



Conservancy Adaptation Project: Pre-Investment Studies

Task 4: Coastal Lowlands Drainage Analysis
and Works Identification

Environmental Assessment for Civil Works

September 2013

Ministry of Agriculture, Government of Guyana



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Acronyms

ECD	East Coast Demerara
EIA	Environmental Impact Assessment
EMC	Environmental Management Consultants
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
GD	Georgetown Datum
GFC	Guyana Forestry Commission
GLSC	Guyana Lands and Surveys Commission
GNBS	Guyana National Bureau of Standards
GoG	Government of Guyana
GPL	Guyana Power and Light Company
GTT	Guyana Telephone and Telegraph Company
GWl	Guyana Water Incorporated
LCDS	Low Carbon Development Strategy
LUP	Land Use Policy
MoA	Ministry of Agriculture
MoPWC	Ministry of Public Works and Communications
NARI	National Agricultural Research Institute
NBAP	National Biodiversity Action Plan
NDC	Neighbourhood Democratic Council
NDIA	National Drainage and Irrigation Authority
NDS	National Development Strategy
NEAP	National Environmental Action Plan
NICIL	National Industrial and Commercial Investments Limited
PPE	Personal Protective Equipment
RDC	Regional Democratic Council

Executive Summary

The Global Environmental Facility (GEF), under the Special Climate Change Fund (SCCF), have provided the grant which has funded the [Conservancy Adaptation Project: Pre-Investment Studies](#). The project aims to strengthen government and donor understanding of the East Demerara Water Conservancy (EDWC) system and coastal drainage patterns through the integration of advanced mapping and engineering analysis. The project also aims to carry out the design of infrastructure investments to improve drainage performance within the Region 4 coastal lowlands, to improve the stability of the EDWC dam, to strengthen the institutional capacity for managing water and floodwater levels, and to guide interventions to reduce Guyana's vulnerability to floods.

A key challenge facing the country, particularly residents living on the coast is the management of its poor drainage infrastructure for flood control. Over the last decade, extreme weather conditions have become more frequent and the prognosis is for this trend to continue. Over the two years from 2004 to 2006, flood events slowed agricultural production and personal losses have been significant. There are severe limitations in the ability to prevent flooding and manage flood waters and the impact of land use changes has clearly damaged the flood control drainage infrastructure. At present, flood control is managed on an emergency basis and control efforts focused on responding to immediate needs rather than the development of long-term control strategies.

The objective of the [Conservancy Adaptation Project: Pre-Investment Studies](#) is to: *'help the GoG adapt to global climate changes by reducing the country's vulnerability to catastrophic flooding. Specific project objectives include: c) identifying key drainage regimes for follow-on intervention....'*

The objective of [Task 4: Coastal Lowlands Drainage Analysis and Works Identification](#) is to *'provide a comprehensive model and framework of evaluation for the management of flood waters and seek to define the existing drainage system and recommend interventions designed to mitigate future flooding.'*

The project is expected to provide a number of long and short terms benefits including a reduction in flooding potential and subsequent loss of livelihood. An assessment has been carried out on the impacts of the project on the environment. Physical, biological and social mitigation measures have been provided to lessen or reduce the impacts of the project. Negative impacts of the project include dust and noise nuisance, minor disturbance to drainage and irrigation, traffic and nearby residents and the possibility of erosion, sedimentation. Negative impacts are short term and are limited to the construction phase of the project. Overall the projects benefits will be positive, the project will improve the existing drainage infrastructure and create short term employment and also create other spin off economic benefits.

Mitigation measures are presented to address the negative externalities of the project and a monitoring framework is provided to guide the execution of the EMP (Section 5). Overall the project will *'help the GoG adapt to global climate changes by reducing the country's vulnerability to catastrophic flooding'*.

1 Introduction

1.1 Introduction to the Conservancy Adaptation Project: Pre-Investment Studies

The Global Environmental Facility (GEF), under the Special Climate Change Fund (SCCF), has provided the grant which has funded the [Conservancy Adaptation Project: Pre-Investment Studies](#). The project aims to strengthen government and donor understanding of the East Demerara Water Conservancy (EDWC) system and coastal drainage patterns through the integration of advanced mapping and engineering analysis. The project also aims to carry out the design of infrastructure investments to improve drainage performance within the Region 4 coastal lowlands, to improve the stability of the EDWC dam, to strengthen the institutional capacity for managing water and floodwater levels, and to guide interventions to reduce Guyana's vulnerability to floods.

1.2 Background

The coastal strip of Region 4 is very low-lying, with ground levels up to 1.8m below mean sea level. It has been estimated that sea level in the area is rising at a rate of 1cm a year and this, combined with the high foreshore levels and mobile sand banks local to the coast, is making the area ever more reliant on pumped drainage to outlet the accumulated rain water.

The drainage systems currently in operation in the area were designed and implemented in order to provide drainage for the cane fields to the south of the urbanised areas. They were never intended as urban drainage systems, and as more housing developments have been constructed in the area the existing drainage systems have been subject to severe stress. This has meant that there is now frequent incidence of flooding in the urban areas.

1.3 Project and Task Objectives

The objective of the [Conservancy Adaptation Project: Pre-Investment Studies](#) is to: *'help the GoG adapt to global climate changes by reducing the country's vulnerability to catastrophic flooding. Specific project objectives include: c) identifying key drainage regimes for follow-on intervention....'*

The objective of [Task 4: Coastal Lowlands Drainage Analysis and Works Identification](#) is to *'provide a comprehensive model and framework of evaluation for the management of flood waters and seek to define the existing drainage system and recommend interventions designed to mitigate future flooding.'*

1.4 Description of Works and Alternatives Considered

1.4.1 Prioritisation of Drainage Regimes

In order to prioritise key areas for analysis and to rationalise the amount of modelling the GoG requested that the drainage areas along the East Coast Demerara would be subject to a multi criterion analysis in order to determine priority areas for further study. This process has been reported in the [CAP: Pre-Investment Studies Task 4 Selection Document, Issue B, April 2012](#). As a result of this process the following drainage regimes were taken forward for further study, as agreed with the GoG (see Appendix C).

1. Liliendaal (Liliendaal Drainage Area Model)
2. Ogle (Ogle Drainage Area Model)

- | | |
|---------------|----------------------------------|
| 3. Montrose | (Montrose Drainage Area Model) |
| 4. Sparendaam | (Montrose Drainage Area Model) |
| 5. Mon Repos | (Mon Repos Drainage Area Model) |
| 6. Annandale | (Mon Repos Drainage Area Model) |
| 7. Strathspey | (Enterprise Drainage Area Model) |
| 8. Enterprise | (Enterprise Drainage Area Model) |
| 9. Paradise | (Enterprise Drainage Area Model) |
| 10. Beehive | (Beehive Drainage Area Model) |
| 11. Clonbrook | (Beehive Drainage Area Model) |

In order to account for cross linkages between adjacent regimes, these eleven drainage regimes were combined to form six drainage areas for the purposes of modelling.

Once the baseline hydraulic models for these areas had been developed (see [CAP: Pre-Investment Studies Task 4 Modelling Report, Issue B, February 2013](#)), several options were considered for interventions to improve the existing drainage relief systems.

The Terms of Reference states that: *'the contractor shall develop and test using the model a series of recommendations for 10 to 15 drainage works in Region 4, designed to mitigate potential future regional flooding, prioritize these works, cost and develop contractor terms of reference for the execution of these works. Works and designs shall be developed to maximise the use of existing structures and systems, gravity-based drainage methods, and to minimize the use of pumps as drainage control where possible. The works selected shall seek to avoid involuntary relocation of affected individuals and shall strictly avoid any projects that may require interventions to the EDWC dam.'*

1.4.2 Intervention Options Considered

For each of the drainage regimes the following intervention options were considered:

1. Increased gravity outfall capacity
2. Increased pump capacity
3. Excavation to increase capacity of primary drains
4. Reconstruction of culverts to remove local constrictions on primary drains
5. Creation of additional flood storage
6. Separation of urban and agricultural drainage

Each drainage area was considered in turn and the relative merit of each of the above options was considered. Specific options for model testing were then developed for each drainage area, and refined following initial model test run results.

Increased Gravity Outfall Capacity

The Terms of Reference state that: *'the contractor shall model the system assuming a 0.5m rise in mean sea level anticipating continued effects of global climate change.'* As such, with the tidal window for gravity discharge of drainage waters already short, the possibility for gravity drainage becomes unfeasible in almost all areas along the coast. Initial inspection of the drainage area models showed that Enterprise is the only area in which increased gravity drainage was a viable option. For Enterprise Drainage Area we did take the increased capacity of the gravity outfall forward to further study using the model, but it was shown to be less effective than other options for the improvement of the drainage relief capacity.

Increased Pump Capacity

The pumps currently in operation along the coast of Region 4 typically have a capacity such that they are able to discharge around flow comparable with a daily rainfall of around 54mm/day. (Liliendaal is slightly higher at 76mm/day). This is consistent with a 1 in 5 year event. Providing a level of service for a 1:5 year event would be generally considered acceptable for agricultural areas, but for urbanised areas where flooding can be tolerated less often, a 1 in 50 year event is more appropriate. As such a considerable increase in pumping capacity would be required to achieve a level of service of 1 in 50 years.

For this reason, despite the caution against providing additional pumping stated in the Terms of Reference, with increased gravity outfall rendered unfeasible with the onerous climate change criteria we have had to consider the option of additional pump capacity in all areas, though we have sought to reduce the extent to which this is used as much as possible.

Excavation to Increase the Capacity of Primary Drains

The baseline models were used to identify any evidence of constrictions to flow caused by undersized primary drains. This information, in conjunction with anecdotal evidence from stakeholder discussions, was used to identify specific drains, which were increased in the model to determine the effect of these channel widenings on the overall discharge characteristics of the area.

It should be noted that while seemingly a simple and obvious solution, channel widenings of this nature are in practice costly and difficult to carry out. In some instances where space is constrained they can lead to land ownership issues. These considerations have been taken into account while assessing the different options tested by the models.

Reconstruction of Culverts to Remove Local Constrictions on Primary Drains

The model was also used to identify localised constrictions, such as undersized culverts and bridges, and verified with site surveys and anecdotal evidence from stakeholders. The effect of increasing capacity at these constrictions was tested using the model. In practice the culverts identified were often those associated with the main Railway and Public Roads. As such the costs of diverting traffic was built into the associated costs when determining the feasibility of carrying out these works.

Creation of Additional Flood Storage

By creating storage upstream of the pumped or gravity outlet it is often possible to reduce the required peak flow drainage capacity, allowing the accumulated rainfall to be discharged into the Atlantic more slowly without causing flooding. The creation of flood storage areas has been considered in most areas, however the dense ongoing development of the East Coast Demerara has meant that available space for such storage ponds has been hard to identify.

While this is often a relatively inexpensive and effective option, it will have an inevitable consequence on development planning in the area, as areas designated for flood storage will not be available for development. This has been considered when assessing possible options for drainage improvements in each area.

Separation of Urban and Agricultural Drainage

As noted above, it is generally recognised that short term flooding can be tolerated more often in agricultural areas than in urban areas. It is general international practice to design agricultural drainage

systems to a level of service sufficient to discharge the 1 in 5 year event, but to apply more onerous conditions, such as the 1 in 25, 1 in 50 or even 1 in 100 year events to drainage systems for urban areas.

As such we have looked at the option of restricting the flow from the agricultural areas to an amount sufficient to discharge the 1 in 5 year accumulated rainfall. This will mean that in more extreme events flooding will be permitted within the agricultural areas. These constrictions would be supplemented with improvements to the downstream drainage systems so that a greater level of service could be achieved in the urbanised areas.

It should be noted that this option should not lead to more frequent flooding in the agricultural areas, but will lead to significantly less flooding in the urban areas.

This option has generally been found to be very effective, and is also comparably inexpensive and would lead to less necessity for the addition of more pump capacity. However, it is recognised that it may be initially unpopular with farmers and other stakeholders, so that while it would be technically a very good alternative, a good deal of preparatory work would be required before implementation to ensure it is accepted by all stakeholders. It is also worth noting that it would be more effective and less costly if one project to separate the urban and agricultural drainage all the way along the coast could be carried out as a single holistic project.

1.4.3 Intervention Options Modelled for Each Area

The specific options for each area which were taken forward to further study using the hydraulic models were developed following inspection of the baseline model results. They were then assessed in terms of the urbanised area which would currently be inundated during the 1 in 50 year event, but would remain dry following the implementation of the proposed intervention option. This area was compared with the cost of implementation to give a cost per urbanised hectare benefited.

Table 1.1 shows the options which were assessed using the hydraulic models. Those options highlighted in yellow are the ones which would create the greatest benefit (in terms of urbanised area which would remain un-inundated) for the least cost. These are the options which we recommend are taken forward to design and implementation.

Table 1.1: Summary of Options Modelled

Drainage Areas	Options Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Liliendaal	Additional Pumping (8.5m ³ /s) Increased culvert capacities	Additional Pumping (4.5m ³ /s) Increased culvert capacities Channel widening Additional storage	No Additional Pumping Increased culvert capacities Channel widening Additional storage			
Ogle	Additional Pumping (6m ³ /s)	Additional Pumping (10m ³ /s)	Additional Pumping (6m ³ /s) Culvert Improvements	Additional Pumping (10m ³ /s) Culvert Improvements		
Montrose La Resouvenir	Additional Pumping (14m ³ /s)	Additional Pumping (14m ³ /s) Offline Storage	No Additional Pumping Restriction of Agricultural Drainage	Additional Pumping (14m ³ /s) Restriction of Agricultural Drainage		
Mon Repos Annandale	Additional Pumping (12m ³ /s) Small Channel Modifications	Additional Pumping (7.5m ³ /s) Restriction of Agricultural Drainage	Additional Pumping (12m ³ /s) Small Channel Modifications Widening façade drain to increase storage	Additional Pumping (10m ³ /s) Small Channel Modifications Widening façade drain to increase storage		
Enterprise Paradise	Additional Pumping (38m ³ /s) Channel Modifications	Additional Pumping (38m ³ /s) Channel Modifications Offline Storage	(Option 2b in Report) Additional Pumping (24m ³ /s) Channel Modifications Offline Storage	(Option 2c in Report) Additional Pumping (29m ³ /s) Channel Modifications Offline Storage	(Option 3 in Report) No additional pumping Additional Kokers	(Option 4 in Report) Additional Pumping (13m ³ /s) Channel Modifications Restriction of Agricultural Drainage
Beehive Clonbrook	Additional Pumping (4.25m ³ /s)	Additional Pumping (8.5m ³ /s) Channel Modifications	No Additional Pumping Channel Modifications Restriction of Agricultural Drainage	Additional Pumping (4.25m ³ /s) Channel Modifications Restriction of Agricultural Drainage	Additional Pumping (12.75m ³ /s) Channel Modifications Offline Storage	

1.5 Description of Construction Works to be Undertaken

1.5.1 Summary of Improvement Works Proposed under CAP: Pre-Investment Studies

The following table shows the works identified as being required to improve the drainage conditions along the coast, and those which will be designed under the current CAP.

Table 1.2: Table of Works Required in Coastal Areas

Table of Recommended Interventions – Those in red to be carried out by MM/CEMCO under CAP: Pre-Investment Studies

Drainage Area	Immediate Works		Medium Term Works	
	Description	Cost US\$	Description	Cost US\$
		1000		1000
Liliendaal	Additional 8.5m ³ /s pumping capacity	1,130		
Ogle	Additional 6m ³ /s of pumping capacity at Ogle PS	800	Embankment Raising between pump station and outfall koker	21
Montrose			Separation of urban and agricultural drainage	1,500
Mon Repos	Additional 2m ³ /s pumping capacity at Good Hope PS	260	Separation of urban and agricultural drainage	1,200
	Additional 2.5m ³ /s pumping capacity at Lusignan PS	330		
	Additional 3m ³ /s pumping capacity at Annandale PS	400		
Enterprise	New pump station at Location 1 with 1.5m ³ /s pump capacity	200	Separation of urban and agricultural drainage	1,600
	New pump station at Location 2 with 9m ³ /s pump capacity	1,190		
	Additional 2.5m ³ /s pump capacity at Hope PS	330		
	Reconstruction of culverts upstream of Enterprise Location 1	500		
	Reconstruction of culverts upstream (west) of Enterprise Location 2	500		
	Reconstruction of culverts upstream (east) of Enterprise Location 2	500		
	Reconstruction of culverts upstream of Enterprise Hope PS	500		
	Widening of Channels upstream of Location 1	2,350		
	Widening of Channels upstream of Location 2	5,000		
	Widening of Channels upstream Hope PS	2,350		
Beehive	Channel Widening	260	Separation of urban and agricultural drainage	435

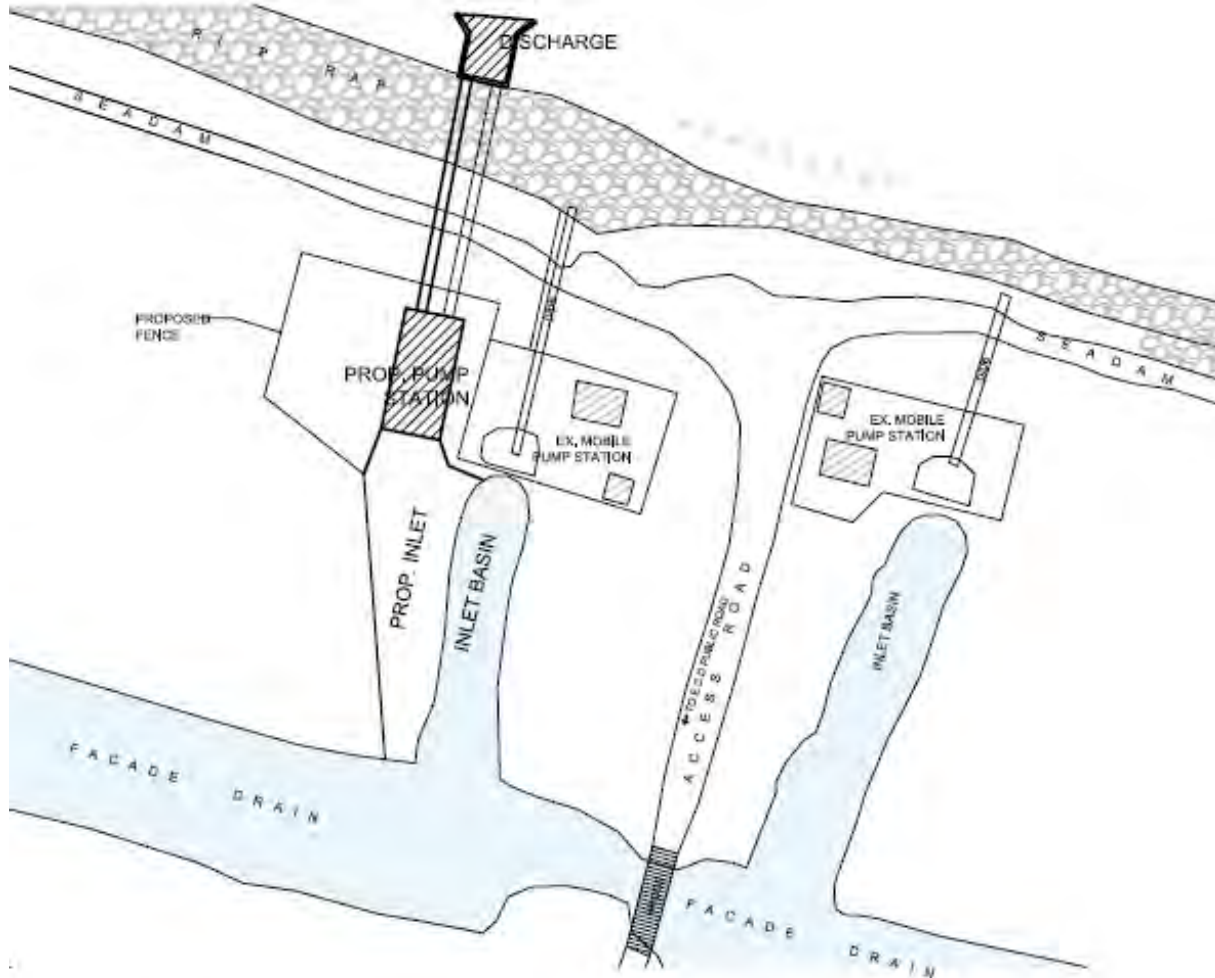
Source: MM

1.5.2 Liliendaal

The proposed works at Liliendaal include the following:

- Construction of new pump station adjacent to existing Liliendaal Pump Station

Figure 1.1: General Arrangement of Proposed Works at Liliendaal



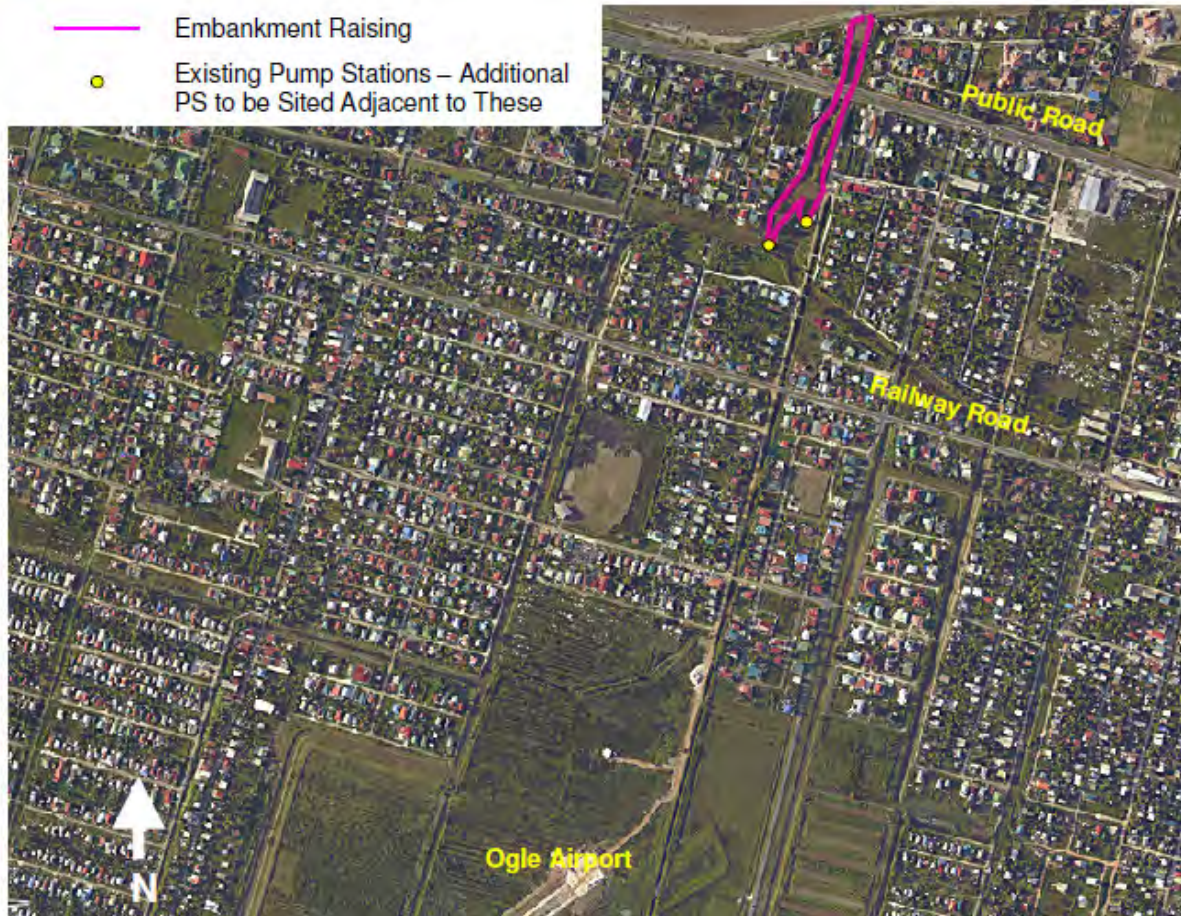
Source: CEMCO

1.5.3 Ogle

The proposed works at Ogle include the following:

- Construction of new pump station adjacent to existing Ogle Pump Station
- Heightening of embankments either side of channel downstream of Pump Station

Figure 1.2: General Arrangement of Proposed Works at Ogle



Source: MM

1.5.4 Montrose La Resouvenir

The proposed works at Montrose include the following:

- Restriction of Agricultural Drainage

Figure 1.3: General Arrangement of Proposed Works at Montrose



Source: MM

1.5.5 Mon Repos Annandale

The proposed works at Mon Repos Annandale include the following:

- Construction of new pump station adjacent
- Restriction of Agricultural Drainage

Figure 1.4: General Arrangement of Proposed Works at Mon Repos Annandale



Source: MM

1.5.6 Enterprise Paradise

The proposed works at Enterprise Paradise include the following:

- introduction of two new pumping stations (Location 1 and Location 2) with capacities of 1.5m³/s and 9m³/s respectively
- increase in the pumping capacity of the Hope pumping station (Location 3) with additional 1.5m³/s capacity
- complete separation of urban and agricultural drainage areas with agricultural areas served by the existing Strathspey and Foulis pumping stations
- channel modifications to feed new and modified pump stations

Figure 1.5: General Arrangement of Proposed Works at Enterprise Paradise



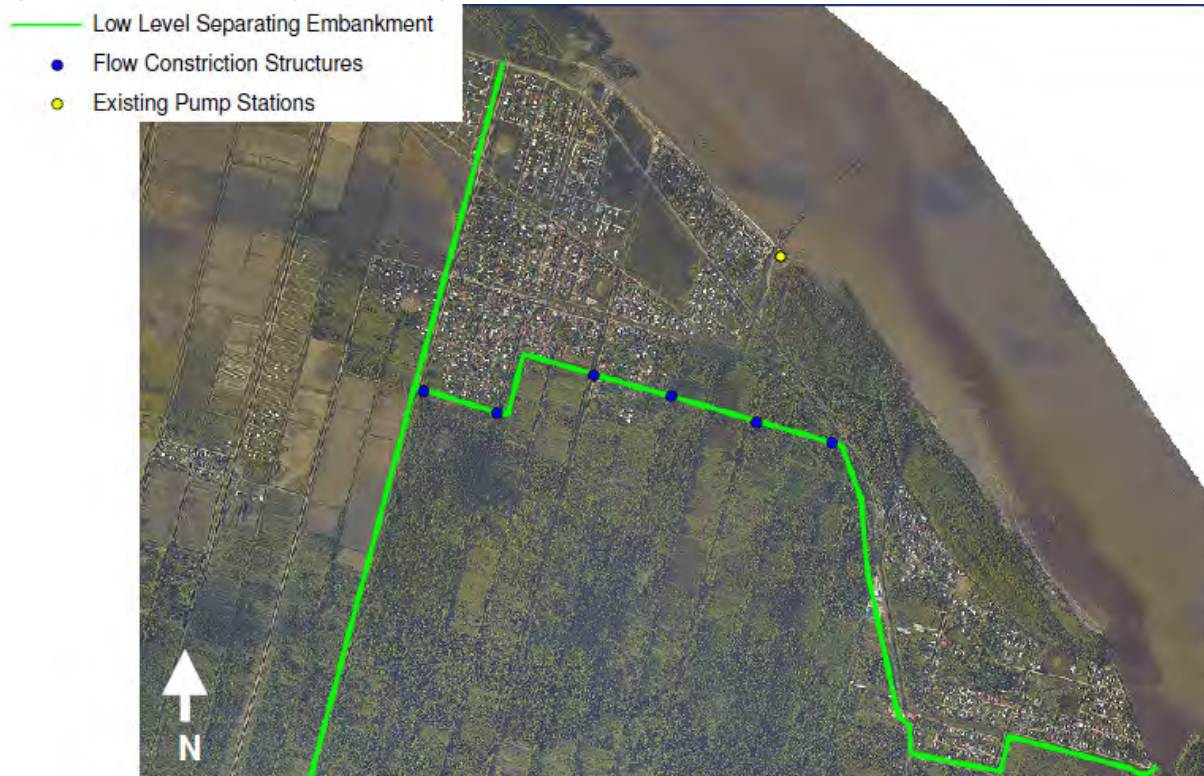
Source: MM

1.5.7 Beehive

The proposed works at Enterprise Paradise include the following:

- no increase in pumping capacity
- widening and deepening of the main drain leading to the pumping station
- restriction of discharge from vegetated areas to a drainage rate to 40 mm/day both with and without additional pump

Figure 1.6: General Arrangement of Proposed Works at Beehive



1.6 EA Methodology

This EA has been prepared using the national guidelines for preparation of Environmental Impacts Assessments as set out by the EPA.

The methodology applied for this project may be loosely categorised as follows.

- Site Reconnaissance Visits
- Discussions with various stakeholders (residents, officials, and other groups)
- Review of Secondary sources of information
- Observation of Land Use in the project area of influence.
- Assessment of Environmental impacts of implementing project and recommended actions associated with projects of similar nature.
- Assess alternative options to this project.
- Review all relevant laws and guidelines that define the implementation of the project.

2 Legal Framework

2.1 Introduction

Several policies, laws and regulations specific to areas of environmental management will bear on the construction activities for the coastal lowlands as proposed by the [Conservancy Adaptation Project: Pre-Investment Studies](#). As a matter of policy, the Environmental Protection Agency requires an environmental permit for projects listed in the fourth schedule of the EPA Act (1996) that would have a significant impact on the environment. As such there is a statutory requirement for conducting an EIA for this project. In this section the relevant policies, statutory requirement and guideline that would impact on the environmental assessment process of this proposed project are outlined.

2.2 Policies

2.2.1 Constitution

The need for a national environmental policy for Guyana has its foundations within the 1980 Constitution in Articles 2:25 and 2:36.

Article 2:25 of the Constitution states that “every citizen has a duty to participate in activities to improve the environment and protect the health of the nation”. And Article 2:36 states that “in the interest of the present and future generations the state will protect rational use of its flora and fauna and will take all appropriate measures to conserve and improve the environment”.

2.2.2 National Development Strategy (2001-2010)

GoG’s policy commitment to environmental management and sustainable development is emphasised in the National Development Strategy (NDS). The NDS supports an accelerated growth process involving the participation of the wider society, as well as, defining the need for environmental protection to be treated as a cross-sectoral issue applied to all aspects of the development process.

2.2.3 National Environmental Action Plan (NEAP)

The GoG’s environmental policy was first identified within the National Environmental Action Plan (NEAP) (1994). The plan presented a 12-point National Environmental Policy reflecting sound principles of environmental management and the ideal of sustainable development. A programme of action over a 3-year period was identified to address priority environmental issues.

The second NEAP (2001-2005) is a continuation of NEAP (1994), setting out the “*environmental development strategy for Guyana for the next five years*” and “*a framework for integrating cross-sectoral environmental concerns in the broader context of the country’s economic and social development programme*”. The Action Plan outlines a further commitment to sustainable development and a thematic approach to environmental protection. The implementation strategy for NEAP involves the identification of programme areas according to sectors and cross-sectors and tools and actions for implementation.

2.2.4 National Land Use Policy (LUP)

The National Land Use Policy (LUP) aims to streamline land use planning and to create conditions necessary to achieve types of land uses which are sustainable, socially desirable and environmentally compatible. The LUP and the National Land Use Plan are prepared by the Guyana Lands and Surveys commission (GLSC).

The Commission aims to also prepare regional plans for specific Administrative Regions of Guyana. To-date the Commission has prepared two (2) Regional Land Use Plans: (i) Region 6 – East Berbice Regional Land Use Plan; and (ii) Region 9 – Rupununi Sub Region 1. Additionally, Corridor Land Use Plans for the Lethem – Linden and Linden to Soesdyke road corridors have been prepared.

2.2.5 Low Carbon Development Strategy

The Government of Guyana in 2009 launched a Low Carbon Development Strategy (LCDS). The LCDS aims to transform Guyana’s current economy to that of a “low carbon economy” while addressing issues related to climate change through a compensatory scheme by marketing Guyana’s standing forest. The strategy is built on Guyana’s vision to encourage investments/economic development while protecting and maintaining its forest cover. The strategy has three pillars: (i) investment in low carbon economic infrastructure; (ii) investment and employment in low carbon economic sectors; and (ii) investment in communities and human capital.

2.3 Legislation

2.3.1 National Drainage and Irrigation Authority (NDIA) Act

The Drainage and Irrigation Act of 2004 provided for the establishment of NDIA. NDIA is the regulatory and co-ordinating agency responsible for the operation, maintenance, control and management of the drainage and irrigation and flood control system and works and harmonising of activities to enhance agricultural production. The Act provides mechanisms for ensuring that existing drainage and irrigation system and flood control and any new expansion that are done, are operated and maintained in a sustainable manner. The Act also allows for public participation in the planning, management and operation of drainage and irrigation facilities through Water Users’ Associations and promotes and encourages the involvement of the private sector in the construction, management, operation and maintenance of drainage and irrigation and flood control systems. The NDIA Act also provides for cost recovery for the sustainable management of primary and secondary elements of drainage and irrigation systems and flood control. Generally, the Act provides for the development of an institutional structure in terms of water resources management strategy and water use planning for the primary purpose of locating, evaluating, conserving and distributing water resources of the country for agricultural purposes.

2.3.2 Environmental Protection Act

The Environmental Protection Act of 1996 is the first comprehensive environmental legislation in Guyana. The Act established the EPA. The goal of the Act is to “*provide for the management, conservation, protection and improvement of the environment, the prevention and/or control of pollution, the assessment of the impact of economic development on the environment, the sustainable use of natural resources and for matters incidental thereto connected therewith*”. The EP Act gives the EPA the mandate for the coordination of environmental management and outlines the legal process for undertaking sustainable and effective management of the natural environment.

The EPA administers the EIA process set out in Part IV of the Act. The Act requires that an EIA be conducted prior to authorization of any project, which may significantly affect the environment. The Act also requires measures to be implemented to prevent environmental pollution. Part V Section 19 (1) states that *“A person shall not (a) Undertake an activity that causes or is likely to cause pollution of the environment unless the person takes all reasonable and practicable measures to prevent or minimize any resulting adverse effect; (b) Discharge or cause or permit the entry into the environment of any contaminant in any amount, concentration or level in excess of that prescribed by the regulations or stipulated by an environmental authorization.”* A nature would require environmental authorization under the EP Act.

2.3.3 Environmental Protection Regulations

The Environmental Protection Regulations, made under the Environmental Protection Act, were gazetted in 2000. These regulations govern Water Quality, Noise, Air Quality and Hazardous Waste Management and are aimed at preventing pollution by regulating discharges and emissions. These pollution management regulations will regulate and control the activities of developmental projects such as forestry operations during construction and operation. Under the Noise Management Regulation, persons cannot carry out activities above the established noise limits without prior approval from The EPA. The Water Quality Regulation protects Guyana’s water by controlling discharges of waste matter into any of the coastal and inland waters or land. The Hazardous Waste Management Regulation protects Guyana’s environment from hazardous waste generated including industrial waste, clinical wastes from hospitals, etc. The Air Quality Regulations requires emissions to be below a level so as to not affect the health of plants, animals and humans.

2.3.4 National Environmental Standards

The Environmental Protection Regulations requires the EPA to develop limits for various parameters. The EPA has so far, in collaboration with the Guyana National Bureau Standards (GNBS), developed the following standards and which are applicable to this project and should be complied with:

- Interim Guideline for Industrial Effluent Discharge into the Environment. (Water Quality Standard); and
- Interim Guideline for Noise Emission into the Environment. (Noise Standard).

2.3.5 Occupational Health and Safety Act

This Act deals with the regulation and registration of workplaces and the occupational health and safety of workers. It gives authorisation for occupational health and safety inspectors to enter and inspect workplaces. Under this Act the employer has a responsibility of ensuring workers health and safety is maintained. The Act requires the employer to display publicly an abstract of the Act, and other sections addressing various issues addressed in the Act. Construction workers are required to be trained and be equipped with the necessary personal protective equipment.

2.4 Institutional Framework

There are a number of Government Agencies and Institutions that have some oversight regarding the construction of the EDWC northern relief channel. These agencies are discussed below:

2.4.1 National Drainage and Irrigation Authority

The NDIA was established by the NDIA Act of 2004. The NDIA has a major role to play regarding the country’s drainage, irrigation and flood control facilities and agricultural production. The NDIA is responsible for coordinating the operation and maintenance of drainage and irrigation activities including

managing, operating and maintaining of drainage and irrigation systems and related access roads and facilities. The NDIA is also responsible for the development of programmes and plans to locate, evaluate, conserve and distribute water resources for agricultural development and for the efficient management, operation, evaluation and monitoring of drainage and irrigation systems. Importantly, the Authority is responsible for the development of procedures, norms, standards including irrigation and environmental as well as operation schedules for the efficient operation and maintenance of the drainage and irrigation systems.

2.4.2 Hydro-meteorological Service

The Hydro-meteorological Service (HYDROMET) is a department under the Ministry of Agriculture. HYDROMET operates the National Meteorological Station Network (NMSN) and the National Hydrological Station Network (NHSN) and evaluates the climate and water resources. HYDROMET collect baseline data and archive information on Guyana's weather and climate and provide meteorological, hydrological and oceanographic services. The agency provides information to those agencies that are planning and designing agricultural and water development projects, and maintaining the sea defences. It also serves as a warning system for the country and supports national and international obligations.

2.4.3 Environmental Protection Agency

The EPA was established under the Environmental Protection Act of 1996. The Agency is governed by a Board of Directors, but falls under the direct supervision of the Office of the President. In Sec. 4 (1) (a), of the Act, the EPA is given the mandate to *“take such steps as are necessary for the effective management of the natural environment so as to ensure conservation, protection and sustainable use of its natural resources”*. In addition the Agency is given the overall responsibility to:

- Take necessary steps for effective management of the natural environment to ensure conservation, protection and sustainable use of its natural resources;
- Ensure that any developmental activity, which may cause an adverse effect on the natural environment, is assessed before such activity is commenced;
- Coordinate and maintain a programme for the conservation of biological diversity and its sustainable use; and
- Coordinate the establishment of national parks and protected areas system and a wildlife protection management programme.

2.4.4 Guyana Lands and Surveys Commission (GLSC)

GLSC has the overall responsibility for land use planning and land administration. The Commission was established under the GLSC Act, Act No. 15 of 1999 in June 2001. The Commission envisions becoming a self-sustaining organization by 2010 with a mission *“to effectively and efficiently administer lands for the benefit of our clients and National Development”*.

The GLSC has three main operational divisions: (i) Land Administration (ii) Land Information and Mapping (iii) Surveys. The General Administrative Divisions, which include support and control, are administered by (i) Office of the Commissioner (ii) Corporate Affairs. The functions of the Commission, as stipulated by the Guyana Lands and Surveys Commission Act, 1999, include the following:

- To have charge of and act as guardian over all public lands, rivers and creeks of Guyana.
- To receive and evaluate offers to purchase or let public lands and to issue, for and on behalf of the President, grants, leases and permits to occupy such lands, in accordance with any law regulating the administration and disposition of public lands.
- To establish and maintain liaison between all the agencies involved in the registration and storage of records relating to public land in any tenure, including the registration of deeds and title to land.

- To formulate policy on geographic and land information, and set standards in relation to digital data, establish the framework for a national network of geographic information systems, and develop and maintain a parcel-based land information system.
- To initiate studies into and formulate policy on the development of public lands, including the feasibility of specific land development projects.
- To establish and maintain liaison with the responsible agencies to promote and monitor, in relation to public lands, the provision and maintenance of drainage and irrigation systems, access roads and other infrastructure, through such measures as may be appropriate.
- To compile and maintain an inventory of all the land resources of Guyana, their quality degree, pattern of utilization and related matters.
- To prepare land use plans for Guyana or any part of Guyana, except any municipality which is subject to a planning scheme (or interim development control pending the preparation of a planning scheme) under the Town and Country Planning Act.
- To advise Government on policy relating to public lands, land surveys and any other matters related to the functions of the Commission.

3 Description of Existing Environment

3.1 Physical

3.1.1 Description of Coastal Plain

With a 430km Atlantic coastline on the northeast, the coastal plain accounts for 5% of the country's total land mass and is home to 90% of its inhabitants. The coastal plain is made up largely of alluvial mud swept out to sea by the Amazon River, carried north by ocean currents, and deposited on the Guyanese shores. Rich clay of great fertility, this mud overlays the white sands and clays formed from the erosion of the interior bedrock and carried seaward by the rivers of Guyana. Guyana has no well-defined shoreline or sandy beaches. Approaching the ocean, the land gradually loses elevation until it includes many areas of marsh and swamp. Seaward from the vegetation line is a region of mud flats, shallow brown water, and sandbars. The coastal area is protected by a combination of natural and man-made sea defence structures, mud banks, mangrove forests and sand flats, all of which protects from inundation and flooding.

3.1.2 Physical Characteristics

3.1.2.1 Soils

The coastal strip of Region 4 is located within the Coastal Plain of Guyana where the soils range from predominantly alluvial deposits over organic material and silts comprising the Demerara Formation to the White Sand plateau at the Cheddi Jagan International Airport and Timehri.

There are four main types of soil on the coastal plain (Bernard, 1999):

- Clays (found near the sea ; known as frontland or marine clays);
- Silty clays (found along major rivers);
- Histosols (known as pegasse in Guyana; found along the coast in swampy areas particularly in the Demerara and Essequibo areas); and,
- Areas of mixed soils (includes clays, silts, laterites, podsols, histosols, regosols).

The soil capability of the soils in the coastal plain is considered to be of good to moderate fertility for agriculture. These soils typically require both drainage and irrigation through an intricate system of drainage and irrigation canals which lead to sluices.

Soils in the study area are typically frontland or marine clays near the existing road, and closer to the conservancy histosols (*pegasse*).

Soil Type	Characteristics
Mara Clay	Poorly drained soil developed from relatively old marine sediments. It occurs in depressions and is characterized by a shallow peat deposit over thick dark grey clay underlain by greenish grey clay subsoil.
Brickery Clay	Poorly drained soil developed in river alluvium. The alluvium may have been deposited over fluviomarine sediments. It is characterized by a thin dark grey clay surface over grey clay subsoil mottled with brownish yellow, yellowish red, and brown. The substratum is soft greenish grey clay, which may contain numerous bits of partially decomposed organic matter. The soil is strongly acid, slowly permeable and has a moderate level of fertility.
Tuschen Clay	Poorly drained soil developed in river alluvium. It is characterized by a thin dark grey clay surface over a grey to greenish grey clay subsoil with mottles of brownish yellow, yellowish red and brown. The soil is strongly acid, slowly permeable and has a moderate level of fertility.

Soil Type	Characteristics
Lama Muck	Poorly drained organic soil occurring in depression areas. The soil consists of well decomposed muck underlain by dark reddish brown peat. The substratum is greenish grey soft clay.
Organic (Pegasse)	<p>Soil The area linking the Demerara Clays and White Sand area is a transition zone comprising organic soils referred to as 'pegasse.' These deep organic soils have poor natural drainage capability; with low fertility and permeability. There may also be pockets of soils containing toxic salts which are often associated with the organic or mineral soils (British Guiana Soil Survey Project: FAO 1966).</p> <p>With proper drainage management, including heavy applications of lime, fertilizers these soils may be induced to produce moderate agricultural yields from certain shallow rooted crops such as ground provisions, vegetables, bananas and coffee.</p>
White Plateau	<p>Sands The southern boundary of the study area is situated on what is commonly termed the "white sand area" and is the beginning of the geological formation referred to as the <i>White Sand Plateau</i>. This physiographic unit is composed of Pliocene and Pleistocene deposits of sands and clays interbedded with kaolinite clay and bauxite. The surface is composed of a combination of white quartz and brown loamy sands and clays.</p> <p>The soils of the southern study area boundary consist almost entirely of quartz sand, a material which is unconsolidated and subject to leaching. The area at the junction of the Soesdyke – Linden Highway and the EBD is undulating with moderate slopes that when stripped of vegetation is prone to erosion. These soils are extremely fragile, poorly drained and low infertility. They do support vegetation but this is due to highly efficient root systems and a closed nutrient cycle. The white sand areas support limited subsistence cultivation of citrus, pineapples, cassava and vegetables.</p>

Clays are the most fertile soils within the study area and have been exploited for agricultural purposes, principally sugar cane.

3.1.2.2 Hydrology/Drainage

The hydrology of the site is largely controlled by its situation in the low coastal plain. The soils within the general area are likely to be clay rich, with poor internal drainage. Much of the area is under agricultural activities and as such there is a network of drainage and irrigation facilities. There are also drainage systems in the residential areas. Generally, drainage along the East Coast Demerara area is done by canals which empty into the Atlantic Ocean and is regulated by sluices. The pattern of settlement and other activities such as agriculture along this area resulted in the construction of numerous drainage ditches which lead into these main canals.

3.1.3 Climate

3.1.3.1 Climate

Guyana has a tropical climate with almost uniformly high temperatures and humidity, and much rainfall. Seasonal variations in temperature are slight, particularly along the coast. Although the temperature never gets dangerously high, the combination of heat and humidity can at times seem oppressive. The entire area is under the influence of the northeast trade winds, and during the midday and afternoon sea breezes brings relief to the coast. Temperatures in Georgetown are quite constant, with an average high of 32°C and an average low of 24°C in the hottest month (July), and an average range of 29°C to 23°C in February, the coolest month. The highest temperature ever recorded in the capital was 34°C and the lowest only 20°C. Humidity averages 70 percent year-round. Locations in the interior, away from the moderating influence of the ocean, experience slightly wider variations in daily temperature, and night time readings as low as 12°C have been recorded. Humidity in the interior is also slightly lower, averaging around 60 percent.

Rainfall is heaviest in the northwest and lightest in the southeast and interior. Annual averages on the coast near the Venezuelan border are near 250 centimetres, farther east at New Amsterdam 200 centimetres, and 150 centimetres in southern Guyana's Rupununi Savannah. Areas on the northeast sides of mountains that catch the trade winds average as much as 350 centimetres of precipitation annually. Although rain falls throughout the year, about 50 percent of the annual total arrives in the summer rainy season that extends from May to the end of July along the coast and from April through September farther inland. Coastal areas have a second rainy season from November through January. Rain generally falls in heavy afternoon showers or thunderstorms. Overcast days are rare; most days include four to eight hours of sunshine from morning through early afternoon.

3.2 Biological

3.2.1 General Description

The proposed development works will entail several civil works projects along the East Coast Demerara. These will include the following:

- Excavation and modification of drains
- Raising of embankments near the sea wall
- Construction of new pump stations
- Construction of new embankment between urban and agricultural areas
- Construction of flow constricting structures on agricultural drains
- Reconstruction of road culverts or bridges

The stretch of area between Crown Dam and the EDWC is characterised by seasonally flooded swamp savannah vegetation consisting mainly of grasses, i.e. Palms and secondary forest 'indicator' vegetation such as, Congo Pump and Black Sage.

The project site including the savannah swamp lands areas are highly disturbed environs with significant amounts of habitat loss/stress already experienced as a result of human interactions/encroachment. As a consequence, the existing biological realm of the area is predominated by species that adapts well to changing environments. It is therefore expected that there will be a rapid recovery of habitats and associated biodiversity owing to species adaptability to the habitat stresses that will ensue from proposed project works. However, this scenario assumes that appropriate mitigation to negate impacts associated with the proposed development will be implemented.

3.2.2 Flora

Along the existing canals and embankments and areas where rehabilitation works are to be done comprises of secondary 'disturbed' vegetation, primarily of common weeds, shrubs, herbaceous plants and trees including domesticated crops. Species found at the site are very common and can be found throughout the Coastal Plain. Species such as the tree types and grasses found along the Canal embankment are important for embankment stability and act as a 'prevention mechanism' against soil erosion. These species also provide a habitat for many faunal species serving as roosting and breeding sites for birds, insects and other fauna. Biodiversity in the area also support the existing farming community through the provision of pertinent ecosystem services such as pollination, water catchments, etc. Consequently, it is crucial that proposed works are done in a manner to allow natural re-vegetation of these species or ensure that re-vegetation is done along the embankments and contiguous areas after works.

3.2.3 Fauna

Fauna observed is typical of areas where human disturbances are frequent. Like the flora, the fauna are very common and can be found throughout the Coastal Plain especially on abandoned and open lands. Even though common within the coastal realm, faunal diversity in the area is sparse primarily due to heavy habitat disturbance. However, faunal diversity is comparatively richer in the mangrove foreshore and savannah swamp habitats. Faunal diversity observed at the site consisted primarily of highly mobile species that adapts easily to changing environments. Species observed are nevertheless confined to micro habitats fragmented by urban structures such as the ECD Public Road, the sea wall, existing canals, housing communities, etc. Most avian species observed were transient, with a home range spanning the project site.

As outlined earlier, there are no endangered species noted at the site and none of the species identified were listed on the IUCN species listings or restricted by the CITIES listings. Habitat loss will be the major impact on faunal diversity. In its present condition, existing habitats are severely stressed by human activity. As such, it is crucial that habitat destruction is minimized and that proposed works are done in a manner that allows natural regeneration/resuscitation of habitats and/or to ensure that re-vegetation is done along embankments and contiguous area after works are completed.

3.2.4 Socio-Economic

Human settlement and infrastructure is concentrated in the reclaimed coastal plain where approximately 90 percent of the population resides. The population is distributed in locations determined by the availability of suitable land for housing and services. The areas of the Essequibo Islands – West Demerara (Region 3), Demerara – Mahaica (Region 4) and the Mahaica – Berbice (Region 5) are the most densely populated areas, with the majority of Guyana's citizens located in Region 4. The highest population densities are found in the vicinity of the capital, Georgetown, and adjoining areas due to its proximity to the agricultural zone and access to port facilities. The project area falls within the region 4 area. The Demerara-Mahaica Region extends East of the Demerara River to the Western bank of the Mahaica River, and is predominantly low coastal plain, with a small portion of the hilly sand and clay region further inland.

The population is concentrated along the coastland, particularly in Georgetown, the capital city, which has a population of 133,000. The population of Region Four is 310,320, with over 104, 429 persons employed in various sectors. Guyana's administrative and commercial activities are concentrated in this Region, especially in and around Georgetown, the main port. There are many sugar estates, such as Diamond, Enmore and La Bonne Intention, owned and controlled by the Guyana Sugar Corporation (GUYSUCO).

Table 3.1: Population Distribution by Gender and Region

Table 1.7: Population Distribution by Sex and Region, Guyana: 2002

Region	Both Sexes		Male		Female	
	Number	Percent	Number	Percent	Number	Percent
Region 1	24,275	3.2	12,815	1.7	11,460	1.5
Region 2	49,253	6.6	24,847	3.3	24,407	3.3
Region 3	103,061	13.7	51,944	6.9	51,117	6.8
Region 4	310,320	41.3	152,136	20.3	158,184	21.1
Region 5	52,428	7.0	26,207	3.5	26,221	3.5
Region 6	123,695	16.5	62,079	8.3	61,615	8.2
Region 7	17,597	2.3	9,373	1.3	8,224	1.1
Region 8	10,095	1.3	5,750	0.8	4,345	0.6
Region 9	19,387	2.6	10,009	1.3	9,378	1.3
Region 10	41,112	5.5	20,874	2.8	20,238	2.7
Total	751,223	100	376,034	50.1	375,189	49.9

Source: National Census 2002

Table 3.2: Population and Employment Distribution

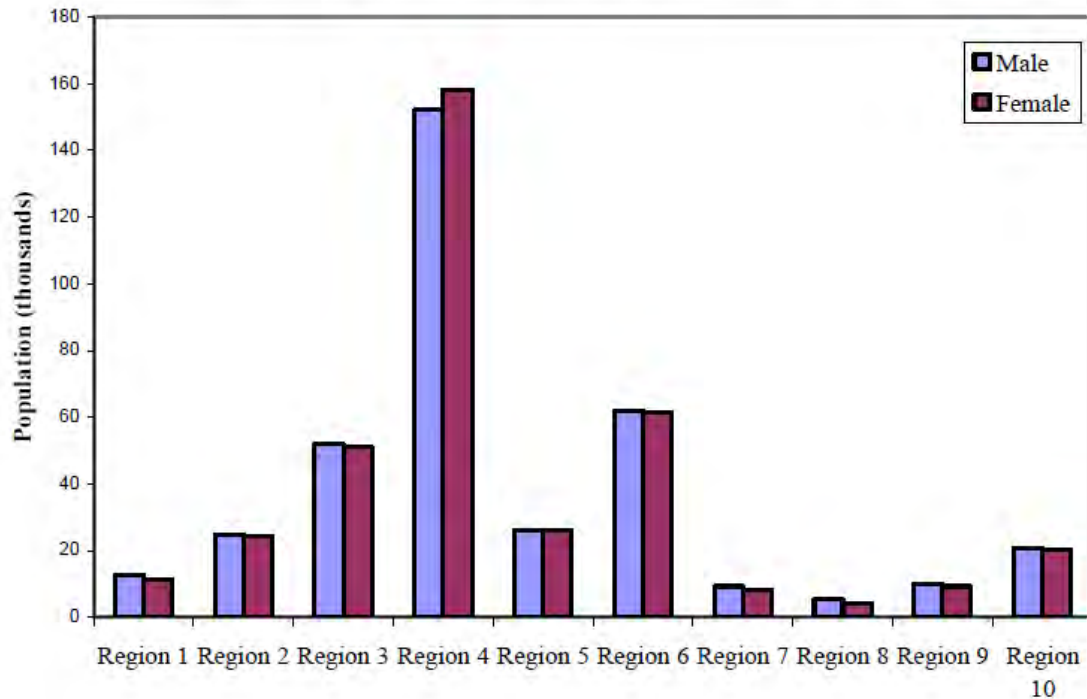
Table 6.16: Percent Distribution of Employed Persons 15 Years and Over by Employment Status, by Region and Sex, Guyana: 2002

Region	Paid Employee - Govt	Paid Employee - Pvte	Unpaid family worker	Trainee	Employer	Own Account	Total %	Number
Both Sexes								
Region 1	15.4	45.8	10.4	0.0	1.8	26.6	100	5,504
Region 2	17.2	54.3	4.0	0.1	3.4	21.0	100	13,719
Region 3	26.6	50.0	1.4	0.1	2.9	18.9	100	32,913
Region 4	22.9	55.1	1.0	0.1	3.2	17.7	100	104,429
Region 5	34.4	39.6	2.4	0.2	2.8	20.7	100	13,514
Region 6	34.9	37.8	1.5	0.1	2.5	23.2	100	34,748
Region 7	12.5	44.7	8.1	0.0	3.2	31.5	100	5,632
Region 8	9.5	54.2	3.6	0.0	3.3	29.4	100	2,809
Region 9	11.8	15.5	15.0	0.1	1.6	55.9	100	5,626
Region 10	31.5	46.5	1.7	0.1	2.9	17.3	100	11,960
Total %	25.1	48.9	2.2	0.1	3.0	20.7	100	x
Number	58,046	112,910	5,103	241	6,866	47,688	x	230,854
Males								
Region 1	10.5	51.1	6.8	0.0	2.0	29.6	100	4,131
Region 2	10.7	60.9	2.8	0.1	3.9	21.6	100	10,536
Region 3	23.3	52.4	1.2	0.1	3.5	19.5	100	25,000
Region 4	18.7	57.9	0.8	0.2	4.0	18.4	100	66,877
Region 5	30.7	42.8	2.1	0.2	3.2	21.0	100	10,788
Region 6	33.7	39.3	1.3	0.1	2.9	22.7	100	27,083
Region 7	7.1	51.6	3.3	0.0	3.9	34.0	100	3,985
Region 8	4.9	59.3	2.5	0.0	3.6	29.7	100	2,310
Region 9	9.3	16.1	8.9	0.1	1.7	63.9	100	3,955
Region 10	25.6	52.3	1.5	0.1	3.4	17.1	100	7,931
Total %	21.6	51.5	1.6	0.1	3.5	21.5	100	x
Number	35,152	83,814	2,635	199	5,762	35,035	x	162,596
Females								
Region 1	30.2	29.9	21.2	0.0	1.1	17.6	100	1,373
Region 2	38.5	32.3	8.2	0.2	1.9	18.9	100	3,183
Region 3	37.0	42.5	2.1	0.1	1.3	17.0	100	7,913
Region 4	30.3	50.1	1.4	0.1	1.8	16.4	100	37,552
Region 5	48.9	27.2	3.6	0.1	1.0	19.3	100	2,726
Region 6	39.2	32.3	2.3	0.0	1.3	24.9	100	7,665
Region 7	25.6	28.0	19.6	0.1	1.6	25.2	100	1,647
Region 8	30.7	30.7	9.0	0.0	1.6	28.0	100	499
Region 9	17.9	14.1	29.5	0.1	1.5	36.9	100	1,671
Region 10	43.2	35.0	2.2	0.1	1.9	17.8	100	4,029
Total %	33.5	42.6	3.6	0.1	1.6	18.5	100	x
Number	22,894	29,096	2,468	42	1,104	12,653	x	68,258

Source: National Census 2002

Figure 3.1: Regional Population Distribution

Fig.1. 4: Regional Population Distribution by Sex, Guyana: 2002



Source: National Census 2002

The project area comprises a mix of land use and land tenure. It is a mixed of residential and commercial small businesses, schools, and places of worship and agricultural land use. The project area falls with the Better Hope, Buxton-Foulis and Clonbrook Neighbourhood Democratic Councils.

A key challenge facing the country, particularly residents living on the coast is the management of its poor drainage infrastructure for flood control. Over the last decade, extreme weather conditions have become more frequent and the prognosis is for this trend to continue. Over the two years (2004 – 2006), flood events slowed agricultural production and personal losses have been significant. There are severe limitations in the ability to prevent flooding and manage flood waters and the impact of land use changes has clearly damaged the flood control drainage infrastructure. At present, flood control is managed on an emergency basis and control efforts focused on responding to immediate needs rather than the development of long-term control strategies.

Flooding is becoming more frequent. The majority of Guyana’s population lives along this reclaimed coastal plain which is also the area where most agricultural activities are located. Unmanaged regional development has exacerbated the flood control problem as development has altered or interdicted water control systems without a sound understanding of the systemic impacts of these changes. In many cases, activities such as backfilling canals and cuts in the levies have changed the functional dynamics of the system.

The project takes a two pronged approach to improving flood protection in Guyana. First, critical near-term civil works will be carried out to increase the drainage relief capacity of the EDWC.

This will allow the GoG to more effectively manage conservancy water levels during times of intense rainfall. Activities to be carried out include improving the Cuhna canal discharge characteristics and changing the internal flow dynamics of the EDWC system to allow for greater flows to the Demerara River and away from the Mahaica-Mahaicony river system.

4 Analysis of Potential Impacts

4.1 Potential Environmental and Social Impacts

This section of the report identifies the potential environmental and social impacts associated with the construction works proposed under [Task 4: Coastal Lowlands Drainage Analysis and Works Identification](#) of the [Conservancy Adaptation Project: Pre-Investment Studies](#) and the feasible mitigation measures and/or preventative actions that can be implemented to address the identified issues.

The potential impacts are described based on the bio-physical and socio-economic effects during the construction and operational phases of the project. A Social Impact Assessment was also conducted and is presented in this section. The significance of the impact is based on the degree and duration, high probability of occurrence and its effect on sensitive receptors. Significance is determined by:

- Magnitude and extent
- Reversibility
- Longevity
- Probability of occurrence

The impacts identified in this section are based, mainly, on those that arise during the construction phase of the project.

The table below summarises those impacts which have been identified during the design phase of this project. These are discussed further in the following sections.

Table 4.1: Summary of Potential Environmental and Social Impacts

Conditions	Environmental Impact	Significance
Construction Phase		
Physical Environment		
Environmental Aspect: Land/Soil		
Construction of the project components	Loss of land through direct land take.	Lo, Irr, LT, UM, Un, Sig.
Land clearing	Removal of shrub type vegetation and grassed areas, where necessary, to widen existing drainage canals, construct culverts and to construct pump houses and ancillary facilities.	Lo, Irr, LT, UM, Un, Insig.
Operation of machines	Compaction of soil from operation of heavy-duty machines to facilitate widening of drainage channels and construction of pump houses.	Lo, Rev, LT, Un, UM, Insig

Conditions	Environmental Impact	Significance
Construction Phase		
Disposal of materials (sediments and vegetation)	Improper disposal of silt and vegetation removed from excavation works.	Lo, Irr, LT, UM, Un, Insig.
Storage of fuel and re-fuelling of equipment.	Fuel and/or oil spill from the operation of heavy-duty machines can cause water and soil contamination.	Lo, ST, Irr, Av, M, Sig
Environmental Aspect: Emissions to Water		
Fuel spills	Water contamination from fuel/oil spills.	Ex, Irr, LT, Av, M, Sig
Erosion and Sedimentation	From material stockpiles and excavated materials resulting in an increase in sediment loading in the existing drainage channels.	Ex, Rev, ST, Av, M, Sig
Waste disposal	Improper solid waste disposal by workers such as food wrappers, boxes etc and also construction waste materail.	Ex, Rev, LT, Av, M, Sig
Environmental Aspect: Emissions to Air		
Operation of heavy-duty machines and equipment	Noise from the operation of machinery and construction activities.	Lo, Rev, ST, Av, M, Insig
Operation of heavy duty machines and equipment	Fumes from the operation of machinery used during the construction period.	Lo, Rev, ST, Av, M, Insig
Operation of machines, storage of materials and construction activities	Dust from construction activities, material and waste stockpiles and movement of heavy duty equipment can affect workers and nearby residents.	Lo, Rev, ST, Av, M, Sig
Biological Environment		
Flora	Habitat loss, destruction, fragmentation due to land clearing as a result of construction activities.	Lo, Irr, LT, Un, UM, Insig

Conditions	Environmental Impact	Significance
Construction Phase		
Fauna	Habitat loss, destruction, fragmentation due to land clearing as a result of construction activities.	Lo, Irr, LT, Un, UM, Insig
Socio-economic Environment		
Environmental Aspect: Risks in the Working Environment		
Employees' safety can be compromised during the operation of machines.	Employees at risk from accidents and excessive noise from the operation of heavy-duty machines.	Lo, ST, A, Irr, M, Insig
Relocation	Residents located within the vicinity of secondary drains will be affected; a few bridges may be relocated.	Lo, Un, ST, Sig, UM, Irr
Drainage and Irrigation	The facilities which provides these services will be disrupted	Lo, Un, ST, Sig, UM, Rev
Flooding	Potential for flooding during construction.	Lo, M, ST, InSig., Rev
Employment	Overall short-term increase in employment.	Ex, Rev, ST, Av, M, Sig (Positive)
Operational Phase: Maintenance Activities		
Periodic de-silting of the drainage channels to remove sediments and weeds.	Risks of accidents to workers and exposure to excessive noise from the operation of heavy-duty machines.	Lo, ST, A, Irr, M, Insig
	Fuel spills from the operation of machines may contaminate water and soil.	Ex, Irr, LT, Av, M, Sig
Vegetative removal to maintain drainage channel embankments.	Continuous habitat disturbance.	Lo, Irr, LT, Un, UM, Insig
Flooding	Breaches along the embankment	Lo, M, ST, Sig, UM, Rev

Impact Significance Parameters

Lo – Localised
ST – Short Term
Sig. – Significant

Ex – Extensive
LT – Long Term
Insig. – Insignificant

Rev – Reversible
Av. – Avoidable
M. – Mitigable

Irr. - Irreversible
Un – Unavoidable
UM – Unmitigable

4.2 Construction Phase – Impacts

The main activities associated with the project during the construction phase are described in detail in Section 1.5. Construction activities will directly or indirectly affect the physical and social environment. Potential impacts are listed in the matrix above and highlights the potential/predicted impacts, their associated magnitude, importance and timeframe during the construction phase of the project

4.2.1 Impacts on the Physical Environment

4.2.1.1 Land/Soil

Potential Impact

Minor clearing of vegetation is necessary to facilitate widening of drainage channels. Construction of culverts along drainage channels that are to be widened will result in minor clearance of vegetative shrub.

The environmental impacts that are likely to result from the aforementioned activities are:

- Loss of land due to expansion of channels (land take)
- Clearing of vegetation and soil disturbance to facilitate the expansion of the drainage channels, excavation works, embankment construction and construction of structures can cause some level of erosion;
- Compaction of soil from the constant movement of heavy machinery within the project area and the wider surroundings.
- Fuel and/or oil spill from the operation of heavy-duty machines can cause soil contamination;
- Improper disposal of excavated material; and

Analysis

Land utilised by the proposed project will be un-available to other uses, though generally the expected land take will be minimal and involves expansion of existing drainage channels and will not affect other productive use. The project area lies entirely within Government of Guyana owned land.

The removal of existing vegetative cover hastens the erosion process by exposing soils to the elements. Soil disturbance can also contribute to erosion. To minimise this effect, and avoid extensive surface runoff, activities should be scheduled to occur during the dry season. Slopes on the embankments would be constructed to the appropriate degree to allow for adequate runoff and prevention of erosion.

The constant use and movement of heavy duty machines and equipment over exposed soil can result in soil compaction; this can eventually lead to ponding during periods of heavy rainfall. Compaction also makes regeneration of vegetation difficult. To avoid or minimize this effect, most of the construction activities should be concentrated to the dry season/period.

Figure 4.1: Access Dams in State of Disrepair (Buxton)



Source: CEMCO

Constant traversing of vehicles through the site can further degrade the existing roads as shown in plate 1.

Management and Storage of fuel and lubricants on site can pose a major environmental problem. Leakage from equipment, refuelling and servicing of machines in the field can result in fuel/oil spills. Workers negligence and inadequate storage facilities can contribute to these spills which can contaminate the soil.

4.2.1.2 Water

Potential Impact

The surface water quality can become contaminated or affected from potential threats as those listed below due to construction activities.

- Water contamination from sedimentation;
- Water contamination from fuel/oil spills;
- Blockage of existing drainage system/outfall structures from erosion and sedimentation; and
- Improper solid waste disposal by workers such as food wrappers, boxes etc.

Analysis

Construction works will be undertaken directly in the drainage channels, this will potentially increase sedimentation. Also there are existing waterways at the pump stations that can be further polluted. During the construction phase, fuel will be stored on site temporarily and will be moved to other areas as the work progresses, therefore limiting the option of constructing the required “Bunded Area” to store fuel. Improper storage and handling can result in water contamination.

Figure 4.2: Enmore Pump Station. There is potential impact on water quality in this case



Source: CEMCO

Spilled material can be easily leached into ground water causing contamination. Given the nature of the construction operation it is not envisaged that a large quantity of fuel will be stored on site. Fuel will be transported to the site as needed. It is recommended that all temporary storage tanks/containers will be elevated to detect any leaks which may occur. Bund trays can be used to ensure any soiled fuel is captured offloading or refuelling activities. An empty sealed container should be kept on site. Fuel should be stored in sealed containers and should not be filled to capacity; this will reduce the likelihood of spillage during transportation. In addition, care will be taken during the re-fuelling process and when transporting fuel from the storage tanks/trucks to the machines to avoid unnecessary spills and reduce the risk associated with contamination. All fuel storage containers should be regularly inspected for leaks. Regular maintenance of machines and equipment must be carried out to ensure proper functioning as this reduces the potential for oil leaks. A maintenance schedule as well a system to check fuel storage containers should be developed.

Materials eroded from the embankment and construction materials and waste debris stockpiles can end up in existing waterways resulting in sedimentation. Materials stockpiles will have to be located away from water bodies and drains. Designated areas for storage of material should be identified. Waste debris, especially construction waste, should not be stockpiled on site for prolonged periods and should be removed in a timely manner. Any blockage of waterways as a result of sedimentation should be removed immediately.

The improper management of solid waste can affect water quality. Solid waste can often end up in water bodies as a result of direct dumping which can lead to contamination and blockage. During the

construction phase, care must be taken by all workers to dispose of any solid waste material generated in keeping with the procedures outlined in this EA.

4.2.1.3 Air

Potential Impact

During the construction phase there are several activities which can affect the air quality in the project area. However, the level of impact will be localised, short-term and insignificant. These impacts are more likely to affect construction workers and residents living nearby; particularly in the Enterprise, Liliendaal and Buxton area, residents are located nearby.

Figure 4.3: Houses in proximity to Site (Buxton)



Source: CEMCO

These impacts can be mitigated by utilising best construction practices. The following impacts can potentially arise as a result of the project.

- Noise from the operation of machinery.
- Rehabilitation of identified structures.
- Fumes from the operation of machinery used during the de-silting process, re-routing of the canal, rehabilitation of the sluice and construction of the bridge; and
- Dust from moving of earth, equipment and stockpiles.

Analysis

Construction activities will generate significant levels of noise. The operation of heavy duty machines and equipment may generate noise levels above the alert threshold of 86 decibels and hazard threshold of 95 decibels. Nevertheless, measures must be in place, as recommended by the EPA, to reduce the noise level from construction activities for workers and other persons on-site and are detailed in Section 6 of this report. Equipment and machinery will be fitted with mufflers to reduce the noise emanating.

The operation of the machines and equipment will also generate fumes which may have some effect on the air quality in the surrounding area. However, the level of impact will be localised, short-term and insignificant, to the point of negligible.

Dust will be generated from earth movement activities and the movement of equipment over dry areas. Construction material stockpiles such as sand can become airborne and contribute to a dust nuisance. Construction activities such as demolition and removal of existing structures can increase dust nuisance. The use of cement products increase dust levels in the immediate area, transportation of material to site can however impact the wider public. Since the project site is located away from housing development, the potential for dust nuisance is not great. However, measures (mainly wetting the site frequently, covering or soaking stockpiles), would be implemented to reduce this impact. Dry areas will be soaked as necessary, depending on the weather condition. All trucks transporting construction materials to the site would be covered to prevent fugitive dust from escaping into the environment.

4.2.2 Impacts to the Biological Environment

4.2.2.1 Flora

Potential Impact

The potential impact on the flora in the project is:

- Direct loss due to removal to facilitate construction.
- Damage to flora during construction work as a result of machinery working in close proximity.

Analysis

The project area is located within communities and is covered predominantly by secondary vegetation and indicates a highly human disturbed area. No rare, threatened or endangered species were found within the area. Vegetation removal is essential to facilitate construction of a new embankment and various other aspects of project and, therefore, unavoidable. The area of immediate influence consists of shrub-like vegetation, aquatic species and tree type vegetation can be found. Most of the vegetation which will be lost is the type which is common within and around the project area and can also be found throughout the coastal area of Guyana. As such this impact is deemed insignificant.

Figure 4.4: Typical Coastal Vegetation (Annandale)



Source: CEMCO

4.2.2.2 Fauna

Potential Impact

The potential impact on the fauna in the project environment is:

- Habitat loss, destruction, due to land clearing as a result of construction activities.
- Migration of faunal species due to the presence of human and machinery.

Analysis

The faunal diversity in the area is sparse and most species observed during the field exercise were domestic animals. Although a small portion of land area will be taken up by the project and some vegetation will be removed, there is available within the project environment enough land to support these animals. Therefore, the impact of habitat disruption on the biological environment will be localised and insignificant especially given that this area has been highly disturbed.

4.2.3 Impacts to the Socio-Economic Environment

4.2.3.1 Displacement and Relocation

Potential Impact

The Project may result in some level of relocation/displacement of access and bridges, no relocation of houses will be done to accommodate the works. In the good-hope area in particular, the access to the work area is shared with fisherfolk and boatbuilders.

Figure 4.5: Access to Pump Station shared with Fisherfolk (Good Hope)



Source: CEMCO

4.2.3.2 Drainage

Potential Impact

Disruption to drainage regime of the coastal areas.

Analysis

Work to the Drainage channels will be executed using best engineering methods, alternative diversions will be identified to dewater sites in cases where relief structures will be programmed so as to avoid disruption to the drainage regime of the coastal areas.

4.2.3.3 Flooding

Potential Impact

Widening of existing canals will not impact greatly on drainage. Replacement of culverts and related structures may cause minor drainage issues, mainly reduced flow, this however is not likely to cause flooding.

Figure 4.6: Typical Drainage Channel / Culvert that will be Widened



Source: CEMCO

4.2.3.4 Employment

Potential Impact

Construction activities will have a positive impact on employment within the wider area.

Analysis

Construction will be done utilising contractors for different aspect of the project. Construction activities will require the employment of skilled and unskilled labour. This provides an opportunity for local individuals to be employed and thus results in an increase income for those persons.

4.2.3.5 Health and Safety

The potential risks to the health and safety of workers and the public during the construction phase are discussed in Section 7. A design stage risk assessment has been carried out and is presented in Appendix B.

4.3 Potential Impacts during the Operational Phase

4.3.1 Maintenance Activities

Potential Impact

The key activities during this phase are those associated with continuous maintenance of the structures that will be rehabilitated and drainage channels that have been widened. The potential impacts associated with these activities are:

- Risks of accidents to workers and exposure to excessive noise from the operation of heavy-duty machines;
- Fuel spills from the operation of machines may contaminate water and soil; and
- Continuous habitat disturbance.

Analysis

Maintenance of the proposed drainage system will entail activities designed to keep the drainage channel clear and the structures in good working conditions. These include manual and mechanical vegetation management and removal, mechanical desilting of channels and especially outfalls, greasing of pulleys, winches and cables for the sluice, and normal preventive maintenance. Although these activities have low environmental impacts, they have the potential for localised negative impacts if good practices are not followed, in particular proper disposal of used oils, careful re-fuelling practices, as well as, health and safety issues such as risks of accidents to works and exposure to excessive noise from the operation of machinery and equipment. Impacts to the surrounding biological environment are also localised and insignificant given that the area is under direct human influence.

5 Environmental Management Plan

5.1 Environmental Management Organisation

To accomplish a successful environmental management program the Contractor, the client and the EPA must establish an effective organisation and reporting procedure. In order to do this the following measures should be carried out.

a) During the pre-construction meeting, the environmental management measures will be discussed with the successful Contractor. This meeting will include representatives from the Ministry of Agriculture, NDIA, engineering and environmental sections and the Contractor, as well as the proposed Environmental Monitor. In addition, the Environmental Protection Agency should be invited to attend.

b) All necessary permits, licences and approvals will be obtained and copies will be on site prior to the start of construction. Furthermore, all work will be undertaken in a manner consistent with the conditions of all permits, licences and approvals.

c) An Environmental Management Plan (EMP) should be included in the Contractor QA/QC Plan and form the framework for the contract/bidding documents so as to ensure that the recommended measures are implemented by the Contractor. The Contractors EMP shall be based on guidance given in this document.

This EMP will identify activities to be undertaken in an effort to mitigate the principal adverse effects of the project. The Plan will describe the way in which the main environmental impacts of the project can be managed, and prescribes appropriate mitigation measures to be adopted during the rehabilitation and construction activities as well as the operational life of the project. These impacts were identified and discussed in section 5 of this document and their significance has been taken as a function of the following criteria:

- Magnitude and extent.
- Reversibility.
- Longevity.
- Probability of occurrence.

The objectives of the EMP will be to:

Set out measures and strategies to address the environmental issues related to the rehabilitation and construction as well as operational activities of the project. Formulate a monitoring plan to ensure that the activities are executed in accordance with these environmental requirements and to establish the impacts of the project with a view to implementing any necessary further action to minimise negative impacts.

This EMP will consist of the following:

- Mitigation Plan
- Monitoring Plan
- Emergency Response Plan

Since both the rehabilitation and construction activities will be undertaken simultaneously the mitigation measures for potential impacts are discussed together.

d) The Contractor at the outset of construction, prepare a waste management strategy providing a plan of action for the reuse, recycling and disposal of all types of waste material generated during construction as

well as during the post-construction period (demolition of construction related facilities). The objective of the strategy will be to minimise disposal through maximisation of reuse and recycling opportunities.

e) The Contractor at the outset of construction prepare an emergency response plan which will encompass the objective and direction provided in the spill contingency plan, this plan shall comprise procedure for notification and reporting of spills, establishment of an emergency response team.

5.2 Responsibility

It has not been agreed, as of the date of this report, whether the NDIA or a Contractor will have primary responsibility for the execution of these works. Whichever organisation carries out the works will be assisted by Supervising Consultants in the form of a Consultancy Firm will be contracted to oversee the implementation of the Project. The Supervising Consultants will ensure the requirements of the EMP are implemented.

The environmental requirements would be communicated to any contractor or sub-contractor utilised in the execution of the Project.

5.3 Roles and Responsibilities

5.3.1 Environmental Officer/Monitor

The Environmental Officer/Monitor should be accountable to the Supervisor's Representative and to proactively advise the Contractors Representative on environmental protection measures during construction. Duties include:

1. Environmental monitoring and assessments
2. Acting as a resource and provide guidance to the Contractor on environmental issues, proactive mitigation measures and innovative technology
3. Communicating with Environmental agencies as required
4. Participating in weekly onsite project meetings
5. Reporting recommendations and weekly summaries to the Supervisor's Representative
6. Assisting with an assessment for all non-compliance events
7. Assessing preventative plans for re-occurrence of adverse events, and follow-up on recommendations
8. Conducting preliminary assessments of proposed design changes to evaluate potential changes to environmental design components and preliminary impact (positive or negative) overview
9. Immediate reporting of non-compliance events to the Supervisor's Representative
10. Producing stop work orders.

5.3.2 Supervisor's (NDIA) Representative

The Supervisor's Representative is accountable to the Contracting Authority. Specific duties of the Supervisor's Representative pertaining to environmental protection include:

1. Meeting weekly with the Environmental officer/Monitor to review past environmental recommendations and project schedule
2. Providing schedules to address assessment recommendations and outstanding works
3. Ensuring environmental issues are dealt with in a timely manner and producing a plan to prevent reoccurrence
4. Ensuring non-compliance events are immediately brought into compliance
5. Reporting non-compliance events to the Environmental Officer/Monitor

6. Discussing potential design changes or changes to the EMP with the Environmental Officer/Monitor prior to undertaking the change
7. Producing stop work orders, as required.

5.3.3 Contractor Representative

The Contractor Representative is accountable to the Contracting Authority. Specific duties of the Contractor representative pertaining to environmental protection include:

1. Meeting weekly with the Environmental Officer/monitor to review past environmental issues, assessment recommendations, and project schedule
2. Providing schedules to address assessment recommendations and outstanding works
3. Ensuring construction is coordinated according to the environmental concerns
4. Requesting advice on environmental interests from the Environmental Officer/Monitor
5. Ensuring environmental issues are dealt with in a timely manner and producing a plan to prevent reoccurrence
6. Ensuring non-compliance events are immediately brought into compliance
7. Reporting non-compliance events to the Environmental Officer/Monitor
8. Discussing potential design changes or changes to the Environmental Management and Monitoring Plan with the Environmental Officer/Monitor prior to undertaking the change.

5.3.4 Project Site Meetings.

The Environmental Officer/Monitor should be involved in regular project meetings with the Supervisor's Representative, and the Contractors Representative. The purpose of such regular meetings should be to outline the schedule of upcoming construction and proposed activities, and to review the activities of the previous week.

In the event that the Environmental Officer/Monitor or Supervisor's Representative deem the compliance regarding environmental requirements to be inadequate at any time during the Project, the frequency of the weekly or biweekly regular meetings should be increased accordingly until the Environmental Officer/Monitor is satisfied with the implemented changes.

5.3.5 Reporting Criteria and Frequency

To facilitate efficient communications, the on-site Environmental Officer/Monitor should report and communicate with the Environmental Agencies.

The Environmental Officer/Monitor should keep written records and photographic records where applicable, of all mitigation activities, compensation works, and construction task assessments and communications regulatory personnel. Weekly summary reports should be submitted to the Supervisor's Representative and should include:

- Number and type of work assessments
- Quality of construction work and work techniques or mitigation recommendations
- Follow-up on previous recommendations
- Outstanding environmental works
- Proactive measures taken to protect the environment
- Other environmental issues
- Communications with environmental agencies
- Areas of work scheduled for upcoming week
- Proposed changes to design

If a special event occurs, the Environmental Officer/Monitor should immediately report the event to the Supervisor's Representative. Subsequent reporting should include event details, quality assurance and prevention plans. If an event results in a spill, the spill response plan should be activated.

5.3.6 Construction Activity to be Assessed

All aspects and phases of construction are to be assessed including planning, scheduling, methodology, and mitigation. Daily planning, scheduling and construction techniques should be discussed and assessed by the Environmental Officer/Monitor.

5.3.7 Assessments

The Environmental Officer/Monitor should record assessments in written format and photographically where applicable. Individual records should be maintained for each environmental section and for each springs/wells compensation sites. Specific activities are to have individual assessment records on file, including any recommendations for follow-up.

Copies of assessment records should be forwarded, as completed, to the Supervisor's Representative, highlighting outstanding works, substandard works requiring improvement, and construction technique recommendations.

The Supervisor's Representative should provide a written response, within 2 days detailing the schedule to accommodate substandard or outstanding works. Recommendations should be discussed at the next weekly meeting.

5.3.8 Compliant /Non-compliant Criteria

A non-compliant activity is any activity that does not comply with the requirements of the Environmental Management and Monitoring Plan, the Special Specifications for the Project, permits, approvals and authorizations, and environmental regulations and acts, regardless of due diligence and mitigation activities.

If a non-compliant activity is detected or reported, the activity creating the non-compliance should cease, and efforts should be undertaken to rectify the non-compliance. The Environmental Officer/Monitor should assess all non-compliance activities and assist the Contractor in returning the activity back into compliance.

The Contractor, in consultation with the Environmental Officer/Monitor, should prepare a prevention plan designed to prevent reoccurrence of non-compliant activities.

The Environmental Officer/Monitor should conduct follow-up assessments on all previously non-compliant activities to assure changes have been made to ensure environmental protection. Follow-up assessments should be submitted to the Supervisor's Representative and the Contracting Authority.

5.3.9 Stop Work Authorisation

Persons with Stop Work Authorisation are the primarily Supervisor's Representative and subsequently the Environmental Officer/Monitor. Stop Work Authorizations are to be used only after all other efforts, such as dialogue with the Contractor and assessment reports, have been employed in an attempt to return a non-compliant or potentially non-compliant activity back into compliance. Although both parties are authorized to issue Stop Work Orders for a particular adverse activity, whenever possible, the Environmental

Officer/Monitor should request the Supervisor's Representative to undertake this Management. If the Supervisor's Representative is not available, or is unresponsive to this request, the Environmental Officer/Monitor should issue the Stop Work Order.

Stop Work Orders should be in writing. Stop Work Orders for environmental protection, or any issued by the Environmental Officer/Monitor must immediately be communicated with the Contracting Authority.

5.3.10 General Environmental Monitor Activities and Deliverables

The activities of the environmental monitoring services should be comprised of routine activity assessments, potential environmental protection activities, unanticipated activity assessments, meetings and reporting, resource assistance and environmental protection.

Routine activity assessments, potential environmental protection activities, meetings and reporting are based on scheduled construction activities. Unanticipated activity assessments are those construction activities that are not planned or scheduled and include activities such as spills and uncontrolled environmental releases, weather influenced activities, field changes, etc.

The Environmental Officer/Monitor services should also act as an environmental protection resource for the Contractor, participating in training, modifying construction techniques, providing recommendations, and assisting in preventative planning toward environmental protection.

The Environmental Officer/Monitor should be expected to participate in weekly Contractor meetings to discuss project schedule, changes, recommendations, works in environmentally sensitive areas, etc.

5.4 Environmental Assessments

5.4.1 Pre-Construction/Construction Phase

A pre-construction report should be prepared by the Consultant before the commencement of construction. This assessment should take the form of a small audit to detail characteristics of the environment in the construction and related areas. This should include a photo log and sketches of area. This report can be used to monitor construction impact on the environment.

The following items should be monitored during the construction phase.

- **General Site condition**

Routine assessment of general site conditions, visual inspection of construction staging area to ensure that EMP is being implemented.

- **Fuel and Hazardous Material Storage Areas**

Routine assessments of fuel and hazardous material storage and general housekeeping practices are to be undertaken on an informal base throughout construction.

- **Noise and Dust**

Monitoring of noise and dust nuisances and measures implemented to mitigate those nuisances.

- **Waste Management**

Assessment/Monitoring of waste collection and disposal practices and general housekeeping on site.

- **Public Complaints.**

Assessment of public complaints and follow up

- **Watercourse Crossings**

Equipment crossings of the drains (channels) are to be monitored for best management practices such as bank erosion reduction, sedimentation, etc.

- **Flag Riparian Zones**

The Environmental Officer/Monitor is responsible to flag all riparian zones simultaneous to the construction contractor project layout, prior to clearing and grubbing operations.

- **Drainage**

All channels, drains and River are to be monitored as and when required, to assure clearing and grubbing activities, and erosion control measures, are undertaken in accordance with the environmental management plan.

- **Sediment Control Monitoring**

Sediment control should be monitored to ensure water quality protection during all phases of construction.

- **Flora and Fauna**

The effect of construction on vegetation clearance and also impact on water bodies and aquatic environment should be assessed.

5.4.2 Post Construction Phase Assessment

Construction site and staging area shall be cleared, all structures dismantled and restored to its original stage as far a practicable as possible. Within one month of completion of construction the Environmental Inspector shall prepare the post construction report and shall be forwarded to the NDIA Environmental Engineer and the Contractor Environmental Office. The following items should be inspected/monitored.

- Site cleanup.

All waste materials should be removed and all existing structures that are not part of the works removed.

- Grading and slope stabilization done.
- Erosion control measures in place, sedimentation identified and recovered.
- Re-vegetation around construction sites to avoid erosion

Monitoring Plan

Monitoring is an integral part of effective implementation of the Environmental Management Plan. The Consultant environmental Inspector should visit all construction area on a daily basis to ensure that mitigation action area implemented.

The main environmental issues to be monitored are water quality, erosion and sedimentation. At each construction site it is important to carry out water quality test (pH and Turbidity), these tests should be done prior to construction to establish benchmark data, during construction to assess the impacts and after the completion of construction.

5.4.2.1 Reporting

The Environmental Officer/Monitor should provide:

- Weekly summary reports of assessments detailing
 - Number and type of work assessments
 - Recommendations and follow-ups
 - Unanticipated activities
 - Proposed design changes
 - Summary of meeting issues
 - Other environmental issues
- Monthly Reports detailing:
 - Environmental construction works to date
 - Outstanding environmental construction works
 - Planned environmental construction works
 - Quality of work and work technique or mitigation recommendations
 - Environmental assessment work projection for the upcoming month
 - Proactive measures taken to protect the environment
 - Communications with environmental agencies
 - Other environmental issues

The Environmental Officer/Monitor should also maintain a daily diary containing details of events, assessments undertaken, communications, and other relevant items. The diary should be delivered to the Supervisor's Representative at the end of each construction season, or at the year's end.

5.4.2.2 Services not provided by the General Environmental Monitor

Environmental monitoring service is not responsible to undertake environmental mitigation activities that are normally performed by the Contractor. Such activities include, but not limited to:

- Sediment control structure implementation, inspections and maintenance
- Mitigation activities required due to weather
- Returning non-compliance activities back into compliance
- Spill control and clean up

5.4.3 Environmental Protection Agency

The EPA main role is to ensure that the project is implemented and the project is in compliance with environmental laws, standards and regulations. The EPA will receive quarterly reports from the MPW&C Engineer during construction and post construction. The EPA is also responsible for periodic monitoring of the project.

6 Proposed Mitigation Measures

6.1 Impact Mitigation

The following mitigation measures have been identified to prevent, minimise and manage the adverse environmental impacts discussed in Section 4. These measures are outlined below and should be included in the Contractors EMP.

General

The Contractor executing construction works is required to:

- dispose of sewage, refuse and chemical wastes in a manner approved by all authorities having jurisdiction;
- conduct all operations in such a manner that there are no unauthorised discharges of any sort (liquid or solid) into waterways given that most of the works will be executed within or adjacent to drainage channels;
- undertake work in compliance with the plans approved by NDIA/EPA, and shall not undertake work not on the approved plans;
- ensure that habitat areas that are not within the work site are protected from disturbance; and
- Ensure that appropriate spill kits are available.
- When night work is authorised by the Consulting Engineer, the Contractor shall provide adequate lighting where work is being executed at night and shall provide and install any additional lighting as required by the Consultant in order to gain access or to supervise the works and carry out testing or examination of material.
- The Contractor shall ensure that access is provided to all properties adjacent to the site for the duration of the contract
- The Contractor shall acquaint himself with the position of all existing services such as sewers, surface water drains, cables for electricity and telephone and lighting poles, water mains and the likes before commencing excavation or other work likely to affect the utilities.

6.1.1 Erosion and Compaction

The following measures should be implemented to reduce the impact of erosion and sedimentation activities:

- Minimise removal of vegetation to areas where it is absolutely necessary.
- Encourage natural re-vegetation in areas where possible to prevent soil exposure.
- Monitor areas of exposed soil during periods of heavy rainfall.
- Slopes should be constructed at the recommended angle to prevent collapse.
- Use appropriate machines for all earth works.
- Designate routes for heavy duty equipment to prevent compaction of soil.
- If ponding is observed due to compaction, it may be necessary to scarify the topsoil.
- Consider the weather pattern before initiating major earthworks. Earthworks should be avoided during periods of heavy rainfall.
- The area around the inlet and outlet of the culvert under the bridge will have to be stabilised as soon as possible to minimise erosion around the culvert.
- Cofferdams and other appropriate measures should be used to prevent water from entering working areas so as to prevent breaches from occurring.

During operation, routine maintenance activities will be conducted as necessary. Maintenance would include:

- Routine inspection to drainage channels and structures
- Routine cleaning of channels
- Routine cleaning of embankments

6.1.2 Fisheries and Watercourses

In order to protect fish, fish habitat, water courses and the quality of water used for domestic and irrigation purposes, the following should be implemented. CONTRACTOR shall:

- minimise and contain suspended sediment within the immediate zone of construction;
- undertake appropriate containment measures during concrete pours to ensure that uncured concrete or concrete leach ate does not enter any watercourse or drainage; and,
- ensure that water intakes or drainage channels for domestic and irrigation purposes are protected from damage at all times.
- Avoid disruption of sluices and impact to hydraulics, drainage shall be controlled and monitored during construction to maintain proper water levels through adequate structural support systems. Waterbodies should be free of obstruction and normal flow of water maintained.
- All waste storage stockpiles or stockpiled material shall not be placed within 10m of any watercourse and shall have a toe berm construction around.
- Significant volumes of dewatering effluent (greater than 3 litres/second) shall be discharged into a “filter bag” that’s designed to retain or filter sediment while gradually releasing water.

6.1.3 Dewatering

- The discharge of dewatering effluent can result in scouring and erosion at point of discharge as well as sediment loading to watercourses and drains.
- The Contractor shall keep the whole works free from water and provide all dams, cofferdams, pumping, piling and temporary drains necessary for this purpose.
- Significant volumes of dewatering effluent greater than 50 gallons per minute shall be discharged into a filter bag that is a geotextile bag to retain or filter out sediments.

6.1.4 Noise

As identified in the impact section, noise will be a significant environmental impact that requires mitigation. The EPA, in collaboration with GNBS, has developed Guidelines for Noise Emission into the Environment. The Standard specifies noise limits for construction activities both for daytime and during the night. The daytime limit (06:00hr – 18:00hr) is 86 dB while the limit in the night is 75dB. Given the proximity of residents to the activities locations noise can be a minor.

However, to comply with the National Standard and reduce this impact the following are measures should be implemented:

- Provide hearing protection to workers exposed to high noise levels such as those involved in demolition.
- Provide earplugs for employees who operate heavy duty machines.
- Employees working in high noise levels areas should be mandated to wear earmuffs or earplugs as required.
- Ensure that machinery and equipment are working efficiently and have installed the required muffler devices.
- Schedule activities to daytime to reduce noise nuisance to nearby residents.

6.1.5 Dust

Dust, though localised, is a potential impact that would require some level of mitigation as outlined in Section 5. The following measures should be implemented to reduce the impact of dust on the environment:

- Personnel working in dusty environments should be required to use respirators.
- During dry periods it may be necessary to soak routes traversed by vehicles and equipment. Dry areas should be soaked as necessary, depending on the weather condition.
- Materials should be transported to site as needed thus resulting in small stockpiles.
- All trucks transporting construction materials should be covered.
- If necessary, the stockpile would also be soaked with water periodically.
- The burning of construction waste and cleared vegetation should be prohibited to avoid smoke nuisance.

6.1.6 Fuel, Lubricants and Chemicals

Fuel and lubricants are classified as hazardous materials and require special consideration in terms of transportation, storage and handling. The following measures should be implemented to ensure the risks of contamination of soil or water from spillages are minimised:

- Since the construction activities would be temporary and fuel storage will be moved as activities progress, it would not be feasible to construct proper facility for fuel storage. As such, it is recommended that fuel be transported to the site as needed or in small quantities.
- Fuel which will require storage should be sited a safe distance from waterways, site offices and work areas and should be elevated to detect any leaks.
- Care should be taken to prevent spillage and leakage of fuel during off loading and refuelling. When refuelling is completed, all nozzles, hoses and other materials should be stored in a proper manner to avoid spills.
- Drip pans can be placed under the fuel/vehicle coupling when vehicle tanks are being filled. This should prevent the possible contamination from leakage of fuel.
- Regular maintenance of machinery should be done to avoid leakages.
- Spill kits should be made available in the event of spillages.
- Workers, mechanics and other staff should be trained on the proper use of these kits.
- Adequate signage should be installed in fuel storage areas such as No Smoking and Flammable Materials.
- Fuel storage tanks/containers should be monitored for leaks.
- Fire containment measures such as extinguishers or sand buckets should be placed in fuel storage/refuelling areas.
- The on-site fuelling area should be deemed a 'no smoking' zone and all staff required to turn off cell phones when in that general vicinity.

6.1.7 Waste Management

Several types of waste can be generated from the various activities that would require different methods of disposal. Domestic and construction waste will be disposed of at the Lusignan Dumpsite.

6.1.8 Health and Safety

In Section 7 the management of Health and Safety during the construction phase is discussed, based on the risk assessment included in Appendix B.

6.2 Specific Management Plans

6.2.1 Erosion and Sediment Control Plan

6.2.1.1 Purpose and Scope

This Plan describes environmental protection measures to prevent erosion and sedimentation.

Protection measures to control sediment and runoff and specific sediment and drainage control plans for all areas of disturbance are contained herein.

6.2.1.2 Sediment Control and Water Quality

Works will be planned, scheduled and performed in such a manner that the quality of water flowing from the site is at all times acceptable. Conditions will be maintained to protect the aquatic environment of watercourses not only during construction, but also during periods of suspended construction activity.

Permanent and temporary soil erosion control features will be constructed at the earliest practicable time, and will be inspected daily during adverse weather conditions or when construction operations are proceeding in Environmentally Sensitive Areas. Control measures will be capable of continuous operation during working and non-working hours, and are subject to approval by the Supervisors' Representative.

During periods of inclement weather, operations will cease, or construction methods will be modified or re-located to an alternative site within the project area to avoid situation of watercourses.

The Environmental Officer/Monitor will conduct regular water quality monitoring for changes in turbidity as result of construction as part of the quality assurance program.

The installation of culverts will be conducted in the dry whenever possible to reduce the risk of sedimentation to local springs and wells that provide water to local households.

During preparation of stream diversions, culvert installations and other dewatering where drainage could readily reach a watercourse, all effluent and silt-laden water will be discharged to a sediment control pond, or alternate sediment control method for removal of sediment prior to its release into that watercourse. This requirement also applies to the control of discharge resulting from curing areas of recent concrete pours for bridges or drainage structure headwalls. The direct discharge via seepage of untreated, silt-laden water or other deleterious substance into any watercourse is prohibited.

6.2.1.3 Riparian Areas

Maintaining adequate buffer zones and employing sediment control measures will protect riparian areas.

6.3 Erosion Control

Once construction has begun, erosion control is the first step in effective management of sediment. While erosion is a natural process that shapes the landscape, construction can accelerate the process and cause significant volumes of material to be transported and potentially adversely impact aquatic resources. Therefore, sites at risk for shallow slope movement will be identified and appropriate control measures applied to minimize the potential of slope movement. Effective and proactive erosion control is more effective than sediment interception and trapping.

The following steps to effectively control erosion are:

- Schedule construction activities at sensitive sites for times when the risk is minimal.
- Inlet and outlets of drainage culverts will be stabilized as per construction drawings as soon as the culvert is installed to minimise erosion around the culvert.
- Where possible construction activities in areas of high erosion potential will be planned for the driest season of the year.
- Equipment movement in erosion prone areas during periods of heavy precipitation will be restricted.
- Retain as much existing vegetation as possible.
- Construction drawings will identify areas of clearing and grubbing and designed to minimise the loss of vegetation;
- Clearing of vegetation will be minimised at equipment storage and marshalling areas and at borrow and other material storage areas avoid exposing sensitive soils;
- The RoW clearing and grubbing boundaries will be flagged to ensure areas are not unnecessarily cleared.
- Re-vegetate/protect cleared areas and bare soils
- Protect temporary fills, stockpiles or exposed soils adjacent to drains, streams and canals with slope blankets or covers. Plastic sheeting, geotextiles and other manufactured products can be used as covers. Angular rocks may be suitable in protecting sensitive soils. All stockpile shall have a toe berm and should not be located within 10m of the watercourse.
- Use mulches and other organic stabilizers to minimise erosion until re-vegetation can be re-established
- Divert runoff away from cleared areas
- Minimise the flow of water onto cleared areas;
- Isolate cleared areas;
- Retain natural drainage patterns wherever possible;
- Establish permanent erosion control as soon as possible

The most important aspect of erosion control is to apply permanent stabilisation and re-vegetation as soon as possible. As soon as areas are graded to final slope lines and levels, and construction traffic no longer needs to access an area, permanent erosion control measures will be put in place.

6.4 Sediment Control

During construction it is often impossible to protect all newly exposed soils from erosion; therefore it is important to also apply sediment control measures at the same time as the erosion controls. Sediment control typically focuses on managing water run-off from erosion prone areas. Water carrying sediment must be directed away from entering waters that provide domestic and irrigation needs and contain aquatic organisms or the water must be treated before it is released into such waters. Steps to control sediment include:

- Control and collect runoff from erosion prone areas
- Minimise runoff velocities and erosive energy;
- Maximise the length of flow paths for precipitation or surface runoff to minimize energy of flow or employ structures such as check dams and ditch blocks.
- Discharge sediment-laden waters to re-vegetated areas where sediment can be filtered out before the water reaches any watercourses.
- Retain sediments on site with sediment control structures.
- Use correctly installed silt fences and other barriers;
- Provide bed-load clean-outs at culverts and ditches;
- Construct sediment traps in areas where ditch water must be intercepted to ensure sediment is not transported into watercourses;
- Construct sediment traps of sufficient size to handle the anticipated runoff.
- Regularly monitor erosion and sediment control measures to ensure that they are working effectively;

- Additional checks are required after rain events;
- Maintenance of sediment control devices includes the removal of accumulated sediments to maintain collection capacity;
- Have extra geo-textile (silt fencing), and /or gravel on hand to repair or install new sediment control structures as required.

6.4.1 Culvert/Bridges Sites

- Minimise clearing of banks and stabilize exposed slopes.
- Ditch water will be directed to vegetated areas or into sediment traps to filter out the sediment before it reaches developed areas.
-

6.4.2 Flooding

Cofferdams constructed to facilitate rehabilitation of culverts can impede drainage flow, in some cases where there is excessive rainfall, minor flooding can result. The following mitigation impacts should be implemented.

- Routine inspection to canal and cofferdams for possibility of rise in water level and breaches in cofferdam.
- Routine cleaning of connected channels that assist with drainage
- Identification of alternative drainage to divert water to.
- Mobile pumps of sufficient capacity should always be present on site to facilitate dewatering.
- In cases where there is no option to divert water, HDPE pipes can be used to facilitate flow of water.
- Constant monitoring of drains that are interconnected especially in areas that are highly populated to ensure that water levels are at minimal.

6.5 Specific Areas of Concern

6.5.1 Erosion and Sediment Control Recommendations for Specific Areas

The following are preliminary recommendations for erosion and sediment controls for the sensitive areas. In some cases more detailed plans will be required prior to construction, and if necessary, will be developed with input from the Contractor, Environmental Monitor and the Supervisors' Representative.

6.5.1.1 Environmentally Sensitive Area

- "Close cutting" of the vegetation as opposed to clearing.
- Erosion and sediment control are a priority in these areas
- Pre-construction planning and a site review with Environmental Monitor will be required before construction activities take place.
- Water from construction areas along the upslope side of the road must not be allowed to flow directly onto cane fields and farm land.
- Ditches will be developed on the upslope side along with sediment traps to prevent sediment entering the cane fields

6.6 Grading and Topsoil Protection

- Excavated material not to be reused shall be stored at temporary sites

- Excess materials shall be placed in piles from which it may be replaced into its original position. Stockpiles shall not be placed within 10 m of any water body.
- Topsoil and subsoil shall be stripped and stockpiled separately to avoid mixing.
- In areas where soils are not to be removed, the grassed vegetative layer shall be maintained, where possible, to protect soils from compaction and erosion
- Topsoil shall be spread to a uniform depth of 5cm on designated areas. Areas where topsoil is to be placed shall be fine graded to a uniform surface. It shall be free of all vegetation and other debris, and free of stones, which would not be covered by the depth of topsoil of 5cm.
- Where excess topsoil is generated, that is not required for restoration of the construction area, this excess topsoil should be donated to the Local Government Authorities, as represented by the Neighbourhood Democratic Council for their use and distribution to local landowners.

6.7 Waste Management Plan

6.7.1 Purpose and Scope

This plan will ensure that waste generated during construction is handled in a way that protects the environment and complies with applicable regulations. The following are some of the materials that can be expected to generate during construction:

- Vegetation strippings
- Concrete forms
- Dimension lumber
- Packing materials
- Containers for various construction materials (e.g. asphalt, concrete and steel)
- Pallets
- Plastics
- Waste oil, filters, lubricants and hydraulic fluids
- Concrete
- Food
- Sewage

The plan addresses open burning, refuse disposal, recycling, reuse, sewage disposal, and camp (yard) waste disposal practices.

6.7.2 Waste Management Practices

All organic and inorganic materials will be placed and/or disposed of so as not to directly or indirectly impact any watercourse or groundwater. The placement and disposal of all such products and materials will be done in an environmentally acceptable manner. Suitable landfill sites should be identified and approved by the N.D.C for disposing of construction waste.

Any waste material that is inadvertently disposed in or adjacent to watercourses or other designated environmentally sensitive areas will be removed immediately in a manner that minimises adverse impacts, and the original drainage pattern will be restored.

All wastes which are not designated, as combustible waste to be burned on-site, will be recycled, disposed of in an approved landfill, or shipped to an approved disposal facility.

Construction debris will not be allowed to accumulate on the construction site but will be collected promptly and regularly removed from the site. Waste materials will be placed and stored in suitable containers.

Storage areas and containers will be maintained in a sanitary condition and covered to prevent spreading of wastes by water, wind or animals.

Solids, sludges and other pollutants generated as a result of construction or removed during the course of treatment or control of wastewaters will be disposed of in a manner that prevents their direct or indirect discharge to any watercourse or ground waters.

6.7.2.1 Open burning

Open burning of wood debris generated by land clearing will be conducted in accordance with the Standard and Special Specifications.

Open burning must be planned so that it does not adversely affect local residents during their daily lives.

Burning methods will be employed that will prevent heat or smoke damage to all vegetation that has been designated for preservation. The use of waste oil and/or tires as fire accelerators is not permitted. Burning pits will not be located within 50 m of any watercourse, wetland or other Environmentally Sensitive Area, or in areas where ditches are to be constructed.

In situations where the material generated as a result of clearing and/or grubbing may not be burned on-site, the disposal method must be approved by the Supervisor's Representative or the Environmental Officer/ Monitor.

6.7.2.2 Strippings

All waste and surplus material will be disposed in designated and approved areas. Not less than fifteen days prior to disposing of any waste or surplus material, the Environmental Officer/Monitor will be provided the locations, nature of the material being disposed, and stabilization technique.

Excavated material will be properly drained, spread and trimmed to a stable slope not exceeding 1.5 to 1, in a manner which minimises disturbance of watercourses and vegetated areas. All waste sites will be re-vegetated immediately after creation of the waste disposal site, or else suitable temporary erosion control measures, such as tarps or plastic will be used until re-vegetation is undertaken.

6.7.2.3 Waste Oils and Special Wastes

Waste oils, special wastes, and refuse generated during the servicing of equipment (e.g., air and oil filters, hydraulic fluids, petroleum products) will be stored, transported and disposed of in accordance with regulations and the contract Specifications, and will not be disposed of by dilution, burial or incineration.

Where possible, waste oil, lubricants and other waste materials generated during the servicing of equipment and machinery will be recycled. The dumping of oil or other deleterious materials on the ground or in a watercourse is strictly prohibited.

Refuse generated during the servicing of equipment will be removed from the site and disposed of in an approved facility.

6.7.2.4 Concrete Wastes

Fresh concrete or cement will be isolated from any designated watercourse for 48 hours after placement. Containers or trucks carrying cement or fresh concrete will be washed at a site approved by the

Supervisor's Representative. Concrete waste, including wastewaters from batching or cleaning, will only be disposed of at approved and designated disposal sites. All cement-contaminated wastewater from cleaning or mixing is to be considered toxic, and must be prevented from entering any watercourse for at least 48 hours to allow the water to reach neutral pH.

6.7.2.5 Food Waste

All food wastes will be collected and stored in containers and either incinerated daily or regularly transported to the nearest operating landfill.

6.8 Fuel and Lubricants Management

Spill Contingency and Response Plan

6.8.1 Purpose and Scope

This document describes spill contingency measures and response plan for this Project. The plan is designed to reduce impacts to the environment in the event of a spill through ensuring materials are available and established procedures are followed.

The purpose of the spill contingency plan is to provide a course of action, which will be implemented to allow a prompt and orderly response to spills that may occur during construction. A spill of any liquid, solid or gaseous substance, which could impair the usefulness of the land, water or air where it is released will be responded to by the procedures outlined in the contingency plan. The main objectives of the Spill Contingency Plan are:

- To reduce the risk of harmful exposure to individuals and the surrounding environment;
- To clearly outline the action to take if a spill will occur; and,
- To ensure that project staff is aware of the correct response required.

"Spill" consists of unauthorised release or discharge into the environment of a substance in an amount equal to or greater than the specified amount, or the uncontrolled release of any deleterious substance to the environment. All spills will require immediate action as necessary, with priorities for:

- Protecting lives and preventing injuries;
- Protecting the environment; and,
- Protecting property.

This plan is intended to provide guidance in the event of a spill. The areas of responsibility of the various personnel who will be directly involved are outlined to provide clear direction of what each person will be doing at the time of an emergency. The Environmental Officer/ Monitor in consultation with the Supervising Consultant will review this plan regularly. The review date will be recorded and kept on file.

6.8.2 Spill Response Plan

This section is designed to provide the reader with the methods of handling spills and the reporting procedures required.

6.8.3 Reporting of Spills

All spills major or minor must be reported. Workers are to report all spills to their supervisor or Environmental Officer/Monitor who will in turn report to the Supervising Consultant.

6.8.4 Minor Spills

Minor spills are those that can be easily and safely handled by those people in the area, and generally by the person(s) initiating the spill. These spills are generally within confined areas, are small in nature, have minimal health and safety risks, and have no chance of migrating into the environment.

6.8.5 Major Spills

These would be spills of greater potential than minor spills and have potential health and safety risks. When in doubt, treat the spill as major. The Supervising Consultant must be contacted with the following information:

- The person's name and telephone number;
- The name and telephone number of the person who caused the spill;
- The location and time of the spill;
- The type and quantity of the substance spilled;
- The cause and effect of the spill;
- Details of action taken or proposed to stop, contain and minimize the effects of the spill;
- A description of the spill location and of the area surrounding the spill;
- Details of further action contemplated or required.

6.8.6 Spill Response Equipment

Spill response equipment will be provided and located in a designated spill response storage facility.

Any operations adjacent to a watercourse will have a spill kit present. Any used spill abatement and clean-up materials will be promptly replaced.

6.9 Spill Conditions

6.9.1 Solid Material Spill in a Dry Area

- Clean up and recover material with protective gear.
- Detoxify the area.
- Store/transport recovered material and review the mode of disposal.

6.9.2 Liquid Material Spill in a Dry Area

- Contain spill using earthen berms.
- Clean up and recover material with protective gear. Material recovery may utilize pumps or absorbents as appropriate for type of spill.
- Detoxify area.
- Store/transport recovered material and review the mode of disposal.

6.9.3 Solid Material Spill in an Area Wet from Rain

- Cover material with plastic.
- Isolate any drainage from the spill area, if possible, using earthen berms.
- Notify downstream users if appropriate.
- Clean up and recover material using protective gear.
- Store/transport recovered material and review the mode of disposal.

6.9.4 Liquid Material Spill in an Area Wet from Rain

- Contain the spill using earth berms.
- Isolate drainage, if possible, using earth berms
- Notify downstream water users, if appropriate.
- Clean up and recover material using protective gear. Material recovery may utilize pumps or absorbents as appropriate for the type of spill.
- Detoxify the area.
- Store/transport recovered material and review the mode of disposal.

6.9.5 Solid or Liquid spill in a Drainage Ditch

- Contain the spill by placing an earth berm across the ditch as far downstream of the spill as possible;
- Isolate drainage, if possible using berm.
- Store/transport recovered material and review the mode of disposal

6.10 Specific Materials on Construction Projects

The following response actions are outlined for specific spills that, however unlikely, could occur during road construction.

6.10.1 Petrol/Gasoline

Petrol/gasoline may be stored on-site for use in light vehicles. A list of the hazards associated with petrol/gasoline, spill response, fire response and recovery methods are listed below. Varsol spills will be treated as petrol/gasoline spills. Petrol/gasoline is:

- Highly flammable;
- Explosive when in a vapour form;
- Easily ignited by flame or spark; lighter than water (floats on water);
- Toxic to humans by ingestion and by aspiration; and
- Toxic to fish and other aquatic organisms

6.10.2 The initial response to petrol/gasoline spill will be:

- Stop the flow at the source if possible;
- Eliminate all possible sources of ignition (e.g., extinguish cigarettes, shut off motors);
- Evacuate danger area
- Carefully consider the hazards and merits of trying to contain the spill. Contain only if it is safe to do so and obvious benefit of containment is apparent (e.g., contain if flowing towards a water course). Otherwise leave gasoline to spread and evaporate.
- Notify the Environmental Officer/Monitor/ or the Supervisor's Representative.

6.10.3 In the event of a fire, the response will be:

- Use CO₂, dry chemical, foam or water spray (fog);
- Use jet streams to wash away burning gasoline;
- Divert the gasoline to an open area and let it burn off under control;
- Use water to cool tank surfaces;
- Be aware of re-ignition if the fire is put out before all the gasoline is consumed.

Petrol/gasoline can be recovered in the following manner:

- Unburned gasoline can be soaked up by sand and peat moss or by commercial sorbents;
- If necessary, contaminated soil will be excavated;
- Gasoline entering the ground can be recovered by digging sumps or trenches and pumping from below the water table

6.10.4 Petrol/ gasoline can be disposed of in the following manner:

Evaporation or incineration under controlled circumstances.

6.10.5 Other Fuels and Petroleum Products

Fuel and petroleum products spills will be contained using local earth materials and/or sandbags. Spill clean-up equipment specifically designed for petroleum products are to be located at camp (will one be established) and in the Maintenance Shop.

Spills or leaks of all light and medium oils, including fuel oil at storage facilities, will be responded to by the following these steps:

- Identify the source of the leak or spill;
- Stop flow if possible
- Eliminate open flame ignition processes
- Contain the spill
- Notify the Supervising Consultant
- Initiate Spill Response Plan
- In the event of a tank rupture, the containment berm is designed to contain the full capacity of the tank. This will allow the oil to be contained and pumped out of the area into salvage tanks. Contaminated soil from the site will be excavated and transported to a treatment facility or treated onsite by air sparging.
- Spilled diesel fuel can be recovered by commercial sorbents or by sand, straw or peat moss. If necessary, contaminated soil will be excavated. Digging sumps or trenches and pumping from below the water table can recover Diesel fuel saturated soil.

6.10.6 Fuel spills on land will be responded to by the following procedures:

- Construct a earth berm down slope of the running or seeping fluid;
- Plastic tarps may be placed at the base of the berm to allow the fuel to pool on the plastic for easy capture with absorbent pads;
- Pads may be squeezed into empty drums and re-used;
- Larger pools can be pumped back into drums;
- Special care will be taken to prevent the fuel from entering a body of water where it will; have greater negative impact;
- Contaminated soil and vegetation may have to be removed and disposed of.

6.10.7 Fire response methods for diesel fuel include:

- CO₂, dry chemical, foam, or water spray;
- Water to cool tank surfaces;
- Diversion of the diesel to an open area and let it burn off under control;
- Awareness of re-ignition if the fire is put before all the diesel fuel is consumed.

Fuel spills on water must be contained immediately to restrict the extent of the floating fuel. The methods, which may be used to contain fuel oil, include:

- Booms deployed to contain the spill area;
- Absorbent pads used to capture small spills on water;
- A skimmer to recover oil contained by the boom and then pump the recovered fuel into empty fuel drums; and
- Culverts (CMP's or plastic) to permit water flow while capturing and collecting fuel. The culvert can be surrounded with absorbent material to capture any fuel on the water surface.

6.10.8 Concrete and/or Concrete Wastewater

During any concrete pour within 15 metres of, or in work areas below, the high water level of any watercourse, carbon dioxide cylinders will be ready for use in the event of concrete or concrete-leachate discharges into the watercourse. The carbon dioxide will be used to neutralise any concrete leachate that is inadvertently discharged into the watercourse.

6.10.9 Acid Spills

Spills of acid will be contained using sandbags and neutralization can be accomplished using either soda ash or lime. Both the sandbags and lime will be stored at the maintenance yard. Following neutralisation, the area must be carefully flushed with water.

Note: Prior to using water in any clean-up, consult the guidelines for the specific chemical, as appropriate use of water may be severely hazardous.

Any water used for flushing a spill will be contained, recovered and disposed of in an approved manner.

Mock Spill activity will be conducted.

A minor spill will be staged and spill response and clean up mechanism will be demonstrated. The following key steps will be outlined/demonstrated during the exercise:

Marked the area to conduct exercise.

- Spill Waste In marked area.
- Spill was identified.
- Notify the Consulting Engineer
- Use of protective gears (gloves, goggles and rubber boots) to clean up and recover the material.
- Apply absorbent pad to absorb spilled liquid.
- Remove recovered material (contaminated soil) using a shovel.
- Remove the portion of the contaminated soil and place in heavy duty garbage bags.
- Store spilled material in a sealed five gallon container.
- Transport to the Site Office and store securely.
- Dispose material at the Haags Bosch Landfill site.

Discussion of use and importance of the following Basic Safety Gears will be identified and use was demonstrated.

- Safety Vests
- Helmets
- Safety Boots
- Goggles

- Gloves
- Dust masks
- Fire Extinguishers.

6.11 Traffic Management Plan

In cases where construction works (culverts or bridges) bypass roadways or secondary roads that are frequently used by motorists the following traffic management strategies should be implemented. Throughout the course of the works the Contractor will be responsible for the safety of all persons present on the site of the works. As such, the Contractor will ensure, as far as is reasonably practicable and to the satisfaction of the engineer, the health, safety and welfare of employees, including those of sub-contractors and all other persons on the site. The responsibilities undertaken will include.

- (a) The execution of suitable arrangements for ensuring safety and absence of risks to health in connection with use, handling, storage, transport and disposal of articles and substances;
- (b) The provision of protective clothing and equipment, first aid stations with such personnel, and equipment necessary and the required information, instruction, training and supervision to ensure the health and safety at work of all persons employed on the works, all in accordance with applicable laws;
- (c) Designation as a safety officer one of his senior staff who has specific knowledge of safety regulations, and experience of safety precautions on similar works and who will advise on all matters affecting the safety of workmen and on measures to be taken to promote such safety;
- (d) The provision and maintenance of access to all places on the site in a condition that is safe and without risk of injury;
- (e) The provision of adequate waterborne sanitation, refuse collection and disposal complying with all applicable laws and bye-laws and to the satisfaction of the engineer, for all houses, offices, workshops, and laboratories erected on the cap site or sites;
- (f) The provision and maintenance of an adequate number of portable toilets and other sanitary arrangements at sites where work is in progress and the execution of appropriate measures in consultation with the appropriate Public Health Authority to control within the site, mosquitoes, flies and pests including the application of suitable chemicals to breeding areas.

General Provisions

The Contractor is required to conduct activities in a manner that ensures the safety and convenience of the public and protects the residents and property adjacent to the site.

- Throughout the project the Contractor shall ensure that the public road remains open and available for use in good condition and that delays to traffic are minimized.
- The Contractor shall keep existing roads open to traffic during construction operations but ensure that one lane is available for access.
- The Contractor shall keep roads and sidewalks affected by the activities free from soil and material spillage and ensure that construction areas can accommodate traffic safely at all times. The Contractor is required to erect and maintain signs, barricades, and other traffic control devices as may be required to guide traffic inside and outside work areas and as indicated by the Manual of Uniform Traffic Control Devices, Part 6- Temporary Traffic control or as by directed by the Engineer. The Contractor, will replace traffic control devices that become lost, stolen, destroyed or deemed unacceptable while their use is required.
- During non-working hours and following completion of a particular construction operation, all warning signs, except those necessary for public safety, will be removed. Retro-reflective and painted surface on signs barricades, and other devices will be kept clean, in a good state of repair and retain their

retro-reflective ability at all times. Sizes, colours, messages and locations will all be to the approval of the engineer.

- The Contractor shall take care at all times to ensure the convenience and safety of residents along and adjacent to the road and any public highway affected by the works. Access to property adjacent to any work site will be maintained at all times.

Obstruction of Traffic

The Contractor will ensure that the flow of traffic is unimpeded by construction-related activities. Two lanes of traffic will be maintained at all times. In cases where it is absolutely necessary to close the road to facilitate the works, the contractor will ensure that closure of one lane is done .

The lane width will be increased by temporarily grading and backfilling the existing road shoulder on both sides of the carriageway. Temporary road surfacing material will be used to widen the road shoulder. All diversions, widened shoulders will be maintained throughout the duration of construction works. If the option of widening the carriageway is not feasible in areas of limited space the option of diverting traffic through the secondary roads in the project area will be explored.

Construction and Advisory Signs

The contractor is required to supply, install, maintain and remove of all works-related signs. All signs will be made in accordance to the Manual of Uniform Traffic Control Devices (MUTCD). Sign panels will be orange with black legend and be mounted on stands. The location and type of each sign will depend on the area of placement.

Flagmen

At each construction site traffic flow should be guided by flagmen with STOP/GO signs when necessary. At the site traffic flow will be two-directional.

Lighting

Any existing roadway lighting that is disturbed during construction will be replaced with sufficient temporary lighting to illuminate the same roadway surface. Adequate lighting will be provided for approved night works to ensure the safety of road users and construction workers.

Access to Residents

The Contractor shall ensure that access to residences is adequately maintained in cases where access is affected by construction works. If access fall within the construction zone that is demarcated, the Contractor will ensure that access to the property is maintained by temporarily removing barricades. In cases where bridges are demolished to facilitate the works, the contractor will provide suitable alternative arrangements to allow access to properties.

Public Information Plan

The public will be informed through selective media of the project, duration and implementation phase. Road users will be informed of possible traffic disruption and the importance of exercising caution in order to minimize accidents. The NDCs will be engaged throughout the duration of the project to ensure information is communicated to the communities. Residents living in close proximity to the works will be

informed of the project, the duration of the construction, possible inconveniences and measures that will be implemented to lessen impacts.

Community Engagement

Contractors should engage affected stakeholders throughout the construction period to ensure that issues that arise as a result of the works are addressed. Community meetings will be held periodically as the works progresses. Contact information of staff members will be provided to community member to ensure that issues are reported and addressed promptly.

6.12 Closure Plan

- Upon completion of construction, the Contractor shall demolish wholly or in part, remove and dispose of all buildings, structures, pipe culverts, fences, barriers and other obstruction that is not to remain on site to an approved landfill site.
- The Contractor shall arrange for disconnecting water supply and electricity supply.
- He shall remove all temporary drains, backfill trenches, fill in any pits created.
- The site and all staging area shall be restored as far as practicable to its original state and be left in a neat and tidy condition.
- The Contractor is responsible for producing a waste management plan of which the dismantling of construction site will have to be outlined in terms of disposal of materials.

6.16 Community Relations

Throughout the project area there are inhabitants that are likely to be affected by the project, residents should be kept informed of ongoing activities at all times, and consulted about any works which would impact their land or access to services, including irrigation supply. Any adverse impact to their land or irrigation supply will be mitigated as described in the sections above. A grievance mechanism should be set up that outlines the framework for addressing issues on site.

6.17 Workers Training Program

All employees directly and in-directly involved in the construction of the proposed culverts shall be trained. This training program should aim to train and familiarize workers with the Environmental Management plan, the implementation of the plan and application of the mitigation measures. Workers should receive basic health and safety training to ensure that accident levels and mishaps on the construction site are kept top the minimal level. The traffic management plan should be discussed in detail with the designated traffic office and other employees responsible for traffic management, to ensure that effective traffic control mechanisms are in place and a free flow of traffic is maintained at all times. Safety of road users and construction employees is an important issue that need special consideration and training in traffic management will assist in implementing the Traffic management Plan.

All construction workers should be familiar with the construction impact and preventative measure identified in this EMP as it related to waste management, general construction, water management, erosion and sedimentation control, dust and noise pollution, flora and fauna protection.

7 Health, Safety and Welfare during Construction

7.1 Management of Health and Safety

7.1.1 Health and Safety Plan

Under the specifications the Contractor will be required to propose a Health and Safety Plan which will outline their strategy for ensuring the safety of all stakeholders in the vicinity of the construction site. This should comply with all guidelines outlined in the Occupational Health and Safety Act, as well as the recommendations listed below.

Consideration should be given to the following measures to manage health and safety during the construction phase in the Health and Safety Plan.

- Designation of a person on staff with responsibilities for Occupational Health and Safety.
- Risk assessment with mitigation measures as discussed below.
- Protocol for training and toolbox talks for all site personnel.
- Protocol for talking through risk assessment with site personnel, and having all site personnel sign risk assessment to agree to follow mitigation measures.
- Reporting procedures for near misses, accidents and dangerous actions.
- Commitment to ensure all PPE, first aid equipment, and safety equipment are provided in accordance with the risk assessment.
- Procedures for site inductions to be given to site visitors.

7.1.2 Health and Safety Risk Assessment and Identification of Mitigation Measures

Key to the development of the Health and Safety Plan is the production of a comprehensive risk assessment. As a minimum the risks and mitigations given in the example risk assessment included in Appendix B must be included.

In determining the mitigations for risks identified, the Contractor should consider that risk control measures should preferably be collective rather than personal. In descending order of effectiveness, the hierarchy of risk control involves¹:

1. changes that eliminate a hazard
2. substitution of less hazardous methodology
3. enclosure – isolation, barriers, guarding or segregation, all of which are designed to separate people from the hazard
4. reduced exposure – changes that reduce the time individuals are exposed to a risk, or the number of people exposed
5. safe systems of work, together with suitable training and supervision
6. written procedures, and the provision of information, instruction, warnings, signs and/or labels
7. use of personal protective equipment (PPE)

In preparation of the risk assessment the Contractor must consider measures to ensure the safety of all persons within the vicinity of the works. Examples of risks and mitigations to be considered are listed below:

- Provision and maintenance of construction sites that are lighted, safe and without risks to health.

¹ CDM 2007 Construction Work Sector Guidance for Designers Section 1.4.7

- Provision of signage and fencing to stop access to work site by members of the general public.
- The execution of suitable arrangements for ensuring safety and absence of risks to health in connection with the use, handling, storage, transport and disposal of articles and substances
- Provision and maintenance of access to all places on site is in a condition that is safe and without risk of injury.
- Provision of protective clothing and safety gear (hard hats, hearing protection, goggles and other devices for activities).
- Provision of First Aids Kits.
- Arrangements for transfer to nearby hospital to deal with emergencies.
- Provision and maintenance of adequate sanitation, refuse collection and waste disposal.
- Provision of continuous supply of fresh water on site.
- Designation of a safety officer of one of the Contractors senior staff who will have specific experience and knowledge of safety regulations on similar projects.

7.1.3 Health and Safety Training for Workers

All employees will undergo Health and Safety Training prior to commencement of constructions. Training sessions will also be ongoing throughout the construction phase to ensure full compliance with the approved Health and Safety Plan. The risk assessment will be discussed with all staff to ensure prescribed procedures and recommendations are clear.

Key points to be covered in training of all site workers

- Obligations on employee as regards adherence to risk assessment and hazard reporting
- Risks posed by Site Conditions and Climate
- Behaviour on site
- Communication with the Public.
- Emergency Response (Fire, Health, Spills)
- Spill Response Mechanism
- Waste Management.
- Traffic Safety and Management
- Working hours and breaks

Discussion of use and importance of the following safety equipment will be identified and demonstrated.

- High visibility clothing
- Hard hats
- Steel toe-capped boots
- Goggles
- Gloves
- Dust masks
- Fire Extinguishers.

Key points to be covered in training of machinery operatives

- Qualifications and licences required for all operatives of heavy machinery
- Safe systems of work to protect operatives, site workers, public and property
- Use of banksmen at all times
- Ground conditions at work site
- Areas to be avoided
- Methods of working to ensure safety in poor ground conditions
- Working hours and breaks
- Carriage of passengers
- Use of seat belts

- Use of PPE
- Use of fire extinguishers and spill kits
- Smoking
- No operative to operate heavy machinery while under the influence of alcohol
- No operative to operate heavy machinery while excessively tired
- Use of mobile phones while operating machinery
- Maintenance of equipment

7.1.4 Site Inductions

All persons who have not undergone training as described above must be given a site induction before entering the work site. Key points to be addressed in this induction include:

- Talking through and signing off on relevant parts of the risk assessment,
- Particular hazards relevant to visitor
- Behaviour on site
- Wearing of PPE
- Location of First Aid and Safety Equipment
- Introduction to nominated safety officer
- Entry and exit routes

8 References

1. SNC. Lavalin International, May, 2001. Mahaica-Rosignol Road-Design and Feasibility Study Environmental Management Plan.
2. NDLEA-CEMCO 2006. Berbice River Bridge Environmental and Social Impact Assessment.
3. NDLEA-CEMCO 2007. Berbice River Bridge. Environmental Management Plan.
4. WSP imc in assoc with CEMCO Inc, April, 2008, Economic Analysis, Environmental Assessment and Design Studies .Lot 2B Transport Infrastructure Rehabilitation Programme Feasibility Report.
5. WSP imc in assoc with CEMCO Inc, April, 2008, Economic Analysis, Environmental Assessment and Design Studies .Lot 2B Transport Infrastructure Rehabilitation Inception Report.
6. WSP imc in assoc with CEMCO Inc, March, 2008, Economic Analysis, Environmental Assessment and Design Studies. Lot 2B Transport Infrastructure Rehabilitation. Condition Study Report of Structure in Lot 2B.
7. EMC- 2011. East Demerara Water Conservancy Northern Relief Structure- Environmental Management Plan.

Appendices

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Appendix A. Example Forms

A.1. Daily Environmental Inspection Summary - Construction

<p>National Drainage and Irrigation Authority.</p> <p>Ministry of Agriculture.</p> <p>PROJECT: <i>Conservancy Adaptation Project – Coastal Civil Works</i></p> <p>DAILY ENVIRONMENTAL INSPECTION SUMMARY-CONSTRUCTION</p> <p>Location(Chainage) ----- to-----</p> <p>Inspection Date:</p> <p>DAY OF:</p>			
General	Yes	No	N/A
<ul style="list-style-type: none"> ▪ Sand Bags, silt fencing and absorbent material readily available for emergency. ▪ Erosion and sediment control measures in place ▪ Dust control measures in place. ▪ All workers outfitted with necessary PPE. ▪ First Aid Kits on site ▪ Spill kits on site ▪ All warning signs in place. 			
<p>Waste and Spills Management</p> <ul style="list-style-type: none"> ▪ Garbage ,scrap material and waste collected in suitable receptacles ▪ No servicing or refilling with 30 m of watercourse ▪ Spill containment material available on site ▪ Vegetation material gathered for removal ▪ Waste construction stockpile not older than 30 days. ▪ Drip pans available in site 			
<p>Erosion and Sediment Control</p> <ul style="list-style-type: none"> ▪ Stockpiles do not interfere with surface drainage 			

<ul style="list-style-type: none"> ▪ Stockpiles protected from wind and water erosion ▪ Silt fencing/trenching/berming in place ▪ Stockpiles not located within 10m of watercourses. 			
<p>Water Management</p> <ul style="list-style-type: none"> ▪ Watercourse flow maintained ▪ No equipment, waste material or construction material stored within 10 m of watercourse ▪ Site dewatering pump outlets to vegetated area and not within 10 m of watercourse. 			
<p>Other Observation/Comments</p>			
<p>Issues Raised</p>			
<p>Environmental Inspector's Signature</p>		<p>Date:</p>	

A.2. Weekly Environmental Inspection Summary - Construction

<p>National Drainage and Irrigation Authority. Ministry of Agriculture.</p> <p>PROJECT: <i>Conservancy Adaptation Project – Coastal Civil Works</i></p> <p>WEEKLY ENVIRONMENTAL INSPECTION SUMMARY-CONSTRUCTION</p> <p>Location(Chainage) ----- to-----</p> <p>Inspection Date:</p> <p>WEEK OF:</p>
<p>Summary of Works completed:</p> <p>Contractor:</p>
<p>Consultant:</p>
<p>Summary of Construction Activities and Site Conditions during the Week.</p>
<p>Environmental Management</p> <ul style="list-style-type: none"> ▪ Onsite Traffic/Traffic Management ▪ Waste Management/Housekeeping
<p>Safety Equipment/Spill Kits</p>
<p>Dust and Noise</p>
<p>Fuel Spills</p>

Sediment and Erosion Control
Dredging and Disposal
Public Complaints
Health, Safety and First Aid <ul style="list-style-type: none">■ Accidents/Near Misses/Lost Time
Licenses – Permits
Outstanding Corrective Actions (attach extra sheets if necessary)
Location:
Action Item and Status:
Issues Raised:
Environmental Inspector's Signature: Date:

A.3. Monthly Environmental Inspection Summary - Construction

<p>National Drainage and Irrigation Authority. Ministry of Agriculture.</p> <p>PROJECT: <i>Conservancy Adaptation Project – Coastal Civil Works</i></p> <p>MONTHLY ENVIRONMENTAL INSPECTION SUMMARY-CONSTRUCTION</p> <p>Location(Chainage) ----- to-----</p> <p>Inspection Date:</p> <p>MONTH OF: .</p>
<p>Summary of Works completed:</p> <p>Contractor:</p>
<p>Consultant:</p>
<p>Summary of Construction Activities and Site Conditions during the Week.</p>
<p>Environmental Management</p> <ul style="list-style-type: none"> ■ Onsite Traffic/Traffic Management ■ Waste Management/Housekeeping
<p>Safety Equipment/Spill Kits</p>
<p>Dust and Noise</p>
<p>Fuel Spills</p>
<p>Sediment and Erosion Control</p>

Dredging and Disposal
Public Complaints
Health, Safety and First Aid <ul style="list-style-type: none">▪ Accidents/Near Misses/Lost Time Licenses – Permits
Outstanding Corrective Actions (attach extra sheets if necessary) Location:
Action Item and Status:
Issues Raised:

A.4. Quarterly Environmental Inspection Summary - Construction

Environmental Inspector's Signature:	Date:
<p>National Drainage and Irrigation Authority. Ministry of Agriculture.</p> <p>PROJECT: <i>Conservancy Adaptation Project – Coastal Civil Works</i></p> <p>QUARTERLY ENVIRONMENTAL INSPECTION SUMMARY-CONSTRUCTION</p> <p>MONTH/YEAR:</p>	
<p>Summary of Construction Activities/Progress:</p> <p>Contractor:</p>	
<p>Summary of Major Environmental Issues :</p>	
<p>Summary of Environmental Mitigation.</p>	
<p>Public Complaints</p>	
<p>Outstanding Corrective Actions (attach extra sheets if necessary)</p> <p>Location:</p>	
<p>Issues Raised:</p>	
Environmental Inspector's Signature:	Date:

A.5. Corrective Action Report

National Drainage and Irrigation Authority. Ministry of Agriculture.	
PROJECT: Conservancy Adaptation Project – Dam Feasibility and Rehabilitation of Structures.	
CORRECTIVE ACTION REPORT	
Location (Chainage) ----- to-----	
Inspection Date:	
Nature of Non-compliance (attach inspectors report):	
Description of Corrective action Taken (attach Photo) :	
Environmental Inspector’s Signature:	Date:

A.6. Post Environmental Inspection Summary - Construction

National Drainage and Irrigation Authority. Ministry of Agriculture.

PROJECT: *Conservancy Adaptation Project – Coastal Civil Works*

POST ENVIRONMENTAL INSPECTION SUMMARY-CONSTRUCTION

Location(Chainage) ----- to-----

Inspection Date:

General	Yes	No	N/A
<ul style="list-style-type: none"> ■ Sand Bags, silt fencing and absorbent material removed where not protecting exposed slopes. ■ Erosion and sediment control measures effectively prevents sedimentation. ■ All services disconnected, buildings dismantled. 			
<p>Waste and Spills Management</p> <ul style="list-style-type: none"> ■ Garbage, scrap material and waste collected in suitable receptacles are removed from site. ■ All spill kits removed. ■ Vegetation material removed ■ Waste construction stockpile have been removed and graded. 			
<p>Erosion and Sediment Control</p> <ul style="list-style-type: none"> ■ Surface drainage around stockpiles restored to pre-construction condition ■ Exposed slopes graded to present erosion ■ Toe berms or sandbags in place where slopes are not stable. 			
<p>Water Management</p> <ul style="list-style-type: none"> ■ Watercourse flow maintained and free of obstruction. 			

Other Observation/Comments

Issues Raised	
Environmental Inspector's Signature	Date:

Appendix B. Example Health and Safety Risk Assessment

Health & Safety Risk Assessment

Project Title	Conservancy Adaptation Project	Project Number	xxxxxx
Project Manager*	xxxxxx	Project Director*	xxxxxx
Work Activities	Civil Works to Region 4 Drainage Regimes		

Hazard / Aspect (1)	Consequence / Impact (2)	Persons at risk (3)	Initial risk level (4)			Can the hazard be avoided? (5) Y/N	Control measures (6)	Residual risk level (7)			Responsibility for implementing (8)	Action completed/ due (9)
			Severity	Likelihood	Risk Level			Severity	Likelihood	Risk Level		
Working Near Water - Sickness	There may be local levels of biological contamination which could lead to sickness, such as leptospirosis, if ingested.	All site personnel	3	1	M	Y	Adequate, easily accessible, safe drinking water should be provided to all site personnel	3	1	M	Contractor Project Manager	Ongoing
Working Near Water - Drowning	Soft, uncompacted and ill-defined bank conditions and extensive working near water increase the probability of site personnel falling into the deep perimeter channel or shallower downstream channels	All site personnel	3	2	H	N	The wearing of buoyancy aides should be enforced for all site personnel. Lone working should not be permitted.	3	1	M	Contractor Project Manager	Ongoing

Operating Earth Moving Plant - Injury from Toppling Plant	Soft, uneven ground conditions increase likelihood of plant toppling, leading to injury of operator or nearby personnel	All site personnel	3	2	H	N	All operators must be well trained. Banksmen must be used at all times. Hazardous ground conditions should be identified and discussed with operator at start of each operation	3	1	M	Contractor Project Manager	Ongoing
Operating Earth Moving Plant - Drowning	Soft, uneven ground conditions and proximity to channels increase likelihood of plant toppling into water, trapping operator underwater	Plant operators	3	2	H	N	All operators must be well trained. Banksmen must be used at all times. Hazardous ground conditions should be identified and discussed with operator at start of each operation	3	1	M	Contractor Project Manager	Ongoing
Operating Earth Moving Plant - injury from plant striking site personnel	Volume of earth moving activities required increases likelihood of bucket or body of machine striking site personnel	All site personnel	3	2	H	N	All operators must be qualified, licensed and well trained. Banksmen must be used at all times. All personnel entering site should be briefed on hazards. Wearing of appropriate PPE, including high-vis and hard hats, should be enforced for all personal entering site. No person who is under the influence of alcohol or excessively tired is permitted to operate machinery	3	1	M	Contractor Project Manager	Ongoing
Site Traffic - Injury from collision	Scale of operation increases likelihood of traffic collision	All site personnel	3	2	H	N	All operators and drivers must be well trained. Banksmen must be used at all times. All personnel entering site should be briefed on hazards. Wearing of appropriate PPE, including high-vis and hard hats, should be enforced for all personal entering site.	3	1	M	Contractor Project Manager	Ongoing
Excavation Collapse	Poor ground conditions and high water table increase likelihood of injury or death following collapse of excavations	All site personnel	3	2	H	N	All site personnel to be briefed on risk. All excavations to be properly shored up.	3	1	M	Contractor Project Manager	Ongoing
Slips, trips and falls	Poor and uneven ground conditions increase likelihood of injury following slips, trips and falls	All site personnel	3	2	H	N	All site personnel to be briefed on risk. Appropriate footwear to be worn at all times.	3	1	M	Contractor Project Manager	Ongoing

Chemical burns	Concrete work during structure rehabilitation could lead to chemical burns from cement	All site personnel	3	2	H	N	All site personnel to be briefed on risk. Appropriate PPE, including gloves and boots, to be worn at all times. Washing facilities to be provided. Eye wash to be made available and readily accessible.	3	1	M	Contractor Project Manager	Ongoing
Working from Height - Injury from Falls	Rehabilitation of Structures, particularly the operating machinery and access improvements, will lead to working from height	All site personnel	3	2	H	N	All site personnel to be briefed on risk. Contractor to provide suitable method statements. Appropriate scaffolding to be provided. Appropriate PPE, including harnesses if specified in method statements, to be worn at all times. No lone working to be permitted.	3	1	M	Contractor Project Manager	Ongoing
Working from Height - Injury from dropped objects	Rehabilitation of Structures, particularly the operating machinery and access improvements, will lead to working from height	All site personnel	3	2	H	N	All site personnel to be briefed on risk. Contractor to provide suitable method statements. Appropriate scaffolding to be provided with footboards. Wearing of hard hats to be enforced for all site personnel.	3	1	M	Contractor Project Manager	Ongoing
Working in Hostile Environments - Injury or Ill Health from Hot Conditions	Hot sunny weather increases risk of burns, sun-stroke and dehydration	All site personnel	2	2	M	Y	All site personnel to be briefed on risk. All site personnel to wear hard hats. Plenty of drinking water to be available and easily accessible. Sun cream to be made available. Working hours to be restricted and breaks to be programmed.	2	1	L	Contractor Project Manager	Ongoing
Working in Hostile Environments - Injury or Ill Health following bites or stings from Hostile Fauna	Hostile fauna include bees, snakes, tarantulas, ants, caiman and piranha.	All site personnel	2	2	M	Y	All site personnel to be briefed on risk and response. Medical officer with first aid training to be nominated. No lone working to be carried out. Vehicles to be available for transfer to hospital.	2	1	L	Contractor Project Manager	Ongoing

Guidelines on how to complete the HRSA

Project

1. Record the hazard or aspect, e.g. exposure to noise, entering a confined space, etc
2. Identify the worst-case effect of the hazard
3. Identify who could be affected by the risk, e.g. Project Team, Sub-consultants/contractors, Members of the public, etc
4. Evaluate the level of risk for each hazard, by identifying its severity of harm and likelihood, using the risk matrix shown below
5. Ascertain if high risk, can hazard be avoided?
6. Identify control measures, noting that each hazard may require more than one control measure
7. Evaluate the level of risk for each hazard, taking into account the effect of the control measure(s)
8. Identify who is responsible for implementing or ensuring that the control measures have been implemented
9. Record the date the actions completed or due

Severity of Harm	Severity Index	Likelihood	Probability Index
Death or major injury	3	Harm is certain or near certain to occur	3
Lost time injury or illness	2	Harm is likely to occur	2
All other injuries or illnesses	1	Harm is unlikely	1

Risk Level			
Severity Index	Probability Index		
	1	2	3
1	L	L	M
2	L	M	H
3	M	H	H

Record of Health & Safety Risk Assessment			
Completed by:	xxxxx	Approved:	xxxxx
(Project Manager)*	xxxxxx	(Project Director)*	xxxxx
Date:	xxxxx	Date:	xxxxx



Appendix C. Correspondence Regarding Drainage Regime Modelling



Our ref JHP/IA/MA/AMK/MHT/270299
T ++ 592 231 8834
E Martha.taylor@mottmac.com
Your ref GEF SCCF Grant No. TF091692

Dr. Elizabeth Ramlal - Director
Agricultural Sector Development Unit
Ministry of Agriculture
Regent & Vlissengen Roads
Bourda, Georgetown

27th November 2012

Guyana Conservancy Adaptation Project – Pre-Investment Studies

Dear Dr. Ramlal,

Re: Scope of Task 4 Modelling Works

Our modelling works for the drainage areas on the coastal lowlands of Region 4 are now well advanced, and we are finding them much more complicated than anticipated. This is largely because many of the areas we have selected are, on closer inspection, in fact comprised of several interlinked drainage regimes. Enterprise / Paradise and Belfield for example both comprise three separate but interconnected drainage regimes.

If we are to be able to complete these works within the timeframe of the project and with sufficient detail to be useful we need to bring the scope back in line with the Terms of Reference. We have discussed this Lionel Wordsworth (CEO: NDIA) and following his suggestion we would like to recommend a revised list of areas, following inspection of the results of the multi-criterion analysis, and further investigation of the drainage areas.

The following table summarises drainage regimes which form the previously selected areas. It also shows the different scoring for each of the areas, as determined by our multi-criterion analysis, and the status of our work on these areas at the moment.

Those in blue text are the areas we propose to complete the modelling works on. This will give a total of eleven drainage regimes, still in excess of the requirements of the Terms of Reference, and incorporates those that are largely complete and those that scored highest in the prioritisation matrix.

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Drainage Area	Drainage Regimes	Total Score from Prioritisation Matrix	Survey Progress	Modelling Progress
Liliendaal	Liliendaal	28	Complete	Largely complete
Ogle	Ogle	28	Complete	Largely complete
Montrose / La Resouvenir	Montrose Sparendaam	23	Complete	Largely complete
Mon Repos / Annandale	Mon Repos Annandale	31	Complete	Not started
Buxton / Friendship	Buxton	25	Complete	Not started
Enterprise / Paradise	Strathspey Enterprise Paradise	28	Complete	Underway
Belfield / Nootenzuil	Nootenzuil Victoria Hope	25	Complete	Not started
Beehive / Clonbrook	Greenfield Beehive	30	Complete	Not started
Helena 1&2	Helena	23	Complete	Not started
Supply and Vereeniging	Supply	23	Complete	Underway

We would like your assurance that this course of action is acceptable to you, and that no financial penalty will be applied as a result. Given the late stage within the project programme, we would need that assurance in good time, so we will assume that, unless we hear to the contrary within the next 7 days, you are happy for us to proceed on this basis.

Please do contact me with any comments or queries.

Yours sincerely,
For Mott MacDonald Ltd



MH Taylor
Deputy Team Leader
c.c. F Flatts (ASDU), A Kirby (MM), I Hogg (MM), L Wordsworth (NDIA), R Latchmansingh (CEMCO).