Lillian Heights, La Florissante, Santa Monica Gardens, La Resource and Timberland (see Figure B-2).

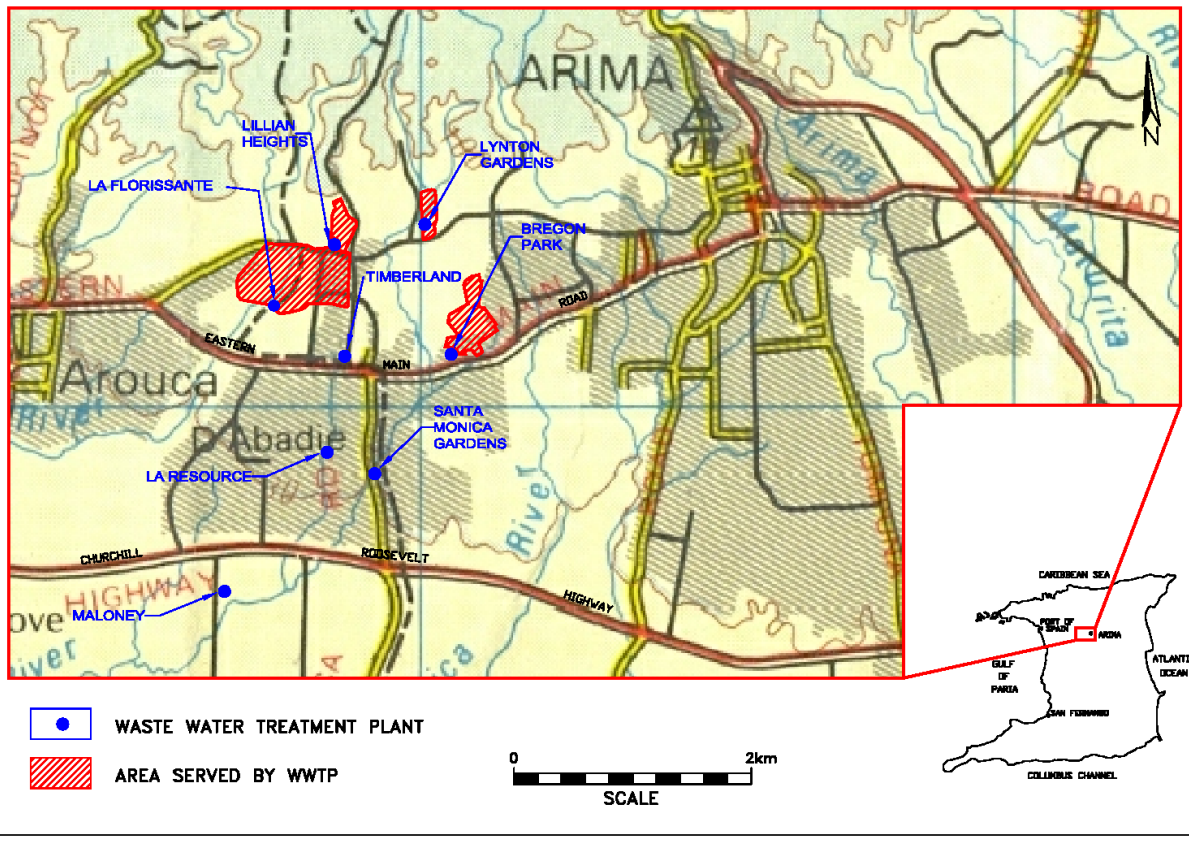

FIGURE B-2: LOCATIONS OF WASTE WATER TREATMENT PLANTS

B.2.1 Maloney WWTP

The Maloney WWTP will be rehabilitated and expanded to accommodate the flows originally treated by the seven smaller WWTPs, as well as provision for future growth. The upgraded Maloney WWTP will utilize some of the structures at the existing Maloney Gardens WWTP, and expand upon these.

The proposed rehabilitation and expansion works are as follows:

- Three new raw sewerage pumps,
- One new wet well,
- One new mechanical fine screen,
- Two new vortex grit chambers,
- Two new aeration tanks with nitrification,
- Two new secondary clarifiers,
- Retrofitting existing aeration tanks to sludge digestion tanks,
- Three new blowers (2 for aeration tanks and 1 for sludge digestion),
- One new sludge thickening system,
- One new Motor Control Centre,
- One new Ultra-Violet disinfection system,
- One new standby generator,
- Four new sludge drying beds,
- Extension of existing access roads to the headworks, sludge drying beds and secondary treatment,
- Rehabilitation of existing buildings, and
- Provision for a plant-wide flushing water system.

B.2.2 Other Proposed Works

In addition to the works at the Maloney WWTP, the following additional works are proposed:

- The Bregon Park, Lynton Gardens, Lillian Heights, La Florissante and Timberland WWTPs will be decommissioned and converted to sewage lift stations.

- A new system of sewer mains will be constructed to convey waste water from these plants to the Maloney WWTP (see Figure 2-2).

- Flow from the existing lift stations at Santa Monica and La Resource will also be routed into the new sewer mains.

To effect the changes listed above, the following additional work items will be necessary:

- Removal and disposal of faecal matter from tanks and wet wells at all WWTPs,
- Removal, treatment and proper disposal of overflowed faecal matter,
- Sanitizing, demolishing and disposal of concrete,
- Sanitizing, dismantling and disposal of steel, and
- Demolishing and disposal of pump houses and control panels.

B.3 PERSONNEL, TRAINING AND TOOLBOX MEETINGS

This chapter will address the hiring of personnel, continued training and tool-box meetings; in the format set out below.

B.3.1 Personnel

Each worker on this project must be competent in performing the work activities in which he / she is involved. At the time of hiring, prospective workers' competence will be judged based on training and past experiences. The Personnel Department of the Contractor and the Supervising Engineer will verify experience claimed by the applicant by phone calls to previous employers.

The hiring process will also include testing to verify competence in specific areas (for example, testing of welders of plumbers). Once hired, workers may be re-tested for competence where problems have arisen on the job, or may be tested for higher competence prior to being promoted.

Once hired, each worker will be given a formal site orientation and (as required) training sessions such as formal courses, toolboxes and hands-on instruction and demonstrations. This can be consolidated by the implementation of a "buddy system", which gives the opportunity to a worker to work in cooperation with another more experienced worker who is familiar with the job and requirements.

Records of all training and competence testing will be kept in each worker's personnel file.

B.3.2 Training

The Contractor's Personnel Manager will arrange for training to promote awareness of environmental, social and H&S performance on the job. Awareness will also be promoted through information documents, review of work plans, issue of work instructions, and highlighting of related incidents on other projects.

The following is a list (non exhaustive) of training normally planned by the Contractor's Personnel Manager:

- Introduction Training: Each employee or worker, including subcontractor, who starts working on the construction site, will be given a specific introduction to ensure full conformity to the legal, contractual and health / safety / environmental (HSE) procedures to be applied on site.
- Personal Protective Equipment,
- Reporting on Pollution,
- Reporting Safety Incidents, and
- Spill Prevention and Response.

B.3.3 Toolbox Meetings

Toolbox Meetings are designed to raise the awareness of the workers with regard to the generic risks they are exposed to on work sites and to develop their ability to communicate on Environment, Health & Safety aspects.

Toolbox Meetings will be conducted by trained environmental, health and safety specialists and adapted specifically to the type of work that will be performed on the construction site. Workers will be briefed on their tasks and they will be thoroughly informed of their duty to observe environmental requirements and safeguards, safe work practices, etc.

The main following themes are examples of what will be covered by the Toolbox meetings:

- Waste Sorting,
- Noise Level & quality of life,
- Storage of Hazardous Products,
- Wildlife Conservation,
- Spills and Leakage, and their control,
- Dust Emissions, and
- Health and Safety Aspects, including health risks associated with the handling of faecally-contaminated matter.

B.4 COMMUNICATION

This chapter will set out guidelines for internal and external communication on this project; in the format set out below.

B.4.1 Internal Communications

With regard to communication among WASA, the Design Engineer, the Supervising Engineer and the Contractor:

- Each party will designate a primary contact and also indicate other persons to be copied on all correspondence.

- All contract-related correspondence from the Contractor must be directed to the Supervising Engineer in the first instance.

- All correspondence from WASA to the Contractor must be copied to the Supervising Engineer.

- The Design Engineer, the Supervising Engineer and the Contractor must obtain prior clearance from WASA before sending correspondence to Government Agencies, Utility Companies or Community Groups.

B.4.2 External Communication

Communication with external parties (government agencies, community representatives) is the responsibility of the WASA, who will develop a Communications Plan in conformity with the requirements of the CEC for this project. WASA may, at its sole discretion, delegate responsibility for specific communications to the Design Engineer, the Supervising Engineer, or the Contractor.

WASA will issue all press releases pertaining to this project. The Design Engineer, the Supervising Engineer and the Contractor will only release information to the media if and when instructed to do so by WASA.

B.5 HSE PROCEDURES DURING CONSTRUCTION

This chapter contains procedures for management and monitoring of HSE performance during construction in a tabular format, where each table consists of two sections. The upper part of each table covers environmental, health and safety management aspects including:

- Identification of the impact,
- Proposed mitigations measures,
- Responsible party,
- Timing to implement the required actions,
- Specialised equipment or material required,
- Special training required to realise the proposed actions, and
- A cost estimate.

The lower part of each table describes the proposed monitoring to ensure effectiveness of the HSE actions including:

- Description of the monitoring activity proposed,
- Frequency at which it should be realized,
- How and by whom it is to be done,
- Specialized equipment or special training requirements, and
- An estimate of the associated costs.

The remainder of this chapter consists of examples of construction-phase procedures. When finalized, this ESMP will contain procedures for all construction-phase mitigation measures identified in the environmental and social assessments.

B.5.1 Air Quality

B.5.1.1	Potential Impact	Impaired Air Quality from Dust and Particle Emissions (vegetation clearing, handling of granular material)			
Mitigation Measures		▪ Clear only area needed for construction, ▪ Wet cleared area, ▪ When handling fine grain granular material, avoid letting them fall from high above the ground to minimize dust generation and dispersion, ▪ Keep stockpiles to a minimum and use as soon as practical, and ▪ Protect stockpiled fine grain granular material from wind action by covering them with tarpaulins when not used or store aggregates in bins or silos.			
Action by		▪ Contractor			
Timing		▪ Throughout the construction phase			
Specialized Equipment or Material		▪ Adequate number of water trucks. ▪ Equipment for washing truck wheels on leaving the site. ▪ Covers on all trucks.			
Special Training		▪ None			
Monitoring					
What / Where		Observe exhaust from equipment and construction vehicles	Measure Respirable Matter (PM10) at Sensitive Receptors	Measure Respirable Matter (PM10) at the closest human receptors	Public Complaints
Frequency		On continuous basis	Fortnightly	As needed	On continuous basis
How / By Whom		Visual inspection by the HSE Inspector	Instrumental monitoring by the HSE Inspector		Verbal or written communication with the Liaison Officer
Specialized Equipment or Material		Environmental Checklists	HiVol Monitors or MiniVol Samplers		Complaints Register
Special Training		Training in the use of the environmental checklists	Training in air quality monitoring		Good public communication and relation skills

B.5.1.2	Potential Impact	Impaired Air Quality from Vehicle and Equipment Exhaust
Mitigation Measures		▪ Perform vehicle inspections and maintenance, ▪ Maintain internal combustion engines, ▪ Use suitable emission controls, and ▪ Optimise the use of equipment and vehicles (control and minimize vehicle movements).
Action by		▪ Contractor
Timing		▪ Throughout the construction phase
Specialized Equipment or Material		▪ none
Special Training		▪ None
Monitoring		
What / Where		Observe exhaust from equipment and vehicles
Frequency		On continuous basis
How / By Whom		Visual inspection by the HSE Inspector
Specialized Equipment or Material		Environmental Checklists
Special Training		Training in the use of the environmental checklists

B.5.2 Water Quality

B.5.2.1	Potential Impact	Impaired Water Quality from Siltation		
Mitigation Measures		▪ Conduct site preparation work only in areas that are required for the project, ▪ Provide temporary drains during the pre-construction phase to control run-off, ▪ Keep material stored on site to a minimum, ▪ Confine temporary stockpiles of cleared material using wooden "cribs" (or other means such as geofabric screens on stakes) around the perimeter. These should be removed after the material in the stockpile has been used or removed from the site, ▪ Install siltation traps (using either hard or soft solutions) within drains to trap silt before it enters any watercourse outside of the site, ▪ Where mains and force-mains are constructed by open-cut parallel to watercourses, place topsoil and backfill material on the opposite side of the trench from the river, ▪ Use topsoil and backfill material to backfill the trench as soon as practical after the installation of mains and force-mains are completed, and ▪ Re-instate the mains and force-mains ROW to ensure proper drainage and re-vegetation, as soon as practical, following installation and backfilling.		
Action by		▪ Contractor		
Timing		▪ Throughout the construction phase		
Specialized Equipment or Material		▪ Silt traps ▪ Geo-fabric screens		
Special Training		▪ None		
Monitoring				
What / Where		Inspect drains, rivers and streams within the project area for turbidity, and solid deposits.	Temperature, salinity, conductivity, dissolved oxygen, pH and Total suspended solids upstream and downstream location.	Public Complaints
Frequency		Daily	Fortnightly	Continuous basis
How / By Whom		Visual Observations by the HSE Inspector	Sampling and testing by the HSE Inspector	Verbal or written communication with the Liaison Officer
Specialized Equipment or Material		None	Water quality monitor / samplers / sterile bottles / laboratory	Complaints Register
Special Training		Environmental training and Checklists	- Trained personnel for sampling in-situ testing - Accredited laboratory	Good public communication and relation skills
B.5.2.2	**Potential Impact**	**Impaired Water Quality from Hydrocarbon Spills and Disposal of Spent Lubricant**		

B.5.2.1	Potential Impact	Impaired Water Quality from Siltation	
Mitigation Measures		▪ Identify specific sites for fuelling and servicing (refuelling of vehicles within a minimum of 30.5 m from surface water bodies will be avoided), ▪ Provide impermeable bunds around fuel storage tanks, ▪ Store chemicals and fuels in bunded areas of adequate capacity, ▪ Promptly clean up spills and remove all soil which may become contaminated during the course of construction to a bioremediation cell for treatment (on-site remediation may be considered if the volumes are small), ▪ Re-fuel vehicles and equipment in bunded areas, ▪ Dispose of spent chemical and fuel containers in a proper and timely manner, ▪ Use of appropriate pumps and nozzles for refuelling activities, ▪ Place disconnected hoses in containers to prevent residual fuel spills, ▪ Provide ongoing maintenance of vehicles and machinery to ensure no leakage from equipment ▪ Minimize spills during construction by "good practice" construction techniques such as use of appropriate containers, avoiding overfilling, etc., and ▪ Avoid "hosing down" of spills and construction material. Instead, use dry clean up and mopping up techniques as appropriate.	
Action by		▪ Contractor	
Timing		▪ Throughout the construction phase	
Specialized Equipment or Material		▪ Secondary containment (bund walls) ▪ Proper pumps, hoses and nozzles for fuelling ▪ Personal protective equipment ▪ Appropriate biological remediation product	
Special Training		▪ Training of workers in use of spill reduction equipment. ▪ Approved bioremediation facility ▪ Trained personnel in spill response	
Monitoring			
What / Where		▪ Inspect drains, rivers and streams within the project area for oil sheen.	▪ Public Complaints
Frequency		▪ Daily	▪ Continuous basis during the construction phase
How / By Whom		▪ Visual Observations by the HSE Inspector	▪ Verbal or written communication with Liaison Officer
Specialized Equipment or Material		▪ Environmental Checklists	▪ Complaints Register
Special Training		▪ Training in the use of the environmental checklist	▪ Good public communication and relation skills

B.5.3 Soil Contamination

B.5.3.1	Potential Impact	Soil Contamination from Hydrocarbon Spills and Disposal of Spent Lubricant

B.5.3.1	Potential Impact	Soil Contamination from Hydrocarbon Spills and Disposal of Spent Lubricant
Mitigation Measures		▪ As for 5.2.2, above
Action by		▪ Contractor
Timing		▪ Throughout the construction phase
Specialized Equipment or Material		▪ Secondary containment ▪ Pumps, nozzles, hoses etc ▪ Spill response kits
Special Training		▪ Training of workers in use of spill reduction equipment ▪ Specialized training required in spill response
Monitoring		
What / Where		▪ Visual inspections to identify unacceptable storage, maintenance and fuelling practices and the presence of ponded hydrocarbons or hydrocarbon stains on the ground. Test such areas to determine the extent of the contamination.
Frequency		▪ Inspect fortnightly. Test as appropriate.
How / By Whom		▪ HSE Inspectors on the Supervising Engineer's Team
Specialized Equipment or Material		▪ Scoop, Hand Auger, Sample Containers, Accredited Lab
Special Training		▪ Training in sampling of contaminated soil

B.6 HSE PROCEDURES DURING OPERATION

This chapter will contain procedures for management and monitoring of HSE performance during operation of the facilities, in a similar tabular format to the one introduced in Section B.5. When finalized, this ESMP will contain procedures for all mitigation measures for the operation phase identified in the environmental and social assessments.

B.6.1 Regulatory Approvals

B.6.1.1	Target	Register the Upgraded / Expanded Maloney WWTP as a Source under the Water Pollution Rules
Tasks		▪ Assemble necessary inputs for the Source Registration Form, including effluent quality information. ▪ Complete the Source Registration Form and submit to the EMA.
Action by		▪ WASA Environmental and Regulatory Compliance Department
Timing		▪ Within 1 month of commissioning of the Upgraded / Expanded WWTP
Specialized Equipment or Material		▪ none
Special Training		▪ none
Verification		
What / Where		▪ Verify that form has been submitted.
Frequency		▪ 6 weeks after commissioning the Upgraded / ▪ Expanded WWTP.
How / By Whom		▪ WASA Deputy General Manager Wastewater Operations
Specialized Equipment or Material		▪ none
Special Training		▪ none

B.6.2 Water Quality

B.6.2.1	Target	Routine Monitoring of Effluent Quality from the Upgraded / Expanded Maloney WWTP
Tasks		▪ Sample the effluent and test for: o pH, o Dissolved Oxygen, o 5-day Biological Oxygen Demand, o Chemical Oxygen Demand, o Ammoniacal Nitrogen, o Total Phosphorus, o Total Oil & Grease, and o Faecal Coliforms. ▪ Compare results with the requirements of the Water Pollution Rules 2005, as amended in 2008, to determine compliance.
Action by		▪ WASA Lab, and ▪ WASA Environmental and Regulatory Compliance Department
Timing		▪ Once per month, within the first ten days
Specialized Equipment or Material		▪ Sampling equipment and sample bottles
Special Training		▪ Training in water sampling
Verification		
What / Where		▪ Verify that sampling has been done and compliance verified.
Frequency		▪ At the end of each month.
How / By Whom		▪ WASA Deputy General Manager Wastewater Operations
Specialized Equipment or Material		▪ none
Special Training		▪ none

B.6.3 Worker Health and Safety

B.6.3.1	Target	Provide necessary Personal Protective Equipment for all Workers in the Upgraded / Expanded Maloney Sewerage Region
Tasks		▪ Identify necessary PPE for Workers in the Wastewater Section, and issue PPE as necessary by class of work.
Action by		▪ WASA Stores
Timing		▪ During each worker's orientation
Specialized Equipment or Material		▪ Various types of PPE
Special Training		▪ none
Verification		
What / Where		▪ Verify that workers have and use necessary PPE.
Frequency		▪ continuously.
How / By Whom		▪ Supervisors in the upgraded / expanded Maloney Sewerage Region
Specialized Equipment or Material		▪ none
Special Training		▪ none

B.7 RELATED PLANS

This section will list other Plans which have been prepared for this project that address specific HSE issues:

- Communications Plan,
- Quality Assurance Project Plan,
- Waste and Hazardous Material Management Plan,
- Traffic Management Plan,
- Spill Prevention, Control and Countermeasures Plan, and
- Emergency Response Plan.

B.8 AUDITING AND MANAGEMENT REVIEW

WASA's Project Manager shall prepare an HSE auditing program and schedule for this project and the ESMP. This auditing program will ensure that all mitigation and prevention measures are properly implemented and that the reporting and correction procedures are understood and followed by all employees.

At least twice a year, WASA's Project Manager will organise a work meeting to review and improve this ESMP, to ensure its reliability in achieving environmental protection objectives. This review of the ESMP will include:

- Status of ESMP documentation,
- How recorded deviations (near miss, incidents, accident) were addressed and corrected,
- Whether orientation, training and tool boxes sessions are being undertaken,
- A summary of all relevant communication / complains from external parties / costumer, stakeholders, third parties feedback, etc.,
- Recommended improvements to be implemented into the Environmental Management System, and
- Allocation of resources to ensure an adequate follow up of environmental aspects.