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**GUYANA**

**GEORGETOWN SOLID WASTE MANAGEMENT PROGRAM  
– GSWMP –  
(GY-0055)**

**ENVIRONMENTAL AND SOCIAL MANAGEMENT REPORT  
– ESMR –**

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## **EXECUTIVE SUMMARY**

The environmental and social management report (ESMR) is a summary of the Environmental Impact Assessment (EIA) report has been prepared for the proposed Sanitary Landfill at Haags Bosch, Guyana to meet requirements of the Guyana Environmental Protection Agency (EPA) and those of the funding agency, the Inter American Development Bank (IDB). The base report was initially prepared by Ground Structures Engineers Consultants Inc. Trow International Ltd. (Trow) in association with Conestoga Rovers & Associates (CRA) was retained by the Government of Guyana (GOG) to undertake due diligence and modify/complete the document to meet specific issues raised by the IDB. This report reflects those modifications by The Trow Team.

## **PROJECT DESCRIPTION AND OBJECTIVES**

### **OBJECTIVES AND DESCRIPTION**

The general objective of the Program is to improve the quality of life of the population living in Georgetown and the participating NDCs and the purpose is to implement sustainable solutions to solid waste disposal in these areas. Specifically, the Program aims to provide a sustainable solution to the solid waste collection and disposal problems in Georgetown and participating NDCs through: (a) strengthening the capacity of the MSWMD of the Municipality of Georgetown for the overseeing of solid waste management and disposal, and improve collection logistics and cost recovery at Georgetown and NDCs (b) raising public awareness within Georgetown and the NDCs for a better management of solid waste among households, industries, commerce, etc., (c) the implementation of a sanitary landfill at Haags Bosch, with the participation of a specialized operator from the private sector; (d) providing resources to study and define technologies to treat health care and hazardous waste; (e) implementing a more efficient waste collection at the NDCs participating in the project; and (f) providing additional resources to rehabilitate and close the Mandela landfill. The implementation of the program is expected to be: sustainable, efficiently prevent pollution, accepted by the stakeholders and protect the public health and the environment.

Budget allocations for the individual components are as follows:

- Institutional Strengthening and capacity building for Solid Waste Management (\$1.6 million USD)

- Community participation and public awareness program (\$1.45 million USD)
- Design, construction, operation of the Haags Bosch Sanitary Landfill (\$9.587 million USD)
- Waste collection from participating NDC (\$1.35 million USD)
- Component: rehabilitation, expansion and closing the Mandela Landfill (\$609,000 USD)
- Treatment and disposal of health care and hazardous waste (\$1 million USD).

## **LEGAL AND INSTITUTIONAL ASSESSMENT**

Georgetown municipality is currently involved in policy making regulation as well as operation and management of solid wastes. The existing legal frame is sufficient in terms of identification and enforcement but centralization is required for effectiveness.

The project aims at the separation of roles. The private sector would assume operations. Regulation would rest with the Municipality. EPA and PUC while the making of policy would be the responsibility of the Ministry of Public Health.

A new department, The Municipal Solid Waste Management Department (MSWMD) will supervise all aspects of the Georgetown Solid Waste Management Program. Significant involvement from the institutional strengthening and capacity building team is required for most elements of the system to provide the necessary expertise and resources to effectively undertake the program. The program includes provision for such capacity building and strengthening.

## **PHYSICAL & SOCIO-CULTURAL ENVIRONMENT AND IMPACTS**

The physical environment of Haags Bosch and its immediate environs will be impacted by the project. Haags Bosch and its environs are considered to be represented by the landfill site, its buffer zone and the adjacent housing areas within 2.5 km (one and one-half miles) of the facility. These housing areas include the New Eccles Housing Development, Republic Park, Continental Park, Nandy Park and Bagotstown.

The subject site (Haags Bosch) is set within the Coastal Plain. Typically, the subsoils consist of at least 20m of very soft to firm bluish grey silty clay with occasional silt seams and organic inclusion overlaying the firm to hard yellowish grey silty clay of the Coropina Formation. Low or relatively impermeable materials extend to at least 30m depth below grade. Groundwater in the area is recovered from wells screened in

confined sand aquifers under artesian conditions at depths of about 160 m. Surface water occurs in ditches, canals and small drains and the levels in these units reflect controlled drainage and irrigation in the specific area, as well as seasonal fluctuations. The Georgetown area receives an average of about 2 m of rainfall per year. In the month of January 2005, greater than 1m was experienced, resulting in significant and prolonged flooding; temperature in the area ranges between 25 and 35°C. Land use in Haags Bosch area is agricultural with industrial and residential units about 2 km removed.

The development of a landfill at Haags Bosch would permit cessation of operations at uncontrolled dumps such as that existing at Mandella Ave (within the confines of Georgetown) which is currently the prime recipient of solid waste from the Greater Georgetown Area. The physical environment at Mandella is similar to that of Haags Bosch with the following exception. The surface water is contaminated with leachate from the uncontrolled waste dumping; land use of immediately adjacent areas include the long operated cemetery and residential development.

The proposed project will impact waste generation and management activities in GM and the NDCs in Region 4. Socio-cultural data has been compiled for GM and NDCs to define baseline conditions prior to implementation of the project. This data is detailed in the body of the EIA report. A socio-cultural overview presents data as follows:

- **Population and household characteristics:** Data from the most recent census (1991) has been presented. The bureau of Statistic Guyana maintains census related activities in intercensal periods. Recent estimates indicate a population for Guyana of about 720,000 to 750,000. Georgetown and Region 4 NDCs are estimated to have a population of between 310,000 and 350,000
- **Economic activities and employment:** The Guyanese Economy exhibited moderate economic growth in 2001-02, based on expansion in the agricultural and mining sectors, a more favourable atmosphere for business initiatives, a more realistic exchange rate, fairly low inflation, and the continued support of international organizations. Growth then slowed in 2003. Chronic problems include a shortage of skilled labour and a deficient infrastructure. The government is juggling a sizable external debt against the urgent need for expanded public investment. The bauxite mining sector should benefit in the near term by restructuring and partial privatization.
- **Social and Economic well being:** Poverty and unemployment showing declining features; life expectancy 65 years (male 62, female 68); literacy 98%; gender gap in favour of males for higher education; collapse of infrastructure in 1990's showing

signs of improvement. Teachers and nurses earning minimum wage of approximately US \$100/month is a concern.

As a result of constructing, operating and maintaining a landfill there are potential environmental impacts and associated risks to the local community, wildlife, above and below ground environments and staff who will be required to operate the Site and associated control systems. This construction will permit closure of uncontrolled dumps with associated net environmental and socio-economic benefits. A systematic review of potential physical, biological, cultural and site specific impact has been undertaken as part of the EIA study. Each identified impact has been systematically categorized and where appropriate, provision has been made for mitigation within the Environmental Management Plan. Contingencies and/or redundancies are incorporated. Details are provided in the body of the report .

The assessments cover the "do nothing" option and clearly support the construction and operation of a state of the art landfill with the appropriate controls and contingencies.

The socio-cultural environment was examined and potential impacts from the construction, operation, closure and post closure of the proposed landfill at Haags Bosch identified. These impacts were categorized for character (beneficial or detrimental) significance duration, reversibility, risk of occurrence and zone of influence.

## **ENVIRONMENTAL MANAGEMENT PLAN**

The purpose of the Environmental Management Plan (EMP) is to clearly address and discuss preventative and contingency measures, which will be established to mitigate environmental impacts and associated risks for the Project. In Section 6 of the EIA report actions related to the Project were systematically assessed and categorized based on potential to create an environmental impact and or associated risk for each individual phase of the Project. Section 5 of this report presents an abbreviated version of this assessment.

In the unlikely event that the mitigation measures established do not function as intended contingency plans have also been prepared to address impacts related to the landfill. Extensive monitoring programs have been established to confirm that the control systems constructed are operating as intended and prevent environmental impact to the local human and wildlife population and other valued ecosystem components. In addition quality control and assurance programs have been prepared



and will be followed during the construction program to confirm that the site is constructed in accordance with the technical specifications and detailed design drawings.

Programs have been established and will be implemented throughout the operating lifespan of the site to keep local residents and environmental groups/agencies apprised of any potential and/or real impacts related to the construction, operation and maintenance of the site. Staff training and worker health and safety is of paramount importance in the successful construction and operation of the Site and have also been clearly addressed through all portions of the project as documented.

It is concluded that all potential impacts have been identified and an effective and sound environmental management plan has been established to protect the human and animal population and other valued ecosystem components through the various types of construction, operation closure, and post closure.

#### **MONITORING PLAN FOR OPERATIONAL COMPLIANCE**

The monitoring program will provide data, which would serve as the basis to determine the environmental performance of the systems. The facility will be monitored to confirm its adherence to sound environmental management practices and contractually established operational standards. Monitoring will be conducted during the construction, operation, closure and post closure phases of the project. The monitoring program is designed to ensure that the trends for specific parameters are tracked. It will also provide information on compliance with legislation, guidelines and contractual requirements for the construction, operation, closure and post-closure maintenance of the facility. Specific items of monitoring in the plan include:

- soil/waste volumes;
- surface water quality;
- groundwater quality;
- leachate system monitoring including head in landfill cells;
- landfill gas; and
- complaints monitoring.

The responsibility for Quality Control (QC) monitoring rests with the operator. The MSWMD will be responsible for (QA) Quality Assurance and audit monitoring. Cost for monitoring would be covered in the operating contract.

## **PUBLIC PARTICIPATION**

Public participation has been accomplished throughout the Haags Bosch EIA Process to date in general conformance with GOG and IDB requirements. Opportunities for further public participation are in place as part of the follow-up programmed. This process included both affected and interested parties. Participation techniques included assemblies, surveys, interviews, meetings consultation forums, and information dissemination techniques such as pamphlet, panels, leaflets and media communications. Key public concerns centered around the proximity of housing to the proposed landfill, with attendant possible decrease in property values, odour, dust and noise issues, open fires, loss of peace and tranquility, traffic, impact on groundwater, the presence of unwanted or questionable characters in the area and the long term sustainability in terms of funding, resolve and regulatory framework. Consultants' response to these issues covered sound design, and operations practices and procedures, mitigation and environmental management plans, regulatory framework and complaints response programmes, and examples of successful similar operations. The final site location was moved significantly to the East of developed areas based on input from the public participation process. Details of the public interaction programs, including tabulated public concerns and consultants responses are presented in Section 14 of the EIA report and in Section 7 of this ESMR.

## **SUMMARY OF KEY RECOMMENDATIONS**

There is a need to change the current system of waste disposal in Georgetown and Environs to protect the environment, the people and animals that live there. A sanitary landfill site at Haags Bosch presents an environmentally sound, sustainable and cost effective component of an integrated waste management plan for Georgetown. The following summarizes some key recommendations arising from the EIA process related to this project.

- Proceed with the Haags Bosch State-of-the-Art landfill.
- Consider combining disposal construction and operation to create a more viable project for potential international bidders with appropriate experience and expertise.
- Minimum guarantees ("put or pay" options) may be required to cover fixed basic costs for private operators.

- BOT approach would optimize economic outlays and provide optimum sequencing and reduced potential impacts.
- Funds should be guaranteed or escrowed to permit safe and effective closure operations at key life cycle points.
- Strict adherence to EMP and related QA/QC issues is required.
- Continuation of the community participation program is recommended throughout the life of the landfill. This should include public liaison committee, public information office, meetings and publications. A semi-annual newsletter covering waste management issues is recommended. The public complaint mechanism must be maintained. Community awareness of waste management issues strengthened.
- Training and institutional strengthening is of paramount importance.
- Other key elements of an integrated waste management approach should be actively pursued.
- It is recommended that the Government of Guyana formally commit to the support of any necessary financial guarantees and legislation to ensure project viability and environmental compliance over the full life cycle including post closure periods.

## 1.0 INTRODUCTION

This Environmental and Social Management Report (ESMR) is a summary of the findings of an Environmental Impact Assessment (EIA) undertaken for the Georgetown Solid Waste Management Programme (Programme). The Guyana Environmental Protection Agency (EPA) determined that the sanitary landfill proposed as a part of the programme, may potentially impact the environment and has mandated that an EIA be conducted to identify environmental impacts, and to develop mitigation measures for potential physical and social impacts. The EIA, was prepared for the Ministry of Local Government and Regional Development (MoLGRD), and conforms to the policy of the Inter-American Development Bank (IDB). This ESMR examines the environmental consequences of all aspects of the programme, one aspect of which is the construction and operation of a sanitary landfill at Hague Bosch, East Bank Demerara.

The sanitary landfill to be located at Hague Bosch will serve Georgetown (GM) and surrounding Neighborhood Democratic Councils (NDCs). The sanitary landfill site (Site) will be owned by the Guyana Land and Survey Commission (L & SC) through the MoLGRD, and leased to the new Georgetown Municipal Solid Waste Management Department (MSWMD), for landfilling operations. The regional Site area and Site location is shown on Figure 1.1. A more detailed Site location is shown on Figure 1.2, which also identifies adjacent land uses.

The contractor to construct the sanitary landfill, and the sanitary landfill operator (Operator) will be selected based on international competitive bidding processes. Sanitary landfill construction and operation will be supervised by the Municipal Solid Waste Management Department (MSWMD). The Inter-American Development Bank will provide funds for all aspects of the Programme including the design of the sanitary landfill and for construction to provide the first ten years of operational life of the landfill. Regular operating and maintenance responsibilities and costs for the commissioned Site will be provided by the MSWMD. The Operator will be paid from tipping fees for waste disposed at the sanitary landfill. MSWMD will monitor waste arriving at the Site and will make payments to the Operator. Haulers of commercial waste will make payments to MSWMD for eventual payment to the Operator.

The landfill at Hague Bosch will receive municipal, commercial and industrial waste from generators in Georgetown (GM) and from fifteen NDCs surrounding GM. Thirteen of these NDCs are located in Region 4 as is Georgetown and two NDCs are in Region 3. The NDCs are Grove/Haslington, Enmore/Hope, Buxton/Foulis, Mon Repos/Le Reconnaissance, Beterverwagting/Triumph, Better Hope/La Bonne Intention, Industry/Plaisance, Ramsburg/Eccles, Little Diamond/Herstelling, Mocha/Arcadia,

Golden Grove/Diamond Place, Caledonia/Good Success and Soesdyke/ Huist Te Coverden in Region 4 and La Grange/Nismes and Malgre Tout/Meer-Zorgen in Region 3. The locations of the NDCs and Georgetown are shown on Figure 1.

Municipal waste from GM will be delivered to The Hague Bosch Sanitary Landfill by waste collection companies contracted by MSWMD. Waste from large commercial and industrial generators will be collected by specially licensed waste haulers and will be delivered to The Hague Bosch Sanitary Landfill. Waste from NDCs will be delivered by tractor trailers or horse drawn carts to transfer stations. Waste from transfer stations will be recovered by waste collection companies contracted by the MSWMD and be delivered to The Hague Bosch Sanitary Landfill.

Hazardous and healthcare wastes from all generators will be collected using dedicated equipment and will be disposed in a facility developed for such wastes. Funds for Hazardous and healthcare wastes management will be provided under the Studies and Investments in Healthcare Waste component of the Georgetown Solid Waste Management Programme (Programme).

The remainder of this ESMR is presented in the following sequence:

- Chapter 2: Project description with a concise description of the project's geographic, ecological, social, and temporal context and including sums budgeted for different components of the project.
- Chapter 3: A description of the legal and institutional framework with details related to the EIA process and the management structure for execution of the project.
- Chapter 4: An assessment of the site selection process for Hague Bosch and a discussion of alternatives to the project. This chapter also presents the social and environmental impacts and risks of the project.
- Chapter 5: A presentation of the environmental management measures to avoid, and minimize the direct and indirect impacts and risks associated with the project together with a schedule for the implementation and management of these measures.
- Chapter 6: The monitoring plan to be implemented during project execution which includes indicators, monitoring schedules, responsibilities and costs.
- Chapter 7: The consultation program undertaken for the project.

## 2.0 PROJECT DESCRIPTION

Georgetown currently disposes of waste at the Mandela Avenue dump. Healthcare and other wastes not disposed in the dump are burned in a waste incinerator. Both activities are sited in residential areas and do not satisfy reasonable standards for protection of the environment. Neither activity is responsive to concerns of adjacent residents.

The Georgetown Solid Waste Management Programme has therefore been developed to manage waste generated by Georgetown and surrounding NDCs. The Mandela dump will be upgraded and closed as part of the environmental upgrades at that site with funds provided by the IDB as part of another project. The Municipal Solid Waste Management Department (MSWMD) will supervise all aspects of the Georgetown Solid Waste Management Programme. This department, details of which are presented in Section 3.2.1, has replaced the former Cleansing Department and became operational in September 2003.

Approximately 40 % of NDCs included in the Programme provide no waste collection services to residents. Waste is collected in the remaining NDCs by tractor and trailer, the sole exception being the Plaisance/Industry NDC which collects waste by horse drawn cart. NDCs collecting waste, all dispose of waste at open dumps within their boundaries. The sole exception is Eccles/Ramsburg, whose waste is delivered to the Mandela dump. Waste collection ranges from 2.5 to 4 tonnes/day. Collection rates are lowered by burning and burial of waste in NDCs. Some NDCs monitor waste disposal sites, excavates pits into which waste is placed and periodically applies cover to waste disposal pits.

Several studies were undertaken to develop an appropriate solution for the solid waste problem in Georgetown (GM) and its environs. The first of these was the Solid Waste Management Pre-Identification Study for Georgetown, undertaken by an individual consultant retained by the IDB in 1998. The conclusions of that study were (i) GM institutional arrangements and technical capabilities were inadequate to manage its solid waste problems following internationally accepted technical and environmental standards, (ii) sanitary landfill is the minimum cost solution to dispose of GM waste (iii) Private Sector Participation (PSP) is necessary to operate GM future landfill.

This was followed by a Waste Characterization and Facility Siting Assessment conducted by Brown and Vence Associates in 2000. This study developed waste characterization data for GM waste and examined several locations for siting the landfill. The IDB subsequently held an open seminar to assess the willingness of the Private

Sector to participate in the Georgetown Solid Waste Management Project and PSP emerged as a feasible option.

Based on Terms of Reference (TOR) prepared by the individual consultant, studies financed through the Pre-Investment Studies for the Georgetown Solid Waste Management Program (ATN/SF-6858-GY) were executed in the period February to June 2002. These studies examined Institutional and Cost Recovery issues for landfill operations and prepared bidding documents for PSP including the performance criteria for the technical, environmental and social aspects of the operation. The findings of the studies were presented at a workshop on May 8, 2003 at which conclusions were defined.

Those conclusions were submitted by the GoG represented by the Ministry of Local Government and Regional Development (MoLGRD), to the IDB on May 13, 2003 and include (i) an institutional model, (ii) creation of a separate account for waste management and (iii) separate bidding for design, construction and operation of a sanitary landfill. The IDB developed an Action Plan on the basis of that submittal and has undertaken to provide funds for a program to solve Georgetown and Environs solid waste disposal problems through the design, construction and operation of a sanitary landfill.

The Preliminary Environmental Assessment conducted during the Waste Characterization and Facility Siting Assessment conducted by Brown and Vence Associates in 2000 identified lands immediately east of an industrial estate in Eccles for the sanitary landfill. That assessment indicated that the proposed location did not satisfy the criterion for proximity to surrounding residents.

Considerable opposition was expressed by residents in proximity to the location proposed by the preliminary assessment during two public consultations held by the Environmental Assessment Board (EAB). The sanitary landfill was therefore relocated to Hague Bosch, an area approximately 1.5 kilometers (km) east of the initially proposed location and some 2.0 km from the nearest residents.

The sanitary landfill will include a segregated area to be constructed for recyclers organized in groups of 24 members to separate valuable materials. The organic content will be deposited in windrows for composting by the Operator. A permanent facility will also be created for the disposal of hazardous and healthcare wastes as part of the Georgetown Solid Waste Management Programme.

Georgetown (GM) will guarantee delivery and payment for a minimum of 120 tonnes of solid waste each day to the landfill. Payment for waste guaranteed by Georgetown will be insufficient to cover operations and maintenance costs for the facility. Georgetown waste will be complemented by wastes from NDCs surrounding GM and by commercial, industrial and other large volume generators in GM and its environs. Waste tipping fees are expected to cover operation and maintenance costs with any surplus being used to cover capital costs for the project.

## **2.1 OBJECTIVES AND DESCRIPTION**

The general objective of the Program is to improve the quality of life of the population living in Georgetown and the participating NDCs and the purpose is to implement sustainable solutions to solid waste disposal in these areas. Specifically, the Program aims to provide a sustainable solution to the solid waste collection and disposal problems in Georgetown and participating NDCs through: (a) strengthening the capacity of the MSWMD of the Municipality of Georgetown for the overseeing of solid waste management and disposal, and improve collection logistics and cost recovery at Georgetown and NDCs (b) raising public awareness within Georgetown and the NDCs for a better management of solid waste among households, industries, commerce, etc., (c) the implementation of a sanitary landfill at Haags Bosch, with the participation of a specialized operator from the private sector; (d) providing resources to study and define technologies to treat health care and hazardous waste; (e) implementing a more efficient waste collection at the NDCs participating in the project; and (f) providing additional resources to rehabilitate and close the Mandela landfill. The implementation of the program is expected to be: sustainable, efficiently prevent pollution, accepted by the stakeholders and protect the public health and the environment.

## **2.2 COMPONENTS**

### **2.2.1 INSTITUTIONAL STRENGTHENING AND CAPACITY BUILDING FOR SOLID WASTE MANAGEMENT (US\$1.6 MILLION)**

The objective of this component is to ensure that the institutions responsible for the provision of solid waste services are adequately capable to implement the program and carry out future activities. To attain such objective a Project Management Firm (PMF) will be hired to support the MSWMD during the execution of this Project. This support will translated into a hands on Institutional Strengthening and capacity building on the following activities: (i) contract supervision; (ii) supervision of the works and operation of the landfill executed by the BOT operator; (iii) project's accounting and budgeting;



(iv) development and implementation of budgets and accounting procedures at the participating NDCs; (v) stakeholders consultation and involvement: (vi) development and/or updating the Operation and Management Manuals: (vii) effective coordination with other local, national and international institutions: and (viii) assistance to the NDCs in the updating their cadastre, property valuation and PT collection system. It is estimated that twenty (20) professionals from the MSWMD will be trained on these eight (8) activities and forty five (45) from the NDCs will be trained on their specific needs for solid waste management. Capacity building will be built on the efforts delivered during project preparation.

## **2.2.2 COMMUNITY PARTICIPATION AND PUBLIC AWARENESS PROGRAM (US\$0.45 MILLION)**

This component will build on the related work on raising awareness and encouraging community participation being executed since 2004, which was financed with PROPEF resources. The overall aim of the component is to plan and implement a comprehensive and targeted awareness-raising Program that fully informs and involves citizens, householders and other key stakeholders of improvements in solid waste management in Georgetown and surrounding NDCs, and engages their participation in the improvements. Resources will be used to hire a consulting firm to implement the following activities: (i) to plan and implement a strategy for raising awareness and encouraging participation in solid waste management in Georgetown and surrounding NDCs; (ii) to build capacity within local counterparts so that community awareness activities are sustainable and ongoing after the completion of the project; and (iii) to ensure strong links between the implementation of this Community Awareness component and the other components of the Program, as well as with other relevant donor, national and local projects and that stakeholder consultation are carried out throughout the project.

## **2.2.2 DESIGN, CONSTRUCTION, OPERATION OF THE HAAGS BOSCH SANITARY LANDFILL (US \$9.587 MILLION)**

This component provides the resources to prepare the designs, search for a BOT operator, construct and set the conditions to operate the HBSL for the first ten (10) years of its twenty-five (25) year lifetime. Shorter periods are not attractive to a BOT operator and longer periods may present disincentives for good performance. The engineering designs of the HBSLF have been completed at cost of US\$541,822. The search for a BOT operator involves hiring consulting services of a private sector structuring and promoter that will update the existing bidding documents prepared simultaneously with the engineering designs and prepare a draft contract to discuss with potential candidates. The consulting services will support the executing agency in all the tender process, that

in addition to preparing the required documents, will include market research to promote the interest of potential BOT operators, tender process, valuation of proposals, determination of a single variable to award the BOT contract(s), and negotiation with the winning bidder(s). The consulting services will include legal work to complete the bidding process and investment banking activities to provide for a successful selection of a BOT operator(s). In addition, to the fix fee estimated in US\$300,000 for the consulting services, the firm that provide the consulting services will obtain a success fee once the BOT operator(s) has signed the contract to provide its services. The BOT operator(s) will pay this success fee, estimated at 25% of the fix fee.

Construction includes the financing of all the necessary fixed structures of the project such as: administration buildings, scales, space for waste recyclers (separation area, place for bathing and eating, first aid equipment, etc.) internal roads, leachate and runoff collection and treatment facilities, gas collection and treatment, recycling and composting facilities and equipment. There are specific activities to be implemented during operation such as: landscaping the base for the first landfill cells preparation of filling areas, filling two to four unused navigation canals and construction of a perimeter fence. The HBSLF, located four (4) kilometers south of the geographical centre of Georgetown, has been designed, will be constructed and operated according to international technical, and environmental standards and good practices. The HBSLF will be equipped with the following main infrastructure items: weighbridge and reception building, administration and social building and workshop facilities; energy and water supply facilities; and wheel washing facilities. It will also incorporate all the mitigation measures identified in the Environmental Impact Assessment (EIA) and included in the project's Environmental and Social Management Plan (ESMP). The construction of these facilities as described in the engineering designs will require financing of US\$ 8.745 million.

Operation will follow the engineering designs, the Manual of Operations and technical specifications included in the bidding documents. The BOT operator will also be responsible for (i) closing and landscaping the site when its lifetime is reached; (ii) technical, environmental and social monitoring as included in the ESMP; and (iii) writing performance reports to the MSWMD and the EPA.

### **2.2.3 WASTE COLLECTION FROM PARTICIPATING NDC (US\$0.35 MILLION)**

This component provides the resources to finance the following activities: (i) conduct a search for potential candidates and tender process to hire the services of private entrepreneurs to collect the waste and deliver at Haags Bosch from the 15 pre-established NDCs; (ii) clean and close approximately twenty (20) dumpsites (US\$55,000); (iii) construct two (2) small transfer stations (US\$20,000); and (iv) buy equipment such as collection bins and small collection vehicles.

#### **2.2.4 COMPONENT: REHABILITATION, EXPANSION AND CLOSING THE MANDELA LANDFILL (US \$609,000)**

This component provides resources through the PROPEF (Loan 1487/SF-GY) to complement the existing budget of the Loan 1052/SF-GY to: (i) rehabilitate the existing land filled area: (ii) prepare five (5) additional acres that will include waste compaction, gas and leachate collection: (iii) construct ancillary areas such as parking spaces, office buildings, wash bays, and workers shed: (v) construct an artificial wetland to treat the collected leachate: and (vi) close and landscape the site when the HBSLF is operational. A private operator has been hired to execute these tasks with the loan resources.

#### **2.3 TREATMENT AND DISPOSAL OF HEALTH CARE AND HAZARDOUS WASTE (US\$1 MILLION)**

The component will finance consulting services for US\$500,000 to assess the sources, quantities, characteristics and to define the most cost effective treatment technology for the health care and hazardous waste generated by Georgetown and participating NDCs. The component will also finance the Health Care waste treatment technology and a special collection truck for US\$500,000 both. The Terms of Reference for these studies have been prepared.

### **3.0 LEGAL AND INSTITUTIONAL FRAMEWORK ASSESSMENT**

Georgetown Municipality is currently involved in policy making, regulation as well as operation and management of solid wastes. The existing legal framework is deemed sufficient, in terms of identification of offences and enforcement. However, responsibilities are dispersed and centralization is required.

This project aims at fostering the separation of roles among the operator, policy maker and regulator. The private sector would assume operation. The Municipality, EPA, and PUC would concentrate in regulation while policy making would rest with the Ministry of Public Health.

#### **3.1 ENVIRONMENTAL PROTECTION REGULATIONS**

These are several regulations developed by the EPA which are applicable to this project. Regulations on Hazardous Waste Management, Water Quality, Air Quality and Noise Management established under the Environmental Protection Act were consulted to establish the regulatory framework for this project. The hazardous waste regulations outline the rules and procedures for transport, storage, treatment and disposal of hazardous wastes. The Environmental Protection Water Quality Regulations 2000 mandate registration and environmental authorization by any operation whose construction, installation, operation, modification or extension of any facility cause the discharge of effluents. These regulations cover parameter limits for effluent discharges, however no standards are proposed for landfill leachate. The EPA has indicated, in consultations, that permissible limits at the point of compliance standards promulgated by the USEPA Code of Federal Regulations (CFR) 258.40 are acceptable for this project.

The Environmental Protection Air Quality Regulations 2000 detail requirements for registration and environmental authorization by facilities which emit air pollution from any process into the atmosphere.

Operations which emit noises are required to apply to the Agency for an environmental authorization. The Guyana National Bureau of Standards has established standards for permissible noise levels in industry, construction and other areas. No noise level standards are established for waste management facilities. The ambient noise level which is considered for the Georgetown Solid Waste Management Programme for both day and night would be 70 decibels.

### **3.1.2      LANDFILL SITING CRITERIA**

The EPA has no siting guidelines for waste management facilities. Consultations with the EPA have resulted in the adoption of location restrictions applicable to landfills in the United States.

The Town and Country Planning Act which regulates development planning and land use development control was consulted together with the Public Health Ordinance which delegates authority for implementation and enforcement of provisions regulating environmental health conditions to local health authorities.

### **3.1.3      WASTE MANAGEMENT LEGISLATION**

Legislation relevant to waste management in Guyana is as follows:

- The Local Democratic Organs Act 1980;
- Municipal and District Councils Act 28:01;
- The Public Health Ordinance Chap. 145, 1953 Ed.;
- City of Georgetown (Collection and Disposal of Waste) By.laws 1981;
- Delegation of Powers under Section 118 by Minister to Regional Democratic Councils BLS 25th June 1983 under Local Democratic Organs Act 1980.

There are provisions providing waste generators with responsibilities under the By-Laws of 1981. These provisions specify the type and number of waste receptacles per household and for public places. There is a requirement for draining and wrapping of wet garbage. Subject to the Public Health Ordinance Chap. 145 the Municipality and local Government under the provisions of the Municipal and District Councils Act are responsible for establishing, maintaining and carrying out sanitary services for the removal and destruction of or otherwise dealing with all kinds of garbage and effluent.

There is no legislation in place mandating citizens or commercial entities to use any specific waste collection and disposal enterprise. The EPA is coordinating the preparation of a Solid Waste Management Act which will create a Solid Waste Management Authority with responsibility for the effective management of solid waste. The Civil Law Act of Guyana Chap. 6:01, s.22 and the Schedule thereto render monopolies contrary to the laws of Guyana and to be void. Municipalities and local Government are required to tender contracts necessary for the discharge of their functions subject to certain exceptions.

The Municipality is authorized to prescribe fees and charges and to issue licences or permits and impose conditions in respect of sanitary services among other things under the Municipal and District Councils Act Chap 28:01. Fees that may be charged are stipulated in the By-Laws No.1 of 1981. These fees are considered inadequate and the MoLGRD is leading an effort to upgrade the legislation to increase these fees.

Enforcement mechanisms are provided for in By-Laws No. 1 of 1981 made under the provisions of Chap 28:01 and the Environmental Protection Act No.11 of 1996. Cleansing Officers, Local Government Officers in the service of the City Council, any member of the City Constabulary or Police Force, the Environmental Protection Agency or a person authorized by the Minister are authorized to institute proceedings for breach of the bylaws or offences under the Act respectively with respect to collection and disposal of waste and littering. The City Council may also recover in Court the expenses incurred as a consequence of the breach.

The Enforcement Unit of the MSWMD will be responsible for enforcing the provisions of this act in GM and NDCs propose to utilize the services of their Waste Management Officers (WMOs) for enforcement. At present, NDCs tend not to enforce these provisions within their jurisdiction due to the absence of waste disposal facilities and enforcement in GM itself is very sporadic. The level of enforcement is also lowered by a lack of awareness by the enforcement officers concerning the authority provided to them under the act and by the miniscule fines imposed for violations. The degree of enforcement and its ability to act as a deterrent can be increased by providing training to the members of the enforcement unit and WMOs of the NDCs and by increasing the fee structure for violations.

### **3.2 INSTITUTIONAL ASSESSMENT**

A special department; the Municipal Solid Waste Management Department (MSWMD) will supervise all aspects of the Georgetown Solid Waste Management Programme. This department has replaced the former Cleansing Department and became operational in September 2003. Its structure was approved by GM in November 2003. Regulatory oversight of the operations will be provided by the Environmental Protection Agency (EPA) and administrative oversight will be provided by an Advisory Board and the Mayor and City Council of Georgetown.

### **3.2.1      MSWMD STRUCTURE**

The structure of the MSWMD is provided in the text shown on the figure following this subsection. This department functions at the same level as the Public Health Department with provisions for separate accounting for municipal solid waste management, to separate different waste management functions and to clarify the roles and responsibilities of the stakeholders involved and to increase overall authority and autonomy in the provision of municipal solid waste services. The department is headed by a director who answers directly to the Mayor and City Council of Georgetown (MCC). Specific tasks of the MCC related to project execution includes reviewing monthly report prepared by the MSWMD, approval of MSWMD strategy and budget and approval and training of MSWMD managerial staff.

An Advisory Board (AB) (comprised of representatives of MOLGRD, GM, NDCs, MOF, local residents of Georgetown and Eccles and the Georgetown Chamber of Commerce) liaises between MCC and the GoG. The Advisory Board provides a basis for open discussion and agreement between stakeholders in relation to the Georgetown Solid Waste Management program. Major decisions and actions by MSWMD related to the program are approved by the Board. Standard decisions related to waste management for which approval is needed, such as basic recruitment, are approved only by MCC. Major issues such as the annual MSWMD budget are approved by the MCC, however the AB is provided an opportunity to comment and influence the planning of the budget. Public concerns and complaints and corresponding responses will be provided to the Board of review to determine if and when further action is needed. The advisory Board will initially meet monthly.

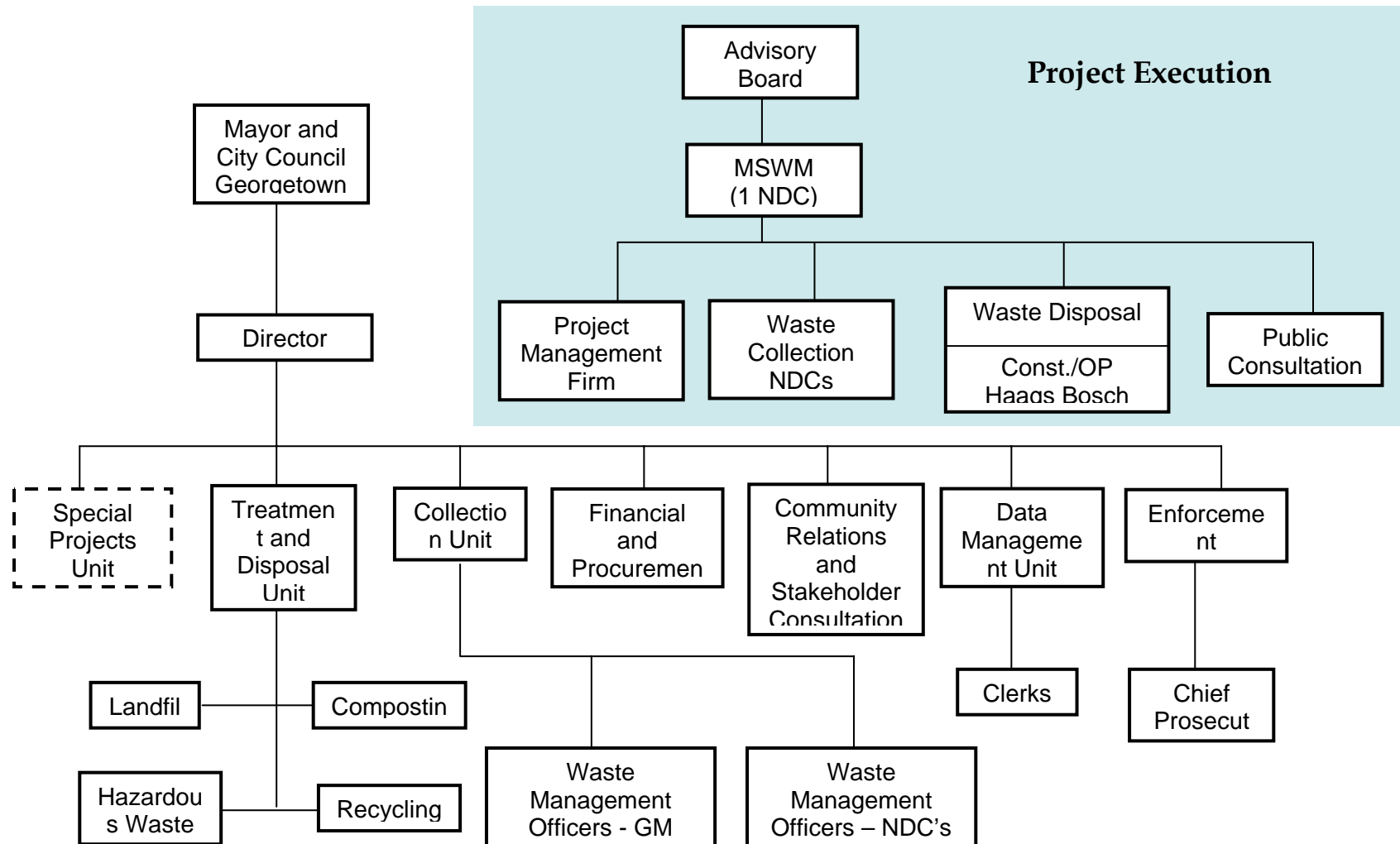
MSWMD will support the NDC Administrations in improving solid waste management by providing advice and support. The MSWMD will maintain regular communication with NDCs related to monitoring of waste flows from NDCs to the Hague Bosch Sanitary Landfill, to obtain data on waste generation for planning purposes and to facilitate sharing information on effective waste management practices and public awareness and education.

Ideally all units will be fully staffed and will be operational before the commencement of construction works at the site in 2005. In the event difficulties are experienced in identifying suitable staff, at least the Treatment and Disposal, Special Projects, Enforcement and Community Relations and Stakeholder Consultation units will be operational by that date. This will ensure that the Capacity Building and Institutional Strengthening Consultant has counterpart personnel in place at commencement of construction works. The other units will be operational by August 2005 to provide a long

enough time frame for training to ensure the development of adequate capacity prior to the MSWMD assuming full responsibility for supervision of the Georgetown Solid Waste Management Programme.



## Organizational Structure of the Municipal Solid Waste Management Department



### **3.2.1.1      SPECIAL PROJECT UNIT**

This unit will undertake specific waste management projects. This unit will undertake the following elements of the Environmental Management and Monitoring Plans for the Programme:

- supervise remedial works for closure of open dumps in GM and NDCs;
- work with Consultants preparing commercial waste inventories for the NDCs; and
- supervise and work with Consultants performing hazardous and healthcare waste study;
- In the longer term, conduct the unit is expected to conduct pilot studies on recycling and composting.

This unit is not yet operational and has no staff. The Unit will consist of five persons in addition to a manager. A retired Chief Environmental Health Officer is being considered for the post of manager and the other members will be sourced from the cleansing department.

### **3.2.1.2      TREATMENT AND DISPOSAL UNIT**

The treatment and disposal unit is responsible for management of the Hague Bosch Sanitary Landfill. This unit will:

- plan all future waste disposal operations and will work along with the Design Consultant to ensure the concept of the new landfill satisfies the MSWMD requirements and concerns.
- manage and monitor both the construction and operational phases of work at the sanitary landfill.
- manage composting and recycling operations which result from pilot studies conducted by the Special Project Unit.
- overseeing implementation of major elements of both the Environmental Management and Monitoring Plans. interact with the EPA and will provide responses to stakeholders on issues concerning the operations of the sanitary landfill through interface with the Community Relations and Stakeholder Consultation Unit. Data acquired from operations monitoring will be provided to the Data Management Unit.

After completion of the study and acquisition of equipment for hazardous and healthcare waste, The Treatment and Disposal Unit will be responsible for long term implementation of the findings of the study and for management of the hazardous and healthcare waste facility.

This unit is now operational and is managed by the individual currently responsible for management of the Mandela Site. This individual has in excess of forty years experience with GM waste management practices. He is supported by a staff of eight individuals. The manager and his subordinate staff are all qualified to the high school diploma level. Several of these individuals have benefited from PAHO/WHO administered courses on waste management and public health.

Additional technical capability will be provided to this unit by the Capacity Building and Institutional Strengthening Consultant. The Deputy Director of the MSWMD is a qualified engineer. He will be trained during the initial two years of the project. That training will qualify him to provide long term capability to the project.

#### **3.2.1.3     COLLECTIONS UNIT**

The collections unit will manage Georgetown waste collection contractors and coordinate the collection of special wastes. This unit will implement minor elements of the Environmental Management and Monitoring Plans.

This unit is operational and is managed by an individual currently responsible for waste collection in Georgetown. The unit staff consists of 24 foremen/drivers, 12 street orderlies and 17 Waste Management Officers. The WMOs will undertake waste management planning, monitor waste collection operations and community relations activities. WMOs will also provide information to the Data Management Unit.

#### **3.2.1.4     FINANCIAL AND PROCUREMENT UNIT**

The Financial and Procurement Unit will be responsible for the transparent and accountable management of finances including payment to suppliers and MSWMD staff and for recording all revenues provided to MSWMD including payments for special waste collection, tipping fees, payment from PT by GM and subventions from MoLGRD. This unit will undertake all tasks related to procurement of services and equipment required by MSWMD. The unit will prepare contracts for waste collection and operation of the Hague Bosch Sanitary Landfill and will prepare monthly financial reports for the

Director and AB. This unit, which is not yet operational, will implement cost recovery proposals for operations of the Hague Bosch Sanitary Landfill and will work with the Collections Unit to establish tariffs for waste disposal at the Hague Bosch Site to ensure implementation of effective cost recovery. Both the accountant and Administrator/Procurement manager for this unit have been identified and commenced work in September 2004. Effective operations of this unit will facilitate effective cost recovery related to implementation of the Programme.

#### **3.2.1.5      COMMUNITY RELATIONS AND STAKEHOLDER CONSULTATION**

This unit will manage the stakeholder consultation process during project implementation and will ensure continuous communication with key stakeholders to gain their confidence on issues critical to project success. This unit will develop and manage public awareness and education campaigns to inform perceptions about waste management and landfill operations and will manage the Public Involvement/Community Outreach component of the Environmental Management Plan. This unit, which is not yet operational, will interact with the Treatment and Disposal Unit to provide official responses to issues raised by stakeholders. It will interface with the Collections Unit to ensure that its public awareness and education campaigns are producing the desired results in GM and in NDCs and will modify the campaigns based on feedback from these units. This unit will have direct contact with the Advisory Board to provide responses on issues raised by project stakeholders and residents of communities in proximity to the landfill which are related to its operation. The unit will confer with the AB to ensure responses to operation issues are satisfactory to both project stakeholders and to residents in the vicinity of the landfill.

The manager for this unit was hired effective September 01, 2004 and is currently attached to the Public Relations firm undertaking the public education/awareness program for the Mandela Site upgrades.

#### **3.2.1.6      DATA MANAGEMENT UNIT**

The data management unit will expand and improve the range of data collected by the MSWMD to ensure that day to day operations and management are informed by proper data. The unit will be responsible for maintaining data on residential waste collection, on commercial and industrial waste generators, waste quantities and types delivered to the landfill and waste collection companies performance provided by the Treatment and

Disposal and Collection Units. This unit will maintain a database of all environmental monitoring and compliance data and will maintain a register of public complaints and responses to each complaint. This Unit will work with the Financial and Procurement Unit to ensure all variables related to cost recovery and waste management charges are considered in the assessments of cost effectiveness of waste collection and operations. This unit is operational and is currently staffed by a manager and two data entry clerks.

### **3.2.1.7     ENFORCEMENT UNIT**

The enforcement unit will monitor the performance of waste collection companies, commercial and industrial waste generators and waste disposal operations. This unit will work closely with the Collections Unit to enforce actions against illegal dumping/littering in GM and NDCs. This unit will manage the monitoring of offsite impacts of facility operations such as impacts on groundwater quality and migration of landfill gases undertaken by the landfill Operator. This unit will also establish targets and monitor the performance of integrated waste management systems, such as recycling and composting. Reported and unreported incidences of non-compliance with sound environmental practices will be investigated by this unit and the unit will be responsible for the implementation of sanctions for the infringement of environmental standards mandated in contracts for both the site Operator and waste haulers. Reports generated by this unit will be provided to the Director of the MSWMD. These reports will also be submitted to the AB to provide information on progress towards optimizing waste management systems in Georgetown and the NDCs.

A manager and assistant were hired into this unit effective September 01, 2004. This department has already undertaken action to prosecute several individuals for littering in Georgetown.

The Environmental Management Division of the EPA, with a staff of several individuals will directly enforce EPA mandates related to this project. The EPA will be responsible for ensuring conformance to the terms and conditions of the permit issued for design, construction, operation and closure of the sanitary landfill. The EPA will review all monitoring data for environmental compliance and will establish guideline values for site emissions to ensure the facility has minimal impacts on the environment. The EPA may also mandate changes to the environmental mitigation and monitoring plans based on the results of the monitoring program.

### **3.2.2      INSTITUTIONAL RESOURCES**

The MSWMD will be provided with resources to ensure effective implementation of the Georgetown Solid Waste Management Programme. The collections unit will be provided with specialized waste collection vehicles for collection of health care and hazardous waste. Georgetown has initiated a program to identify hazardous waste generators and these generators will be targeted to segregate hazardous wastes from other waste before pick up. Hazardous and healthcare wastes will be delivered to the facility specially constructed for the disposal of this waste. This facility will be completed before landfilling commences at the sanitary landfill.

Waste Management Officers will be provided with motorcycles. The motor cycles will ensure adequate coverage of areas falling under the jurisdiction of each WMO. The department will be provided with specialized equipment to recover groundwater and surface water samples, and leachate samples and to monitor for the presence of landfill gases. The equipment provided to this department shall be in addition to those mandated to be provided by the Operator as part of his contractual obligations. Members of the Treatment and Disposal Unit will be trained by the Capacity Building and Institutional Strengthening Consultant to operate each piece of equipment. Data acquired by the MSWMD will be used to check the validity of results provided by the Operator and to complement the environmental monitoring data base for the project. This data will also be available for public access.

The MSWMD offices will be refurbished and will be equipped with computers. A suitable database management package will be provided to the department.

### **3.2.3      INSTITUTIONAL ANALYSES**

Supervision of several elements of the Environmental and Monitoring Plans will require a significant degree of technical expertise. The Institutional Strengthening and Capacity Building Component will bring this expertise to the Programme in the medium term and will provide training for members of the MSWMD. The skills present in the MSWMD are inadequate to effectively deal with waste water treatment issues. The Institutional Strengthening and Capacity Building Consultant will be mandated to focus on developing the waste water engineering capability of the MSWMD to address this deficiency.

Several of the tasks to be undertaken by the Special Project Unit require specialist knowledge. These include closure systems for open dumps and supervision of the study to examine disposal options for hazardous and health care wastes. The department has

the management capability to supervise the operations but its technical abilities to examine and comment on the validity of the findings are limited. The EPA also lacks technical capability to support the MSWMD. Specialized aspects of the Programme will be supervised by the Institutional Strengthening and Capacity Building Consultant in the short term. The EPA and MSWMD will both be trained by the Institutional Strengthening and Capacity Building Consultant to develop this specialized expertise for long term management and monitoring of the Programme.

The budgets of most NDCs are inadequate to cover payment for waste tipping charges and special measures such as increases in property taxes and waste management fees will have to be enforced to generate revenues. The MoLGRD has recorded its willingness to modify its subvention regime to allow subventions to be used for waste management services and this may compensate for shortfalls payments for waste management services by NDCs.

In the initial stages of the project WMOs may experience some difficulty with enforcement of anti-littering laws. A training program should be mounted to educate WMOs about aspects of the anti-littering legislation to ensure long term effectiveness of their roles.

Several NDCs covered by this project are immediately next to NDCs not involved in this project. The public awareness and education campaign and enforcement of anti-littering laws should also target residents of adjoining NDCs which adjoin Nismes/La Grange, Malgre Tout/Meer Zorgen and Grove/Haslington not in the project to minimize illegal dumping.

The capability of all departments of the MSWMD and of the EPA will be enhanced by counterpart training provided by the Capacity Building and Institutional Strengthening Consultant. This training will extend through the construction phase of the sanitary landfill construction. All MSWMD and EPA personnel expected to be involved in project execution will be trained to a level of competence to ensure effective project implementation. These individuals will be tasked by their individual departments to provide training to other members of each department to ensure a reservoir of trained individuals for long term Programme implementation.

The only revenue sources for NDCs are property taxes and a subvention of \$3,000,000.00 per year from GoG. Property tax (PT) collection rates are generally low and range from approximately 35% to 70%. Use of the sanitary landfill must be accompanied by a mechanism for cost recovery. Some NDCs have initiated efforts to charge a waste management fee but have faced opposition from residents. This cost recovery

mechanism must precede any improvement in waste management. Public awareness programs would be implemented in the NDCs to sensitize people both to waste disposal and to the plan for waste management.

Illegal dumping currently occurs in NDCs in spite of collection services. Legislation should be updated to increase fines and to have the fines paid to the NDC. These fines should be dedicated to waste management. The legislation should permit the hiring of Rural Constables (RC) to enforce law. These RC should be hired and fired by the NDC. The Legislation should also provide more autonomy to the NDC in waste management matters.

### **3.3 REGULATORY FRAMEWORK FOR EIA**

The Environmental Protection Agency mandated that an Environmental Impact Assessment be performed for the Georgetown Solid Waste Management Programme since it has the potential to impact the environment. The EIA must conform to several International, National and Local level policy statements, legislation and regulations. The specific terms of reference (TOR) for the development, execution and documentation of the EIA and associated reports, required as part of the proposed Haags Bosch Landfill development including the legal and Institutional Framework is presented in detail in Section 3 of the EIA report. The Process adheres to international and national policies established for the suitability and effective management of the environment in the context of specific development proposals. The roles of the National Environmental Protection Agency (EPA) have been presented. Specific requirements of the Inter-American Development Bank (IDB), which encompass those of the named local environmental agencies, have been included. Pertinent regulations include the Environmental Protection Act, the Town and Country Planning Act, the Public Health Ordinance and the Occupational Health and Safety Act of Guyana.



## 4.0 ENVIRONMENTAL IMPACTS OF PROPOSED OPERATION

### 4.1 SITES AND ALTERNATIVES CONSIDERED

A series of studies were undertaken to develop an appropriate solution for the solid waste problem in Georgetown (GM) and its environs. The first of these was the Solid Waste Management Pre-Identification Study for Georgetown, undertaken by an individual consultant retained by the IDB in 1998. This was followed by a Waste Characterization and Facility Siting assessment conducted by Brown and Vence Associates (BVA) in 2000. This study developed waste characterization data for GM waste and examined several locations for siting the landfill.

BVA undertook a study to examine the suitability of six sites identified by the GoG as possible locations for development of solid waste disposal and transfer facilities. During the study, BVA examined four landfill sites, two transfer station sites, and one incinerator site. The site assessment was separated into two phases. Phase 1 of the assessment involved an initial assessment of each of the six sites to identify fatal flaws which could warrant its elimination from future consideration. Phase 2 involved a detailed assessment of the most suitable site, including a field investigation of the geologic, geophysical, hydrogeologic, soils, meteorological, atmospheric, and topographic conditions and an environmental review.

BVA study was preceded by GM, MoLGRD and the EPA constituting a committee to identify possible landfill, transfer station, and incinerator sites for management of GM waste. The Solid Waste Management Pre-Identification Study for Georgetown done by Sandra Cointreau-Levine also identified possible solid waste facility sites. A list of possible sites was compiled from the results of these two studies. The six sites identified for waste management and the possible use of each site are as detailed in Table 1.

**Table 1: Sites Considered during Assessment of Waste Disposal Options**

<i>Site</i>	<i>Possible Site Use</i>
Municipal Incinerator Site	Transfer Station, Incinerator
Eccles	Transfer Station, Incinerator, Landfill
Golden Grove	Landfill
Linden Mines	Landfill
Omai Gold Mines	Landfill
Tidal Lands	Landfill

Each site was screened based on the following criteria:

1. Area is not within watersheds designated for drinking purposes or aquifer recharge.
2. Area is of sufficient size to provide 20 years of landfill life or to accommodate a transfer station and incinerator.
3. Area is not subject to frequent flooding which cannot be mitigated with practical design and construction methods.
4. Area does not have high groundwater.
5. Area is not within 300 metres of bodies of water or wetlands.
6. Area is where geologic formations will provide adequate support.
7. Area is not within 3 km of a licensed operating runway.
8. Area is not likely to be cost prohibitive based on construction, transportation and mitigation requirements.
9. Area is not in close proximity to sensitive receptors.

The phase 1 assessment indicated Eccles as the most suitable site for a transfer station or incinerator. All sites except the incinerator site were evaluated for siting the landfill. Eccles fulfilled five of the screening criteria. Concerns associated with this site included frequent flooding, proximity to groundwater, proximity to canals and proximity to residents. The Golden Grove site has the same impediments as the Eccles site. Use of the Golden Grove site will however, entail additional transportation costs. Both the Linden and Omai Mine sites were eliminated due to the significantly greater waste transportation costs. The tidal site fulfilled only two of the site screening criteria. The Site Assessment resulted in Eccles being identified as the most appropriate site of the six considered.

Phase Two of the BVA study consisted of an environmental assessment of the Eccles site. The Environmental Assessment considered land use, geology and soils, air quality, noise, odors, water resources, biological resources, floodplain/wetlands, cultural resources, socioeconomic conditions, traffic and health and safety. The Environmental Assessment identified no fatal flaws and Eccles was identified as the location for a sanitary landfill for GM and its environs. The IDB subsequently held an open seminar to assess the willingness of the Private Sector to participate in the Georgetown Solid Waste Management Project and PSP emerged as a feasible option.

The preliminary environmental assessment conducted by BVA had identified proximity to surrounding residents as one of the non-conformance criteria for the Eccles Site. This was further evidenced by strong opposition of residents of surrounding communities to the sanitary landfill being sited at the initially proposed location. A decision was consequently made to both allay fears of residents and to gain greater conformance to the siting criteria and the proposed sanitary landfill site was relocated to Hague Bosch, an area approximately 1.5 kilometers east of the initially proposed location and some 2.0 km from the nearest residents.

The new location at Hague Bosch has essentially the same physical and environmental characteristics as the initially proposed site. The most significant distinction between Hague Bosch and the former site is its greater isolation from residential areas and potential receptors. The new location will practically eliminate any potential impacts to residents and is directly responsive to the concerns expressed by the community. Further, the validity of conclusions of the environmental assessment for the former site is applicable to Hague Bosch since the physical environmental conditions of the former site are replicated at Hague Bosch. The area proposed for the facility is approximately 1800 m east of an industrial estate which borders the Eccles New Housing Scheme (Figure3).

If the Programme is not implemented, GM will have to continue utilization of the Mandela Site without any environmental upgrades. GM is unlikely to accept waste from NDCs if this is the only alternative available. NDCs will therefore continue to utilize their current waste management option. This alternative is considered as the No Action Alternative and would result in continued illegal dumping in canals flowing through NDCs and inadequate management of wastes deposited at the Mandela dump.

The alternatives considered were a state of the art landfill or burial of waste and continued use of Mandela Site (No Action). Impacts on the physical and socio-cultural environment associated with each alternative were developed. The environmental costs and benefits were also compiled for each alternative. The least cost alternative was determined to be the engineered sanitary landfill proposed to be sited at Eccles and subsequently relocated to Hague Bosch.

#### **4.2        DESCRIPTION OF PHYSICAL AND SOCIAL ENVIRONMENT**

The physical environment of Haags Bosch and its immediate environs will be impacted by the project. Haags Bosch and its environs are considered to be represented by the landfill site, its buffer zone and the adjacent housing areas within 2.5 km (one and

one-half miles) of the facility. These housing areas include the New Eccles Housing Development, Republic Park, Continental Park, Nandy Park and Bagotstown.

The subject site (Haags Bosch) is set within the Coastal Plain. Typically, the subsoils consist of at least 20m of very soft to firm bluish grey silty clay with occasional silt seams and organic inclusion overlaying the firm to hard yellowish grey silty clay of the Coropina Formation. Low or relatively impermeable materials extend to at least 30m depth below grade. Groundwater in the area is recovered from wells screened in confined sand aquifers under artesian conditions at depths of about 160 m. Surface water occurs in ditches, canals and small drains and the levels in these units reflect controlled drainage and irrigation in the specific area, as well as seasonal fluctuations. The Georgetown area receives an average of about 2 m of rainfall per year. In the month of January 2005, greater than 1m was experienced, resulting in significant and prolonged flooding; temperature in the area ranges between 25 and 35°C. Land use in Haags Bosch area is agricultural with industrial and residential units about 2 km removed.

The development of a landfill at Haags Bosch would permit cessation of operations at uncontrolled dumps such as that existing at Mandella Ave (within the confines of Georgetown) which is currently the prime recipient of solid waste from the Greater Georgetown Area. The physical environment at Mandella is similar to that of Haags Bosch with the following exception. The surface water is contaminated with leachate from the uncontrolled waste dumping; land use of immediately adjacent areas include the long operated cemetery and residential development.

#### **4.2.1 SOCIO-CULTURAL ENVIRONMENT**

The proposed project will impact waste generation and management activities in GM and the NDCs in Region 4. Socio-cultural data has been compiled for GM and NDCs to define baseline conditions prior to implementation of the project. This data is detailed in the body of the report. A socio-cultural overview presents data as follows:

- **Population and household characteristics:** Data from the most recent census (1991) has been presented. The bureau of Statistic Guyana maintains census related activities in intercensal periods. Recent estimates indicate a population for Guyana of about 720,000 to 750,000. Georgetown and Region 4 NDCs are estimated to have a population of between 310,000 and 350,000
- **Economic activities and employment:** The Guyanese Economy exhibited moderate economic growth in 2001-02, based on expansion in the agricultural and mining

sectors, a more favourable atmosphere for business initiatives, a more realistic exchange rate, fairly low inflation, and the continued support of international organizations. Growth then slowed in 2003. Chronic problems include a shortage of skilled labour and a deficient infrastructure. The government is juggling a sizable external debt against the urgent need for expanded public investment. The bauxite mining sector should benefit in the near term by restructuring and partial privatization.

- **Social and Economic well being:** Poverty and unemployment showing declining features; life expectancy 65 years (male 62, female 68); literacy 98%; gender gap in favour of males for higher education; collapse of infrastructure in 1990's showing signs of improvement. Teachers and nurses earning minimum wage of approximately US \$100/month is a concern.

#### 4.3 POSITIVE ENVIRONMENTAL IMPACTS

Implementation of the Programme including the design, construction and operation of a sanitary landfill at Haas Bosch will satisfy a demand for environmentally sound management of wastes generated in GM and surrounding NDCs and will result in a diminished level of illegal dumping and improved management of solid waste. The Programme implementation will result in enhanced aesthetics in GM and NDCs. The availability of the sanitary landfill at Hague Bosch will reduce unregulated disposal of waste in NDCs and the associated likelihood of health impacts associated with improper waste disposal in these areas.

However, implementation of the Programme will only eliminate illegal dumping to the extent that there is adherence to good solid waste disposal practices by the population. The health impacts on residents of Georgetown adjacent to the Mandela Site will be partly mitigated by closure of the dump after the sanitary landfill becomes operational. These impacts will extend over the duration of the Programme and will have positive residual impacts on the health and aesthetics of the NDCs and Georgetown.

The Coastal Plain Physiographic Province of Guyana has significant thickness of high plasticity, low permeability clays ( $k < 10^{-7}$  cm/s) at ground surface. The minimum thickness of these clays exceeds 150 m in GM and NDCs being considered by this EIA. Records of wells recovering potable water in the County of Demerara (Worts, 1958) indicate potable water is recovered from a minimum depth of 161.6 m in the Eccles area. The siting and operation of a sanitary landfill at Hague Bosch will therefore not impact groundwater quality.

Methane gas generated by decaying waste in the landfill may potentially be used to generate power and reduce dependence on oil imports for power generation and result in foreign currency savings for the country. The generation of energy from methane as well as the sale of carbon credits will be subject to further study and would only be implemented if the study considers it to be a feasible option.

Direct economic benefits will result from expenditures by the Contractor and Operator of the Hague Bosch Sanitary Landfill. These impacts will extend over the medium term and will have minor positive residual impacts on wage rates and power generation options for the country as a whole.

Closure of the Mandela Site after the Hague Bosch site becomes operational will permanently reduce incidences of flooding in areas around the Mandela Site and will lead to increased property values in areas surrounding the Mandela Site. Implementation of effective waste management practices in Georgetown and NDCs will permanently decrease the incidences of flooding in down town areas by reducing illegal dumping in drainage canals and natural areas and will result in a significantly more aesthetically pleasing environment. These impacts are long term impacts which will have residual effects.

Implementation of the Programme will permanently eliminate open dumps used by NDCs and will contribute to improved aesthetics in these communities. It will also reduce expenditures for maintenance of drainage infrastructure, compromised by illegal waste dumping, in NDCs. Implementation of the Programme will also eliminate open burning and illegal dumping of waste and their associated threats to health and the environment. These impacts will extend over the duration of the landfill operations.

Composting will result in beneficial use of the organic stream of the waste and may generate revenues for GM and the Site Operator. It may also lower the initial investment cost for waste management facilities for waste from GM and the NDCs. Both of these impacts will extend over the duration of landfill operations.

In 1992, several developed countries agreed to the United Nations Framework Convention on Climate Change (UNFCCC), which imposes limits on greenhouse gas emissions to minimize the adverse effects of climate change (Kyoto Protocol). Under the UNFCCC, countries are permitted to use a trading system to help meet their emissions targets. In principle, a country can allocate permits to individual companies for emissions of a certain quantity of greenhouse gases. If permits are only issued to a level equal to or below the assigned amount, then a country can meet its Kyoto commitment. If a country is incapable of meeting its target, it can purchase permits from countries that

are under their targets. Guyana is below its target and emission credits can be sold to countries above their targets.

The volume of methane generated by the Hague Bosch Sanitary Landfill after four years of operation is conservatively estimated to be 1650 m<sup>3</sup>/hr. The use of methane generated by the landfill for power would avoid Carbon Dioxide emissions ranging from 438000 to 730,000 tonnes per year. The avoided carbon dioxide emissions can be traded through a broker to industries in a developed country to provide a revenue stream for the project.

#### **4.4 NEGATIVE ENVIRONMENTAL IMPACTS**

There are no receptors within 2 km of the Hague Bosch Sanitary Landfill boundaries consequently the negative impacts of the sanitary landfill operations are negligible. The primary negative impact of the Programme implementation would be due to construction and service vehicles passing along the road that separates Eccles from Bagotstown. These trucks may emit noise above levels currently common to the area. The East Bank Highway is the only artery into Georgetown. All construction trucks hauling aggregate for construction of the four lane roadway linking Georgetown to Peters Hall, Mahaica to Rosignol and for construction of bridges between Georgetown and Rosignol use this artery. The number of construction and service vehicles each day accessing the Site will be significantly less than those hauling aggregate. Noise will be mitigated by incorporating specific equipment performance criteria for construction and service vehicles and limiting operating hours.

Gaseous exhaust consisting primarily of carbon monoxide and unburned hydrocarbons and fugitive dust emitted by heavy construction equipment may impact air quality at the site itself. Receptors are too far removed from the site for their air quality to be impacted. Noise levels above the alert threshold of 86 decibels and hazard threshold of 95 decibels will be produced from earthmoving equipment at the site. Odors will be generated by the leachate ponds. The impacts will extend over the duration of landfill operations. Dispersion modeling has indicated that tolerable levels will be attained within a maximum distance of 750 m from the sanitary landfill boundary. The closest community is located approximately 1.5 km from the Hague Bosch Sanitary Landfill boundary. No communities will consequently be impacted.

Filling of canals for the Hague Bosch Sanitary Landfill footprint will result in minor losses of surface water storage capacity which will be compensated for by the onsite stormwater management ponds. Clearing lands of sugar cane will result in a change in the floristic composition of the landfill footprint. Waste containing organic matter and

food will attract insects, birds and animals. These impacts will be short term and temporary since mitigation measures will be implemented to minimize access to food in waste disposed at the landfill and the area will be revegetated after landfill closure.

Several people gain their livelihood by collecting waste from the Mandela dump for sorting and sale of objects and materials such as glass, metals, plastics, paper/cardboard and textiles. Closure of the Mandela Site and operation of the Hague Bosch Sanitary Landfill will result in permanent cessation of this activity and permanently displace persons who currently earn a livelihood from scavenging. This impact is temporary and will be mitigated by relocation of these individuals to the Hague Bosch Sanitary Landfill.

The streets in several NDCs are only wide enough to support one-way vehicular traffic and were not designed for the heavy wheel loads imposed by garbage trucks. The use of garbage trucks may lead to structural collapse of streets in NDCs.

Commercial and industrial waste generators in NDCs are unaccustomed to paying a waste tipping fee. Imposition of waste tipping charges may lead to illegal dumping of waste in NDCs by these generators. This risk will be managed by using Waste Management Officer (WMOs) to enforce sanctions against littering and illegal dumping. The ability of these officers to identify likely offenders will be reinforced by access to the inventory of commercial and industrial waste generators in NDCs to be compiled as part of the Hazardous and Healthcare Waste Management component of the Programme. Waste disposed by these generators will be compared to data in the inventory and generators will be targeted for monitoring in instances where waste disposal volumes fall short of the inventory data.

There may be a shortfall in revenue generation if the NDCs do not generate the additional 100 tons/day. The present costs for waste disposal at Mandela are US \$2.65 per tonne. The proposed fee to be paid by the MSWMD to the Hague Bosch Sanitary Landfill Operator is US \$8.60 per tonne. The MoLGRD has indicated the GoG willingness to compensate for these shortfalls in revenues. This will eliminate risks to the project related to insufficient waste generation and to NDCs inability to pay the tipping fees.

There is likely to be significant community opposition to the Hague Bosch Sanitary Landfill. This opposition is primarily related to perceived loss in property values and the loss of quietude in communities in the environs of the landfill. The sanitary landfill has been relocated to be more than 2 km from any communities and fears about loss of property values are unlikely to be realized. The relocation of the sanitary landfill will also ensure that there is practically no impact to the quietude of the surrounding area.



Waste trucks will be constrained to using the new bypass road and southern access extension to the Site. Concerns related to impacts on quietude by waste truck traffic will therefore not be realized. All onsite roads are more than 1.5 km away from residential areas and dust emissions from these roads will have no impact on residents of surrounding communities.

## 5.0 MITIGATION PLAN - ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Section 6 of the EIA identified environmental impacts and associated risks that can potentially be encountered as a result of designing, constructing, operating and closing the Site. The purpose of the Environmental Management Plan (EMP) is to clearly address and discuss preventative and contingency measures, which will be established to mitigate environmental impacts and associated risks for the Project. In Section 6 of the EIA report actions related to the Project were systematically assessed and categorized based on potential to create an environmental impact and or associated risk for each individual phase of the Project. Although the assessment was somewhat redundant in that similar impacts can be attributed to different phases it was a very important exercise in that all potential actions through all phases of the Project were thoroughly explored. In this section of the EIA report, to avoid repetition, mitigating and contingency measures are established for only those actions, which can potentially impact the environment. The order established in Section 6 is continued in this section.

This EMP discusses mitigation and contingency measures, which will be established and executed during the Project to address those actions, which can potentially impact the environment throughout the operating lifespan of the Site and during the following phases.

- Design.
- Construction.
- Operation.
- Post Closure.

For selected areas of study noted above mitigating and contingency measures have been established for actions related to the project, which have a potential to create an environmental impact and associated risk. The EMP will identify strategies for the mitigation of environmental impacts and associated risks and establish contingency planning for those actions, which directly relate to Site conditions noted below.

- Physical Environment.
- Biological Environment.
- Social Impact and Human Resource.
- Environmental Control Systems.

For the purposes of the EMP physical environment impacts that must be managed are considered to be those that affect the immediate and local surroundings and include:

- site conditions;
- animal habitat and/or population;
- plant species and/or vegetation
- surface water; and
- noise and odour.

For the purposes of the EMP biological environment impacts that must be managed are considered to be those that can impose a biological change and include:

- air quality;
- surface water quality;
- groundwater quality;
- native soil quality; and
- human health.

For the purposes of the EMP social and cultural impacts that must be managed are considered to be those that can impose a change to way of life or human impact and include:

- opposition to proposed Site;
- staffing;
- health and safety;
- public involvement and notification; and
- archeological and heritage issues.

For the purposes of the EMP environmental control systems are considered to be those that provide protection to the local surroundings and environment and include:

- waste containment;
- leachate collection and treatment;
- landfill gas collection and treatment.

## **5.1        DESIGN**

For more complete details on the final project design and complementary studies undertaken the reader is referred to the document entitled "Detailed Design and Operations Report for a New Sanitary Landfill in Haags Bosch", which was prepared by Trow International Ltd., in association with Conestoga-Rovers and Associate and E A Consultants and prepared for the Ministry of Local Government and Local Development and submitted under a separate cover on December 2004.

### **5.1.1        PHYSICAL ENVIRONMENT**

No physical environmental impacts and/or risks noted in design phase.

### **5.1.2        BIOLOGICAL ENVIRONMENT**

No biological environmental impacts and/or risks noted in design phase.

### **5.1.3        SOCIAL ISSUES AND HUMAN RESOURCES**

This sub-section discusses management of social issues and human resources during the design program.

#### **5.1.3.1        OPPOSITION**

An ongoing management mechanism will be established to respond to concerns that arise in surrounding communities, NDCs and GM that are related to solid waste management and operation of the facility. The committee will be comprised of members of the communities around the facility, residents of NDCs and members of the Advisory Board. This committee will meet quarterly or with greater frequency if circumstances dictate, to discuss issues and concerns related to waste management and operations at the landfill. At a minimum the committee will conduct periodic stakeholder and facility management reviews. The stakeholder review will entail continuous monitoring and review of communities, NDCs, commercial/industrial generators and other stakeholders to identify new or evolving issues as well as knowledge and perceptions about landfill operations and waste management. The landfill management review will

entail continuous monitoring and review of management systems to identify objectives, strategies, procedures and attitudes conducive to effective responses and constructive community relations.

Communities will be encouraged to report instances of waste trucks passing along non designated site access roads and illegal dumping by waste haulers or generators. Results of environmental monitoring will be made available for review by members of adjacent communities. Members will also be informed of all incidents during operations that do not conform to sound environmental practice and specified operational environmental standards as set forth in the management, mitigation, emergency and Health and Safety plans, and of mitigation and management measures implemented to prevent or remedy such occurrences and to counter their reoccurrence. Reports will be issued quarterly or upon occurrence of a violation and will be publicly and easily available from the Operator or MSWMD upon request.

During community consultations residents expressed concerns about the long term management and maintenance of the facility and cost recovery mechanisms to ensure its long term viability. The community outreach program will include providing data on equipment availability and on the progress of the Institutional Strengthening aspect of the project. The cost recovery mechanism and inputs by GOG to the project to ensure its continued viability will also be made public. The resources and capability of the regulatory agency such as the EPA to ensure environmental compliance would be periodically discussed and updated with surrounding communities.

#### **5.1.3.2 PUBLIC INVOLVEMENT AND NOTIFICATION**

The communities will be encouraged to become directly involved in community clean-up campaigns in public open spaces such as parks, school zones, and canals and to monitor the behavior of commercial and industrial waste generators, haulers and landfill operators and their compliance with the objectives of the project.

The Operator will provide plans to MSWMD, for approval, to deal with environmental incidents that may harm the environment or demonstrate that the resources are readily available to implement those plans. The MSWMD will review all plans to ensure conformance to the quality assurance and quality control aspects of the project and will supervise the operator and enforcement of aspects of the plan including remediation measures required for non-compliance incidents.

The plans, prepared by the operator will include details on how the public would be provided with information on environmental incidents and dangerous releases on the site. Plans will include the methodology for providing warnings and information to the public by press and radio and for disseminating information to the site environs prior to press and radio announcement.

The plans will also include specific procedures to enforce remedial action for non-compliance issues such as failure of landfill slopes, failure of the leachate containment pond and landfill fires. The Plan will define responsibilities and provides procedures designed to identify unusual and unlikely conditions which may endanger the facility in time to take preventive and remedial action and to notify the appropriate public officials of possible, impending, or actual imperilment of the environment. The plan will also contain notification procedures to safeguard the lives, health, safety and property of citizens and site personnel and to safeguard the environment in areas adjacent to the site in the event an emergency develops.

#### **5.1.4      ENVIRONMENTAL CONTROL SYSTEMS**

No environmental control system impacts and/or risks noted in design phase.

### **5.2          CONSTRUCTION**

The technical specifications and engineering drawings required to tender, administer and construct and develop the Site over the initial construction period and operating lifespan are provided in the document entitled "Construction of Sanitary Landfill in Haags Bosch, Specifications, Book B", which was prepared by Trow International Ltd. In association with Conestoga-Rover and Associates and E & A Consultants Limited and submitted under a separate cover on October 2004.

#### **5.2.1      MANAGEMENT OF PHYSICAL ENVIRONMENT**

This sub-section discusses management of the physical environment during the construction program.

#### **5.2.1.1     SITE CONDITIONS**

##### ***Erosion***

Erosion will be mitigated during construction operations through the use of siltation fencing and temporary surface water controls as identified in the construction specifications. Continued construction inspection will be undertaken to ensure compliance.

##### ***Dust***

Dust will be mitigated during construction operations through the use of water sprinkling as identified in the construction specifications. Continued construction inspection will be undertaken to ensure compliance.

Daily and interim cover soils for the active disposal area will be excavated during the preparation of adjacent landfill stages and transported directly to the location where it is required to minimize double handling of soils and the quantities of materials that may need to be stockpiled. Active stockpiles of cover materials required for the proposed Site operations will be oriented and operated from the lee side of the stockpiles. The exposed inactive faces of all stockpiles will be provided with interim vegetation to minimize wind erosion concerns to the extent practical.

##### ***Traffic***

Traffic planning and control will be addressed in the construction specifications. Continued construction inspection will be undertaken to ensure compliance.

#### **5.2.1.2     ANIMAL HABITANT/POPULATION**

##### ***Habitant***

Wildlife habitant will be monitored during construction and operation of the Site. Although unexpected, if construction and/or operation of the Site has a detrimental affect on local wildlife habitant restoration of disturbed areas will be considered and implemented as necessary in accordance with local wildlife management agencies.

##### ***Population***

Wildlife population will be monitored during construction on operation of the Site. Although unexpected, if construction and/or operation of the Site has a detrimental affect on local wildlife population restoration of disturbed areas will be considered and implemented as necessary in accordance with local wildlife management agencies

#### **5.2.1.3 PLANT SPECIES/VEGETATION**

Plant species will continue to be monitored through construction, operation and post closure. Although unexpected, if construction and/or operation of the Site has a detrimental affect on plant species restoration of disturbed areas will be considered and implemented as necessary in accordance with local wildlife management agencies.

#### **5.2.1.4 SURFACE WATERWAYS**

The design of the Site accounts for any changes and diversion of surface water. The contractor will be held accountable for constructing and maintaining surface water controls in accordance with the technical specifications and drawings.

### **5.2.2 MANAGEMENT OF BIOLOGICAL ENVIRONMENT**

This sub-section discusses management of the biological environment during the construction program.

#### **5.2.2.1 AIR QUALITY**

The Site has been relocated approximately 1.5 km from the closest population center. This distance will serve to mitigate any potential impacts associated with emissions from construction equipment. Contract specifications will mandate that equipment be maintained in good working order with all the manufacturer supplied systems.

The landfill will be buffered by approximately 121 hectares of cane fields. Dust generation will be localized and removed from potential receptors and, based on prevailing weather conditions at the Site location is expected to be very infrequent.

#### **5.2.2.2 SURFACE WATER QUALITY**

Replacement oils and fluids inventory would be monitored to ensure no more than reasonable quantities are on hand. These materials would be stored in a cool, dry area in a separated area or room away from regular maintenance activities. Used oils and fluids would be stored in approved containers to be emptied periodically by a licenced waste



hauler. Oils and fluids would be stored so that any spills or leaks are contained and spilled materials can be treated with absorbents suitable for their clean up. Welding or other activities that could create heat or sparks and set off a fire would be carried out away from the oil and fluid storage area. Fire extinguishers would be located throughout the building so that personnel can attack a small fire. Open flame shall only be permitted within the designated maintenance areas of the main building.

Compressed gases used for cutting and/or welding would be stored in racks and chained to ensure safe storage. Tanks, when transported to a work area, would be chained into a carrier with valve covers in place, and not allowed to free stand as they could fall or be knocked over resulting in potential damage to the tank valve assembly which could lead to an explosion and/or fire. Only gases in use would be in the work area, with both spare and spent tanks stored away from the work area. A portable fuel tank will be kept on Site for refueling equipment. The portable tank shall be a dual walled tank or a secondary containment area shall be provided.

### **5.2.3      MANAGEMENT OF SOCIAL ISSUES AND HUMAN RESOURCES**

This sub-section discusses management of social issues and human resources during the construction program.

#### **5.2.3.1      STAFFING**

Contractors will be required to employ competent and/or licensed staff to construct the Site in accordance with the technical specifications and drawings. Continued construction inspection will be undertaken to ensure compliance.

#### **5.2.3.2      HEALTH AND SAFETY**

Contractors will be required to adhere to a site specific health and safety plan (HASp) in accordance with the technical specifications. Continued administration and construction inspection will be undertaken to ensure compliance.

#### **5.2.4      MANAGEMENT OF ENVIRONMENTAL CONTROLS**

This sub-section discusses management of environmental control during construction.

Contractors will be required to employ competent and/or licensed staff to construct environmental control systems in accordance with the technical specifications and drawings. Continued construction inspection will be undertaken to ensure compliance.

A Construction Quality Assurance Plan developed for the Site presents the construction quality assurance/quality control procedures to be implemented during the construction. Specifically the following construction components will be dealt with:

- Construction facilities and temporary controls;
- Base of landfill grading and preparation;
- Sand and aggregate liner materials and installation;
- Geocomposite liner materials and installation;
- Stormwater collection system materials and installation;
- Leachate collection and treatment system equipment, materials and installation; and
- LFG collection system piping materials and installation.

The objective of the CQA plan is to ensure that the above components are constructed to meet all material and design criteria, as laid out in the approved drawings and specifications. Throughout construction there will be numerous inspections and testing requirements for specific work tasks. The inspection and testing requirements will ensure compliance with the specifications, as well as completion of the work tasks to the highest level of quality. Inspections and testing will provide a qualitative means of monitoring the quality and progress of work performed.

#### **5.3      OPERATION**

For more complete details on the sanitary operation and closure of the Site the reader is referred to the document entitled "Site Operations Manual, Sanitary Landfill in Haags Bosch", which was prepared by Trow International Ltd., in association with Conestoga-Rovers and Associate and E A Consultants and prepared for the Ministry of Local Government and Local Development and submitted under a separate cover in March 2005.

### **5.3.1      MANAGEMENT OF PHYSICAL ENVIRONMENT**

This sub-section discusses management of the physical environment during the Site operations program.

#### **5.3.1.1      SITE CONDITIONS**

##### **Traffic**

The Site operator will be responsible for traffic planning and control in accordance with the Site Operations Manual. Continued operation inspection will be undertaken to ensure compliance.

#### **5.3.1.2      ANIMAL HABITANT/POPULATION**

The following operational and management measures will be utilized to effectively control vector and vermin at the Haags Bosch Site.

##### **Flies and Insects**

Normal landfill operation procedures such as covering the waste material on a daily basis reduces the number of flies at a landfill because the layer of cover material and the steadily advancing active face prevents mature flies from being able to leave the waste material. Should an outbreak of flies occur at the Site, an insect exterminator would be used as an interim measure to control the flies at the source. Daily cover will be applied over waste at the end of each day and the amount of time allotted for the waste pickers to carry out recycling activities will be controlled and enforced.

##### **Rodents**

Uncovered wastes will not be allowed for any extended periods to allow rodent populations to develop. Occasional rodents and other vermin may occur at the landfill site, but the active waste face would be moving on a regular basis and these animals will not find the landfill operations conducive to stable habitation. Should an outbreak of rodents or other vermin occur at the Site, the vermin will be exterminated or controlled as an interim measure. The extermination of rodents would be conducted by a licenced exterminator in a manner that is appropriate for the vermin in question. Regular placement of cover and good control of the waste picker areas such that waste is not kept exposed for extended periods will be enforced to control rodents.

As the use of transfer locations that will route waste to the Site increases, measures will be enacted to control the length of time and condition in which the transferred waste is delivered to the Site. Inactive portions of the landfill will be inspected to ensure that the interim cover is adequately maintained and that rodent populations are not allowed to develop in those areas.

### **Birds**

Various bird species may be present at the landfill site due to the presence of food wastes. As with the other vectors, the application of daily cover will reduce access to food scraps and other attractive material available to the local bird population. Consistent implementation of this measure would help to limit the local bird population in the vicinity of the Site. The stormwater sedimentation and control ponds that are constructed on the Site would also be operated and maintained in a manner that does not encourage resident bird populations. The stormwater sedimentation and control ponds will provide an alternative location for local birds to reside, and would disperse the birds over a larger area further away from the active landfill area. Re vegetation of disturbed or completed areas will be undertaken as quickly as practicable to reduce the loafing areas that are cleared of vegetation.

### **Waste Hauling Vehicles**

The mode and timing of transfer station operations may result in infestation of waste hauling vehicles by vermin and vector. There will be a requirement that waste hauling vehicles conform to specific design standards and that all vehicles are included in the vector control program. The requirements will include that all vehicles be washed with water at high pressure and be disinfected at least twice each week and that all wash water be drained to the LTS.

#### **5.3.1.3 NOISE AND ODOUR**

### **Noise**

Potential noise impacts from the Site will result from operation of landfill equipment. The operation of this equipment will be conducted in such a manner as to minimize noise impacts, wherever possible. Haags Bosch is a considerable distance from the closest residential area (more than 1,500 m). This significantly reduces the likelihood that residents would be impacted by the noise produced by the operation of equipment. In addition, noise from landfill operations will be limited to the daylight hours. Given the Site location, vegetated screens and setback distances, noise is not considered to be a significant issue for this Site. In accordance with good practice all equipment being utilized at the Site will be maintained in good condition with all sound suppression

systems or components (e.g., muffler systems) in a good state of repair in accordance with the manufacturer's specifications.

### **Odour**

Leachate related odours are associated with open exposure to raw leachate in the landfill cells or in the LCS. This will be controlled by ensuring that exposed standing leachate in the base of the cells is not permitted for any extended period and that the pump station manholes are properly constructed and vented. The leachate treatment system addresses odour concerns with the treated leachate.

Waste odour generated by recently disposed waste will be controlled by effective management of the tipping face, by keeping the size and open area controlled, and by the application of daily cover. Masking agents and odour control agents will be used on an as needed basis. Care will be taken to not leave residual wastes in the waste picker area for any extended periods since this will lead to odour problems and to problems with rodents and other vectors.

Dispersion analyses of odour emissions indicate attainment of WHO standards within 100 m of the site boundaries. There are no receptors within 1.5 km of the site boundaries and these impacts are unlikely to be experienced by residents of surrounding communities. Several odour emitting facilities are located in the industrial estate which is upwind of the Eccles New Housing Scheme. A public outreach program will be mounted in the areas adjacent to the industrial estate to sensitize residents to the potential odours emissions of the industrial estate to eliminate the possibility of perceptions developing that the odours are attributable to landfill operations.

## **5.3.2 MANAGEMENT OF BIOLOGICAL ENVIRONMENT**

This sub-section discusses management of the biological environment during Site operations.

### **5.3.2.1 AIR QUALITY**

The Site has been relocated approximately 1.5 km from the closest population center. This distance will serve to mitigate any potential impacts associated with emissions from construction equipment. Specifications will mandate that equipment be maintained in good working order with all the manufacturer supplied systems.

The landfill will be buffered by approximately 121 hectares of cane fields. Dust generation will be localized and removed from potential receptors and, based on prevailing weather conditions at the Site location is expected to be very infrequent.

Daily and interim cover soils for the active disposal area will be excavated during the preparation of adjacent landfill stages and transported directly to the location where it is required to minimize double handling of soils and the quantities of materials that may need to be stockpiled. Active stockpiles of cover materials required for the proposed Site operations will be oriented and operated from the lee side of the stockpiles. The exposed inactive faces of all stockpiles will be provided with interim vegetation to minimize wind erosion concerns to the extent practical.

#### **5.3.2.2 SURFACE WATER QUALITY**

Surface water control in the proposed landfill Site will be achieved through the construction of temporary berms around the base excavations and the upper limits of the active disposal area. All surface water contacting exposed waste will be collected by the LCS and treated as leachate. The facility will be designed, constructed and maintained with a run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 10-year storm and with a run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 10-year storm.

When waste contours have reached the proposed top of waste/daily cover elevation, interim cover of at least 300 mm in depth will be placed and maintained. Final cover for the completed areas will be placed within 12 months of an area reaching final grade and being deemed ready for closure. The surface water from these areas will be drained directly to the stormwater sedimentation and control pond, since exposed waste will not be present. When any section of final cover or ditch is at its final grade, the area would be revegetated. Until the vegetation is fully established in that area and upstream drainage areas, silt control fences or other similar measures shall be put in place to minimize silt losses into the stormwater management swales and ponds. Periodically on an as needed basis, the silt will be removed and placed into the landfill.

Potential operational issues that may lead to contamination of surface water features at and adjacent to the Site may include the following:

- Overload of leachate treatment facility;
- Bypass of leachate treatment facility; and
- Flooding of leachate collection and holding facilities.

In addition effluent will be monitored at a number of locations around the Site. The trigger levels for surface water quality will be set at the following:

- The average annual concentration of any parametre measured at a downstream surface water monitoring location in the north and south drainage canals exceeds the average annual concentration at the corresponding upstream location (i.e., background) by 33 percent; and
- The discrete concentration of any parametre measured at a downstream surface water monitoring location in the north and south drainage canals exceeds the discrete concentration at the corresponding upstream location by 50 percent.

#### **Surface Water Contingency**

Inherent contingencies have been built into the design of the leachate treatment facility in order to address the situation of a power failure. Generator connection points have been designed into the system for prolonged power outages that could shut down the pumps and cause overflow of the system. Short term power outages (i.e., those expected to last for no more than 24 hours) are acceptable due to the storage capacity of the landfill and leachate treatment facility. The design incorporates redundant pumping capacity and also requires that backup pumps be kept available at all times.

The purpose of the surface water contingency plan is to illustrate the surface water trigger levels and contingency measures to be implemented due to potential contamination of surface water features on and adjacent to the Site.

#### **Trigger Criteria – Water Quality**

The trigger levels for surface water quality will be set at the following:

- The average annual concentration of any parametre measured at a downstream surface water monitoring location in the north and south drainage canals exceeds the average annual concentration at the corresponding upstream location (i.e., background) by 33 percent; and
- The discrete concentration of any parametre measured at a downstream surface water monitoring location in the north and south drainage canals exceeds the discrete concentration at the corresponding upstream location by 50 percent.

The upstream and downstream surface water monitoring locations are indicated on Figure 13.1 (Appendix A). Should any of the trigger levels be exceeded, the notification and response process discussed above will be set in motion. Contingency measures may include actions such as:

- Improving interim or final cover over landfilled areas;
- Implementation of berms to ensure surface water runoff from active disposal areas does not contact non active areas; and
- Ensuring that effluent from the leachate treatment facility that is released to the primary stormwater sedimentation and control pond meets discharge criteria.

Treatment of water at the Site depends on how it is classified, and improper classification can lead to contamination and improper discharge. Once surface water has reached a certain trigger level, or has been contacted with an active waste area in the landfill it will automatically be diverted to leachate treatment instead of stormwater.

#### **5.3.2.3     GROUNDWATER QUALITY**

The landfill is designed as a hydraulic trap. The leachate flow has been modeled for all operating conditions, including post closure conditions, including post closure conditions with leachate collection system not operating. These assessments show containment of major contaminants at relatively shallow depths in the surficial aquitard of low permeability clays. The aquifer used for groundwater recovery is at a depth of 160 m. The facility will therefore have no impacts on groundwater quality. An engineered base and leachate collection system will be installed below the area to be landfilled to recover and to direct leachate to the LTS. The purpose of groundwater monitoring is to demonstrate how to readily identify and respond to any potential groundwater quality issues at the Site. The hydraulic performance of the Site is the most reliable and readily definable indicator of the effective overall performance of the Site.

The water levels monitored both within the Site and in the buffer zones will provide the earliest possible indicator that the Site is not performing as designed allowing any remedial actions to be taken before there is any evidence of any off-Site impacts. Trigger levels and a contingency response plan will ensure that the hydraulic trap at the base of the landfill is effectively maintained



Potential conditions that could, if not remedied, compromise the hydraulic trap condition resulting in unexpected degradation of the groundwater quality at and adjacent to the Site, flooding of landfill stages, and leachate seeps may include the following:

- Improper operation of the part or all of the LCS; or
- Loss of the hydraulic capacity of the LCS.

In order for the leachate collection system to continue to function as designed through the life of the Site regular video inspection, flushing and cleaning of the underdrain system will be completed.

The trigger level for the leachate elevation within the waste fill area has been set at approximately 1 m below the corresponding groundwater elevation for the Site, i.e., approximately 2 m below ground surface.

#### **Leachate Management/Groundwater Contingency**

The purpose of the leachate management/groundwater Contingency Plan is to demonstrate how to readily identify and respond to any potential groundwater quality problems at the Site. The hydraulic performance of the Site is the most reliable and readily definable indicator of the effective overall performance of the Site.

#### **Trigger Criteria**

The trigger level for the leachate elevation within the waste fill area has been set at approximately 1 m below the corresponding groundwater elevation for the Site, i.e., approximately 2 m below ground surface. Should trigger levels for leachate be exceeded, the following contingency measures may be implemented, as appropriate:

- Due to improper operation of the LCS (i.e., insufficient pumping of leachate), the LCS will be pumped more aggressively to remove built up leachate; and
- Due to leachate mounding within specific areas (e.g., Stage 1) due to localized LCS failure, the LCS piping will be inspected and attended to as needed to ensure that there are no blockages in the system.
- Upon inspection, if a portion of the LCS piping is found to be plugged, flushing of the lines will be completed in order to remove the blockage within the pipes. If flushing of the lines proves to be ineffective, and leachate elevations within the landfill continue to rise irrespective of precipitation and leachate pumping rates,

then a localized failure of the leachate collection piping is to be suspected and it must be excavated and either repaired or replaced.

#### **5.3.2.4     NATIVE SOIL QUALITY**

A construction Quality Assurance (Q/A) plan will be developed for the Site to confirm assurance/quality control procedures are implemented during the construction.

Specifically the following construction components will be dealt with:

- Construction facilities and temporary controls;
- Base of landfill grading and preparation;
- Sand and aggregate liner materials and installation;
- Geocomposite liner materials and installation;
- Stormwater collection system materials and installation;
- Leachate collection and treatment system equipment, materials and installation; and
- LFG collection system piping materials and installation.

The objective of the Q/A plan is to ensure that the above components are constructed to meet all material and design criteria, as laid out in the approved drawings and specifications. Throughout construction there will be numerous inspections and testing requirements for specific work tasks. The inspection and testing requirements will ensure compliance with the specifications, as well as completion of the work tasks to the highest level of quality. Inspections and testing will provide a qualitative means of monitoring the quality and progress of work performed.

In addition to the Q/A plan there will also be continued monitoring of the leachate levels within the landfill cell. If the leachate levels exceed a pre-determined elevation above the base of the landfill contingency measures as identified above will be implemented.

#### **5.3.3     MANAGEMENT OF SOCIAL ISSUES AND HUMAN RESOURCES**

This sub-section discusses management of the social issues and human resources during Site operations.

### 5.3.3.1 STAFFING

#### **Employee Training**

Prior to commencing any landfilling activities, an employee training program will be conducted for employees that are actively involved with any of the day to day landfill operations.

The training session will stress the importance that each attendee understand the following important information:

- basic principles of personal protection and safety;
- how to perform their assigned job tasks in accordance with the manufacturers or other specified requirements and in a safe and environmentally responsible manner;
- how to conduct activities in accordance with all applicable local and Guyanese waste management regulations; and
- how to respond in an appropriate manner to any landfill related emergency which may arise.

Only trained and properly qualified persons familiar with all safety procedures will work on equipment, electrical systems, fuel systems, compressed gas systems, pressure piping, chemical feed, or other associated landfill systems.

Background information pertinent to the Site will be provided and the various components of the program will be presented followed by an opportunity to ask questions to ensure that each attendee understands the program. Site personnel who have not successfully completed this training program will not be permitted to work in potentially hazardous areas of the Site. Site specific procedures for items such as confined space entry protocols will be developed and incorporated into the staff training programs.

The contractor and operator will maintain records of all mitigation measures implemented in all phases of the project. Record for each phase shall include the following:

- media impacted;
- applicable regulations and standards; and
- mitigation measures.

### **Records and Documentation**

Records will be filed with the EPA and MSWMD quarterly and a copy of each record will be maintained on site for review by EPA quality assurance personnel. All records and project documentation will be made available to the public upon request. The public will also be informed of their rights to request additional information through the public outreach campaign. The Operator would be mandated to develop reporting protocols for industrial and commercial facilities to ensure proper disposal of all waste generated. The MSWMD and EPA would also adopt these protocols to develop information on generators who may have contravened the waste disposal regulations and on major pollution sources and waste generators.

The procedure for public reporting of non-compliance incidents will be made available to the public as part of the awareness campaign. The campaign will also identify typical non-compliance incidents such as unauthorized traffic through housing areas, suspicious discharges, dumping or poor environmental conditions around major generators of waste. The procedure will also identify the agency with enforcement powers to which the non-compliance incidents should be reported. The EPA shall be the primary agency for receipt of non-compliance complaints. The MSWMD and Operator shall also be mandated to receive non-compliance incidents for action when within their jurisdiction.

### **5.3.3.2 HEALTH AND SAFETY**

Proper safety procedures and equipment appropriate to the task at hand would be provided. Several safety features are incorporated in the landfill design and in the mechanical and electrical/control equipment to assure safe operation of the Site. To minimize the hazards involved in the daily operation of the Site both management and operators will be continuously vigilant in following safe working procedures. All employees will exercise caution in all activities in and around the Site and each employee would be responsible to protect others working at the Site. Potential problems at the Site would be identified and corrected before a safety related incident occurs. If an accident or injury does occur, the equipment established procedures or implementation of procedures would be carefully examined and any deficiencies in equipment, working procedures, and operator capability or other cause would be corrected immediately. The procedures will be reviewed and updated regularly as changing equipment and practices warrant.

The Health and Safety Program will be applicable to all personnel who will be working at the Site, including subcontractors and visitors. Subcontractors conducting project activities at the Site will be responsible for the health and safety of their own personnel.

Several safety features have been incorporated into the design of the Site to prevent injury and reduce potential hazards to employees. General safety and personal hygiene rules for the Site would include:

- Eating or drinking at the Site being limited to administration building and an area designated for the waste pickers;
- Smoking on or near the waste footprint, LFG collection piping, or LFG management facility, when installed, would be prohibited and smoking would only be allowed in designated areas;
- The "buddy system", i.e., working in pairs, will be used for all activities at the Site other than routine monitoring and light maintenance activities;
- Site security personnel would retain records of entry and exit of all Site personnel, subcontractors, and visitors;
- Individuals getting wet to the skin with effluent from the leachate treatment facility, leachate from the landfill, any waste matter or chemicals from the leachate operations will wash the affected area immediately. If clothes in contact with skin are wet, then these will be changed;
- Hands will be washed with soap and water before eating, drinking, smoking, and before using lavatory facilities;
- Waste produced on Site will be properly stored until such time that it is disposed of in accordance with appropriate regulations;
- All spills will be immediately cleaned up to prevent slipping and cross-contamination of Site areas;
- All appropriate personal protective equipment (PPE) including splash shields on hard hats, chemical-resistant aprons, and gloves will be worn when there is a potential for contact with hazardous substances;
- The administration building will be kept clean at all times; and
- All first-aid, safety, and emergency response equipment will be inspected periodically including the stationary and portable eyewash units, and portable fire extinguishers. All eyewash units will be flushed monthly with fresh water, and a record maintained of this occurrence.

Different levels personnel protective equipment (PPE) will be provided depending upon the nature of the work task to be performed at the Site. All activities performed at the Site involving contact with potentially impacted materials will be considered operations requiring personal protective equipment. The basic PPE requirements for all personnel at the Site will include:

- Full length pants;
- Safety footwear;
- Safety glasses with side shields as needed;
- Work gloves for any waste pickers or workers in contact with waste and recyclable materials;
- Hearing protection in designated areas; and
- Hard hat as needed. The use of hard hats shall include all work areas in proximity to operating construction equipment for cell development activities, waste filling activities or other similar works.

Upgrades to the PPE required for activities such as the laboratory testing of leachate samples shall be specified for these individual tasks.

In the event that there is a specific odour concern, workers will be requested to remove themselves from the affected area and obtain directions from supervisory personnel before continuing to work in this area. Should dust become an issue in drier months, dust masks will be employed as a temporary control measure for the comfort of on-Site operating personnel and waste pickers. Operators of landfill equipment will be provided with hearing protection consisting of ear plugs or cap-mounted ear muffs. Any other Site personnel working in the immediate vicinity of the landfill equipment would also wear the same hearing protection.

Site personnel will check weather forecasts for the next day and week of work to provide advance notification of any severe weather conditions. Severe weather conditions likely to be experienced at the Site may cause unsafe conditions and in some situations work may have to be temporarily suspended. In the event of inclement weather the following measures will be implemented if necessary:

- Restriction of Site activity;
- Battening down light equipment or building materials;
- Partially enclosing localized work areas;

- Selection of preferred filling locations that are better protected; and
- Reduction or stoppage of some or all work activities.

#### **5.3.4      MANAGEMENT OF ENVIRONMENTAL CONTROLS**

This sub-section discusses management of environment controls during Site operations. In general contingency measures to be conducted to facilitate the implementation of response action would involve the following steps:

- Verification - Verify that trigger criteria have been exceeded through appropriate sampling and/or further evaluation. Consult with the MSWMD upon verification that trigger conditions have occurred.
- Assessment - Evaluate the likely source of the problem, including completion of the potential impacts and evaluate trends. If further actions are required, proceed to next step.
- Evaluation - Review any pre-determined contingency measures as well as any other potential solutions. Carry out any further investigative/design tasks necessary to evaluate alternative solutions and to develop the selected contingency measure. Proceed to next step.
- Implementation - Notify the MSWMD of the need to implement the contingency plan. Prepare detailed plans, specifications, and descriptions for the implementation, operation, and maintenance of the plan. Review with the MSWMD and receive approval. Implement the contingency plan. While going through the above process, if it is determined that no further action is warranted, the routine monitoring program will be re-implemented and re-evaluation of the triggering parameters and levels will be undertaken.

The specific implementation program developed and put into place would be dependent upon the situation that is to be addressed. Contingency plans are provided for individual environmental control systems within the appropriate sub-section.

##### **5.3.4.1      WASTE CONTAINMENT CELL(S)**

#### **Unacceptable Waste**

Site personnel actively involved with day to day landfill operations will be trained to identify waste loads which are unacceptable for landfilling.

Signage would be posted at the main gate with the following indicated:

- operating authority, telephone number, and address;
- contact information including telephone number;
- waste types acceptable for disposal at the Site; and
- hours of operation.

A single scale with traffic signals will be located at the Site entrance so that waste material entering the Site can be weighed and recorded. Provisions will be made for an optional second scale as warranted by waste disposal traffic and quantities. A daily record of weighing operations would be maintained by the scale operator. The information contained in this record would include the date, quantity of waste in tonnes, and type of waste received.

If a load is refused due to an unacceptable waste profile, efforts will be made to obtain the following information:

- the source of the load;
- name of driver;
- licence number of vehicle; and
- company name on truck.

This information, including date and reason for refusal, will be maintained on Site for record keeping purposes. A list of prohibited materials will be posted on signs at the Site entrance. The weigh scale operation will permit tracking of licence numbers of offending vehicles and companies to permit follow up response measures to be taken in the event that non compliance by some parties becomes a chronic issue. It is expected that over time, the list of restricted materials would be modified. These types of modifications will be based on public consultation and notification as well as a phase in period to ensure that all users of the Site become aware of any changes to policy and the Site specific requirements.

### **Waste Placement**

Waste will be placed utilizing the area method, that is, the waste will be filled and compacted over the prepared base, in layers, and daily cover will be applied following the waste segregation and recycling activities carried out by the Site's licenced waste pickers.



Waste hauling trucks will unload at the designated drop off area within the landfill footprint for waste diversion activities including access for waste pickers. Waste pickers will be given access to a number of restricted areas of the Site and will be given a specified time allocation to have access to the waste. An area close to the tipping face will be designated for waste pickers. Waste placement will be staged such that after the allocated time period for recycling/segregation activities has expired, all waste pickers will be required to vacate the specific area and the waste will be pushed into the disposal cell and compacted. Waste pickers will not be granted access to the active tipping face areas due to safety and operational concerns.

The waste pickers will be allowed to move recoverable materials to the assigned staging area for subsequent sorting and cleanup. Any residual wastes from the sorting operation will be placed in another designated area to be moved back into the filling area on a daily basis. Residual wastes will not be retained in the sorting area for more than 24 hours. Waste pickers that do not adhere to the above procedures will lose their Site access privileges.

Waste will be compacted in lifts not exceeding 2.0 m thick using multiple passes with the landfill compactor, depending on the equipment available and the material being compacted. Daily cover consisting of native soils, wood chips, and suitable imported material designated as ADC will be placed in accessible portions of the working face prior to the end of each operating day. The type, amount, and area that the daily cover has been applied to will be included in the Site operator's daily report.

As previously noted, a flow diagram which depicts the route waste takes from when it enters the Site to final placement and compaction is provided in Appendix D.

### **Litter**

Preventative litter control measures will be taken to minimize the blowing of litter from the active area of a landfill. The following measures would be employed at the Site during site operations to achieve this goal:

- Daily cover will be applied to waste that will be exposed after it has been removed from the waste picker area and placed into the tipping face, thereby confining light weight material;
- Waste picker/recycling areas will have perimeter fencing and wind breaks established to mitigate against blowing litter;

- All vehicular traffic transporting waste to and around the Site will be tarped, if required, to prevent litter from blowing out of the vehicle;
- The working face location will be selected based on the direction and intensity of the wind to provide maximum shelter for the active area. The aerial extent of the working face will be kept to a minimum on windy days;
- Temporary, moveable, litter control fencing, approximately 3.0 m in height, will be utilized at the active disposal area;
- Disposal operations will be reduced or stopped and relocated to alternate disposal areas if prevailing weather conditions cause off Site litter impacts; and
- A litter control program that includes site perimeter maintenance and off Site litter control will be implemented, for monitoring and cleanup of litter along the primary access route.

### **Fire**

Site access will be controlled to prevent scavenging, and recycling will be carried out only by the Site's licenced waste pickers. Open burning of waste will be prohibited at all times during operation of the Site. No smoking or open flames of any type would be permitted within the landfill cell areas or near the LFG collection and management facility once installed and operational. Designated areas for smoking and for any open flames will be established. A "hot work" permit process would be established for any maintenance or repair activity that requires the use of an open flame such as for a torch or welding equipment.

Should a surface or underground fire occur, it will be contained and extinguished as soon as possible using on Site equipment. No excavation equipment will be used to try to open up any area where there is a suspected fire. Landfill fires will be smothered and forced to extinguish themselves by a lack of the oxygen necessary to sustain the combustion.

LFG will be generated and emitted from the landfill Site. In the event of a fire at the landfill, this Site has an ideal water supply base available at all locations on the property for use to extinguish a fire. There are canals on three sides of the Site and there will be three stormwater sedimentation and control ponds, all of which will be sources of water for fire suppression.

Fire fighting will be augmented by addition of cover soils adjacent to the area of a suspected fire if it is deemed necessary. If there is an active LFG collection system operating and there is a suspected or known fire, LFG collection from any vertical wells

or horizontal trenches in the vicinity of the suspected fire will be temporarily shut down. This will remove a potential oxygen supply source from the area of the fire and assist in allowing the gas generation in the landfill itself to assist in smothering the fire.

Any fire noted at the Site will be reported to the Site supervisor and MSWMD. There would be a ban on any open flame, spark, smoking or maintenance activities on top of the waste disposal areas without specific and extensive precautions in place. The waste picker rules and qualifications requirements will be quite stringent and will focus heavily on Site safety, with the open flame issue being one of the most critical issues.

#### **Final Cover**

Exposed and open waste on the crest of the landfill may potentially negatively impact the aesthetics of the area. Final cover will be applied to waste after attainment of final waste levels. The cover system will be designed to provide long-term performance with minimal maintenance, to minimize infiltration of precipitation into the waste and to promote good surface drainage and resist erosion. It will also control landfill gas migration and/or enhance recovery and separate waste from vectors. A healthy vegetative layer will be placed on top the final cover to provide erosion protection. Plant species that are not deeply rooted will be planted on the final cover. Grass on the cover layer will have the ability to thrive in low-nutrient soils with minimum nutrient addition and will have the ability to survive and function with little or no maintenance. The use of vetiver grass would be considered for the vegetative species.

A visual impact assessment has determined that the extensive setback provisions associated with the new location of the landfill are now such that visual impacts are not a concern for actual landfilling operations. Palm trees will be planted along the western limit of the property. The maximum leaf density of these trees is at tree top level and will provide optimal screening of the upper half of the landfill.

#### **5.3.4.2 LEACHATE COLLECTION AND TREATMENT**

As part of the design of the leachate treatment system, precautions have been taken to prevent failure due to flooding. The storage ponds and tanks for the system have been designed with excess capacity to accommodate the peak 10-year 24-hour rainfall event.

If in the event that the leachate treatment facility exceeds its capacity, leachate will be pumped back into the aerobic equalization lagoon, which has a capacity of 10,000 m<sup>3</sup>. Additionally, leachate can be retained within the waste fill area itself for a period of time to allow the overload condition to be rectified. The hydraulic loading to the leachate

treatment facility is the most sensitive in the period immediately following the opening of an additional section of the cell base. In non power-related situations, the trigger level for leachate quantity will be a flow within 10 percent of the maximum leachate treatment facility flow. In such cases, the following contingencies may apply:

- Recirculation of effluent to the aerobic equalization lagoon;
- Investigation of off-Site disposal of raw leachate; and
- Investigation of expansion of leachate treatment facility.

Potential operational issues that might compromise the leachate collection and treatment system may include the following:

- Power failure;
- Pump failure; and
- Overload or improper operation of the leachate treatment facility.

Inherent contingencies have been built into the design of the leachate treatment facility in order to address the situation of a power failure. Generator connection points have been designed into the system for prolonged power outages that could shut down the pumps and cause overflow of the system. Short term power outages (i.e., those expected to last for no more than 24 hours) are acceptable due to the storage capacity of the landfill and leachate treatment facility. Pump failure will be prevented by monitoring programs described in the Site Operations Manual. The design incorporates redundant pumping capacity and also requires that backup pumps be kept available at all times.

### **Contingency**

The purpose of the leachate treatment system contingency plan is to illustrate the trigger levels and contingency measures to be implemented should it be determined that treated effluent is not meeting the required discharge criteria.

Trigger levels of key compounds listed in the Design and Operations Report will be set at 75 percent of the maximum allowable concentration in accordance with Guyanese water criteria as developed for the Site. If trigger levels of key compounds in the leachate treatment facility effluent continue to be exceeded, the following contingencies will apply:

- Enhanced recirculation of leachate within the leachate treatment facility; and
- Expansion of leachate treatment facility.

### **5.3.4.3      LANDFILL GAS COLLECTION AND TREATMENT**

A full LFG management system has been designed for the Site. The active LFG control system will provide supplementary benefits for odour control since it will be interconnected with the LCS for the Site. The main LFG header will be installed initially at the Site until such time as the trigger level discussed in this section is attained. The primary trigger for the active LFG controls would be quality of life odour related impacts. One trigger for installation of the active LFG control system would be a nuisance odour to the users of the Site. The trigger level for the LFG contingency will be related to odour concerns and excessive complaints received from off-Site receptors. Excessive complaint is defined as more than two validated odour complaints per month from off-Site receptors.

In the event that the trigger noted above is exceeded and all other operational aspects of the Site are in proper order, the installation of the LFG management system would be initiated, installed, and commissioned for all of those areas of the Site that are at or near their final grade elevation. It is expected that this response will immediately remove the odour concerns and complaints as an issue. If there is a persistent odour issue, the response is to initiate collection of additional LFG from the active disposal areas of the Site as they are being constructed.

It should be noted that there are other sources of potential odour associated with both the raw waste that is being disposed of in the Site and the associated waste picker operations. It is assumed that these operations are being well maintained and that daily cover is being effectively used at the tipping face. The first response measure is verification that these areas are operating in compliance with the established programs and procedures for the Site. If not, these operational issues would be remedied before initiating the active LFG management system commissioning or expansion.

## **5.4              POST CLOSURE**

For more complete details on the post closure maintenance requirements for the Site the reader is referred to the document entitled " Site Operations Manual, Sanitary Landfill in Haags Bosch", which was prepared by Trow International Ltd., in association with Conestoga-Rovers and Associate and E A Consultants and prepared for the Ministry of Local Government and Local Development and submitted under a separate cover in March 2005.

Maintenance activities would be undertaken to ensure that all of the required infrastructure and systems are able to satisfy the compliance and performance requirements for the Site. The level of maintenance required would be defined in the operating manuals and other documentation that will support the various systems that will be constructed and commissioned at the Site. These systems will be operated according to specifications of the manufacturer and such additional specifications as are provided for the operations of the overall systems.

Proper tools would be made available and be maintained in good, clean condition. The majority of the necessary tools for maintenance and calibration of equipment at the leachate treatment facility, LFG management facility, and any other equipment needed at the Site would be provided along with tool bench and tool storage facilities. Laboratory equipment, field instruments and tools removed for use would be returned to the proper storage place. In the case where more than one person has access to tools a checkout system would be used so that tools are not lost and are available when needed.

Specialty and delicate tools and instruments will be stored in a secure location with restricted access so that they will not be inadvertently damaged by poor storage. Micrometres, dial gauges, calipers, taps and dies, multi metres, and feeler gauges are some examples of items which require care in storage

#### **5.4.1      MANAGEMENT OF PHYSICAL ENVIRONMENT**

After Site closure, monthly inspections would be carried out by landfill personnel of the various Site features including the landfill cover system, channels, ditches, culverts, access roads, and perimeter Site fence. The inspections of will consist of:

- Inspection of landfill cover for signs of erosion and to ensure the cover is intact;
- Inspection of vegetative cover and identify areas requiring attention;
- Inspection of perimeter fence and gates to ensure they are intact;
- Inspection of landfill cover for areas of erosion and surface water ponding;
- Inspection of landfill cover for evidence of exposed waste or leachate seeps;
- Inspection of landfill cover for evidence of animal burrows;
- Inspection of on site access roads to ensure they are driveable; and
- Inspection of swales for sediment accumulation and erosion.

If a seep is found, Site personnel will evaluate size, duration, flow, and impact to determine the appropriate response. Additional clay cover would be applied and compacted in the area of the breakout or seep. If the area is large or initial remedial efforts are unsuccessful, the excavation will be filled with granular material to improve drainage into the landfill and an improved hydraulic connection to the leachate collection drain blanket and piping will be installed as a french drain or toe drain. Any disturbed cover areas will be repaired and compacted with clay soil. Leachate breakouts or seeps will also be evaluated in the context of Site operations as a performance indicator. All seep locations and repair methodology will be recorded.

#### **5.4.2      MANAGEMENT OF BIOLOGICAL ENVIRONMENT**

Management of the biological environment in the post closure phase is consistent with the Site operations stage.

#### **5.4.3      MANAGEMENT OF SOCIAL ISSUES AND HUMAN RESOURCES**

Management of the social issues and human resources in the post closure phase is consistent with the Site operations stage.

#### **5.4.4      MANAGEMENT OF ENVIRONMENTAL CONTROLS**

Management of environmental controls in the post closure phase is consistent with the Site operations stage.

#### **5.5        SUMMARY**

An environmental management plan (EMP) has been created to mitigate any potential environmental impact and associated risk. In the unlikely event that the mitigative measures established do not function as intended contingency plans have also been prepared to address off-site impacts related to the landfill. Extensive monitoring programs have been established to confirm that the control systems constructed are operating as intended and preventing environmental impact to the local human and wildlife population. In addition quality control and assurance programs have been prepared and will be followed during the construction program to confirm that the site

is constructed in accordance with the technical specifications and detail design drawings.

Programs have been established and will be implemented throughout the operating lifespan of the site to keep local residents and environmental groups/agencies apprised of any potential and/or real impacts related to the construction, operation and maintenance of the site. The design team retained to complete the design and oversee construction and operation of the Site clearly understand the importance of being a good neighbor and are committed to keeping opposition to the site at a minimum to the best of our ability. Staff training and worker health and safety is of paramount importance in the successful construction and operation of the Site and have also been clearly addressed through all portions of the project as documented.

The following table presents a summary of environmental impacts and where mitigative and/or contingency measures are assigned.

<i>Area of Study</i>	<i>Design</i>	<i>Construction</i>	<i>Operation</i>	<i>Post Closure</i>
<b><u>Physical Environmental Impacts</u></b>	<b>Mitigation</b>	<b>Mitigation</b>	<b>Mitigation</b>	<b>Mitigation</b>
Site Conditions	No Impact	QA/QC	Site Ops Manual	D & O Report
Animal Habitat and/or Population	No Impact	QA/QC	Site Ops Manual	D & O Report
Plant Species and /or Vegetation	No Impact	QA/QC	Site Ops Manual	D & O Report
Surface Waterways	No Impact	QA/QC	Site Ops Manual	D & O Report
Noise and Odour	No Impact	QA/QC	Site Ops Manual	D & O Report
<b><u>Biological Environmental Impacts</u></b>				
Air Quality	No Impact	QA/QC	Site Ops Manual	D & O Report
Surface Water Quality	No Impact	QA/QC	Site Ops Manual	D & O Report
Groundwater Quality	No Impact	No Impact	Site Ops Manual	D & O Report
Native Soil Quality	No Impact	QA/QC	Site Ops Manual	D & O Report
Human Health	No Impact	HASP	HASP	HASP
<b><u>Social and Cultural</u></b>				
Opposition	Notification	Notification	Notification	Notification
Staffing	No Impact	QA/QC	Site Ops Manual	D & O Report
Health and Safety	No Impact	HASP	HASP	HASP
Public Involvement and Notification	Notification	Notification	Notification	Notification
Archeological and Heritage Issues	No Impact	No Impact	No Impact	No Impact



### Environmental Control Systems

Waste Containment Cell(s)	No Impact	QA/QC	Site Ops Manual	D & O Report
Leachate Collection and Treatment	No Impact	QA/QC	Site Ops Manual	D & O Report
Landfill Gas Collection and Treatment	No Impact	QA/QC	Site Ops Manual	D & O Report

**No Impact** - The action has no negative environmental impact. Where the action had no impact and/or associated risk no mitigation and/or contingency measures are developed.

**Notification** - Initial public input has been considered and will continue to be addressed throughout the operating life span of the project. The public will be kept aware and notified of any potential environmental impact and/or associated risk resulting from the construction and/or operation of the Site throughout the operating lifespan of the project.

**QA/QC** - Quality Assurance. All construction works will be completed in accordance with technical specification and detail design drawings prepared and sealed on behalf of the owner by a qualified engineering company. During construction, contract administration and inspection will be carried out by a qualified engineering company that clearly understands the technical specifications and drawings as well as the overall objective of the project. Quality Control - In addition to engineering consultant that provides contract administration and inspection services there will also be third party inspection and testing carried out by an independent consulting firm.

**HASP** - Health and Safety Plan. In order to protect site workers from injury and/or bodily harm a site specific HASP will be in effect throughout the operating lifespan of the project. All site workers will be required to complete training on the environmental control system they will be responsible for in order to understand the objective and related risks to that specific piece of equipment.

**Site Ops Manual** - Site Operations Manual. A Site operations manual has been prepared for the Owner to provide detailed operating procedures for the solid waste management facility. The procedures identified in the manual are to be followed by the selected contractor who enters into an agreement with the Owner to operate the Site in accordance with terms and conditions set for in a contract. The contractor will be responsible for operating and maintaining the Site in accordance with the terms and conditions of the contract.

**D & O Report** – Design and Operations Report. A D & O Manual has been prepared for the Owner. A portion of the manual specifically discusses post closure monitoring and aftercare of the Site. Following closure of the Site the Owner and/or a hired contractor will be expected to maintain the Site in accordance with the guidelines outlined in the D & O.

## **5.6        WASTE RECYCLERS**

Informal waste pickers at the Mandela dump have developed livelihoods and some totally support their families based on recovery and resale of recyclables from wastes disposed at this site. These individuals would lose their income source after operations cease at the Mandela dump.

A resettlement plan has been designed to facilitate the relocation of the recyclers to Hague Bosch and to provide support for these individuals during the transition phase to the new site to ensure a continuation of income generation.

Waste pickers working at the Mandela dump up to the cutoff date of June 24, 2004 will become members of a cooperative society which will be relocated to and authorized to continue recycling operation at the Hague Bosch Sanitary Landfill. Members of this cooperative will be the sole individuals authorized to work at the Hague Bosch Sanitary Landfill as waste pickers. The cooperative society will consist of the 121 persons determined to be operating at the Mandela Site up to June 24, 2004. Daily operations at the Hague Bosch Sanitary Landfill will, however be undertaken by four subgroups of the cooperative, with any subgroup being allowed to provide a maximum of 24 persons on any day.

Two options for access were proposed:

*Option 1:* Subgroups work on an hourly basis. This can take the form of two and one-half hour/subgroup/day.

*Option 2:* Subgroups work on a daily basis. This will take the form of day/subgroup/four days

During the transition period, the two options identified above will be explained to the recyclers and agreement will be sought on their implementation.

Establishment of a cooperative with an organized structure would require specific support to ensure its functional effectiveness. A program of confidence building must

also be implemented before the cooperative begins to function at Hague Bosch Site. A two phased approach has therefore been adopted to make the cooperative an effective and functional entity. The first phase will begin in February 2005 and will entail the identification of a firm or individual to oversee the formation, training and development of the operational structure of the cooperative to be implemented after it begins operation at Hague Bosch.

The second phase will consist of the Institutional Strengthening and Capacity Building Consultant coordinating operations of the cooperative and working with the cooperative to modify its rules and structure based on operational features of the Hague Bosch Sanitary Landfill. Both phases will be supervised by the MSWMD. This will result in approximately two and one-half years of institutional support for the cooperative. The members of the cooperative shall assume sole responsibility for its management after this period.

The formation and operation of the cooperative may prove to be difficult as inferred from the level of interest demonstrated by attendance at formal gatherings during this exercise and may result in a cooperative dominated by a few members. This will be countered by awareness and training programs to generate greater interest. In addition, the MSWMD would continuously inform the recyclers of developments related to reforms to recycling operations through the group's steering committee/committee of management.

The first official meeting of the cooperative will be held in March 2005 and at that initial meeting, a steering committee shall be elected. Meetings shall be held on a weekly basis and records kept conforming to the regulations of the Cooperative Act. A cooperative officer from the MLHS&SS shall attend all meetings for the first two months of the cooperative operation and shall attend one meeting each month after. The steering committee shall be responsible for the management of the group. The immediate responsibility of this committee will be to verify the rules and by-laws of the group developed during the pre-formation stage. The rules and bylaws shall include rules for conflict resolution. After operations for six months, a permanent executive shall be elected at a meeting supervised by the Cooperative Officer. Meetings shall be held once per month and the cooperative officer shall be present at a meeting once per quarter. The cooperative shall become fully operational in June 2006. However its principles and practices shall become effective in October 2005 to allow for identification and correction of problem areas.

Recycling operations at the site shall be governed by strict rules and regulations developed by the MSWMD and the Operator in consultation with the recyclers steering

committee. These regulations would govern how recyclers operate at the landfill, their conduct, enforcement of rules and penalties for breaking rules. The MSWMD will assist with negotiating arrangements for access by waste recyclers to the active area. Members shall conform to these arrangements and conformance shall be a basis for the continuing presence of individual members at the Hague Bosch Sanitary Landfill. These arrangements shall be negotiated in March 2006 prior to commencement of operations at Hague Bosch.

Recyclers will be mandated by rules to work in a disciplined and safe manner. Rules shall forbid the recovery of materials from trucks before they reach the tipping face or while trucks are in the process of tipping. In addition, members shall be forbidden from working within 50 m of waste compacting and placing equipment.

A training program will be developed for members of the cooperative and will be supported by proper supervision and coaching to enable members to understand procedures of cooperative management including its financial arrangements under the Cooperative Act. Training shall be provided by the Kuru Kuru Cooperative College (KKCC). Attendance at all training sessions shall be a prerequisite for acceptance into the cooperative.

Public awareness sessions will be conducted by the firm during the transition phase to inform recyclers about the various processes that will support their relocation and operation to the Hague Bosch Sanitary Landfill.

Resolution of any conflicts will be addressed by the MSWMD, the cooperative society management, the Firm up to June 2005 and the Institutional Strengthening Consultant during a two year phase which will extend over the one year construction period and the initial one year of operation at the Sanitary Landfill. Mechanisms developed for conflict resolution during the transition and initial operation phases shall act as a guide for future conflict resolution. If the resolution arrived at is unacceptable to all parties, any party may request that an arbitrator be appointed to determine a solution which will bind all parties. The Chief Cooperative Officer supervises the activities of all cooperatives in Guyana. He or someone knowledgeable in the operations of cooperatives and acceptable to all parties, will serve as the arbitrator.

The by-laws of the society will be developed by its members under the guidance of the MSWMD and the Cooperative Department with legal support being provided as needed. The by-laws will address issues such as eligibility for membership, behavior of cooperative members, sanctions to be imposed for violations of the site operation guidelines and cooperative rules, responsibility for sales and payment for recyclables,

licensing fees for operating at the site and operational parameters for the cooperative itself. These by-laws will establish the framework for conflict resolution between members of the cooperative, between the cooperative and MSWMD and between the cooperative and the Site Operator and identify sanctions. The Cooperative act provides for the intervention of the Chief Cooperative Office in resolution of disputes between members and the society.

Several activities related to the relocation of the recyclers will commence before actual project implementation and funds will be required to support the relocation program during this time. Activities expected to commence during this time include retaining a firm to guide the program, provision of legal services to the cooperative for development of by-laws and training and confidence building for cooperative members. The GoG and the MSWMD may be required to provide financing for some elements of the transition phase.

The staging of members at the Mandela Site for transportation to Hague Bosch may incur a recurring cost for maintenance of the building at Mandela and for transport charges to and from Haaguebosch. These elements of the relocation will be finalized during actual implementation. It is expected that members of the cooperative may have to absorb some charges for these recurring costs. Alternately, by-laws of the cooperative can be developed for members to invest sweat equity in maintaining the building at Mandela and for transportation charges to be subsidized by membership fees only to the extent that they exceed charges currently incurred for transport to the Mandela Site.

Facilities to improve the conditions under which recyclers operate will be provided by the project. Facilities to be provided will consist of the following:

- a covered and paved area for cleaning and storing materials recovered from waste;
- a sanitary block and dressing rooms;
- one fifteen seats vehicle;
- one Scale graduated to 200 kg; and
- an area for food vendors.

These resources will be provided as a part of the project facilities. In addition to the physical resources the cooperative shall be provided with the following resources for use by all members:

- First Aid facilities and Training in First Aid and Basic Emergency Procedures;
- protective clothing and footwear; and
- identification cards.

The first set of these personnel facilities will be provided to members free of cost. However, it is expected that the licensing fees will be adequate to cover the costs for providing these personnel facilities to members of the cooperative. Availability and use of the personnel equipment shall be a basis for access to the site. Replacement items shall be purchased by members through the cooperative cost recovery mechanism. The payment of fees by individual recyclers is likely to be very sensitive as currently no fees are charged and the institution of fees for operating at Hague Bosch may not be readily acceptable to potential members. Licensing fees will be gradually introduced based on a determination of the willingness of members to pay from the assessment of income generated during the initial phase of operations at the Mandela Site.

**Table 2: Summary of Training Needs for Recyclers**

<i>Area</i>	<i>Suggested Course</i>	<i>Target</i>	<i>Course Duration</i>	<i>Timing</i>	<i>Facilitators</i>	<i>Cost (US\$)</i>
Establishment of cooperative group	Talk on requirements of the Act for the establishment of cooperative society and development of rules and by-laws of cooperatives	Recyclers Consultant MSWMD staff	1 day	Feb 04	MLHS&SS	No cost
Cooperative administration	Principles in cooperative philosophy Cooperative management and administration Business activities of cooperative, marketing strategy, record keeping, contract negotiations, team building, office management skills, data base management, preparation for audit, etc.	Recyclers general membership Steering committee members and key leaders Consultant	39 4 hrs sessions	Feb 05 – Nov 05	KKCC	13,096
Health and safety	First aid and emergency procedures Occupational health and safety	Recyclers Consultant	As necessary	ongoing	Red Cross MLHS&SS	No cost
Monitoring and supervision	Management of recycling activities Monitoring of output Development of communication strategy for promoting health and safety among recyclers Supervision to ensure discipline	Steering and discipline committee members and other key leaders Consultant	2 days	1 <sup>st</sup> Q 05	Independent consultant PAHO	1,500
Study tour	Study tour should be organized for hands on learning of operating a waste recycling cooperative. A visit should be made to a similar size landfill in one of the Latin American countries from where the model was adopted	At least 2 members of the committee of management nominated by their colleagues and 1 person from the firm	3 days	2 <sup>nd</sup> Q 06		6,000

The MSWMD in collaboration with the firm retained to oversee the first phase of the relocation of recyclers to Hague Bosch will further inform the recyclers of the plans for the new landfill and indicate to them that a cooperative shall be the only entity allowed to operate at the Hague Bosch Sanitary Landfill. The cooperative department of the MLHS&SS will be invited to brief recyclers on the formation of a cooperative and the regulations governing their formation and operation. Legal support will be provided to the recyclers for developing the rules and by-laws of the society. Training in the operations of a cooperative should commence by February 2005. Representatives of the firm will be involved in all activities to provide guidance to the cooperative in its initial stage of operation.

Rules of the cooperative shall include prohibition against selling by individual members. The cooperative shall be the only entity authorized to negotiate and sell recycled materials individually to buyers. All selling shall take place at the area provided for storage. The bye-laws will mandate adherence to schedules to prevent unregulated access to the site by buyers.

Members will be paid after items are sold, by the cooperative, on the basis of their output and all members will pay a fee for providing this service. The Institutional Strengthening and Capacity Building Consultant will provide support in maintaining records of output, and revenues and with monitoring financial aspects of the operation. All financial records should be managed by the financial committee drawn from members. In keeping with the Act a yearly audit shall be conducted of the cooperative.

For the entire duration of the transition phase at the Mandela Site, the firm will record the quantity of recyclables collected by each recycler on a daily basis. A record will also be maintained of daily receipts from the sale of such materials by each recycler. This data will be compiled over the first five months of operations at Hague Bosch. The financial returns to each recycler will be compared to determine whether there is a significant loss of earnings associated with the new rotated schedule and to make modifications to the schedule.

During the development of by-laws for the cooperative, The MSWMD and the firm will consult with the recyclers to establish a compensation package for recyclers who choose on a strictly voluntary basis not to move to the Hague Bosch Sanitary Landfill.

The by-laws would establish conditions for former members opting to rejoin the cooperative.

Before operation commences at the Hague Bosch Sanitary Landfill, a coordinating committee comprised of the MSWMD, the Institutional Strengthening Consultant and



the executive committee of the cooperative will meet and establish the modalities for moving to and operating at Hague Bosch.

After consultations with its members, the executive of the cooperative and MSWMD shall compile a list of members of the cooperative eligible to operate at the Hague Bosch Sanitary Landfill. The executive committee of the cooperative shall also determine, based on consultation with its membership, the names of persons in each sub-group and will establish departure and pickup times for the Mandela and Hague Bosch locations respectively. This schedule will apply to the operations and will only be modified based on acceptance of proposed changes by the MSWMD.

Costs for the resettlement plan are presented in Table 3. These represent sums not provided for by project estimates. Some facilities such as the sanitary block and changing areas are included as elements of the project and no allowances are made for these estimates in the resettlement costs.

**Table 3: Summary of Budget for Resettlement Plan**

<i>Budget Items</i>	<i>Time Frame</i>	<i>Cost (US\$)</i>
Training and evaluation	February 2005 – July 2005	15,196
Dining area and selling area	January 2006 – June 2006	-
Purchasing one Fifteen seat Vehicle	June 2006	11,000
Maintenance of Waiting Area at Mandela Site	June 2006 -	2,000
Identification badges	June 2006	1,200
Payment to Firm to Support Cooperative	February 2005 – July 2005	36,548
<b>Total</b>		<b>65,944</b>

**Table 4: Implementation Matrix - Mitigation Measures Georgetown Solid Waste Management Programme**

Environmental Media	Mitigation Measure	Implementation		Costs (\$US)
		Responsibility	Schedule	
Air quality	Relocation of sanitary landfill 1.5 km from the closest population center. Provision of 95 hectares buffer zone of cane fields. Limit on vehicles speed of 15 km/hour. Application of dust suppressants on an as needed basis. Wetting of working and stockpiling areas when required. Cleaning of paved roads in the vicinity of the Site. Accelerating vegetative cover on completed or inactive areas of the Site.	Government of Guyana	Design Phase	
		Operator	Operation Phase	
Surface Water Quality	Temporary berms around base excavations/upper limits of the disposal area. Treatment of water contacting waste Run-on controls to prevent flow onto active portions of landfill. Drains in maintenance facility leading to oil water separator. Final cover on completed areas within 12 months of area reaching final grade. Use of silt control fences to minimize silt losses.	Operator	Operation Phase	
Groundwater Quality	Recovery and treatment of landfill leachate	Operator	Operation Phase	
Vermin and Vector	Daily cover of waste Extermination services for vermin and vector Disinfection of waste trucks	Operator	Operation Phase	
		Waste Haulers	Operation Phase	
Unacceptable Waste	Training site personnel to identify restricted waste Updates to list of restricted waste	Operator	Operation Phase	
Landfill Gas	Setback distance of 1.5 km from nearest residents. Contingency plans to address unusual situations due to LFG Possible utilization of LFG for continuous supply of power up to 2035.	Government of Guyana/Design Consultant	Design Phase	
		Operator	Operation/Closure Phases	
Odors	Setback distance of 1.5 km from nearest residents	Government of Guyana	Design Phase	

Environmental Media	Mitigation Measure	Implementation		Costs (\$US)
		Responsibility	Schedule	
		Operator	Operation Phase	
	No exposed and standing leachate in base of landfill cells Venting of pump station manholes Treatment of landfill leachate Minimization of the size of the tipping face Use of masking/odor control agents when necessary Effective management of waste from waste picking area Provision of active LFG control system Public outreach program in areas adjacent to the industrial estate	MSWMD		
Noise	Setback distance of 1.5 km from nearest residents Curfew on site Operations	Government of Guyana	Design Phase	
		Operator	Operation Phase	
Site Security and Access	Security fence on west side of the landfill between canals Access gate on southwest corner of the Site Locks on secondary access gate at northwest corner of the Site Restriction of traffic to new bypass road and extended south service road Involvement of community members in monitoring use of unauthorized roads	Operator	Operation Phase	
Waste Placement	Application of daily cover Tipping of loads at designated points in landfill footprint Restriction on waste pickers time Staging of waste placement Compaction of waste in lifts less than 2.0 m thick	Operator	Operation Phase	
Site Roadways	Primary roads constructed of on-Site soil, and imported sand and aggregate. Secondary access constructed of inert industrial waste or on-Site soil Periodic cleaning and maintenance of site roads	Operator	Operation Phase	
Landfill Litter	Application of daily cover to waste from waste picker area Perimeter fence and wind breaks in waste picker area Tarp over vehicles transporting waste to and around the landfill Selection of working face based on wind direction and intensity Minimization of working face on windy days Moveable litter control fence around active disposal area; Reduction/cessation/relocation of operation when weather causes off-Site litter	Operator	Operation Phase	

Environmental Media	Mitigation Measure	Implementation		Costs (\$US)
		Responsibility	Schedule	
	Litter control program around site perimeter			
Fires	Prohibition on open burning of waste Prohibition on smoking or open flames around LFG collection and management facility. Provision of fire fighting equipment Addition of cover soils adjacent to area of suspected fires Temporary shutdown of LFG collection from wells/horizontal trenches in vicinity of suspected fire. Ban on any open flame, spark, smoking or maintenance activities on top of the waste disposal areas. Restrictions on waste pickers activities	Operator	Operation Phase	
Leachate Breakouts/Seeps	Application of granular material and/or additional clay cover over area.	Operator	Operation Phase	
Regional Litter	Closure of open dumps in NDCs and GM Provision of waste bins in GM and in NDCs Provision of specially equipped vehicles to clear litter bins. Provision of large collection boxes at accessible points in NDCs Construction of transfer stations at mutually agreeable locations in NDCs. Public education and awareness campaign in NDC and GM Update of by-laws to curtail illegal dumping and littering Sharing of revenues from fines for littering/illegal dumping.	Operator	Operation Phase	\$190,000.00
		MSWMD	Construction/Operation phases	\$125,992.00
		Government of Guyana	Construction/Operation phases	
Composting	Small scale pilot project landfill site.	Operator	Operation Phase	
	Public education/awareness related to compost use	MSWMD		
Waste Collection Fee	Public education/awareness program related to cost recovery Establishment of separate accounting system for waste management	MSWMD	Operation Phase	
Public Awareness /Community Outreach	Mechanism to respond to concerns from surrounding communities. Establishment of Advisory Board	MSWMD	Operation Phase	
		Government of Guyana		
		Advisory Board		

Environmental Media	Mitigation Measure	Implementation		Costs (\$US)
		Responsibility	Schedule	
	Periodic landfill management review Community monitoring of traffic on non designated roads/illegal dumping Access to environmental monitoring data Access to non-compliance incidents reports and responses Provision of data on Institutional Strengthening aspect of the programme Involvement in community clean-up campaigns in public open spaces	MSWMD/Operator		
Environmental Incidents /Non-compliance	Development of plans to deal with environmental incidents. Public information on environmental incidents/ dangerous on site releases Implementation of corrective/ remedial action for non-compliance issues	MSWMD/Operator	Operation Phase	
Site Aftercare	Monthly inspections of landfill features; cover system, channels, swales, culverts, access roads, fence, etc.	Operator	Closure Phase	
Waste Recyclers	Formation of Cooperative Society Resettlement to Sanitary Landfill Site Subgroups at landfill site to satisfy capacity constraints Institutional support for cooperative formation/operation Awareness and training programs for cooperative members Development of rules and by-laws for cooperative Negotiated access to waste by waste recyclers Establishment of conflict resolution procedures Licensing fees for waste pickers Provision of facilities for recyclers Compensation package for recyclers who do not relocate	MSWMD/Waste Pickers	Operation Phase	
				36,548.00
				15,196
				1,200
				15,650

## 6.0 MONITORING

The monitoring program will provide data which would serve as the basis to determine the environmental performance of the systems. The facility will be monitored to confirm its adherence to sound environmental management practices and contractually established operational standards. Monitoring will be conducted during the construction, operation, closure and post closure phases of the project. The monitoring program is designed to ensure that the trends for specific parameters are tracked. It will also provide information on compliance with legislation, guidelines and contractual requirements for the construction, operation, closure and post-closure maintenance of the facility.

Stakeholders in communities in the environs of the facility will be mobilized to support the site monitoring programs. A hotline will be established to report illegal dumping, suspect releases, unusual health conditions or environmental conditions around the operations of major polluters who do not conform to performance requirements. Information on landfill and waste management operations and polluters and waste generators will be maintained at the landfill site and disseminated through public channels and local authorities to enable access by stakeholders to identify problems and sources quickly. The hotline would also be linked to the EPA and other appropriate authorities to effect emergency response, remediation and investigation when needed.

The monitoring plan addresses leachate generated by the landfill, groundwater and surface water quality, off site migration of landfill gases, and concerns raised by communities impacted by the project. In each instance the Monitoring Plan includes the parameter(s) to be monitored, the frequency of monitoring and responsibilities and costs for execution. The results of all monitoring programs will be maintained on site and will be available for accessing by members of the public at the site and at the EPA. The Community Relations and Stakeholder Consultation Unit will also provide yearly summaries of all results of monitoring to the public by both press and radio announcements. All data generated by the monitoring program will be sent to the EPA, MSWMD and to the Inter-American Development Bank.

A small on-site laboratory will be provided to check key parameters for the leachate treatment system and for surface water discharge. The costs for installation of all the monitoring networks are included as part of the operation costs of the sanitary landfill. The yearly monitoring costs are included as a part of the tipping fees to be paid to the Operator. The obligations for payments of tipping fees inclusive of the annual environmental monitoring costs will be assumed by the MSWMD as a part of its obligations.

## **6.1        WASTE/SOIL VOLUME MONITORING**

A survey of the active landfill stages will be conducted during each year of active landfilling operations. The survey data will be used to calculate the volume of land space that has been utilized and to develop estimate of the refuse density of the waste placed to date. This data will be used to update the cover soil balance and to estimate the site capacity remaining. These projections will also be used for planning to establish schedules for additional cell development and for capital purchases of equipment and materials to continue the development and operation of the landfill facility.

## **6.2        GROUNDWATER MONITORING**

The groundwater monitoring program is simplified due to the natural hydraulic trap conditions at the Site. The proposed groundwater quality and quantity monitoring program has been established to verify the Site performance.

Six on-Site shallow groundwater wells will be installed and be maintained adjacent to the limit of waste in each landfill stage at the locations shown Figure 13.1. Monthly water level measurements will be recorded in all on-Site groundwater monitoring wells to ensure the performance of the hydraulic trap. Groundwater samples will be recovered annually and analyzed for the following list of parameters:

- Biochemical Oxygen Demand (BOD);
- Chemical Oxygen Demand (COD);
- PH;
- Total Ammonia Nitrogen;
- Total Dissolved Solids (TDS);
- Total Suspended Solids (TSS);
- Volatile Suspended Solids (VSS);
- Total Kjeldahl Nitrogen (TKN);
- Total Phosphorus;
- Alkalinity;
- Hardness (Ca and Mg);
- Chloride;

- Fluoride;
- Phosphate;
- Sulfates;
- Nitrite; and
- Nitrate.

During the first year of operations, groundwater samples will be recovered quarterly from all wells and will be tested for the list of parameters above in order to develop a more complete database for the Site. Groundwater samples recovered quarterly thereafter from all wells will be tested to determine the presence and concentration of the reduced list of parameters listed below.

- Biochemical Oxygen Demand (BOD);
- Chemical Oxygen Demand (COD);
- PH;
- Total Ammonia Nitrogen;
- Total Suspended Solids;
- Total Kjeldahl Nitrogen (TKN);
- Total Phosphorus; and
- Alkalinity.

The groundwater monitoring program will be reviewed periodically as the database for the Site is further developed. Suggested revisions to the monitoring program will be noted in recommendations in the annual monitoring and operations report for review by the EPA and other relevant authorities before implementing changes to the program.

The Operator will be responsible for measuring groundwater depth and for recovering groundwater samples from each well working under the supervision of the MSWMD. Samples will be submitted to an independent laboratory for testing. Results of all tests will be provided to MSWMD, the EPA and to the Inter-American Development Bank. A summary of all test results shall also be maintained onsite for inspection by the EPA.

### **6.3 LEACHATE HEAD MONITORING**

The leachate hydraulic monitoring together with the groundwater level monitoring are critical aspects of the overall monitoring program. The groundwater level data and the



leachate level monitoring data would be coupled to document that the inward gradient into the landfill cells is maintained.

The leachate management system monitoring program will include the installation and maintenance of six leachate monitoring wells at the toe of slope around the perimeter of the landfill at the locations shown on Figure 13.1. Monthly water level measurements will be recorded in all leachate monitoring wells to ensure the performance of the hydraulic trap. Daily water level measurements would be recorded at each of the leachate pump stations (PS 1 to 4) along with daily measurement of leachate pumping volumes. The quantity of leachate influent and effluent to the Leachate Treatment Process shall also be monitored on a daily basis. Leachate pumps will be monitored on a regular basis by the Site operator, as part of regular maintenance activities. Any pumping system malfunctions will be recorded as well as the remedy to the operations problem.

The proposed leachate management system monitoring program would be reviewed periodically as the database for the Site is further developed. Any suggested revisions to the monitoring program would be noted as a recommendation in the annual monitoring and operations report for review by the relevant governing authorities before implementing any changes to the program.

The Operator will be responsible for measuring leachate heads and measuring levels at the leachate pump stations in addition to maintaining the pumping records working under the supervision of the MSWMD. Results will be provided to MSWMD, the EPA and to the Inter-American Development Bank. A summary of all results shall also be maintained onsite for inspection by the EPA.

#### **6.4        SURFACE WATER MONITORING**

The surface water quality and quantity monitoring program will apply to effluent from the on-site stormwater sedimentation and control ponds, which discharge to the adjacent north and south drainage canals. The objective of this aspect of the monitoring program is to ensure that all discharges to the local environment have been fully treated. The monitoring program will be staged according to construction of the individual stormwater sedimentation and control ponds.

The surface water monitoring network will include four monitoring points in the north and south drainage canals at points upstream and downstream of the site as indicated on Figure 13.1. Monthly flow measurements will be made at all canal surface water

monitoring locations. Daily flow quantities of surface water will also be monitored at each stormwater pump station.

Surface water samples would be recovered annually analyses at all canal monitoring locations and from stormwater pump stations (PS 5 to 7). These surface water samples will be recovered and analyzed for the following list of parameters on an annual basis.

- Biochemical Oxygen Demand (BOD);
- Chemical Oxygen Demand (COD);
- PH;
- Total Ammonia Nitrogen;
- Total Dissolved Solids (TDS);
- Total Suspended Solids (TSS);
- Volatile Suspended Solids (VSS);
- Total Kjeldahl Nitrogen (TKN);
- Total Phosphorus;
- Alkalinity;
- Hardness (Ca and Mg);
- Chloride;
- Fluoride;
- Phosphate;
- Sulfate;
- Nitrite; and
- Nitrate.

During the first year of operations, surface water samples will be recovered quarterly from all canal monitoring points and from stormwater pump stations and tested for the parameters above to develop a more complete database for the Site. Surface water samples recovered quarterly thereafter will be tested to determine the presence and concentration of the reduced list of parameters listed below.

- Biochemical Oxygen Demand (BOD);
- Chemical Oxygen Demand (COD);
- PH;
- Total Ammonia Nitrogen;

- Total Suspended Solids;
- Total Kjeldahl Nitrogen (TKN);
- Total Phosphorus; and
- Alkalinity;

A semi-annual inspection will be conducted of all ditches for evidence of excessive erosion.

The stormwater management pumps will be monitored on a regular basis by the Site operator, as part of regular maintenance activities. Any pumping system malfunctions will be recorded as well as the remedy to the operations problem. The surface water monitoring program will be reviewed periodically as the data base for the Site is further developed. Any revisions to the monitoring program will be noted as a recommendation in the annual monitoring and operations report for review by the relevant governing authorities before implementing any changes to the program.

The Operator will be responsible for measuring surface water flow volumes, for recovering surface water samples for analyses and for inspection of on site ditches, working under the supervision of the MSWMD. Surface water samples will be submitted to an independent laboratory for testing. Results of all tests will be provided to MSWMD, the EPA and to the Inter-American Development Bank. A summary of all test results shall also be maintained onsite for inspection by the EPA.

## **6.5 LEACHATE TREATMENT SYSTEM MONITORING**

The Leachate Treatment System (LTS) monitoring program is intended to ensure the performance of the LTS equipment and processes. The leachate compliance monitoring program will include measurements of leachate flows monitored by the use of run time meters and monitoring of pumping system records from both the leachate pump stations and the pumps for the leachate treatment facility. In addition raw leachate quality samples from the leachate pump stations, influent leachate to the LTS and treated effluent samples from the LTS will be recovered for analyses.

Raw leachate samples will be recovered from both the leachate pump stations and from the influent to the LTS. Treated leachate samples will be recovered from the effluent from the LTS. These samples will be recovered annually and analyzed for the following parameters:

Biochemical Oxygen Demand (BOD);

Chemical Oxygen Demand (COD);  
PH;  
Total Ammonia Nitrogen;  
Total Dissolved Solids (TDS);  
Total Suspended Solids (TSS);  
Volatile Suspended Solids (VSS);  
Total Kjeldahl Nitrogen (TKN);  
Total Phosphorus;  
Alkalinity;  
Hardness (Ca and Mg);  
Chloride;  
Fluoride;  
Phosphate;  
Sulfate;  
Nitrite; and  
Nitrate.

During the first year of operations, leachate samples will be recovered quarterly from the leachate pump stations, LTS influent and LTS effluent and tested for the parameters above to develop a more complete database for the Site. Leachate samples recovered from the leachate pump stations, LTS influent and LTS effluent quarterly thereafter will be tested to determine the presence and concentration of the reduced list of parameters listed below.

Biochemical Oxygen Demand (BOD);  
Chemical Oxygen Demand (COD);  
PH;  
Total Ammonia Nitrogen;  
Total Suspended Solids;  
Total Kjeldahl Nitrogen (TKN);  
Total Phosphorus; and  
Alkalinity.

The leachate treatment monitoring program will be reviewed periodically as the database for the site is developed. Any revisions to the monitoring program will be noted as a recommendation in the annual monitoring and operations report for review by the relevant governing authorities before implementing any changes to the program.

There will be much more extensive field monitoring of leachate quality by the operator to regulate and control the treatment processes and the operation of the leachate treatment facility. This extensive field monitoring program will be included as part of the operations and maintenance manual which is to be developed for the leachate treatment facility following its commissioning.

The Operator will be responsible for recording influent and effluent flow volumes and for recovering leachate and effluent samples working under the supervision of the MSWMD. Samples will be submitted to an independent laboratory for testing. Results of all tests will be provided to MSWMD, the EPA and to the Inter-American Development Bank. A summary of all test results shall also be maintained onsite for inspection by the EPA.

## **6.6        LANDFILL GASES MONITORING**

The only area where the monitoring of landfill gas (LFG) migration through the soils is warranted is in the built up area of the administration building and other service facilities. The landfill gas monitoring program will include the installation and maintenance of two on-Site LFG probes in the vicinity of the administration buildings and leachate treatment facility as shown on Figure 13.1 and quarterly monitoring of the major constituents of LFG. A portable field measurement instrument will be used to provide all of the required data that will also be useful in monitoring gas levels in the various leachate pumping stations and other in-ground installations. Landfill gas will be monitored for the following:

- Methane;
- Carbon Dioxide;
- Oxygen;
- Temperature; and
- Pressure.

Measurements and sampling will be performed by the Operator and shall be overseen by MSWMD. A record shall be maintained onsite of all LFG concentration measurements.

A record will be maintained of the incidences and relative frequency of any odor complaints. The Operator will record the following data for each odor complaint received at the site:

- description, time, and date of the incident;
- current status of all Site operations that may have triggered the event;
- wind direction at the time of the incident; and
- description of the measures taken to address the cause of the incident and to prevent a similar occurrence in the future.

This proposed LFG monitoring program will be reviewed periodically as the data base for the site is developed. Any suggested revisions to the monitoring program will be noted as a recommendation in the annual monitoring and operations report for review by the relevant governing authorities before implementing any changes to the program.

The Operator will be responsible for monitoring LFG working under the supervision of the MSWMD. Results of all measurements will be provided to MSWMD, the EPA and to the Inter-American Development Bank. A summary of all test results shall also be maintained onsite for inspection by the EPA.

## **6.7      LEACHATE POND MONITORING**

Water levels observations in the leachate pond will be recorded daily and will be noted in the daily inspection report. After site closure, two of the ponds will be modified to remove the pumped controls. The pond which receives the leachate effluent after site closure will be subject to a period of extended monitoring. It will initially be monitored for a period of 5 year and subsequent monitoring will be based on a review of the results. This exercise will incur no cost during the operation phase of the project.

## **6.8      INSPECTION AND RECORD KEEPING**

Regular Site inspections will be conducted by Site personnel to verify that nuisance factors associated with housekeeping procedures such as dust, litter, and odor, are

under control, to prevent routine operation nuisances from developing into more serious environmental problems. These inspections will be conducted on a monthly basis. Site personnel will maintain a checklist of housekeeping items that are implemented on a regular basis. Records of observations made during the Site inspections and all regular housekeeping activities carried out will also be maintained. In addition, the scale attendant will ensure that all material entering the Site is recorded as to the type, source, and quantity/weight of each load.

## **6.9            MONITORING OF COOPERATIVE OPERATIONS**

The operations of the cooperative shall be monitored to ensure its effective functioning and to ensure that the recyclers resettled at the Haaguebosch site work to attain the project objectives. The implementation schedule of Table 17 shall be monitored to ensure adherence to the schedule for resettlement of recyclers. Initial monitoring of the activities of the cooperative shall be undertaken by the MLHS&SS cooperative department. Meetings shall be kept in accordance with by-laws and minutes of these meetings shall serve as verifiable indicators of conformance. The Consulting Firm will monitor all meetings of the cooperative up to June 2005. The Institutional Strengthening and Capacity Building Consultant shall assume this responsibility after this date.

Since recycling has never taken place in an organized manner it is likely that there will be some conflict at the beginning of operations. A record will be maintained of all conflicts and their resolution. The cooperative shall also monitor and maintain records of thefts and bullying and sanctions to trouble makers at the site.

The cooperative shall monitor the recycling operations and maintain comprehensive records of items recovered for sale and by which member. This information shall be recorded on a daily basis and shall include:

- type of materials recovered and by whom;
- quantity recovered of each type of materials;
- daily selling price of various materials; and
- payments to members.

**Table 5: Proposed Action Plan for Resettlement**

Activities	2005												2006												2007												
	J	F	M	A	M	J	J	A	S	C	N	D	J	F	M	A	M	J	J	A	S	C	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
Identification of firm, development of terms of reference, finalization of arrangement <b>(MSWMD)</b>	■	■																																			
Setting up of groups and organizing meetings/awareness sessions, development of rules and regulations <b>(Firm)</b>		■	■	■																																	
Initiate the process for registration of cooperative - invite cooperative officer to explain the Act and the requirements for registration <b>(Firm)</b>			■	■																																	
Promote and support the holding of regular meetings to discuss business of the group, preparation of minutes and facilitate action <b>(Firm)</b>			■	■	■	■																															
Training of recyclers to undertake the business of cooperative <b>(Firm &amp; MSWMD)</b>				■	■	■																															
Commencement of process for registration of cooperative, review of rules developed by group, prepare by-laws that will govern cooperative <b>(Firm, MSWMD, Institutional Strengthening Consultant)</b>				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Evaluation of groups activities at Mandela site <b>(Institutional Strengthening Consultant)</b>																■	■	■	■																		
Training in emergency procedures (Firm & Institutional Strengthening Consultant)																	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	



## **6.10      ENVIRONMENTAL COMPETENCE AND PLANNING**

The Operator will undertake all aspects of the monitoring plan under the supervision of the MSWMD project implementation team. The Operator will develop a plan for implementation of the monitoring program detailed above. Resources required for each aspect of the monitoring plan will be sourced prior to the commencement of operations at the site. In several instances, national standards for water quality have not been yet been promulgated and the EPA has accepted the application of WHO and USEPA standards to this project for aerial emissions and water quality respectively. The Operator will liaise with the EPA to determine the effective date of national standards which are promulgated for aerial emissions and water quality. The monitoring program will be modified to ensure compliance with newly promulgated national standards only in those instances where the new standards are more stringent than those initially adopted for the project.

## **6.11      REPORTING**

An operations report for the Site will be prepared on an annual basis to ensure compliance with all Site operations and maintenance procedures. The following would be covered by the annual report:

- results and interpretive analysis of all leachate, groundwater, surface water, and LFG monitoring programs, particularly:
  - assessment of leachate/groundwater elevation data with respect to trigger elevations; and
  - assessment of the need to amend the monitoring program.
  - assessment of the operation and performance of all engineered facilities, the need to amend the design or operation of the Site, and the adequacy of and need to implement the contingency plans;
- site plans showing the existing contours of the Site, areas of landfilling operations during the reporting period, areas of intended operation during the next reporting period, areas of excavations during the reporting period, the progress of final cover and intermediate cover application, previously existing Site facilities, facilities installed during the reporting period, and Site preparations and facilities planned for installation during the next reporting period;
- calculations of volume of waste, daily and intermediate cover, and final cover deposited or placed at the Site during the reporting period and a calculation of the total volume of Site capacity used during the reporting period;

- calculation of the remaining capacity of the Site and an estimate of the remaining Site life;
- Summary of the quantity of any leachate removed, and/or treated and discharged from the Site during each operating week;
- summary of the weekly, maximum daily and total annual tonnage of waste received at the Site;
- summary of any public complaints received by the owner and the responses made; and
- discussion of any operational problems encountered at the Site and corrective actions taken.

## **6.12 SUMMARY OF RESPONSIBILITIES AND COST OF MONITORING**

The operator will be responsible for Quality Control (QC) monitoring of all aspects of the EMP. The cost of undertaking the quality control monitoring will be included in the operations contract.

Responsibility for verification and Quality Assurance (QA) monitoring including the audit function will rest with the MSWMD and delegated third parties as needed. An annual sum of \$25,000 should be included in the operations contract for this function.

## **7.0 CONSULTATION - COMMUNITY PARTICIPATION AND PUBLIC AWARENESS**

The community awareness and public participation program included the following objectives:

- Ensure all interested parties are informed of all relevant project information;
- Ensure public awareness and understanding of the studies allowing for meaningful input from affected parties and the community at large;
- Develop a positive community relationship so that concerns raised are aired and addressed through the study process; and
- Ensure that current and historical experience with landfilling is used to enhance design and operations of the new facility, including mitigation plans.

The program used involved (a) the provision of information and (b) consultation and involvement.

For the provision of information component, activities have been and will continue to be focused on informing the public of:

1. the concepts of Integrated Solid Waste Management
2. Solid Waste Services and their sources of funding
3. Roles and Responsibilities of government the EPA and public in effective waste management practices
4. what to expect in terms of performance for the improved systems.

The program components cover short, medium and long term activities using printed information materials, mass education campaigns (newspaper, television) training of trainers, school programs, help line services etc. In the longer terms consideration of a semi-annual or quarterly newsletter covering waste management issues is being considered. These activities continue with involvement of the EPA, Georgetown Municipalities, NDCs and the Ministry of Local Government.

Consultation and involvement focused on primary and secondary stake holders. The following sections detail some specific activities carried out as part of the process.

Primary stakeholders for this project include groups and individuals directly affected by the project. Primary stakeholders include individuals likely to be directly affected due to their proximity to the proposed site. Secondary stakeholders are the public and/or private sector organizations who may have a role and responsibility in the implementation and/or monitoring of the project. In addition to residents in close proximity to the site, other primary stakeholders include MoLGRD and GM and those NDCs which would be disposing of waste at the facility as well as the waste pickers

working at the Mandela Site. Secondary stakeholders are regulatory bodies consisting of the Environmental Protection Agency (EPA) and the Ministry of Health (MoH) and households and commercial and industrial generators in both GM and NDCs who would be impacted by possible fees for waste management imposed by GM and NDCs.

Consultations were held with all primary stakeholders. Consultations with residents of communities in proximity to the facility were facilitated by two meetings hosted by the Environmental Assessment Board (EAB) on January 19 and February 08, 2004. A description of the project and its expected impacts were outlined at the meeting of January 19. Residents were subsequently invited to identify issues and concerns for inclusion into the impact assessment and management measures for the facility. As a group, residents of the area expressed vehement opposition to the siting of the facility at the initially proposed location.

Primary reasons cited were the close proximity of the western end of the proposed facility to a new housing development, the presence of unwanted and questionable characters at the facility, open fires at the site and decreases in property values. Additional concerns included the management of hazardous waste at the site, the impact of operations at the site on the cricket stadium proposed to be sited at Nandy Park, the location of the access road to service the facility and the impact of the facility on groundwater since a well located in Eccles provides water to 40 % of the residents of the East Bank of Demerara.

Additional consultations were conducted with residents of the communities in proximity to and downwind of the proposed facility. Questionnaires were administered to residents of these communities during this exercise. A simple random sample generator was used to identify homes in each community for administration of the questionnaire. This method was modified in Republic and Nandy Parks to homes willing to participate in the survey since response was generally poor.

Findings inferred from administration of the questionnaires did not differ significantly from the views expressed at public meetings. Perception of the project is fueled by knowledge of operations at the Mandela Site. There was total resistance to the facility being sited at its initial location with the primary concerns being loss of peace and tranquility generally associated with the area and lowered property values.

As a result of the opposition expressed to the landfill being sited at Eccles, Project Stakeholders met on several occasions to factor the opposition of residents into a determination of the most appropriate location for the facility. Stakeholders represented at these meeting included GuySuCo, MoLGRD, MoF, IDB, MSWMD and Georgetown

City Council. The GoG plans for roadways to link Cheddi Jagan International Airport with Mandela Avenue and the East Coast Highway to this newly proposed road and with the existing Demerara Harbor Bridge would result in the former roadway passing through the 120 ha area initially proposed for the landfill.

Stakeholders had previously undertaken to move the landfill to the extreme eastern area of the 120 ha. The proposed road would however have passed through this area. A decision was consequently taken on June 9, 2004 to move the entire landfill site approximately 2.0 km east of the Eccles New Housing Scheme. This new location at Haags Bosch to the East of Eccles provides a 12 ha buffer zone between the landfill and the road proposed to link Mandela Avenue with Cheddi Jagan International Airport.

During public consultations concerns were also expressed about the long-term financial viability of the project after IDB funds are no longer available. The MoLGRD gave an undertaking that short falls in charges for environmentally sound operation and management of the landfill will be made up by allocations from the GoG. In addition, the penalty structure of both Chapters 28.01 and 28.02 will be modified to produce significant increases in fines for littering. These fines will also be retained by GM and NDCs to pay for management of solid waste.

The MoLGRD retained a public relations firm to undertake a program of public education related to the environmentally sound management of landfill sites. The firm has conducted a detailed community attitude survey of residents of communities in the environs of the proposed site. The survey has indicated that a large percentage of the residents concerns were based on their knowledge of open dump operations in Guyana and on the lack of institutional capacity to effectively implement an environmentally sound landfill operation. The relocation of the site to facilitate the opposition of residents has also been greeted with a positive response by a significant percent of the residents.

The EPA was consulted to determine the regulatory framework for performing the EIA and to determine environmental standards for design, construction, operation and closure of the facility. The EPA also outlined the schedule for consultation and review of the EIA after it submittal. Additional consultations were conducted with representatives of the Ministry of Local Government and Regional Development, Georgetown and Neighborhood Democratic Councils. Representatives of Georgetown consulted included the Director of the MSWMD; Mr. Rufus Lewis and The Deputy Mayor, Mr. Robert Williams. Several meetings were held with the Permanent Secretary, MoLGRD. Meetings were also held with representative(s) of each NDC identified to be served by the facility. NDCs were most often represented by their Chairman and Overseer. In a few minor instances either of these two individuals was present at the meeting.

Additional issues related to siting, construction and operation of the facility raised at meetings and consultations undertaken by ERM were also noted.

Two pilot projects are currently in progress and are being undertaken by the Mon Repos and BV/Triumph NDCs. The intention of the pilot projects is to determine the waste generation rate in these NDCs and to establish a transfer station to service both NDCs to facilitate final disposal at the Mandela Site. The Director confirmed that approximately sixty million Guyana dollars/year are generated by the waste pickers operations. The Director of MSWMD indicated that the maximum number of waste pickers that can function effectively at the Haaguebosch Site is 24. Approximately 48 percent of the waste currently disposed at Mandela Site is organic material that can be composted. The municipality has successfully undertaken a pilot study for composting in the incinerator compound.

Discussions with the Deputy Mayor identified several contributing reasons for the waste disposal problems in GM. The city is inundated with plastics and Styrofoam. These materials were not considered during the development of waste management practices for the city and no source separation occurs. In addition, there is pronounced importation of second hand and reconditioned goods by the commercial sector. These goods which have a relatively short life span add to the waste generated in the city. Industrial activity has also increased in the city. This increase has not been accompanied by a change in the waste management culture in the city. Squatting has added another dimension to the waste disposal problem. Squatters tend to concentrate on the embankments adjacent to the city drainage facilities. Waste is thrown into the canals in squatting areas. Efforts to clear the drainage ditches are impeded by both the squatters and by the presence of waste. This feedback is useful in final planning of the new project.

In addition to the above activities, a logical framework session is planned to refine the structure of the process and communicate essential information about the project. Attendees will include key stakeholders such as Georgetown Municipality, NDCs, MLGRD, EPA, consultants, Ministry of Health and affected or interested citizens.

Some of the key issues/concerns articulated during the consultation process and the responses from consultant are summarized in the following table.

### Summary of Key Public Concerns and Consultant's Responses – Public Participation Process

<i>Concerns</i>	<i>Consultant's Response</i>
Proximity to housing	<p>Technically Landfill can be designated to mitigate potential impact. Examples of Keele Valley in Toronto and other similar landfill proximity condition in developing countries cited.</p> <p>Other points of note:</p> <p>Buffers and screens included</p> <p>Increase separation of about 2m by proposed site relocation further East.</p>
Unwanted/questionable characters	The landfill site would be fenced and security installed. Waste pickers would be licensed and controlled.
Open fires at Landfill	A strict program of fire prevention and elimination would be included in the design and operation protocols. Procedures would include prohibition of open fires, designated smoking areas, procedures to contain and eliminate any fires etc.
Decrease in property values	The landfill would be operated in an environmentally sound manner. Buffers and screens would be in place. The final relocation further to the East would be favourable.
Loss of Peace and Tranquility	Sound operation and management should not significantly impact this item. The plans and commitment are in place for such management.
Management of Hazardous Waste	At this time the management of hazardous waste is not proposed for the Haags Bosch site. A plan to study the requirement for hazardous waste control is being developed. All attendant hearings and related EIA requires to be executed as part of the overall waste management strategy for Guyana.
Impact on the Cricket Stadium	No significant impact is indicated for a well designed and operated landfill facility as planned and sited. Example of sport stadium in St. Lucia, where the landfill successfully operates with 100m of stadium was presented. St. Vincent also presented as example.
Location of Access	Access through the East-West road at Eccles from the existing East bank road will not significantly affect traffic. Flow plans are to use the Southern by-pass as access as soon as it is constructed.

<i>Concerns</i>	<i>Consultant's Response</i>
Impact on Groundwater	Wells in the area are screened in aquifers more than 150m below grade. The landfill proposed has been modeled for all potential operating conditions and no significant impact determined given the favourable geologic/hydrogeologic setting and landfill design approach. Monitoring plans within contingencies are in place. Action plans with a regulatory framework are part of overall strategy.
Long term financial viability when no IDB funds available	Funds from the IDB loans are earmarked for the upgrading of institutional capacity to service environmentally sound and sustainable landfill activities.



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APPENDIX A  
TERMS OF REFERENCE

## **TERMS OF REFERENCE**

### **ENVIRONMENTAL AND SOCIAL IMPACT MANAGEMENT REPORT**

A separate Environmental and Social Impact Management Report (ESMR) shall be prepared for submission to the IDB. This ESMR shall contain the following:

**Project description:** Concise description of the project's geographic, ecological, social, and temporal context, including any GoG investments that may be required by the project;

**Environmental Impacts:** A presentation of the key direct and indirect social/environmental impacts or risks of the proposed operation including if applicable, gender issues, impacts on indigenous and afrodescendants communities, on vulnerable groups and occupational safety and health concerns.

**Mitigation Plan:** The proposed social/environmental measures to avoid, minimize and mitigate the key direct and indirect impacts or risks associated with the project.

**Institutional Assessment:** Institutional responsibility to implement the mitigation measures with an explanation of the institutional capacity to successfully handle these responsibilities.

**Costs:** The schedule and budget allocated for the implementation and management of the social/environmental mitigation measures designed to the feasibility level.

**Consultation:** The consultation program undertaken for the operation

**Monitoring:** The framework for monitoring of social and environmental impacts throughout the execution of the project including clearly defined indicators, monitoring schedules, responsibilities and costs.

APPENDIX B  
COST BASIS FOR REGIONAL LITTER CONTROL  
DUMP CLOSURE



**Cost Basis for Regional Litter Control  
Dump Closure**

<b>Total Number of Dumps</b>	<b>Surveying and Mapping Cost/dump (\$US)</b>	<b>Total Costs for Surveys (\$US)</b>
7	2,500	17,500

<b>Location</b>	<b>Surface Area of Dump (ha)</b>	<b>Thickness of Cover (m)</b>	<b>Volume of Cover Soil (m<sup>3</sup>)</b>	<b>Unit Cost of Cover US \$/m<sup>3</sup></b>	<b>Total Cost for Cover US \$</b>
Enmore/Hope	1.2	0.5	6000	8.50	51,000.00
Buxton/Foulis	1.0	0.5	5000	8.00	40,000.00
Mon Repos/Le Reconnaissance & Beterverwagting/Triumph	0.4	0.5	2000	7.50	15,000.00
Better Hope/La Bonne Intention	0.2	0.5	1000	7.50	7,500.00
Industry/Plaisance	1.0	0.5	5000	7.25	36,250.00
Little Diamond/Herstelling	0.1	0.5	500	6.50	3250.00
Golden Grove/Diamond Place	0.1	0.5	500	6.50	3250.00
Project Supervision	Lump Sum				3750.00

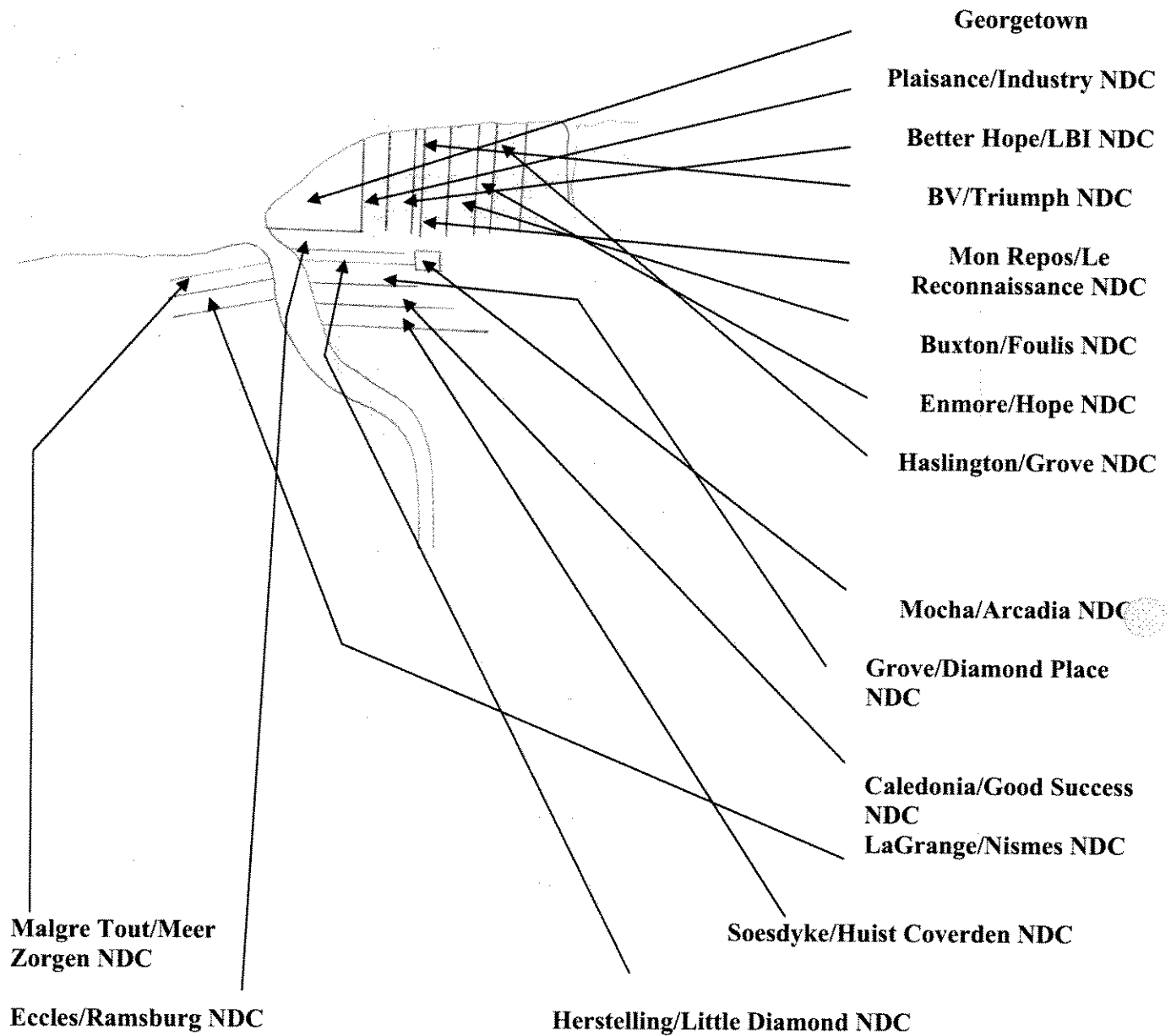
**Transfer Stations**

<b>Number Of Transfer Stations</b>	<b>Floor Surface Area (m<sup>2</sup>)</b>	<b>Unit Cost/m<sup>2</sup> \$US</b>	<b>Total Costs \$US</b>
5	200	55.00	55,000.00



APPENDIX C  
FIGURES AND DRAWINGS

**Figure 1: Location of NDCs and Georgetown**





**REPUBLIC  
PARK**

**Proposed  
Cricket Stadium**

**NANDY PARK**

**DEMERARA RIVER**

**ECCLES NEW HOUSING  
SCHEME**

**AGRICOLA**

**ECCLES INDUSTRIAL  
ESTATE**

**ECCLES LANDFILL SITE**



**Figure 2: Proximity of Sanitary Landfill Surrounding Communities**

Figure 3: Location of Wards of GM Relative Mandela Site

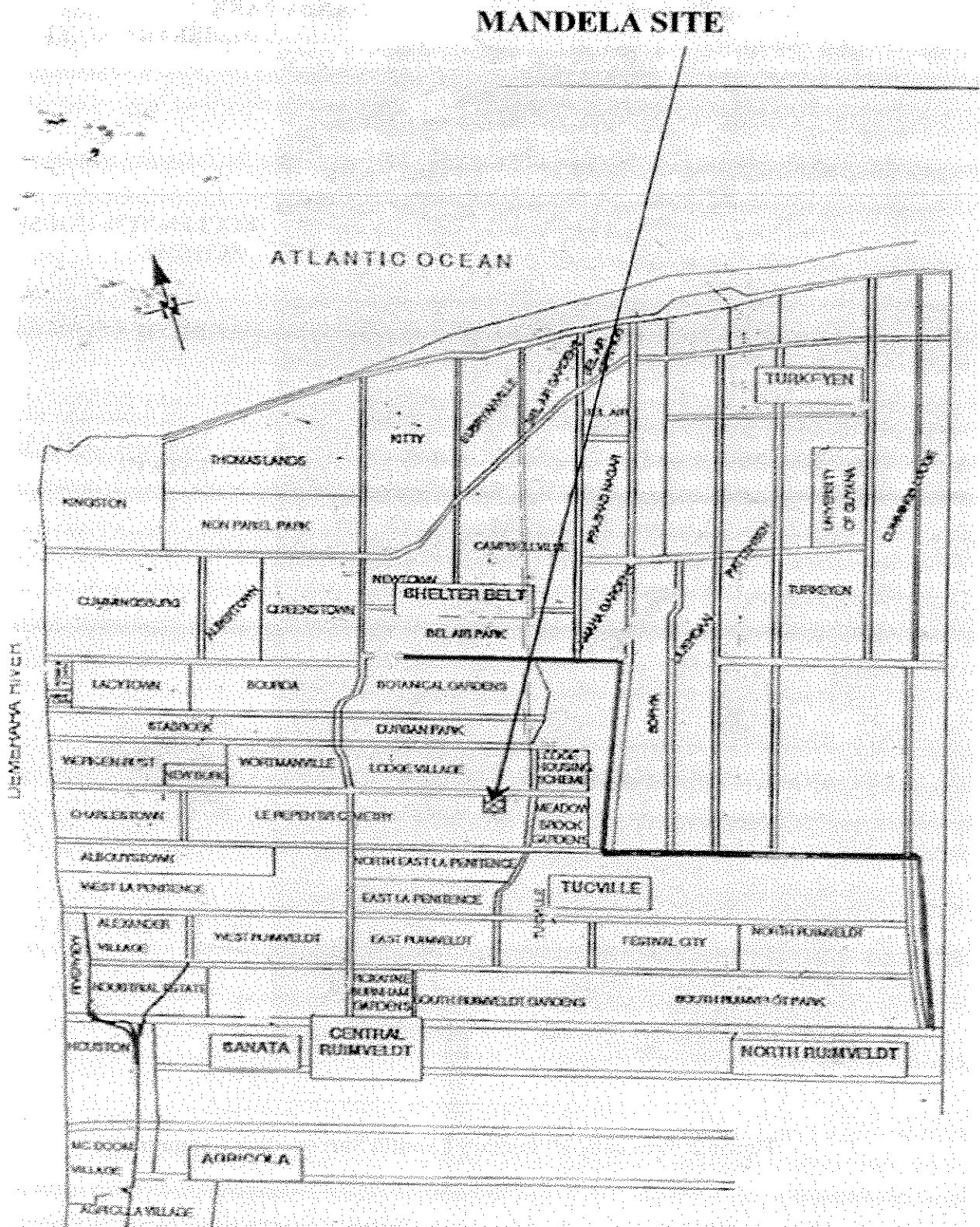
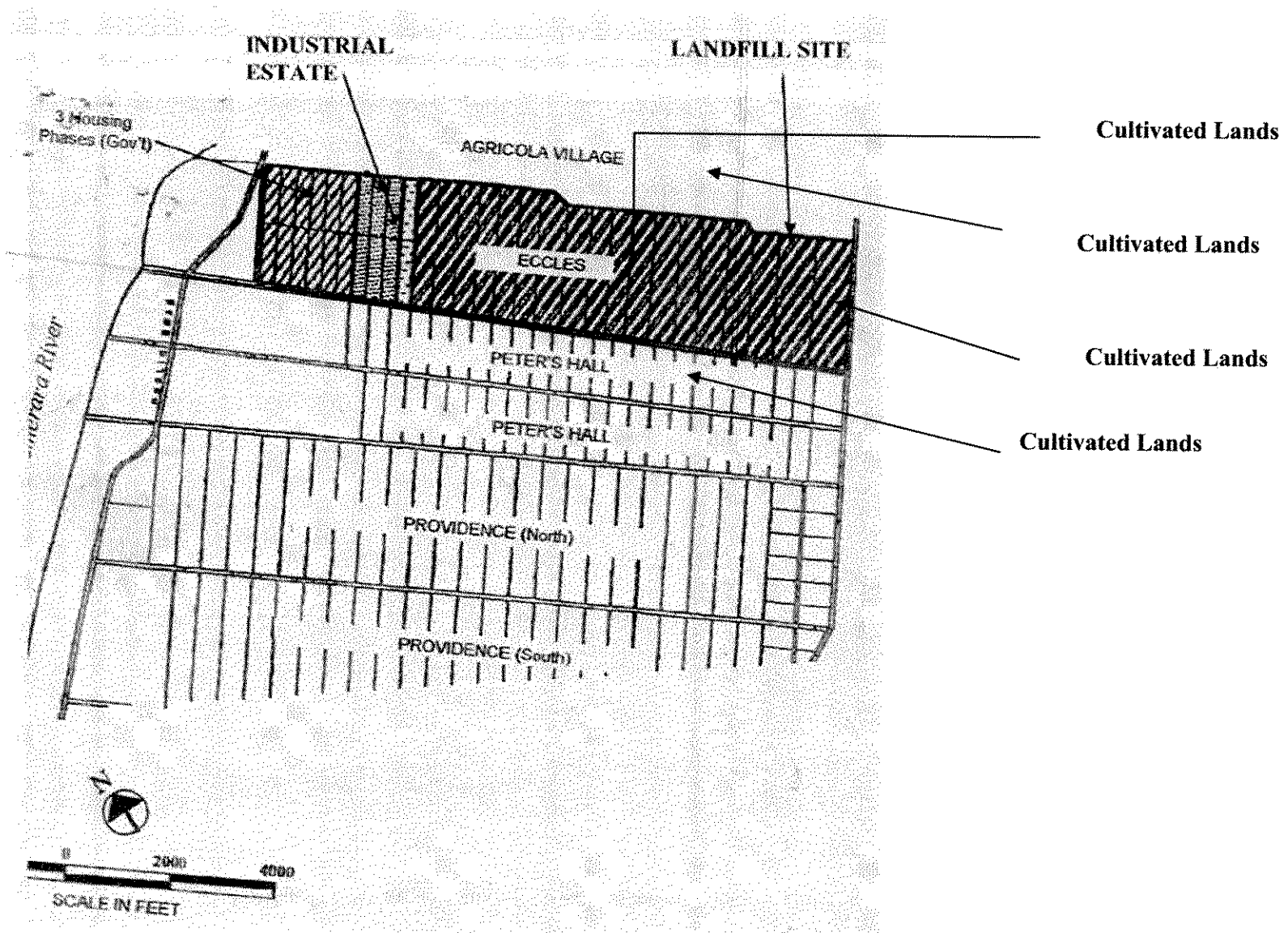
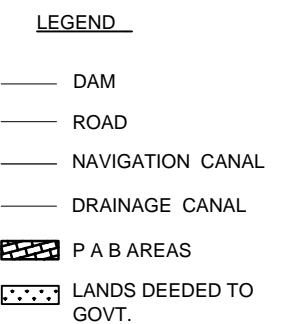




Figure 5: Location of Well at Eccles Relative to Sanitary Landfill Site

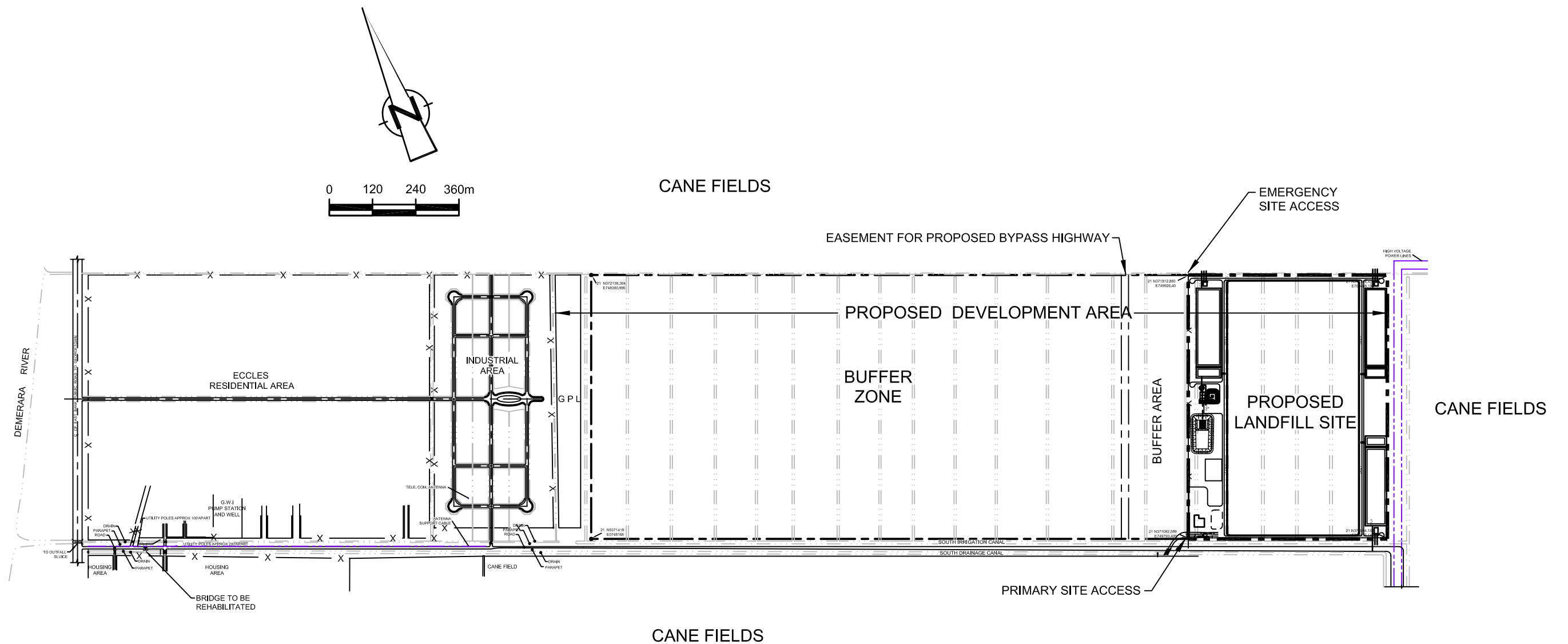




REGIONAL SITE LOCATION  
DESIGN AND OPERATIONS REPORT  
NEW SANITARY LANDFILL IN HAGS BOSCH, GUYANA  
*Ministry of Local Government and Regional Development*







LEGEND	
	PROPERTY BOUNDARY
	SITE BOUNDARY
	CANAL
	FENCE
	BRIDGE
GPL	GUYANA POWER AND LIGHT
GWI	GUYANA WATER INC.

**SOURCE:**  
SITE PLAN FROM TROW ASSOCIATES INC.  
JUNE 2004

**NOTES:**  
1) ALL MEASUREMENTS IN METRES  
UNLESS OTHERWISE INDICATED  
2) NORTH AND SOUTH DRAINAGE  
CANALS DRAIN WEST TO THE  
DEMERARA RIVER.

figure 1.2  
SITE LOCATION PLAN  
DESIGN AND OPERATIONS REPORT  
NEW SANITARY LANDFILL IN HAAGS BOSCH, GUYANA  
*Ministry of Local Government and Regional Development*



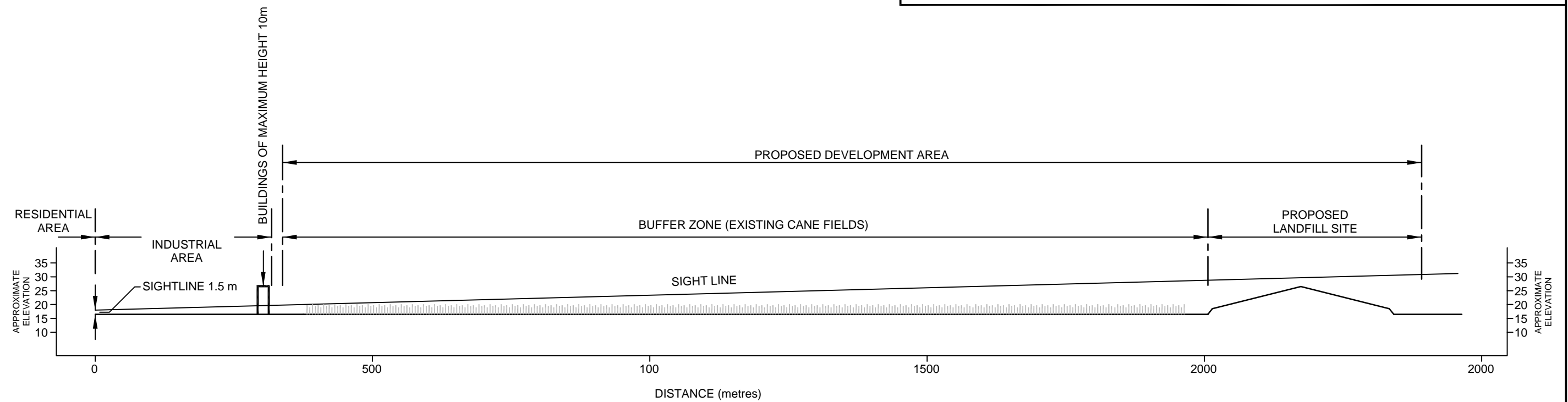
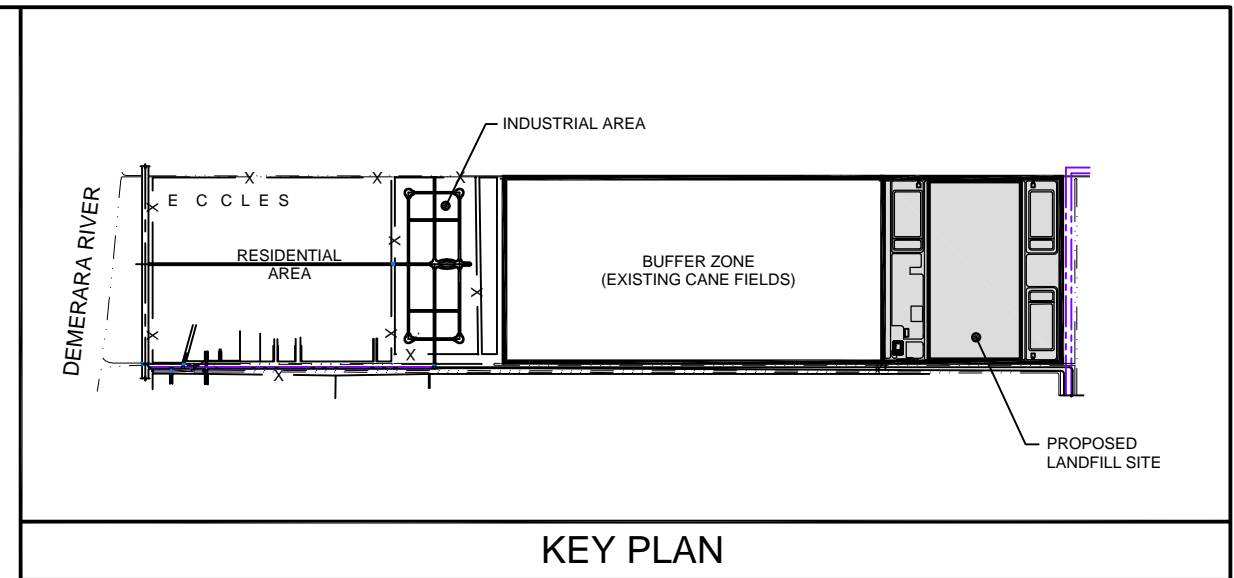
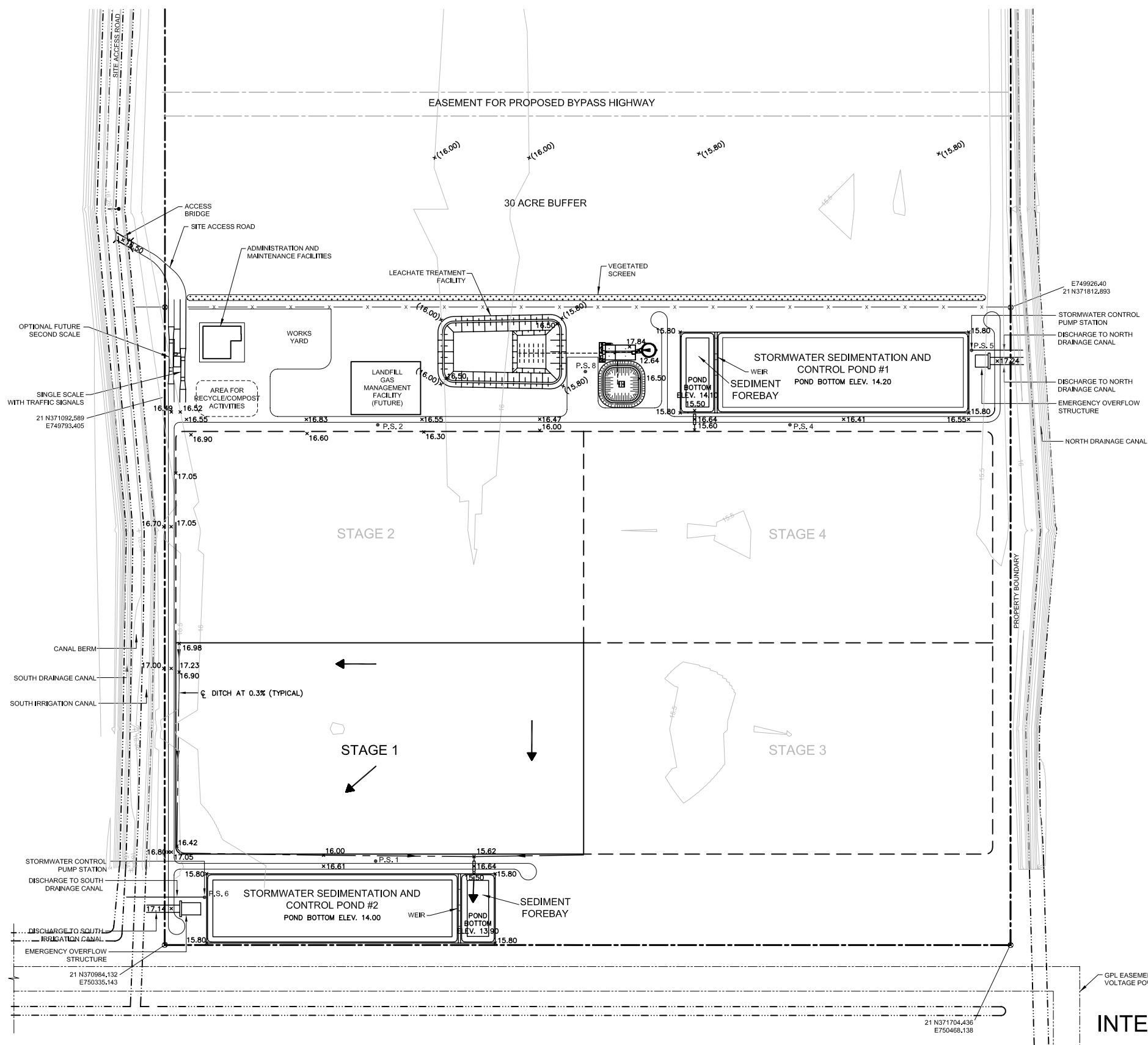
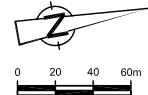


figure 4.1  
 VISUAL SITE LINE  
 DESIGN AND OPERATIONS REPORT  
 NEW SANITARY LANDFILL IN HAAGS BOSCH, GUYANA  
 Ministry of Local Government and Regional Development





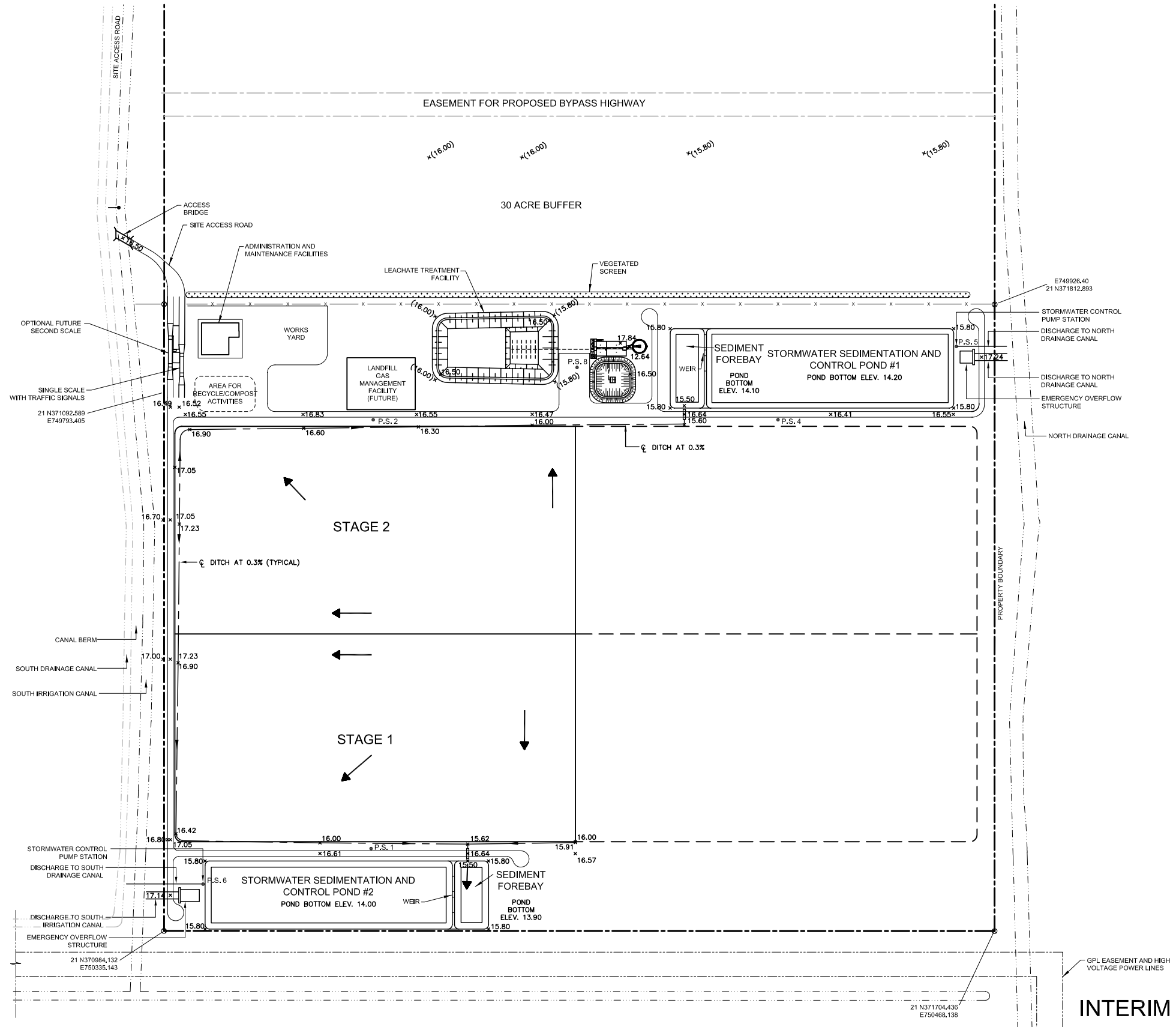
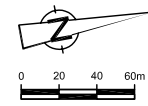
**LEGEND**

- OVERLAND FLOW
- \* (15.80) EXISTING GRADE TO REMAIN
- x 16.60 PROPOSED GRADE

figure 6.1  
**INTERIM SITE DRAINAGE PATTERN  
STAGE 1**  
**NEW SANITARY LANDFILL IN HAAGS BOSCH, GUYANA**  
*Ministry of Local Government and Regional Development*



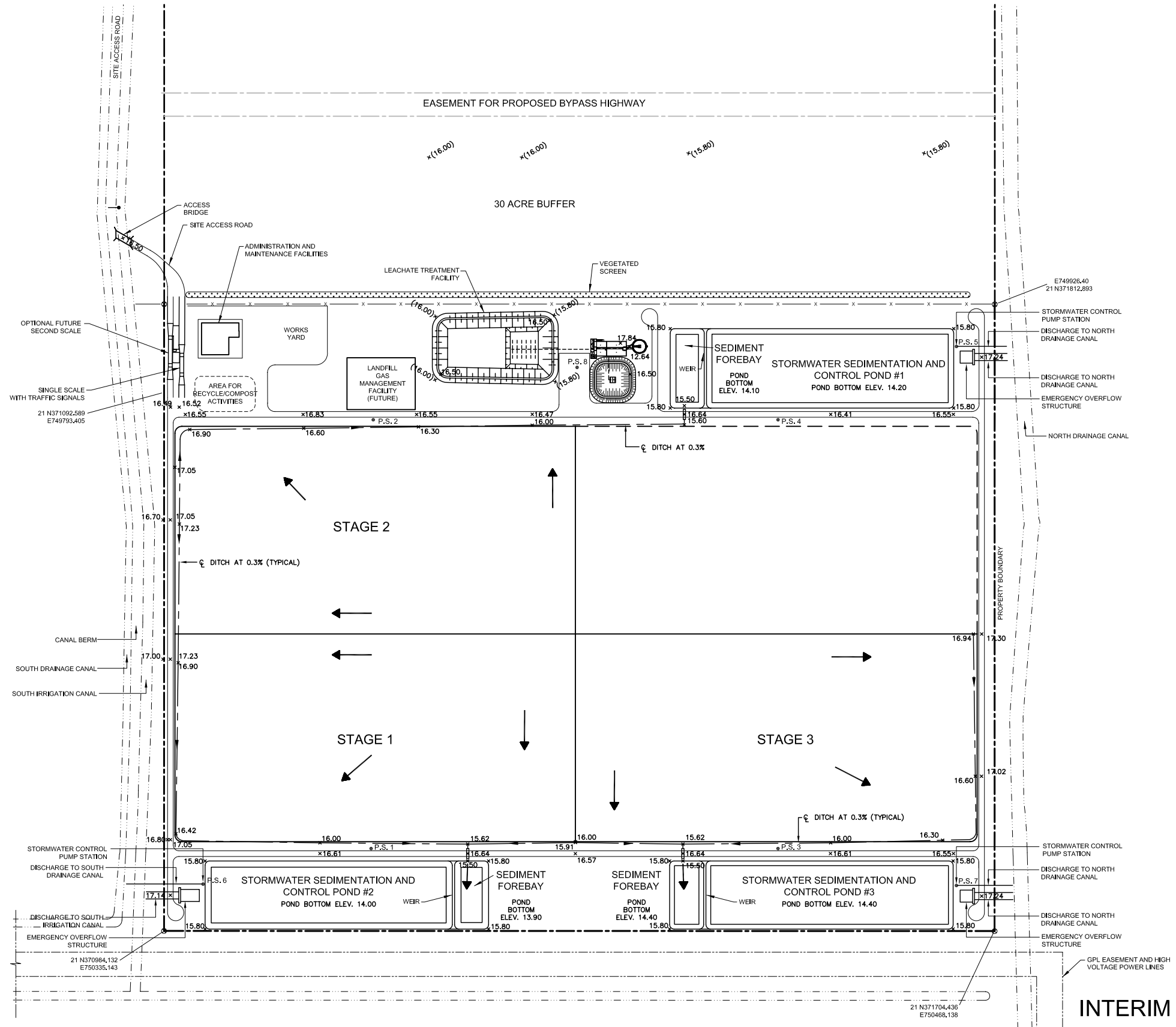
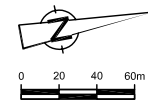




- LEGEND**
- OVERLAND FLOW
  - x(15.80) EXISTING GRADE TO REMAIN
  - x 16.60 PROPOSED GRADE

figure 6.2  
**INTERIM SITE DRAINAGE PATTERN  
STAGE 2**  
**NEW SANITARY LANDFILL IN HAAGS BOSCH, GUYANA**  
*Ministry of Local Government and Regional Development*





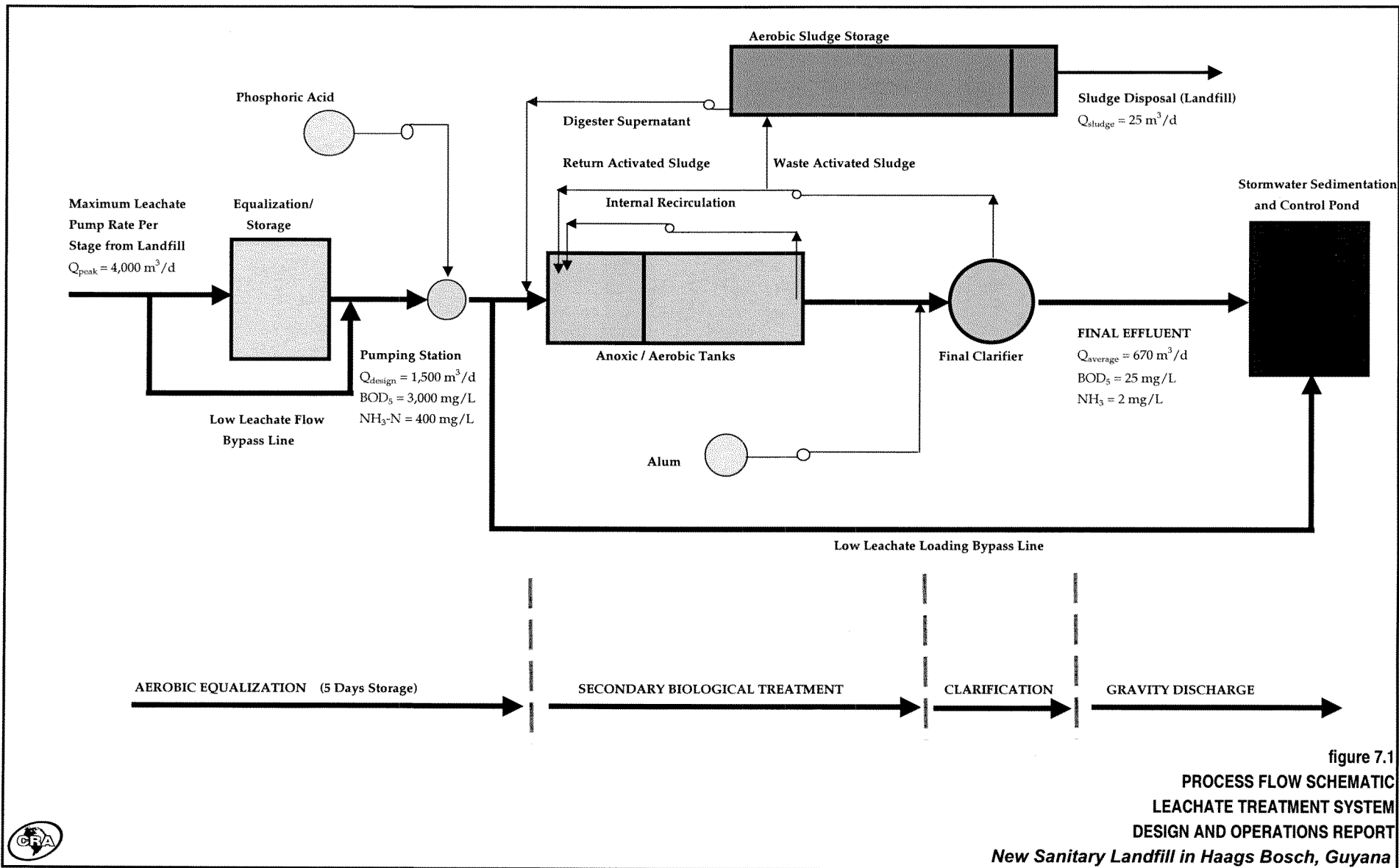
- LEGEND**
- OVERLAND FLOW
  - x(15.80) EXISTING GRADE TO REMAIN
  - x 16.60 PROPOSED GRADE

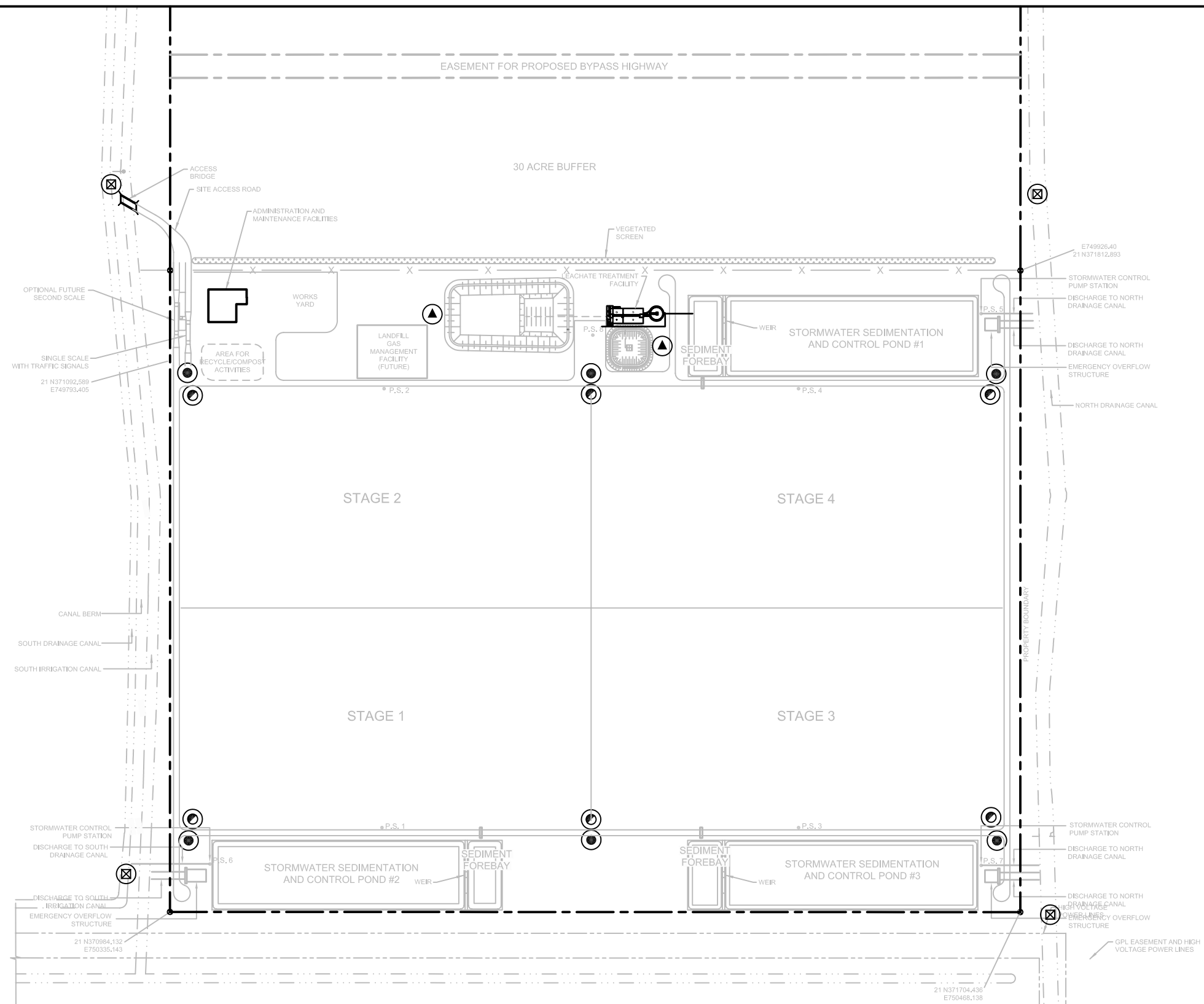
figure 6.3

**INTERIM SITE DRAINAGE PATTERN  
STAGE 3**

**NEW SANITARY LANDFILL IN HAAGS BOSCH, GUYANA**  
*Ministry of Local Government and Regional Development*







# CONSTRUCTION OF SANITARY LANDFILL IN HAAGS BOSCH

## GUYANA

### MINISTRY OF LOCAL GOVERNMENT AND REGIONAL DEVELOPMENT

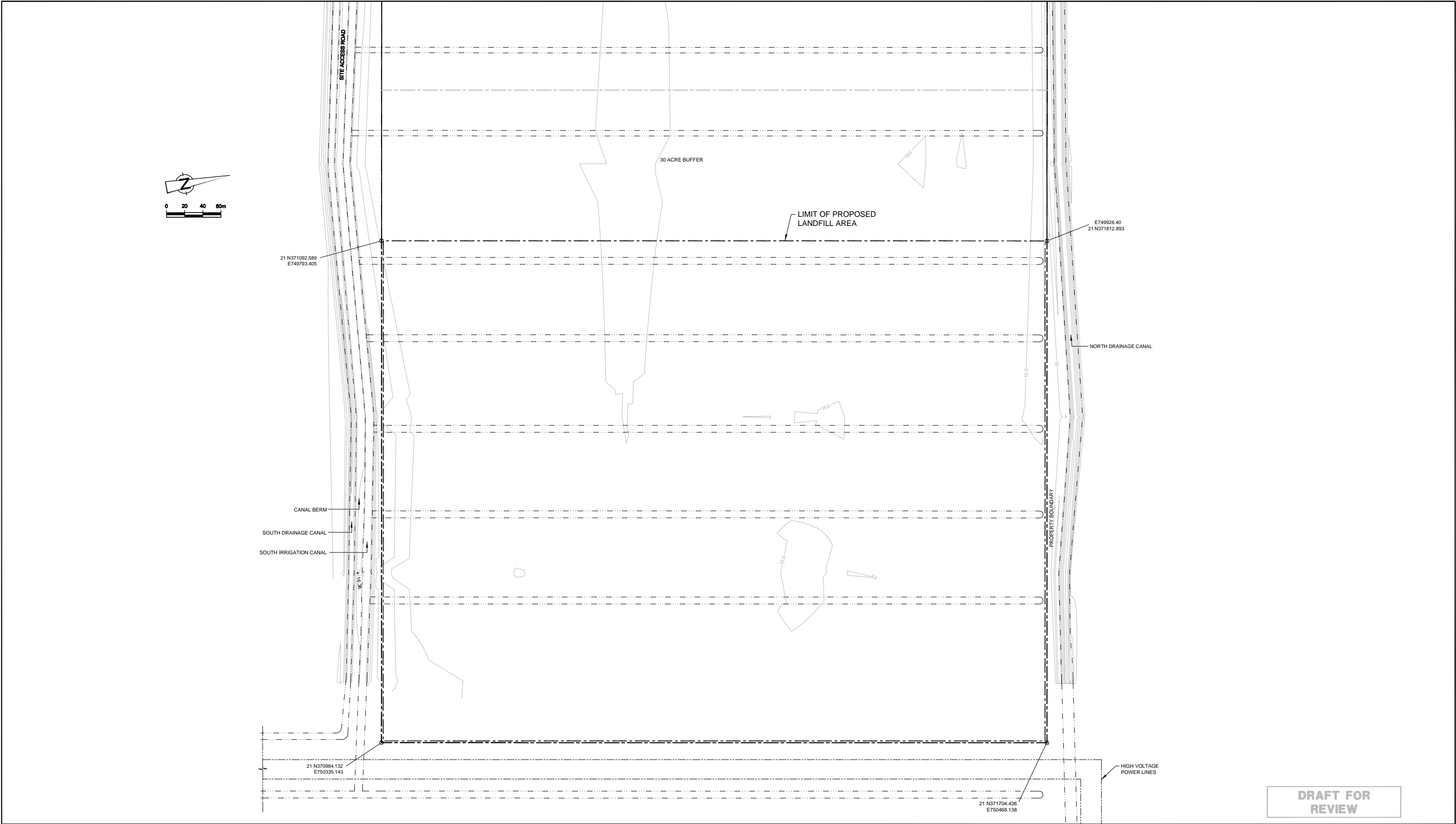


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G-01	0	JANUARY 2005	COVER PAGE	C-38	0	JANUARY 2005	BRIDGE DETAILS
G-02	0	JANUARY 2005	ABBREVIATIONS AND DETAIL DESIGNATIONS	C-39	0	JANUARY 2005	ADMINISTRATION BUILDING
G-03	0	JANUARY 2005	MECHANICAL LEGEND	C-40	0	JANUARY 2005	BUILDING ELEVATIONS AND SECTIONS
G-04	0	JANUARY 2005	ELECTRICAL LEGEND	C-41	0	JANUARY 2005	FOUNDATION PLANS AND DETAILS
G-05	0	JANUARY 2005	INSTRUMENTATION AND CONTROL LEGEND	C-42	0	JANUARY 2005	SUN SHELTER
<b>CIVIL</b>				<b>STRUCTURAL</b>			
C-01	0	JANUARY 2005	EXISTING CONDITIONS (OVERALL SITE AREA)	S-01	0	JANUARY 2005	ANOXIC AND AERATION TANK PLAN
C-02	0	JANUARY 2005	EXISTING CONDITIONS (PROPOSED LANDFILL AREA))	S-02	0	JANUARY 2005	CLARIFIER PLAN AND SECTIONS
C-03	0	JANUARY 2005	SITE PLAN (PROPOSED LANDFILL AREA)	S-03	0	JANUARY 2005	ANOXIC AND AERATION TANK SECTIONS
C-04	0	JANUARY 2005	SITE DEVELOPMENT SEQUENCE (1 OF 3)	S-04	0	JANUARY 2005	LEACHATE TREATMENT FACILITY SECTIONS AND DETAILS (1 OF 2)
C-05	0	JANUARY 2005	SITE DEVELOPMENT SEQUENCE (2 OF 3)	S-05	0	JANUARY 2005	LEACHATE TREATMENT FACILITY SECTIONS AND DETAILS (2 OF 2)
C-06	0	JANUARY 2005	SITE DEVELOPMENT SEQUENCE (3 OF 3)	S-06	0	JANUARY 2005	STANDARD DETAILS (1 OF 3)
C-07	0	JANUARY 2005	BASE CONTOUR PLAN	S-07	0	JANUARY 2005	STANDARD DETAILS (2 OF 3)
C-08	0	JANUARY 2005	FINAL CONTOUR PLAN	S-08	0	JANUARY 2005	STANDARD DETAILS (3 OF 3)
C-09	0	JANUARY 2005	LANDFILL AREA SECTION A AND B	<b>MECHANICAL</b>			
C-10	0	JANUARY 2005	LANDFILL AREA SECTION C AND D	M-01	0	JANUARY 2005	ANOXIC AND AERATION TANK PLAN
C-11	0	JANUARY 2005	LEACHATE COLLECTION SYSTEM	M-02	0	JANUARY 2005	CLARIFIER PLAN
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C-15	0	JANUARY 2005	PROPOSED ACCESS ROAD	M-06	0	JANUARY 2005	LAGOON AERATION SYSTEMS AND PUMPING STATION 8
C-16	0	JANUARY 2005	STORMWATER SUBCATCHMENT AREA, PRE-DEVELOPMENT CONDITION	M-07	0	JANUARY 2005	STANDARD DETAILS
C-17	0	JANUARY 2005	STORMWATER SUBCATCHMENT AREA, POST-DEVELOPMENT CONDITION	M-08	0	JANUARY 2005	STORMWATER PUMPING STATION
C-18	0	JANUARY 2005	SITE GRADING AND DRAINAGE	<b>ELECTRICAL</b>			
C-19	0	JANUARY 2005	STORMWATER CONTROL POND NO.1 LAYOUT	E-01	0	JANUARY 2005	ELECTRICAL SITE PLAN
C-20	0	JANUARY 2005	STORMWATER CONTROL POND NO.1 ELEVATIONS	E-02	0	JANUARY 2005	POWER DISTRIBUTION SINGLE LINE DIAGRAM
C-21	0	JANUARY 2005	STORMWATER CONTROL POND NO.2 LAYOUT	E-03	0	JANUARY 2005	ELECTRICAL MCC DIAGRAM
C-22	0	JANUARY 2005	STORMWATER CONTROL POND NO.2 ELEVATIONS	E-04	0	JANUARY 2005	INSTRUMENTATION LAYOUT
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C-25	0	JANUARY 2005	PERIMETER DITCH CROSS-SECTIONS	E-07	0	JANUARY 2005	ELECTRICAL CONTROL SCHEMATICS (1 OF 5)
C-26	0	JANUARY 2005	DISCHARGE STRUCTURE DETAILS	E-08	0	JANUARY 2005	ELECTRICAL CONTROL SCHEMATICS (2 OF 5)
C-27	0	JANUARY 2005	LEACHATE TREATMENT FACILITY SITE PLAN	E-09	0	JANUARY 2005	ELECTRICAL CONTROL SCHEMATICS (3 OF 5)
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C-31	0	JANUARY 2005	LANDFILL GAS TRENCH CONNECTION PLAN AND PROFILE	<b>PROCESS</b>			
C-32	0	JANUARY 2005	LANDFILL GAS COLLECTION SYSTEM DETAILS (FUTURE)	P-01	0	JANUARY 2005	PROCESS FLOW DIAGRAM AND AND HYDRAULIC GRADIENT DIAGRAM
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C-36	0	JANUARY 2005	BURIED SITE UTILITIES (PROPOSED LANDFILL AREA)				
C-37	0	JANUARY 2005	MISCELLANEOUS CIVIL DETAILS				



CONESTOGA-ROVERS & ASSOCIATES





DRAFT FOR REVIEW

NOTES

- 1) NORTH AND SOUTH DRAINAGE CANALS DRAIN WEST TO DEMERARA RIVER
- 2) MEAN HIGH WATER LEVEL IN SOUTH DRAINAGE CANAL 15.75m GD, MEAN LOW WATER LEVEL 15.12m GD.
- 3) MEAN WATER LEVEL IN SOUTH IRRIGATION CANAL 16.31m GD (STATIC)
- 4) MEAN HIGH WATER LEVEL IN NORTH DRAINAGE CANAL 16.00m GD, MEAN LOW WATER LEVEL 15.22m GD.

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

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No	Revision	Date	Initial

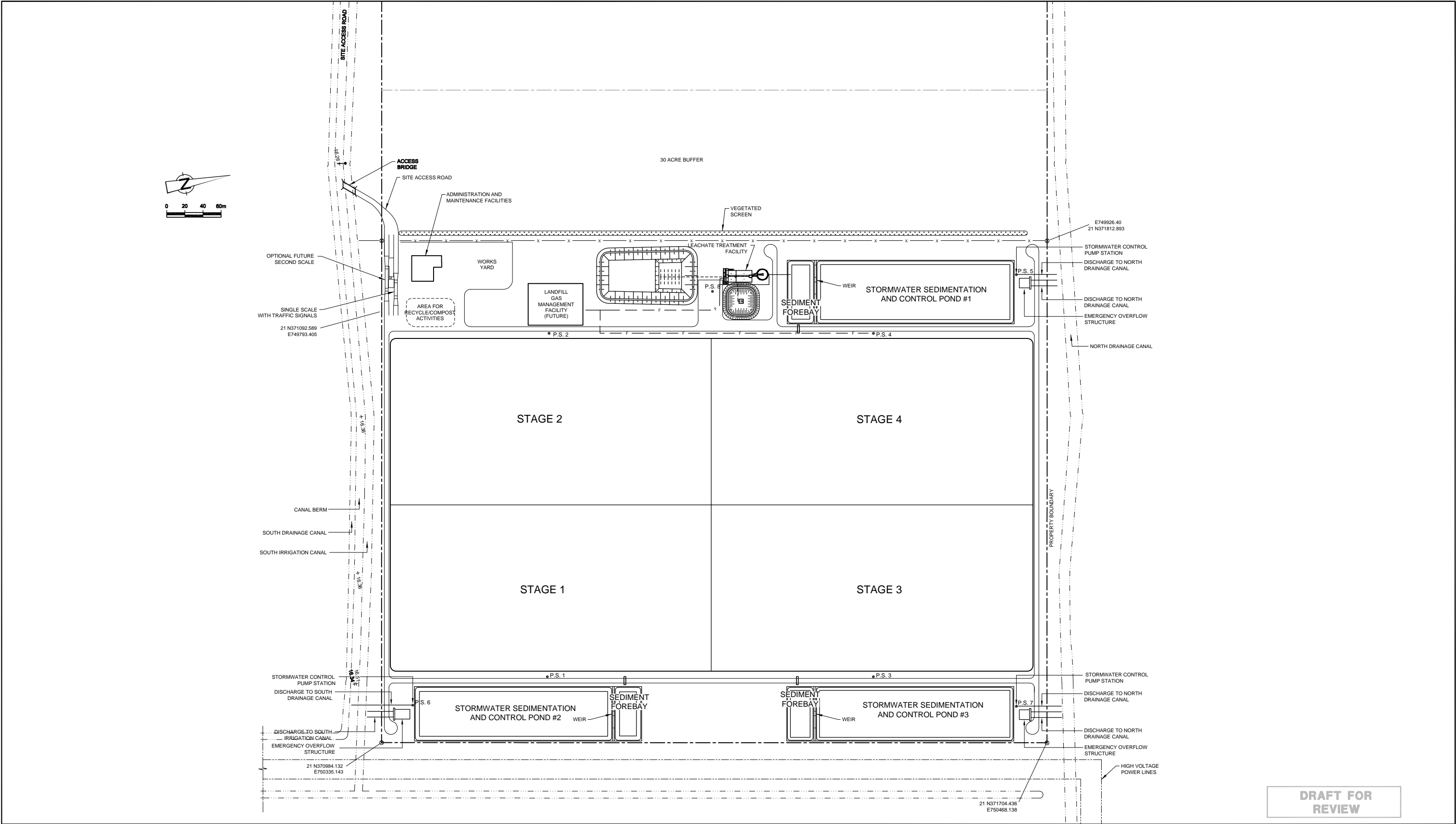
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GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

EXISTING CONDITIONS  
(PROPOSED DEVELOPMENT AREA)

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Project Manager: R. MOSHER	Reviewed By: D. MILLAR	Designed By: D. HATRICK	Drawn By: I. ROBERTSON
Scale: 1:2000	Project No: 35919-30	Report No: 002	Drawing No: C-02






NOTES:  
1. ALL ELEVATIONS ARE GIVEN IN METRES,  
REFERENCED TO GEORGETOWN DATUM (G.D.).

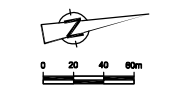
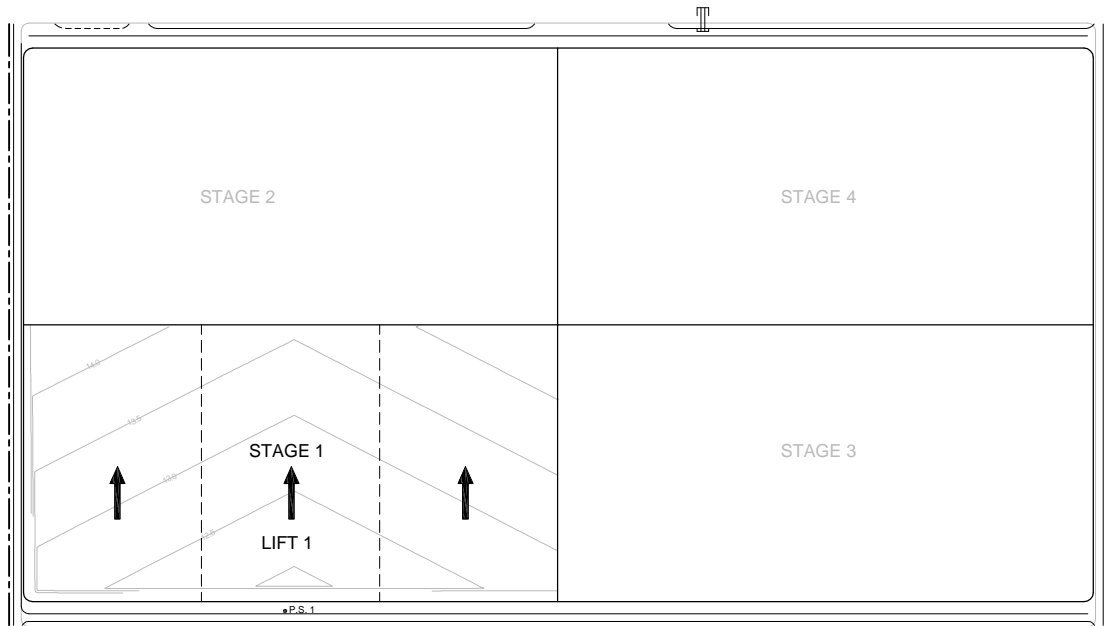
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No	Revision	Date	Initial

Approved

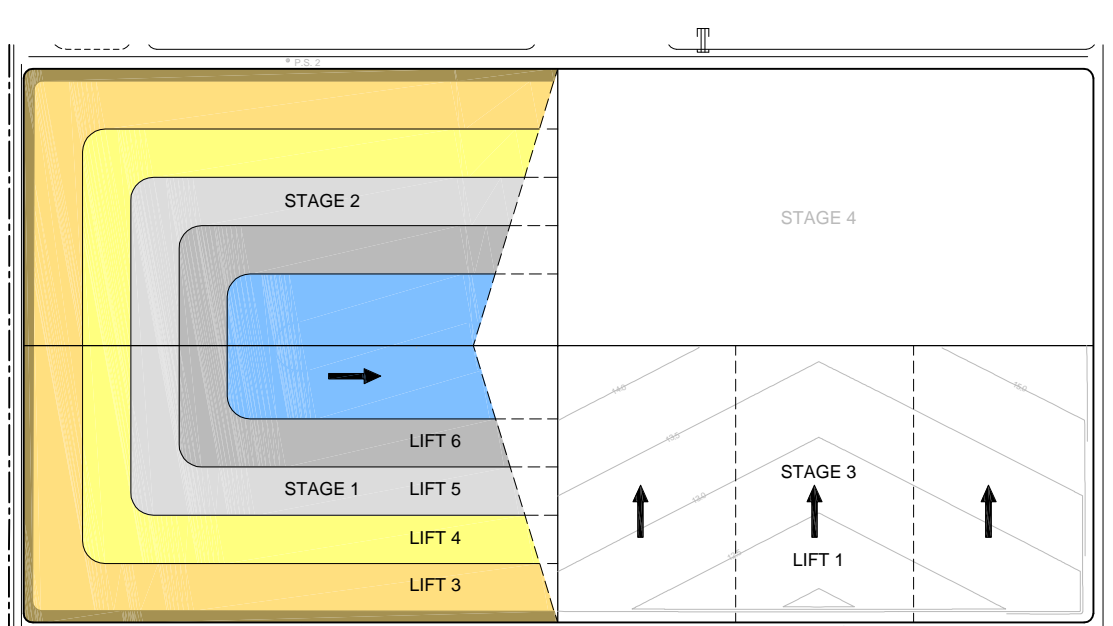
GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT  
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH  
SITE PLAN  
(PROPOSED LANDFILL AREA)

					
Source Reference:				Date: OCTOBER 2004	
Project Manager: R. MOSHER		Reviewed By: D. MILLAR		Designed By: D. HATRICK	
Scale: 1:2000		Project No: 35919-30		Drawing No: C-03	



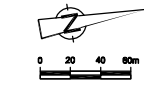
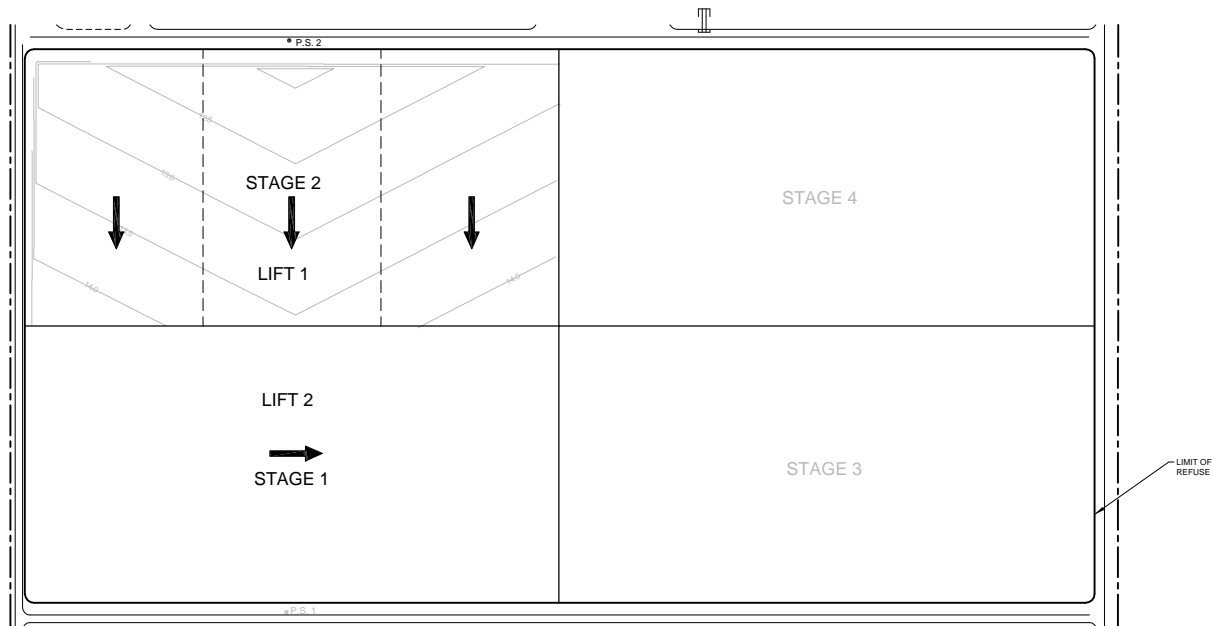
FILL SEQUENCE 1

NOTES:  
BASE PREPARED AND FIRST LIFT OF WASTE PLACED IN STAGE 1. BASE IS EXCAVATED AND PREPARED AS SHOWN ON DRAWINGS C-07 AND C-11. FIRST LIFT OF WASTE PLACED BEGINNING WITH CENTER PORTION IN VICINITY OF PUMP STATION, FOLLOWED BY SOUTHERN PORTION, THEN THE NORTHERN PORTION. FILLING ADVANCES IN A WESTERLY DIRECTION IN EACH PORTION AS INDICATED BY THE ARROWS.



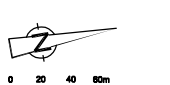
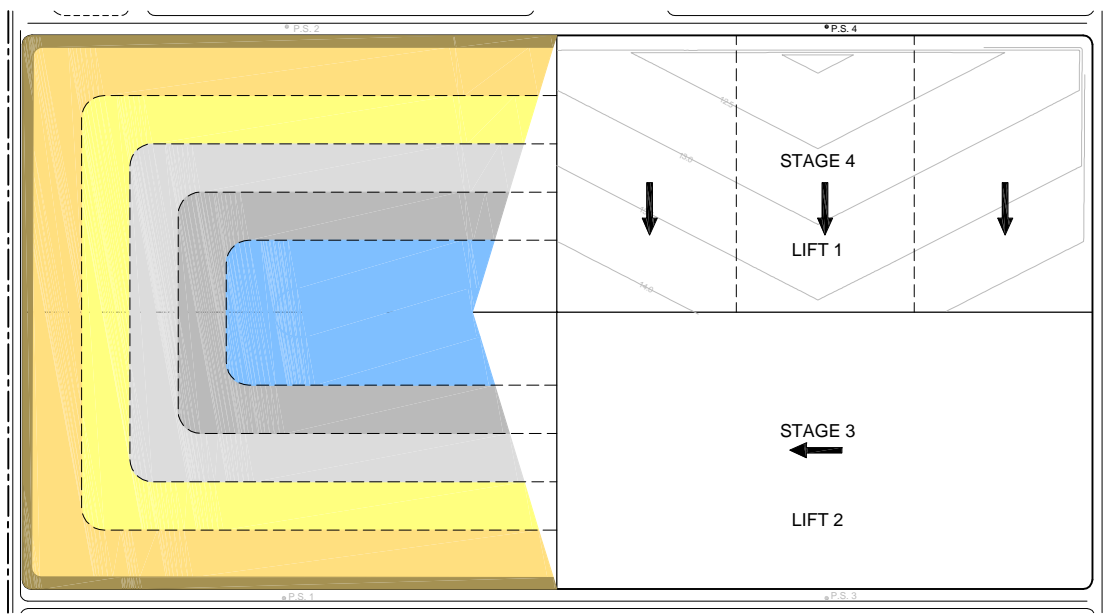
FILL SEQUENCE 3

NOTES:  
THE SECOND LIFT IF WASTE IS PLACED IN STAGE 2 IN A SIMILAR MANNER TO STAGE 1, WITH FILL ADVANCING IN A NORTHERLY DIRECTION. LIFTS 3 THROUGH 6 CONTINUE IN THE SAME NORTHERLY DIRECTION. A THIRD LIFT OF WASTE IS PLACED IN STAGE 2 UNTIL IT REACHES THE SAME POINT IN LIFT 3 AS STAGE 1, AND BOTH STAGES 1 AND 2. THE SIXTH LIFT OF WASTE IN STAGES 1 AND 2 ARE PLACED CONCURRENT TO THE BASE PREPARATION OF STAGE 3. AS SOON AS THE BASE IS READY TO RECEIVE WASTE THE FIRST LIFT IS PLACED IN STAGE 3, IN A SIMILAR MANNER TO STAGE 1, BEGINNING WITH CENTER PORTION IN THE VICINITY OF THE PUMP STATION, HOWEVER THE MOVING TO NORTHERN PORTION, THEN SOUTHERN.



FILL SEQUENCE 2

NOTES:  
SECOND LIFT OF WASTE PLACED ABOVE FIRST IN STAGE 1, STARTING FROM THE SOUTHERN LIMIT AND ADVANCING IN A NORTHERLY DIRECTION. THIS WILL FILL STAGE 1 TO APPROXIMATELY GROUND LEVEL. A THIRD LIFT OF WASTE IS PLACED IN STAGE 1 IN THE SAME MANNER AS LIFT 2 CONCURRENT TO THE BASE PREPARATION OF STAGE 2. AS SOON AS THE BASE IS READY TO RECEIVE WASTE THE FIRST LIFT IS PLACED IN STAGE 2 IN A SIMILAR MANNER AS FOR STAGE 1, HOWEVER WITH FILL ADVANCING IN AN EASTERLY DIRECTION TO MEET STAGE 1.



FILL SEQUENCE 4

NOTES:  
THE SECOND AND THIRD LIFTS OF WASTE ARE PLACED IN STAGE 3 IN A SIMILAR MANNER TO STAGE 1, BEGINNING AT THE NORTHERN LIMIT OF STAGE 1 AND ADVANCING IN A NORTHERLY DIRECTION. THE THIRD LIFT OF WASTE IS PLACED IN STAGE 3 CONCURRENT TO THE BASE PREPARATION OF STAGE 4. AS SOON AS THE BASE IS READY TO RECEIVE WASTE THE FIRST LIFT IS PLACED IN STAGE 4 IN A SIMILAR MANNER TO STAGE 2, BEGINNING WITH THE CENTER PORTION, THEN MOVING TO THE NORTHERN PORTION, THEN THE SOUTHERN AS WITH STAGE 3.

DRAFT FOR REVIEW

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

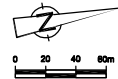
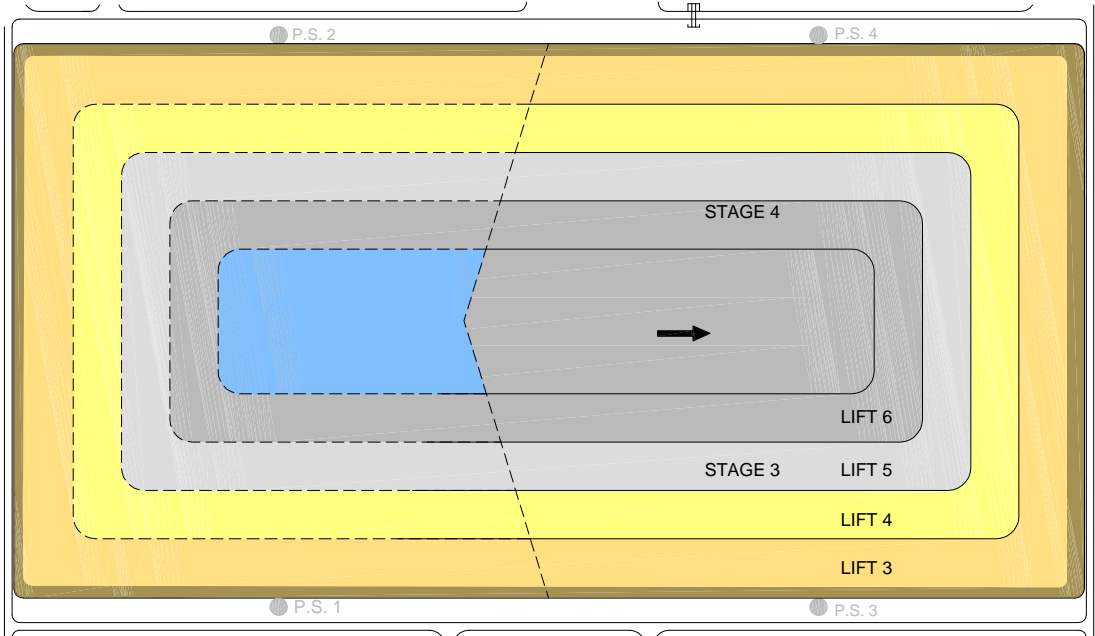
No	Revision	Date	Initial

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GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT  
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH  
SITE DEVELOPMENT SEQUENCE (1 OF 3)

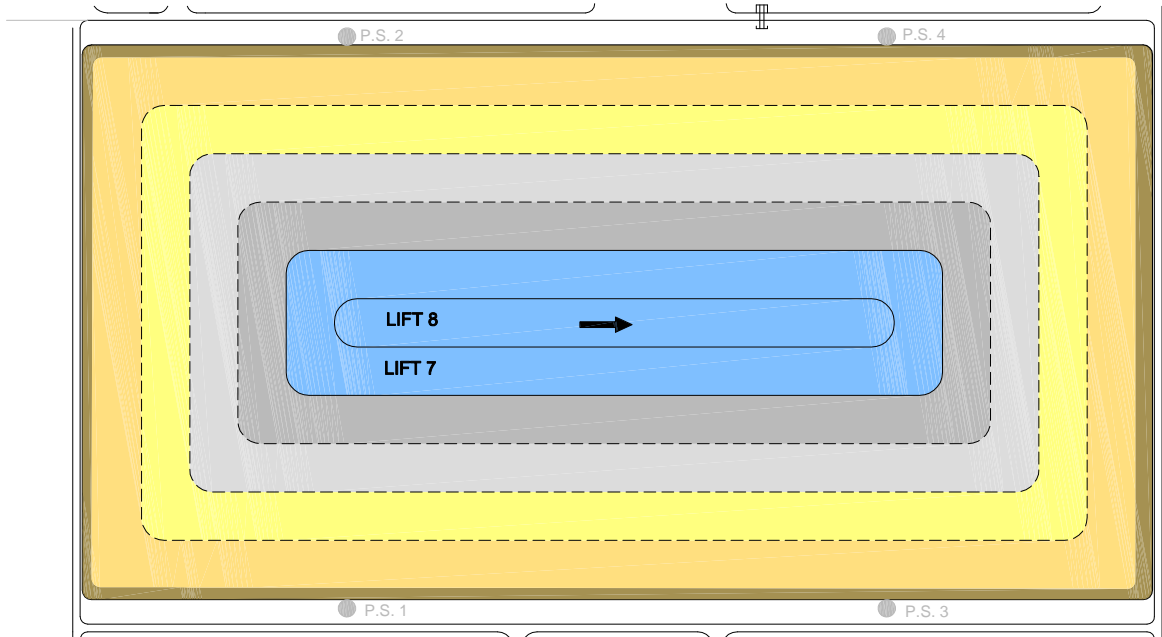
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Project Manager: R. MOSHER	Reviewed By: D. MILLAR	Designed By: D. HATRICK
Scale: 1:2500	Project No: 35919-30	Report No: 002
		Drawn By: I. ROBERTSON
		Drawing No: C-04





FILL SEQUENCE 5

**NOTES:**  
THE SECOND LIFT OF WASTE IS PLACED IN STAGE 4 IN A SIMILAR MANNER TO STAGE 3 UNTIL IT REACHES THE SAME POINT IN LIFT 3 AS IN STAGE 3, THEN BOTH STAGES ARE FILLED CONCURRENTLY FOR LIFTS 3 TO 6.



FILL SEQUENCE 6

**NOTES:**  
LIFTS 7 AND 8 ARE PLACED ACROSS ALL STAGES, EXTENDING ACROSS ALL SETTLED AREAS IN ORDER TO BRING THE SITE TO FINAL CONTOURS AS INDICATED ON DRAWING C-08. IT IS NOTED THAT ALL LIFTS ARE FILLED BEYOND THE CONTOUR INDICATED ON DRAWING C-08 DURING INITIAL FILLING TO ACCOUNT FOR WASTE SETTLEMENT.




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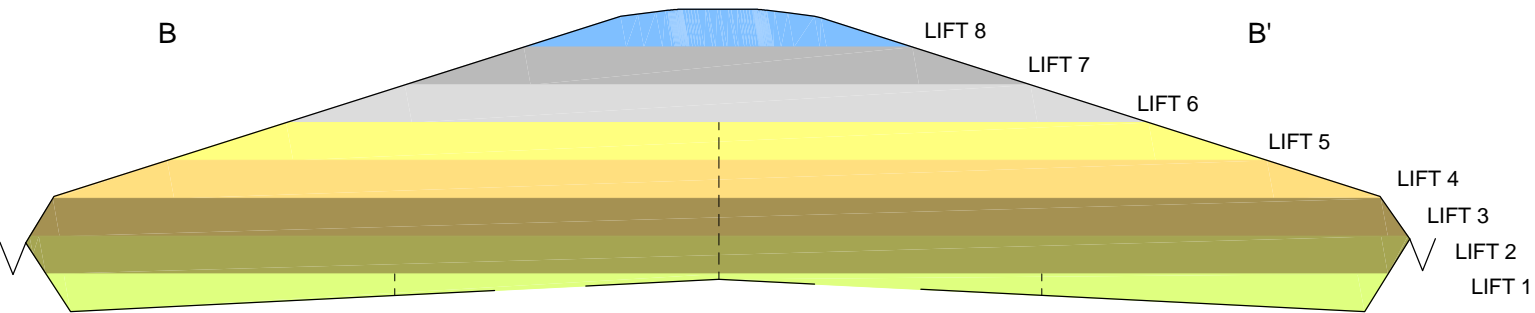
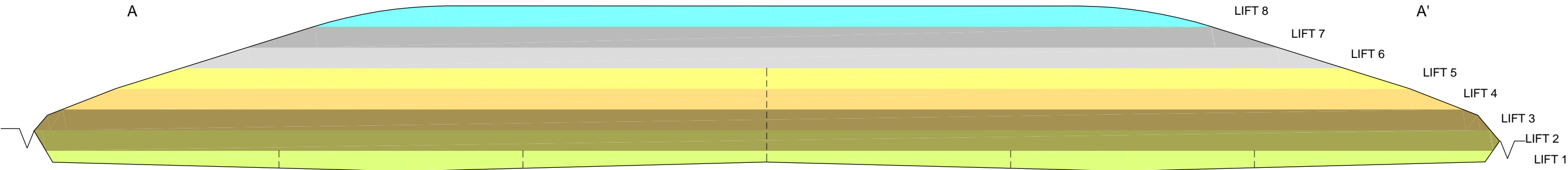
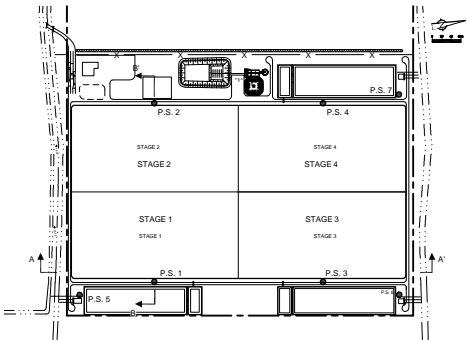
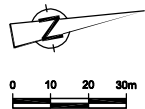
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No	Revision	Date	Initial

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GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT  
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH  
SITE DEVELOPMENT SEQUENCE (2 OF 3)

		 <b>Trow</b>			
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Project Manager:  R. MOSHER		Reviewed By:  D. MILLAR		Drawn By:  I. ROBERTSON	
Scale:  1:2500		Project No:  35919-30		Drawing No:  C-05	






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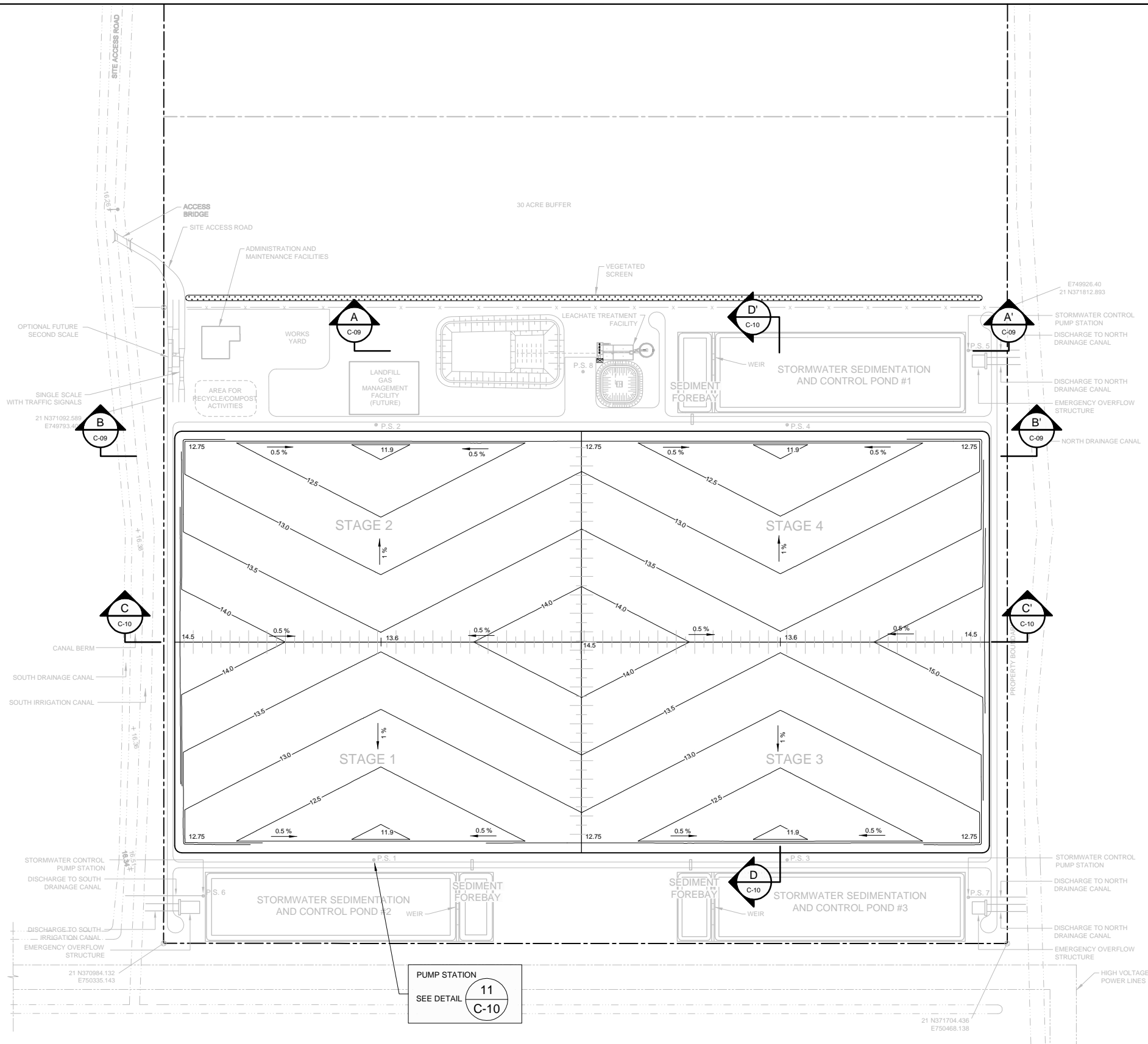
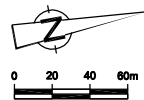
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No	Revision	Date	Initial

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GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT  
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH  
SITE DEVELOPMENT SEQUENCE (3 OF 3)

					
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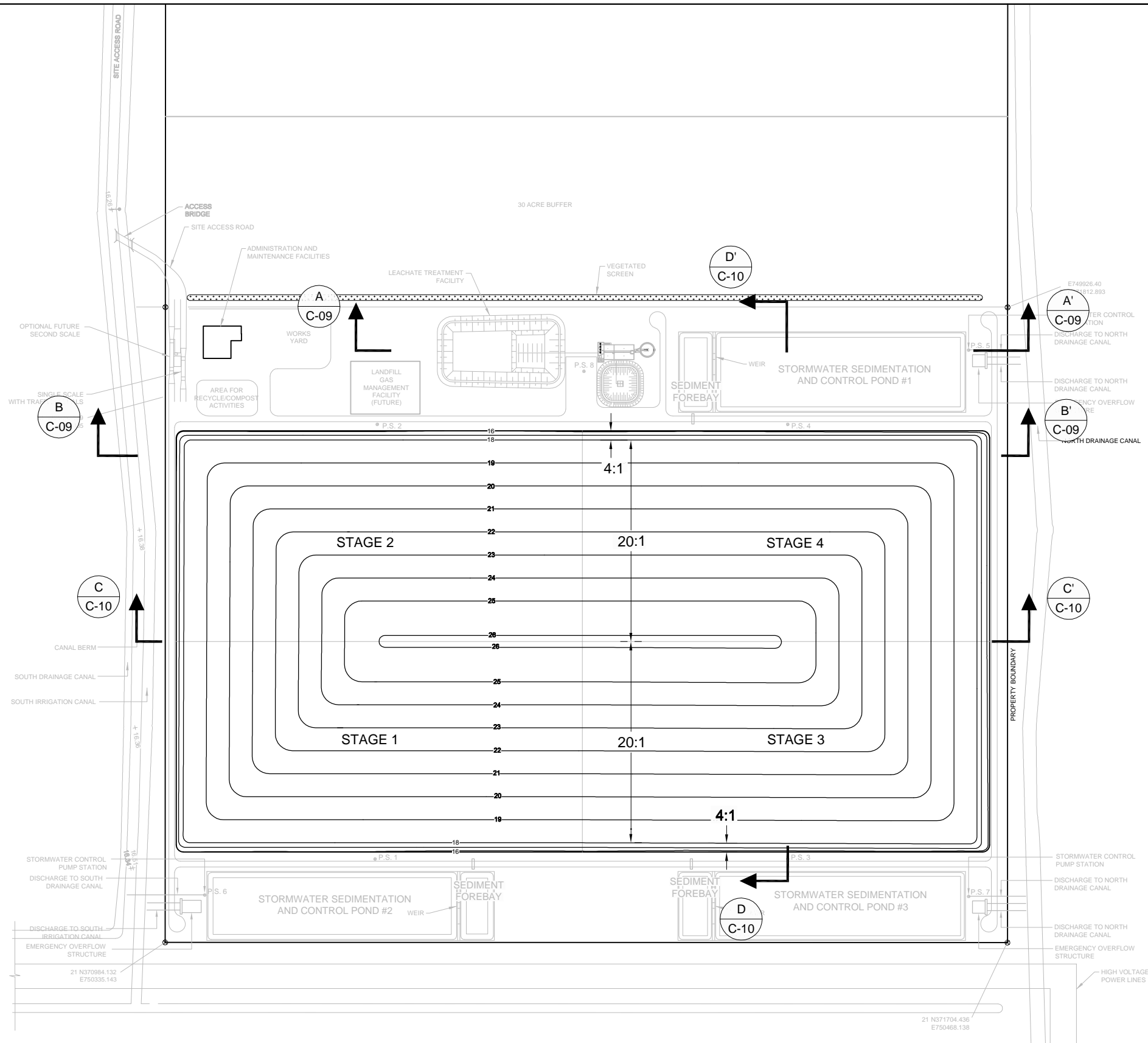
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No	Revision	Date	Initial	

Approved	
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GUYANA MINISTRY OF LOCAL GOVERNMENT AND REGIONAL DEVELOPMENT	CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH			
	BASE CONTOUR PLAN			

		 <b>Trow</b>			
Source Reference: INTERAMERICAN DEVELOPMENT BANK				Date: OCTOBER 2004	
Project Manager: R. MOSHER	Reviewed By: D. MILLAR	Designed By: D. HATRICK	Drawn By: I. ROBERTSON		
Scale: 1:2000	Project No: 35919-30	Report No: 002	Drawing No: C-07		



  	
<b>Trow</b>	
Source Reference: _____	
Date: _____	
Project Manager: R. MOSHER	Reviewed By: D. MILLAR
Scale: 1:2000	Project No: 35919-30
Designed By: D. HATRICK	Report No: 002
Drawn By: I. ROBERTSON	Drawing No: C-08

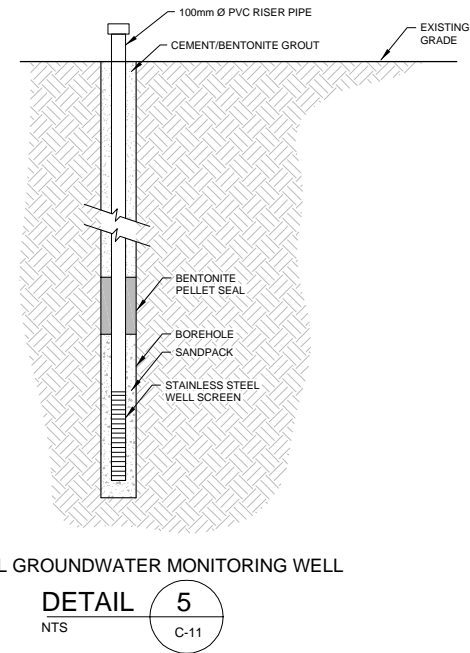
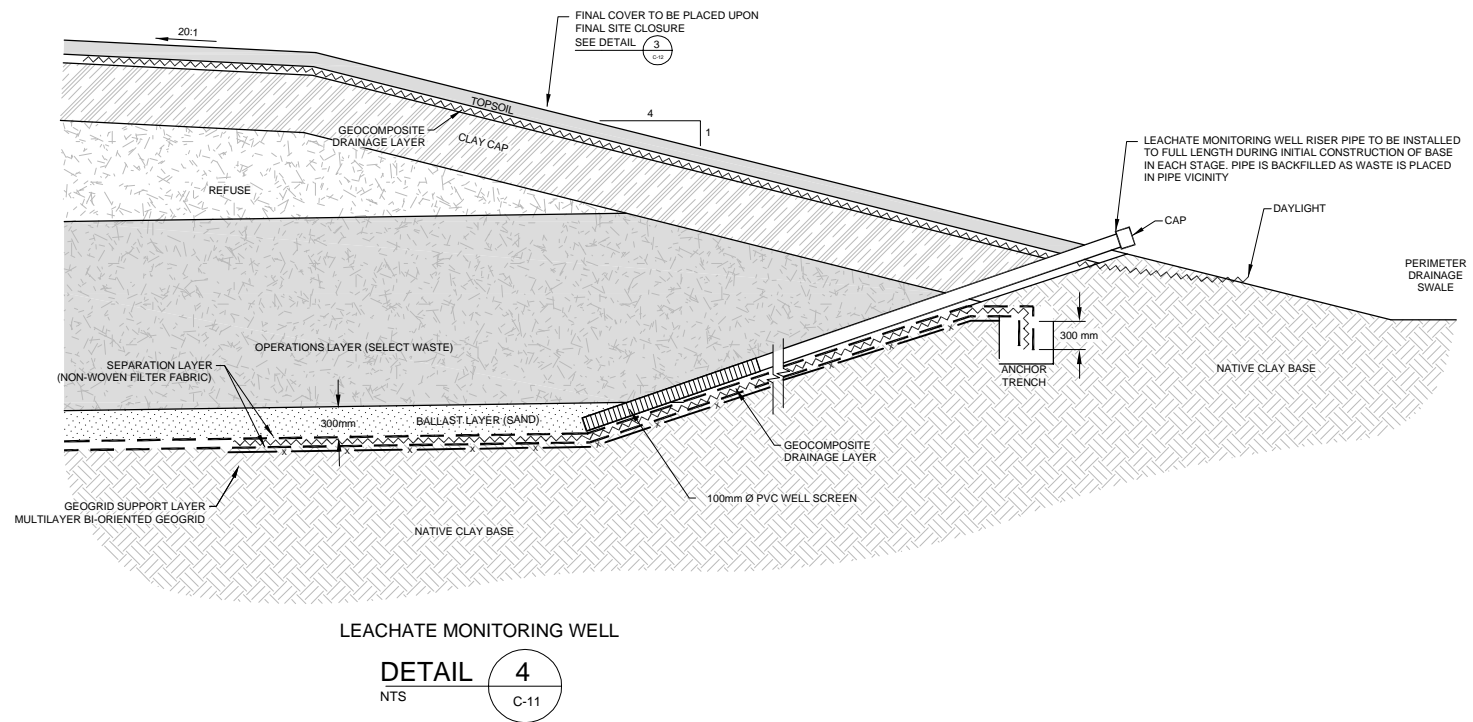
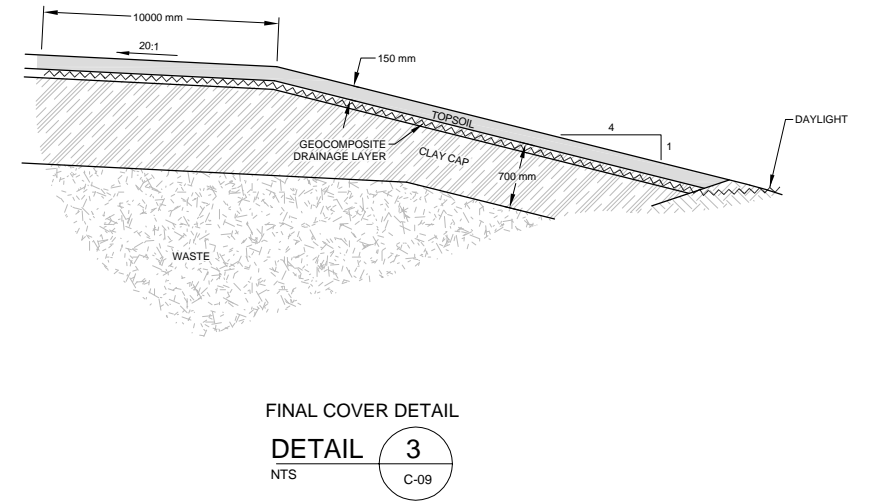
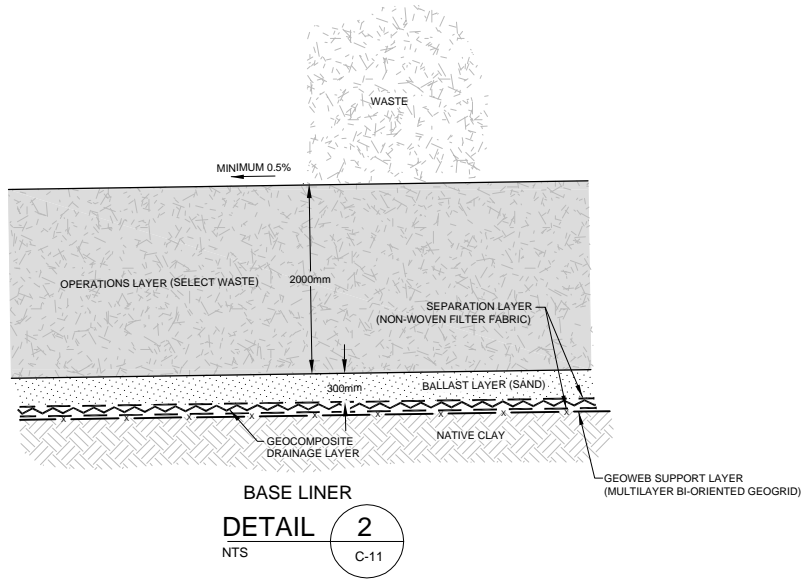
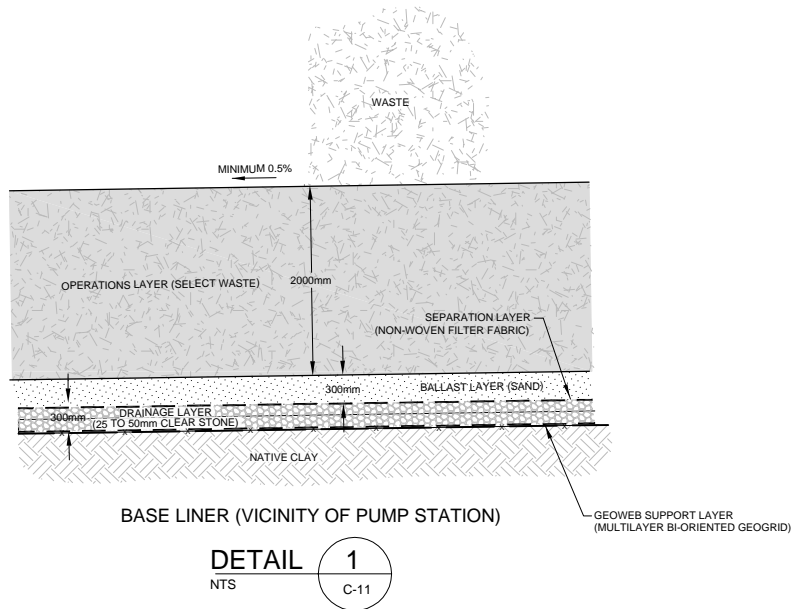
**SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.**

			
No	Revision	Date	Initial

Approved

### FINAL CONTOUR PLAN








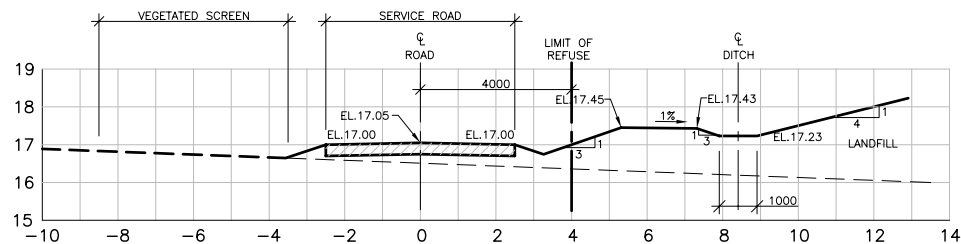
DRAFT FOR REVIEW

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.			
No	Revision	Date	Initial

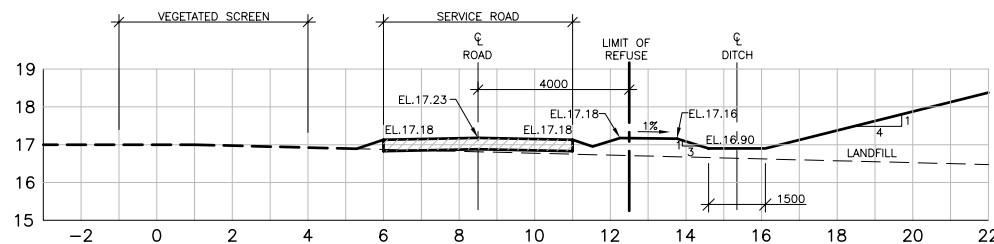
Approved	

GUYANA MINISTRY OF LOCAL GOVERNMENT AND REGIONAL DEVELOPMENT
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH
BASE LINER AND FINAL COVER DETAILS

					
Source Reference:				Date: OCTOBER 2004	
Project Manager: R. MOSHER		Reviewed By: D. MILLAR		Designed By: D. HATRICK	
Scale: AS SHOWN		Project No: 35919-30		Drawing No: C-12	



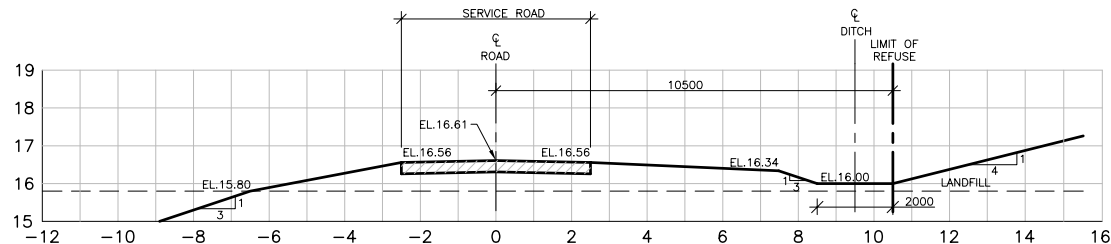
A SECTION  
C18



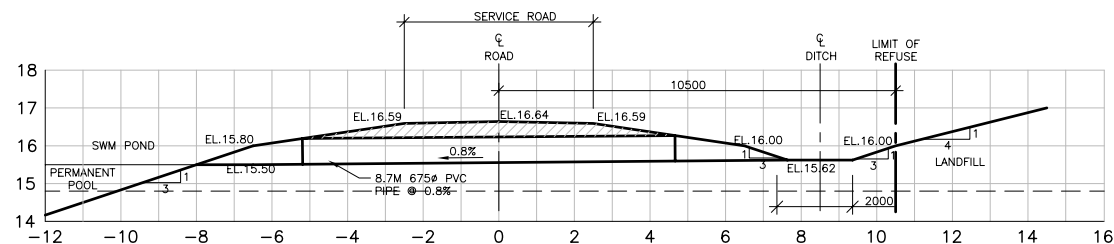
B SECTION  
C18



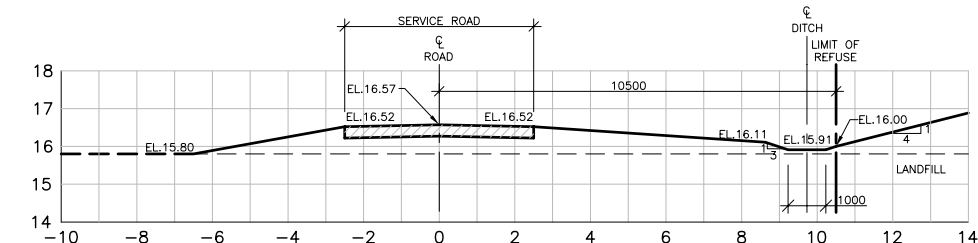
C SECTION  
C18



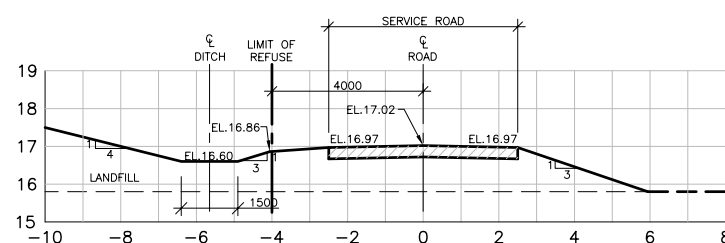
D SECTION  
C18



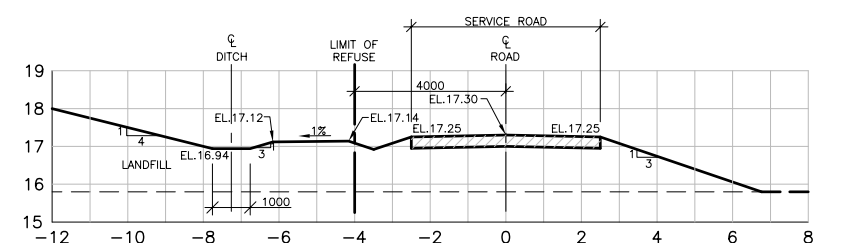
E SECTION  
C18



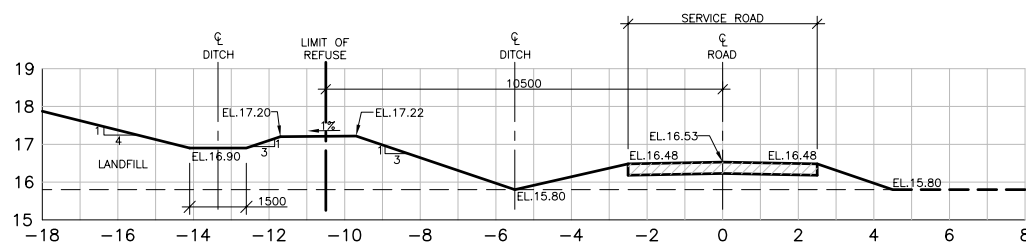
F SECTION  
C18



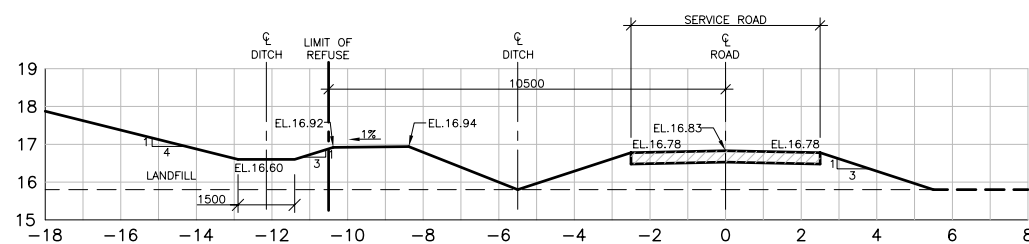
G SECTION  
C18



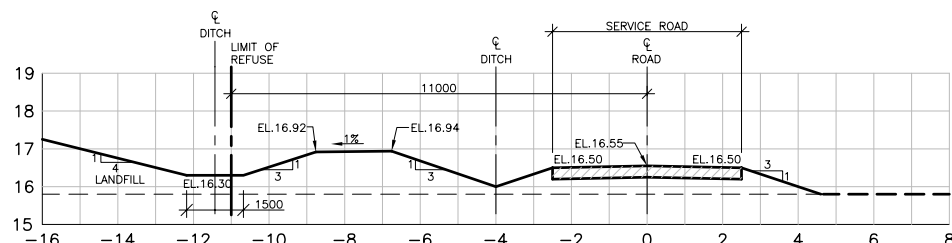
H SECTION  
C18



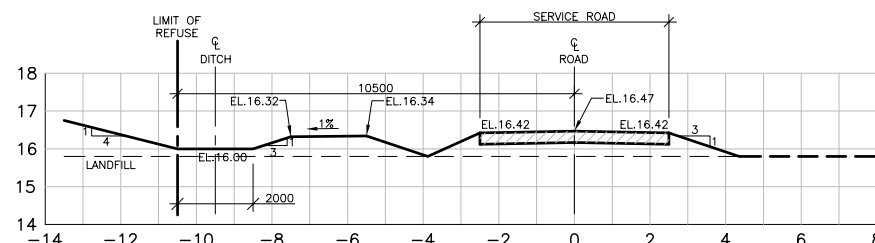
J SECTION  
C18



K SECTION  
C18



L SECTION  
C18



M SECTION  
C18

DRAFT FOR  
REVIEW

# LEGEND

- PROPOSED GROUND
- APPROXIMATE EXISTING GROUND
- APPROXIMATE EXISTING GROUND TO REMAIN

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial

Approved

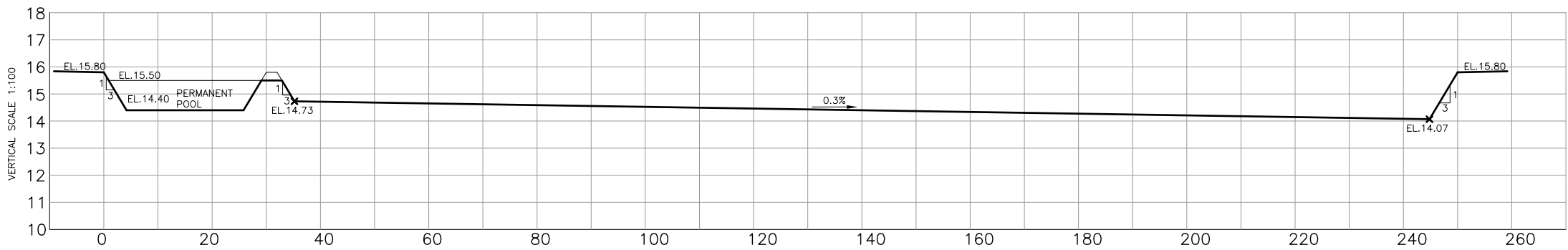
GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

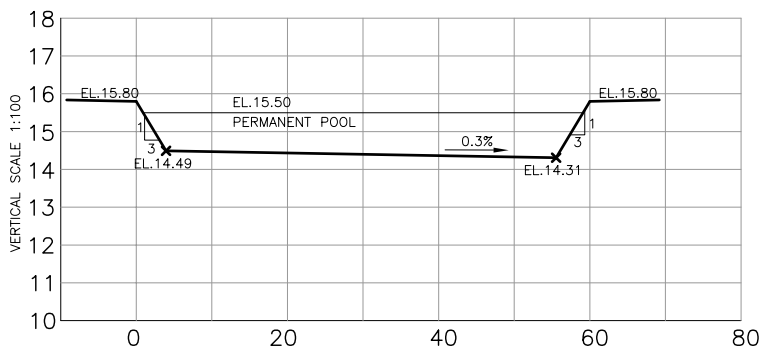
PERIMETER DITCH CROSS-SECTIONS



Source Reference:	Project Manager: S. GONSALVES	Reviewed By: E. CHENG	Designed By: P. LIM	Date: OCTOBER 2004
Scale: 1:100	Project No: 35919-30	Report No: 002	Drawing No: C-25	



F SECTION  
C23 VERTICAL SCALE 1:100  
HORIZONTAL SCALE 1:500



G SECTION  
C23 VERTICAL SCALE 1:100  
HORIZONTAL SCALE 1:500

DRAFT FOR REVIEW

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.




No	Revision	Date	Initial

Approved

GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

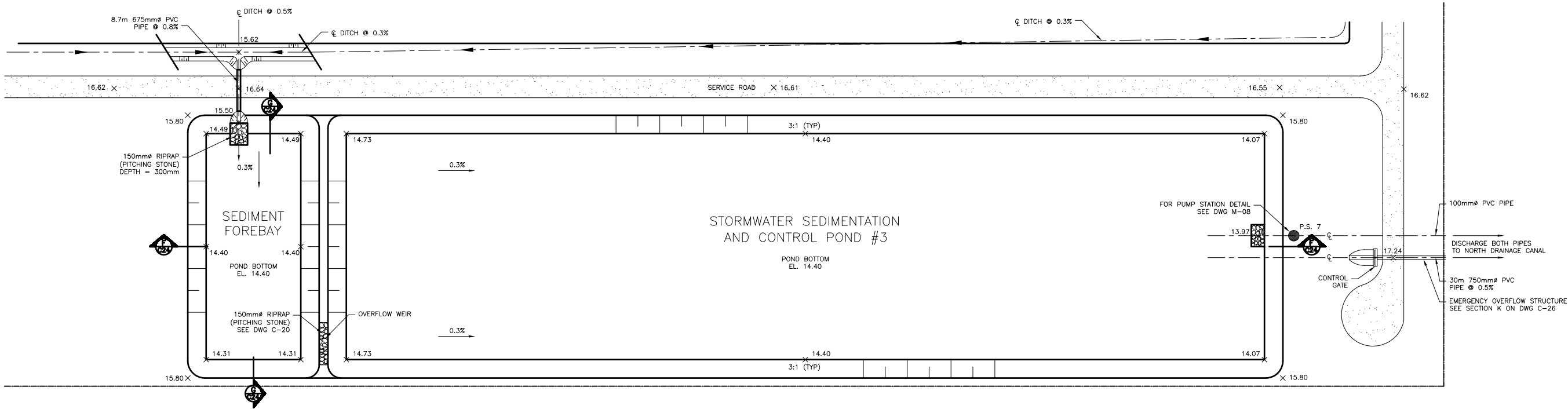
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

STORMWATER CONTROL POND NO. 3  
ELEVATIONS



Source Reference:			Date: OCTOBER 2004
Project Manager: S. GONSALVES	Reviewed By: E. CHENG	Designed By: P. LIM	Drawn By: V.B. & M.S.A.
Scale: AS SHOWN	Project No: 35919-30	Report No: 002	Drawing No: C-24





DRAFT FOR  
REVIEW

LEGEND:

- × 15.80 PROPOSED GRADE
- × (15.80) EXISTING GRADE TO REMAIN

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.






No	Revision	Date	Initial

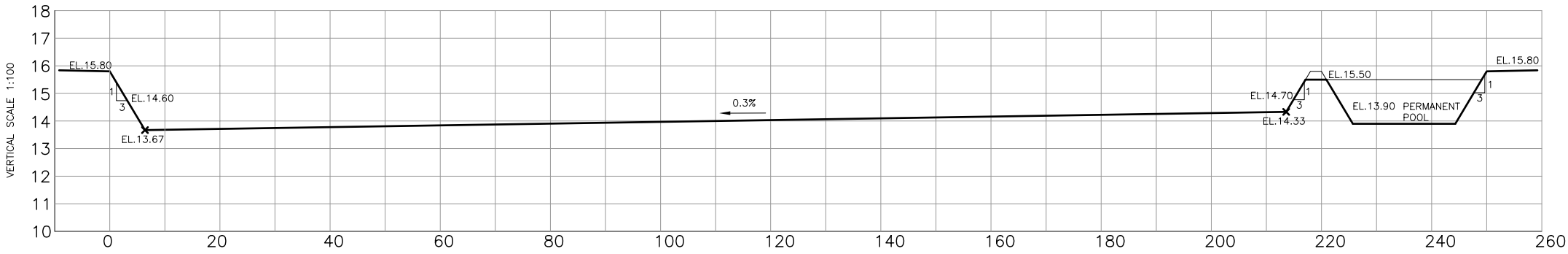
Approved

GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

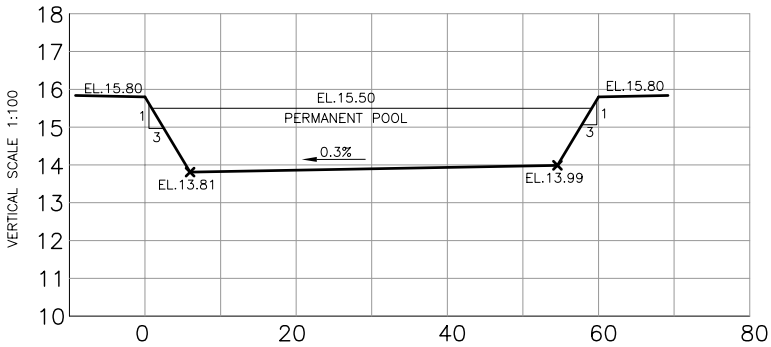
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

STORMWATER CONTROL POND NO. 3  
LAYOUT

					
Source Reference:				Date:	
Project Manager:				OCTOBER 2	
S. GONSALVES				E. CHENG	
Reviewed By:				Designed By:	
E. CHENG				P. LIM	
Designed By:				Drawn By:	
P. LIM				V.B. & M.	
Scale:				Drawing No:	
1:500				C-23	



D SECTION  
C21 VERTICAL SCALE 1:100  
HORIZONTAL SCALE 1:500






E SECTION  
C21 VERTICAL SCALE 1:100  
HORIZONTAL SCALE 1:500

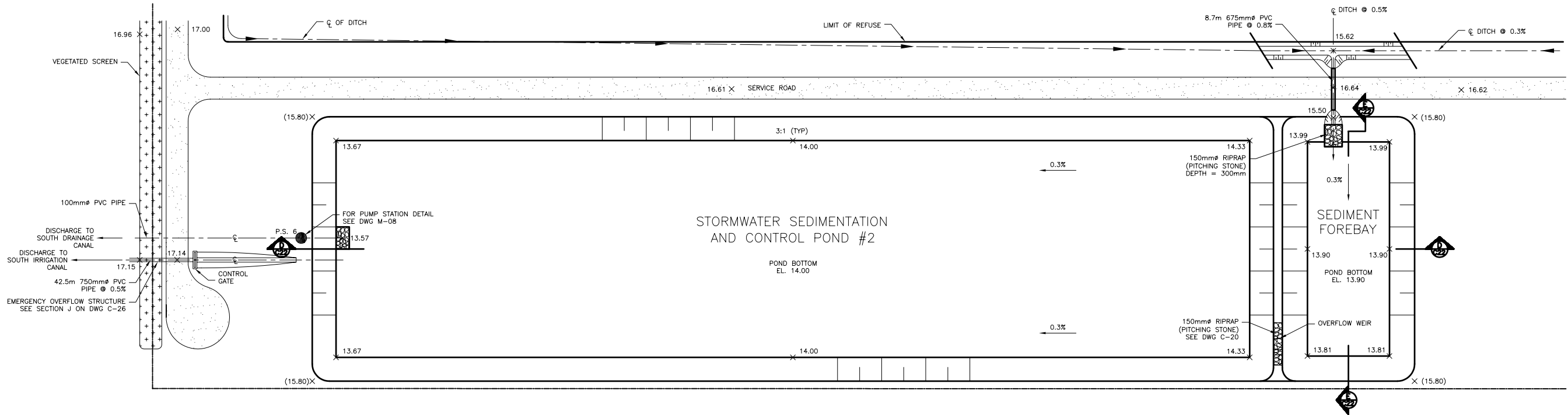
DRAFT FOR REVIEW

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.			
<div></div>			
No	Revision	Date	Initial

Approved	
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GUYANA MINISTRY OF LOCAL GOVERNMENT AND REGIONAL DEVELOPMENT
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH
STORMWATER CONTROL POND NO. 2 ELEVATIONS

					
Source Reference:				Date: OCTOBER 2004	
Project Manager: S. GONSALVES		Reviewed By: E. CHENG		Designed By: P. LIM	
Scale: AS SHOWN		Project No: 35919-30		Drawing No: C-22	






DRAFT FOR REVIEW

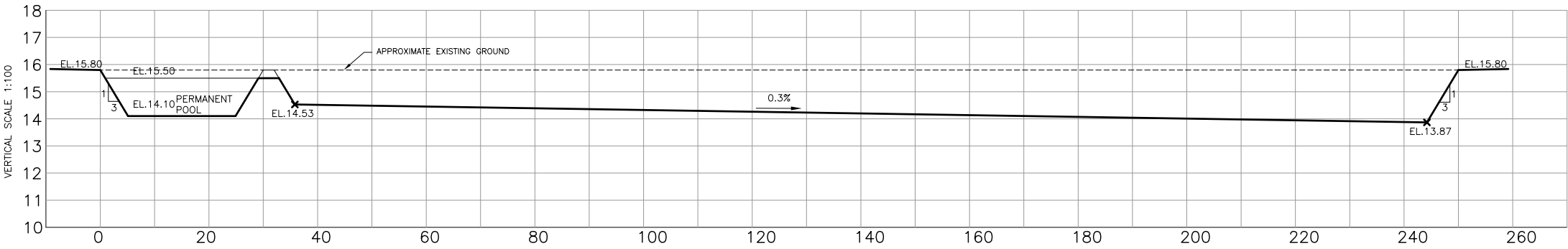
- LEGEND:**
- × 15.80 PROPOSED GRADE
  - × (15.80) EXISTING GRADE TO REMAIN

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.			
No	Revision	Date	Initial

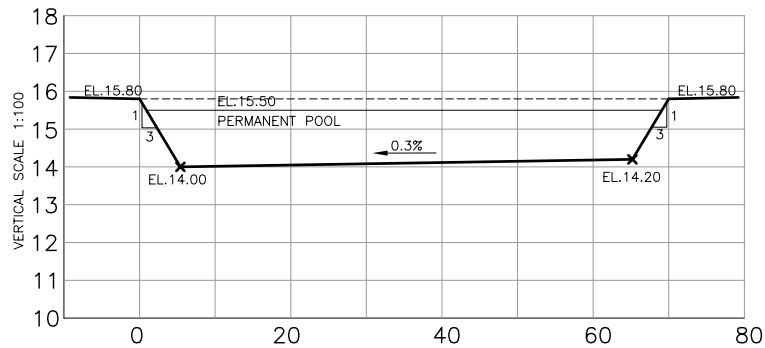
Approved	

GUYANA MINISTRY OF LOCAL GOVERNMENT AND REGIONAL DEVELOPMENT
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH
STORMWATER CONTROL POND NO. 2 LAYOUT

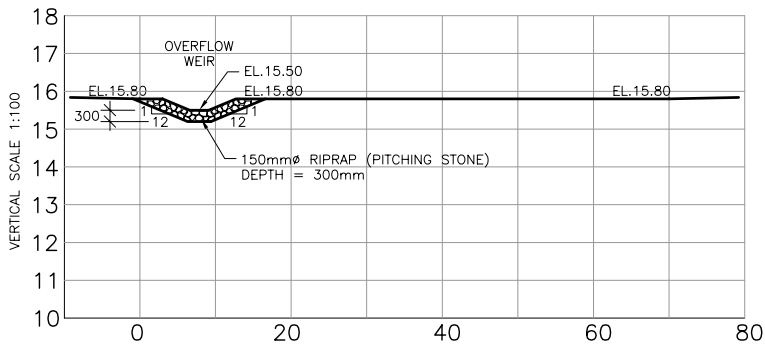
					
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Project Manager: S. GONSALVES		Reviewed By: E. CHENG		Drawn By: V.B. & M.S.A.	
Scale: 1:500		Project No: 35919-30		Report No: 002	
				Drawing No: C-21	
				OCTOBER 2004	



**A** SECTION  
C19 VERTICAL SCALE 1:100  
HORIZONTAL SCALE 1:500



**B** SECTION  
C19 VERTICAL SCALE 1:100  
HORIZONTAL SCALE 1:500



**C** SECTION (TYPICAL)  
C19 VERTICAL SCALE 1:100  
HORIZONTAL SCALE 1:500

DRAFT FOR  
REVIEW

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.






No	Revision	Date	Initial

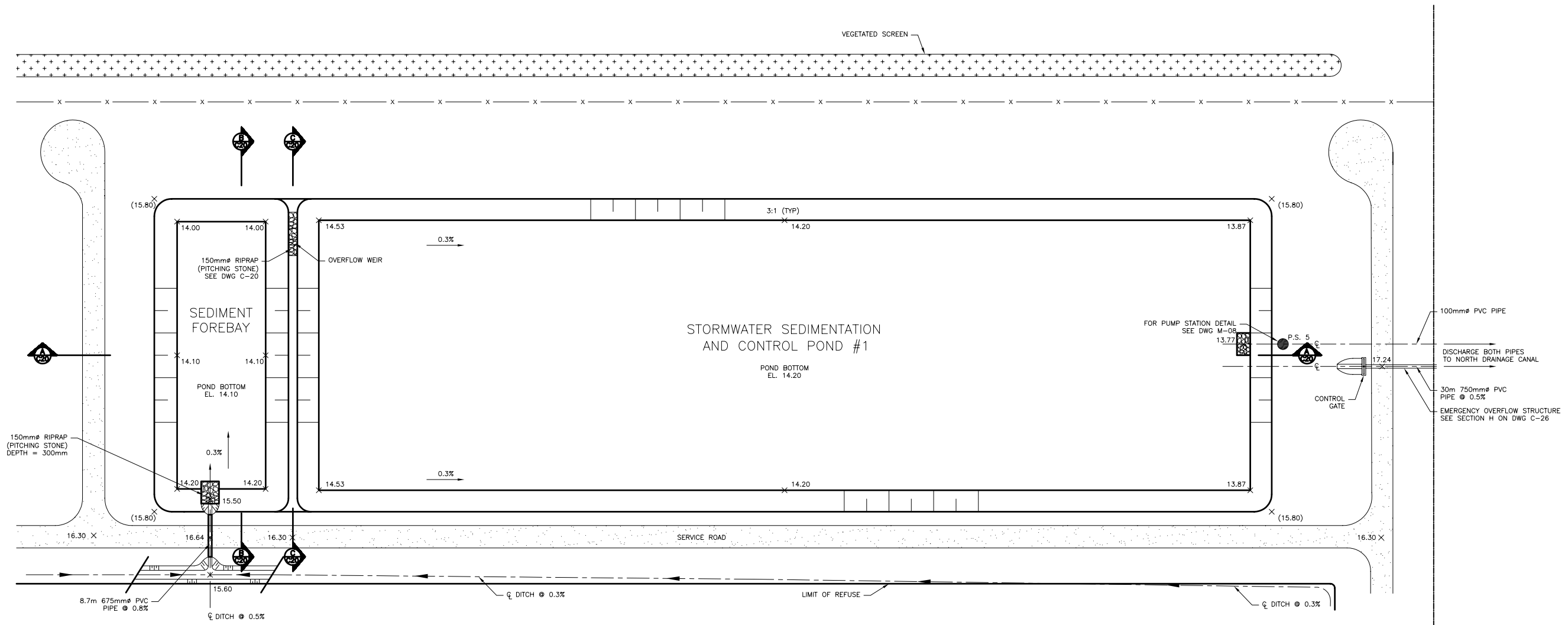
Approved

GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

STORMWATER CONTROL POND NO. 1  
ELEVATIONS

						
Source Reference:			Date:		OCTOBER 2004	
Project Manager: S. GONSALVES		Reviewed By: E. CHENG		Designed By: P. LIM		Drawn By: V.B. & M.S.A.
Scale: AS SHOWN		Project No: 35919-30		Report No: 002		Drawing No: C-20



DRAFT FOR REVIEW

**LEGEND:**




× 15.80 PROPOSED GRADE

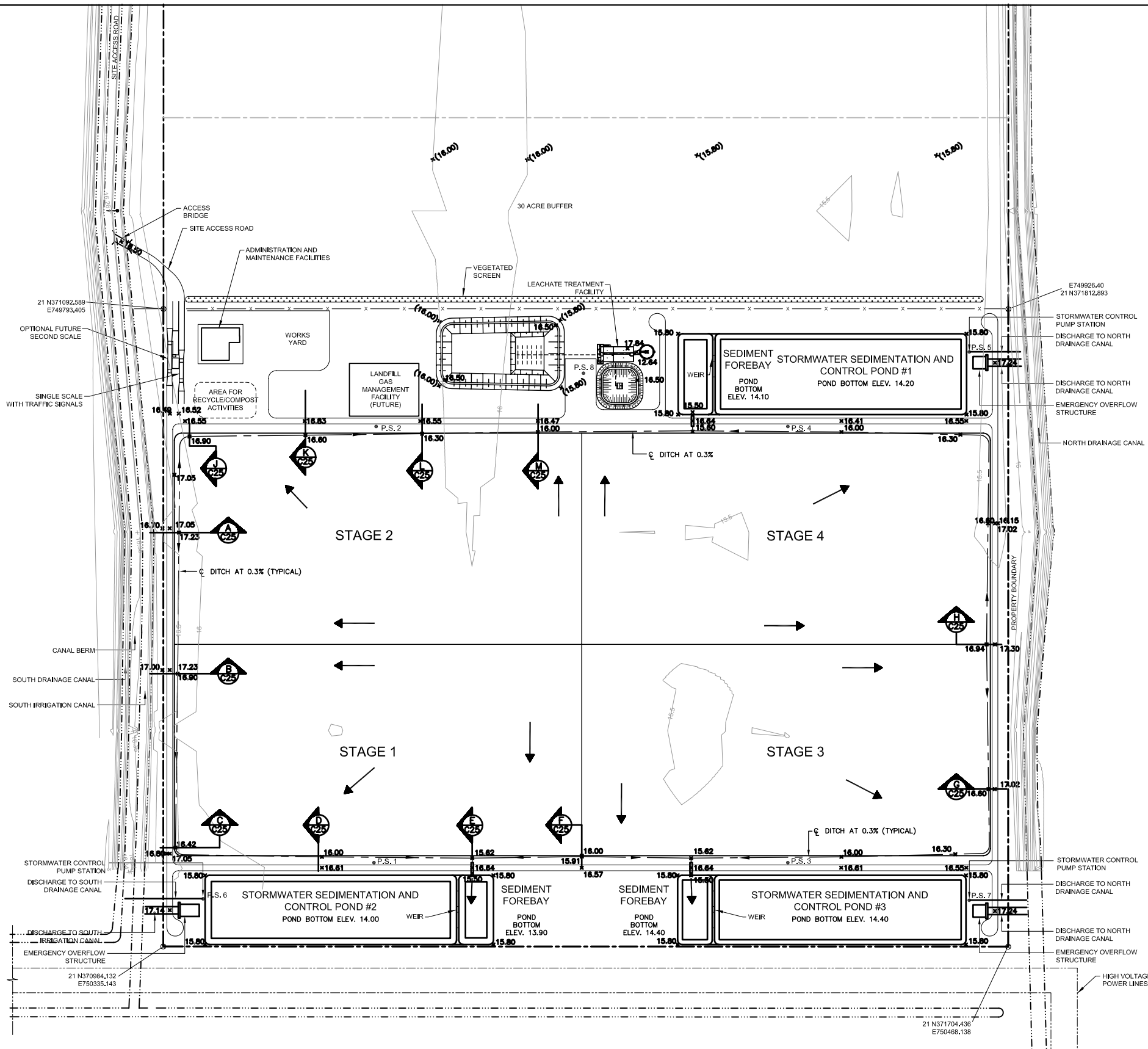
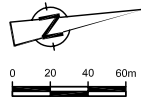
× (15.80) EXISTING GRADE TO REMAIN

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.			
No	Revision	Date	Initial

Approved	

GUYANA MINISTRY OF LOCAL GOVERNMENT AND REGIONAL DEVELOPMENT	CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH			
	STORMWATER CONTROL POND NO. 1 LAYOUT			

					
Source Reference:				Date: OCTOBER 2004	
Project Manager: S. GONSALVES		Reviewed By: E. CHENG		Designed By: P. LIM	
				Drawn By: V.B. & M.S.A.	
Scale: 1:500		Project No: 35919-30		Report No: 002	
				Drawing No: C-19	



DRAFT FOR REVIEW

NOTES:  
1. ALL ELEVATIONS ARE GIVEN IN METRES,  
REFERENCED TO GEORGETOWN DATUM (G.D.).

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial

Approved

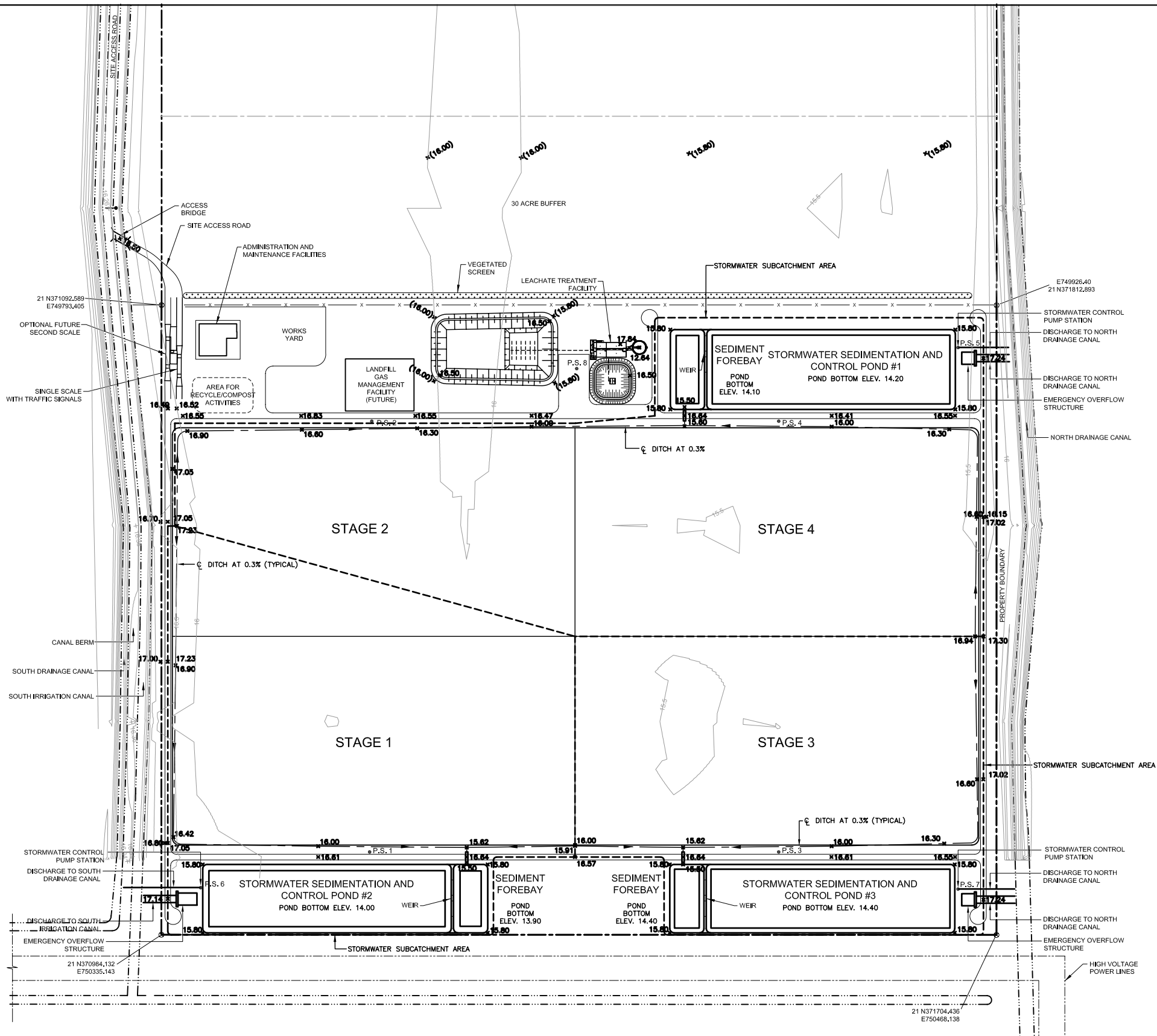
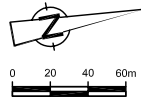
GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

SITE GRADING & DRAINAGE



Source Reference:			Date: OCTOBER 2004
Project Manager: S. GONSALVES	Reviewed By: E. CHENG	Designed By: P.LIM	Drawn By: M.S.A.
Scale: 1:2000	Project No: 35919-30	Report No: 002	Drawing No: C-18



DRAFT FOR REVIEW

NOTES:  
1. ALL ELEVATIONS ARE GIVEN IN METRES,  
REFERENCED TO GEORGETOWN DATUM (G.D.).

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial

Approved

GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

STORMWATER SUBCATCHMENT AREA  
POST-DEVELOPMENT CONDITION



Source Reference:			Date: OCTOBER 2004
Project Manager: S. GONSALVES	Reviewed By: E. CHENG	Designed By: P.LIM	Drawn By: M.S.A.
Scale: 1:2000	Project No: 35919-30	Report No: 002	Drawing No: C-17



DRAFT FOR REVIEW

NOTES:  
1. ALL ELEVATIONS ARE GIVEN IN METRES,  
REFERENCED TO GEORGETOWN DATUM (G.D.).

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial

Approved

GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

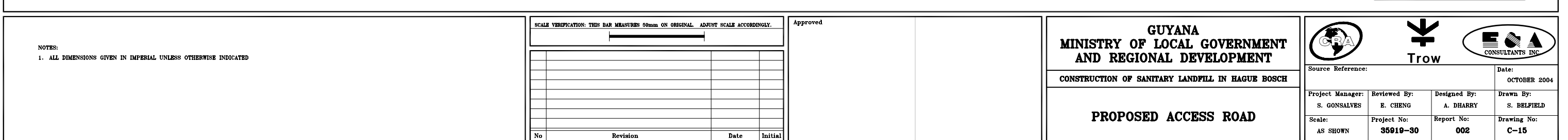
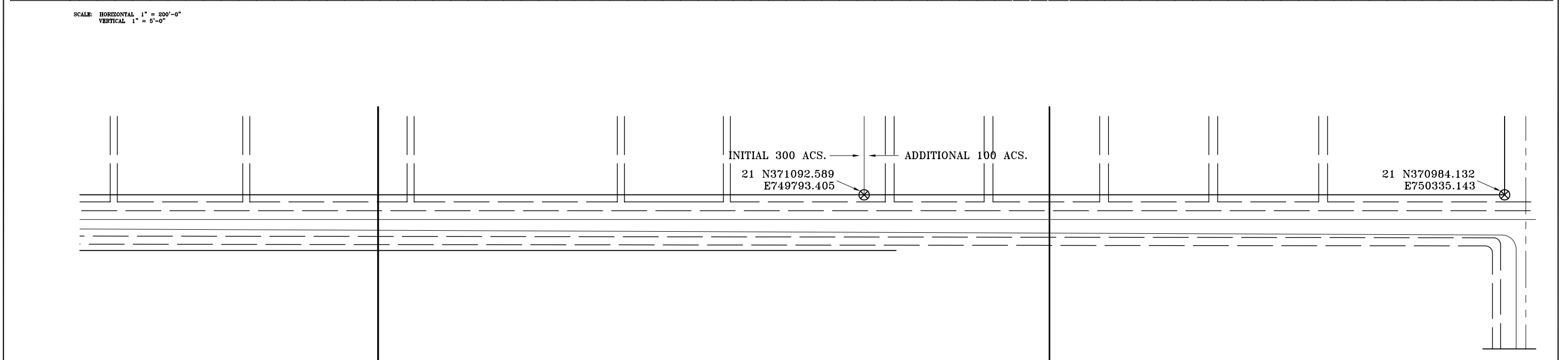
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH


STORMWATER SUBCATCHMENT AREA  
PRE-DEVELOPMENT CONDITION






Source Reference:			Date: OCTOBER 2004
Project Manager: S. GONSALVES	Reviewed By: E. CHENG	Designed By: P.LIM	Drawn By: M.S.A.
Scale: 1:2000	Project No: 35919-30	Report No: 002	Drawing No: C-16

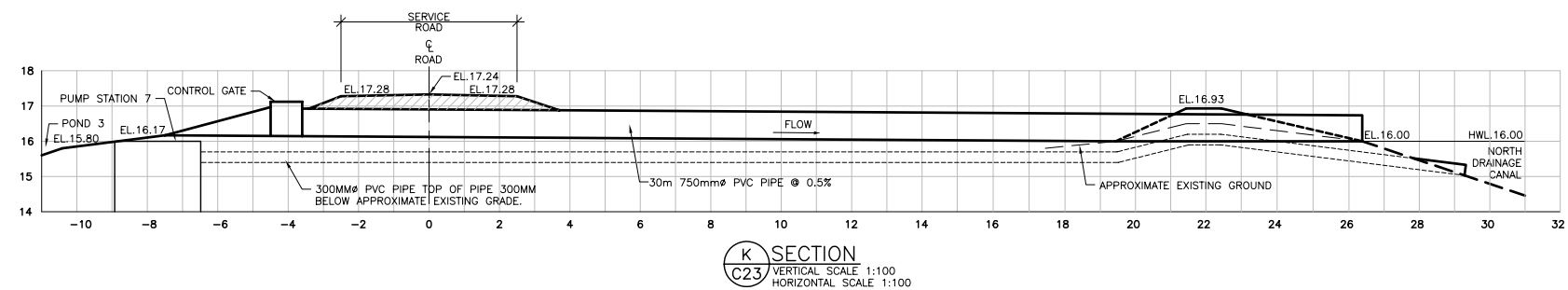
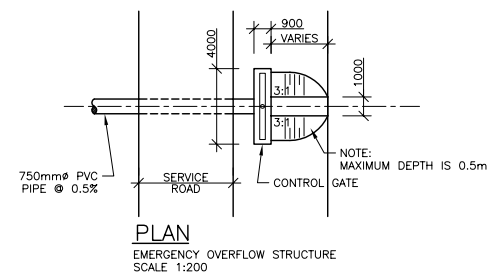





SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.			
			
No	Revision	Date	Initial

**PROPOSED ACCESS ROAD**

		
Source Reference:		Date: <div style="text-align: right;">OCTOBER 2004</div>
Project Manager: S. GONSALVES	Reviewed By: E. CHENG	Designed By: A. DHARRY
Scale: AS SHOWN	Project No: <b>35919-30</b>	Drawing No: <b>C-15</b>



DRAFT FOR  
REVIEW

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.			
			
No	Revision	Date	Initial

Approved

GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

## DISCHARGE STRUCTURE DETAILS



Trow



Source Reference:

Date: OCTOBER 2004

Project Manager:  
S. GONSALVES

Reviewed By:  
E. CHEN

Designed By:	P. LIM
--------------	--------

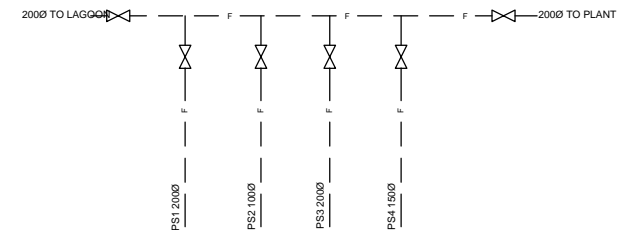
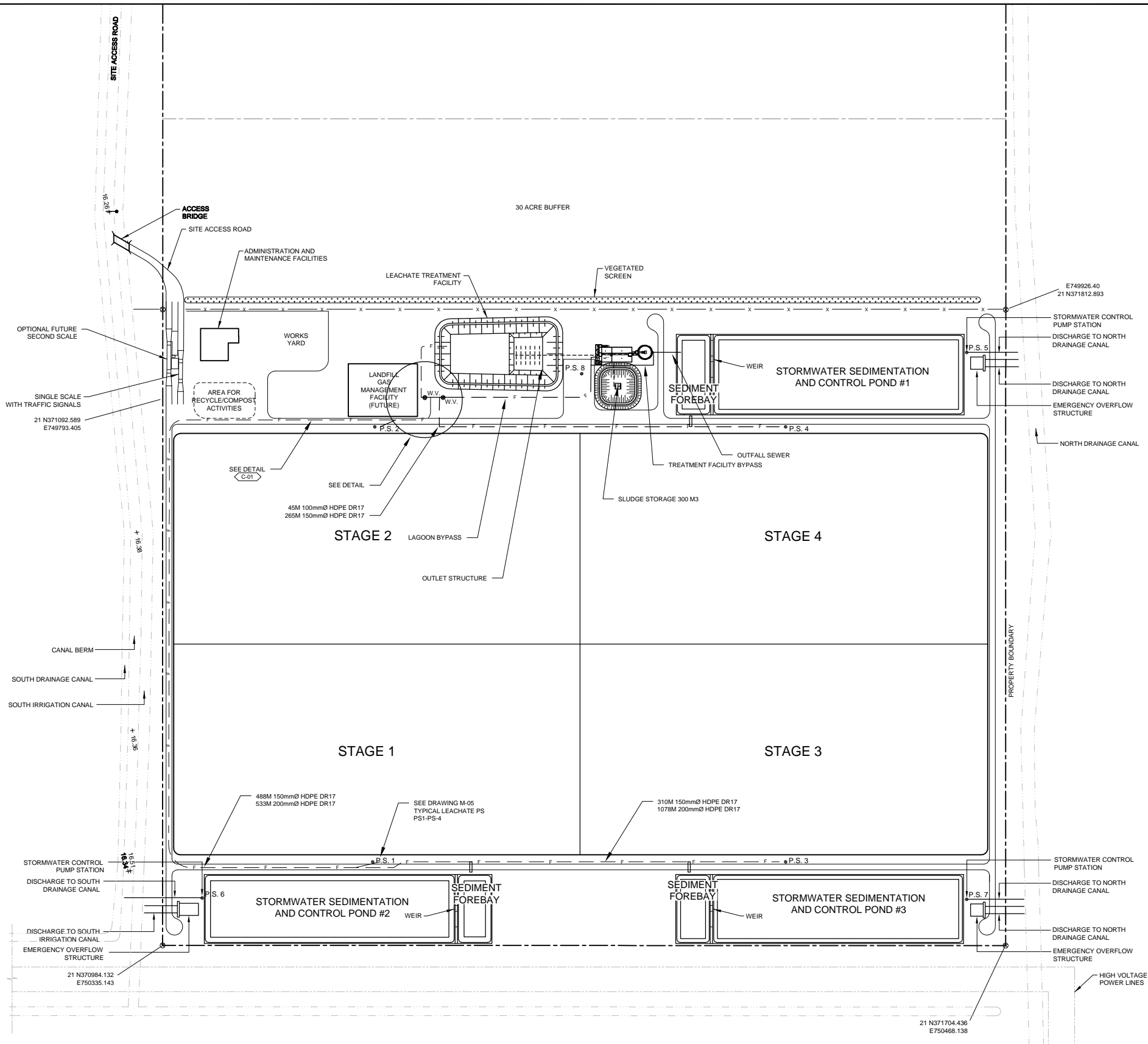
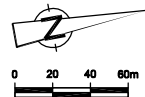
Drawn By: M.S.A.

Scale:  
AS SHOWN

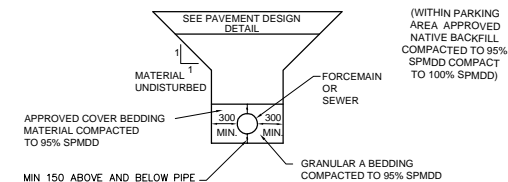
Project No:  
35919-30

Report No: 002

Drawing No: C-26



DETAIL 'A'



TYPICAL TRENCH SECTION

C-01

DRAFT FOR REVIEW

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

No	Revision	Date	Initial

Approved

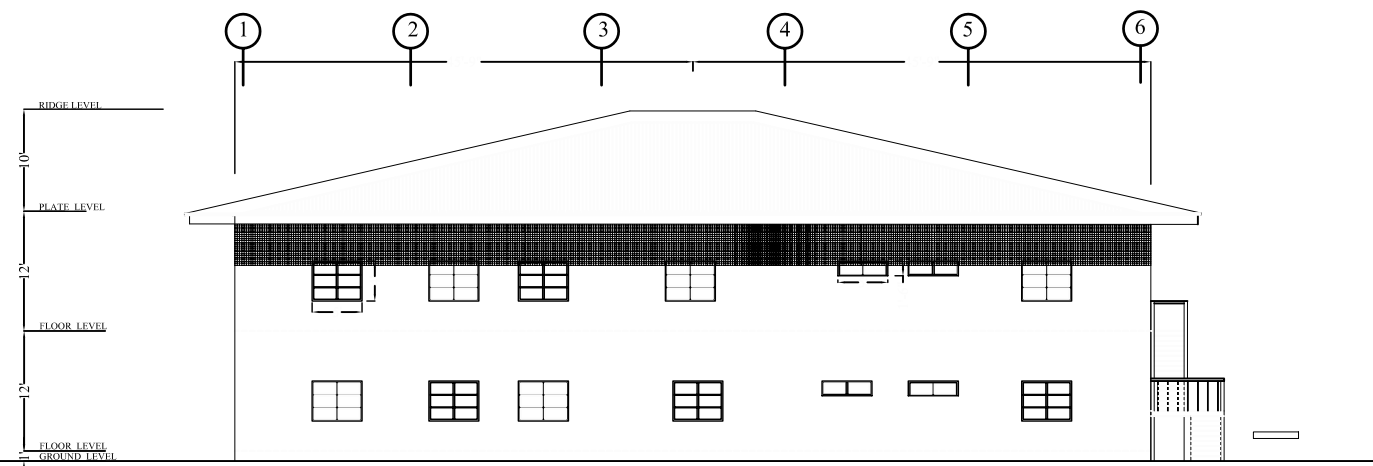
GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

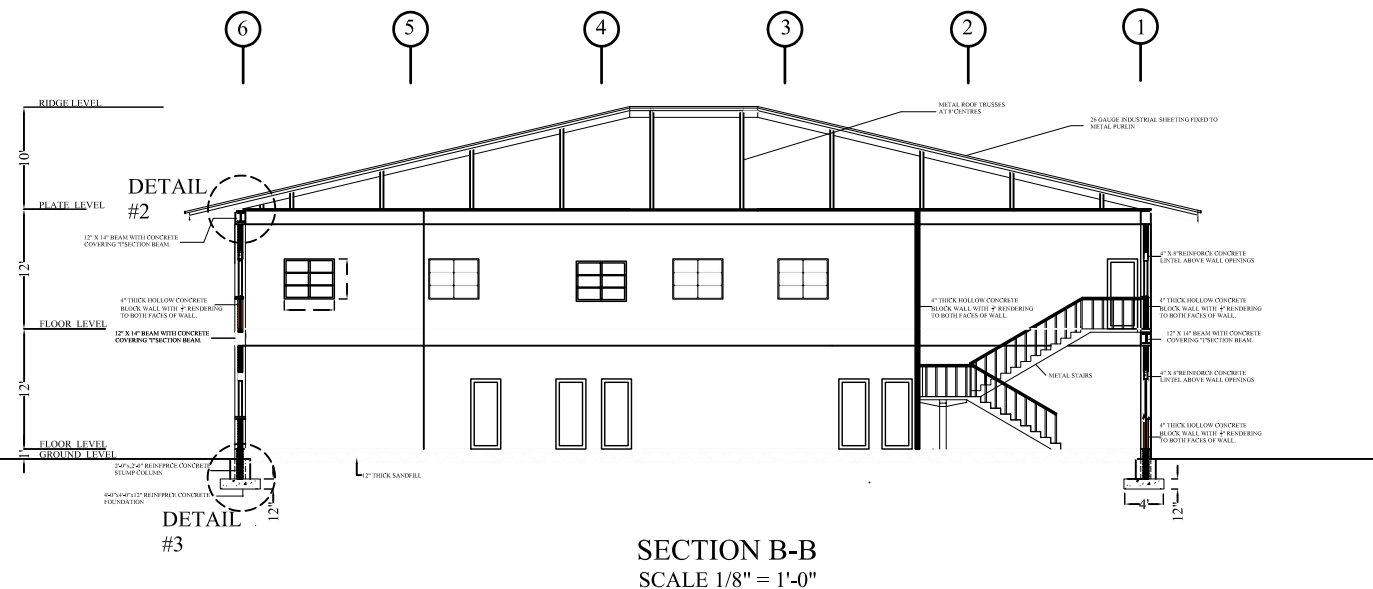
LEACHATE TREATMENT FACILITY  
SITE PLAN

Source Reference:	Date:	OCTOBER 2004
Project Manager: R. MOSHER	Reviewed By: D. MILLAR	Designed By: B. APP
Scale: 1:2000	Project No: 35919-30	Report No: 002
		Drawn By: I. ROBERTSON
		Drawing No: C-27






SOUTHERN ELEVATION  
SCALE 1/8" = 1'-0"



NOTES:

1. ALL DIMENSIONS GIVEN IN IMPERIAL UNLESS OTHERWISE INDICATED

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY

<div style="text-align: center;">  </div>			
No	Revision	Date	Initial

Approved

GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

BUILDING ELEVATIONS AND SECTIONS



Source Reference:

Date:

Project Manager:	S. GONSALVES
------------------	--------------

Reviewed By:	E. CH
--------------	-------

Designed By:	A. DHARRY
--------------	-----------

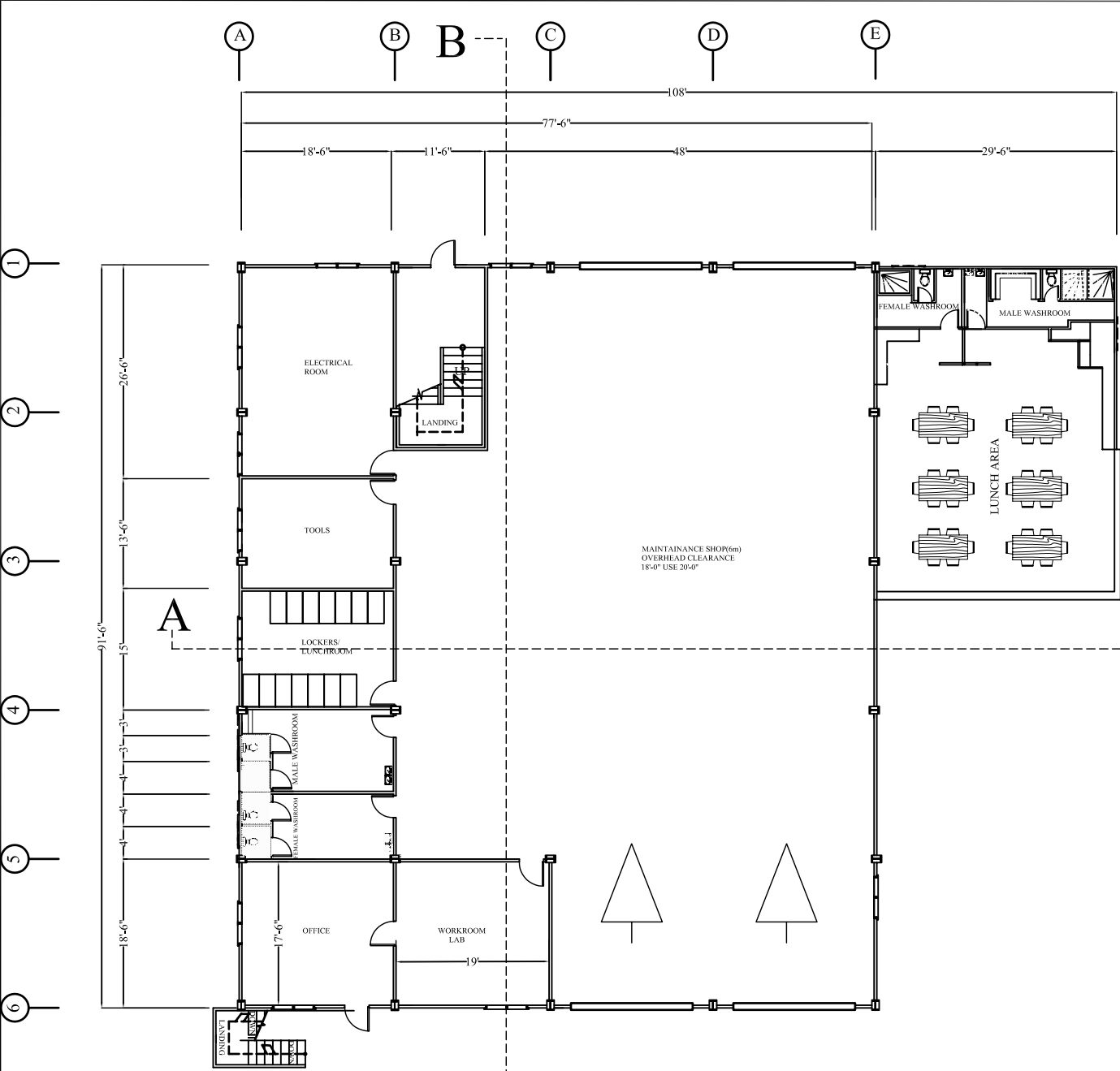
Drawn By:	J. OUDKER
-----------	-----------

Scale:  
AS SHOWN

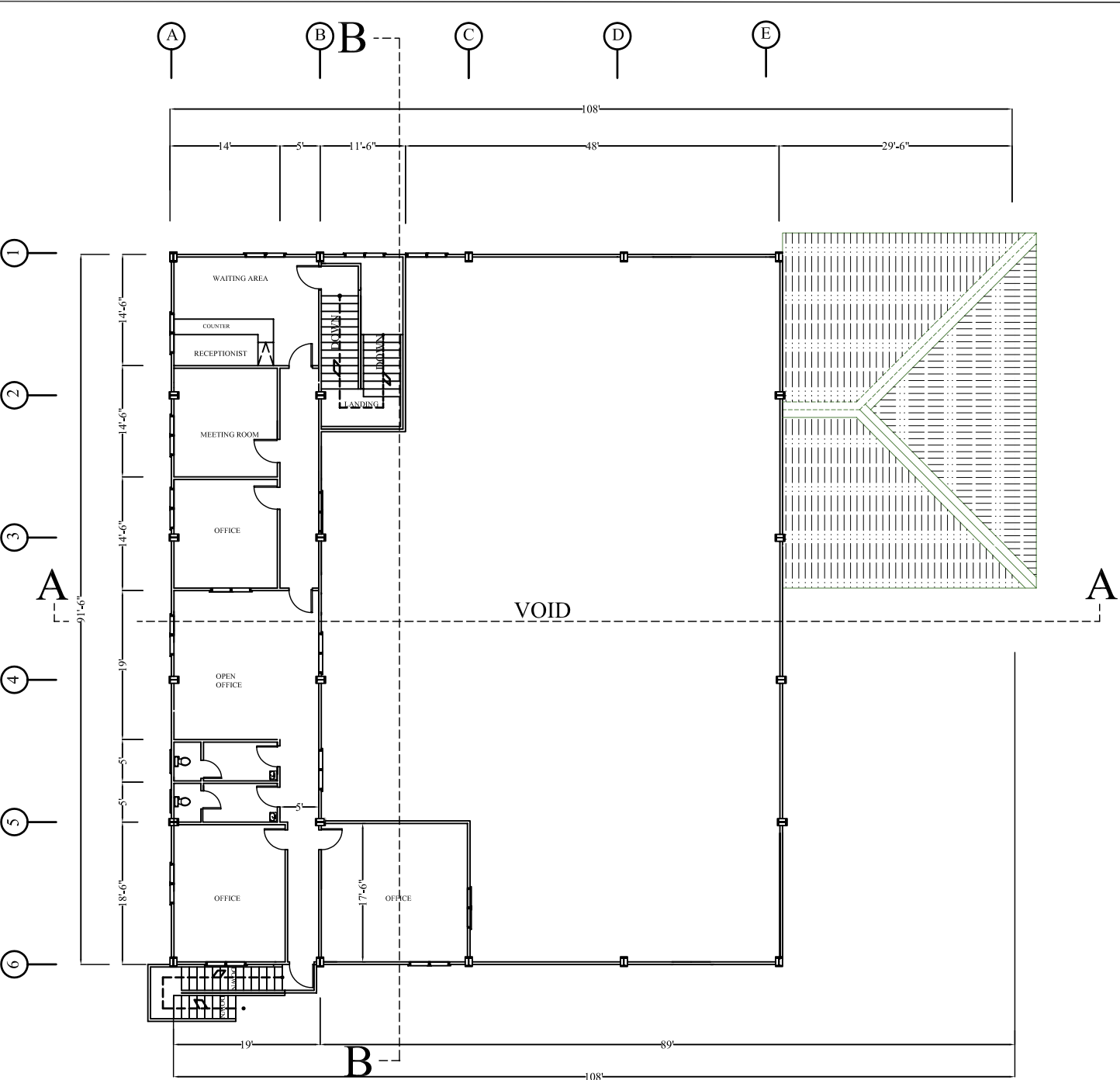
Project No:	35919-30
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Report No:	002
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Drawing No:	C-40
-------------	------



**B**  
GROUND FLOOR PLAN  
SCALE 1/8" = 1'-0"



**B**  
FIRST FLOOR PLAN  
SCALE 1/8" = 1'-0"

DRAFT FOR  
REVIEW




NOTES:  
1. ALL DIMENSIONS GIVEN IN IMPERIAL UNLESS OTHERWISE INDICATED

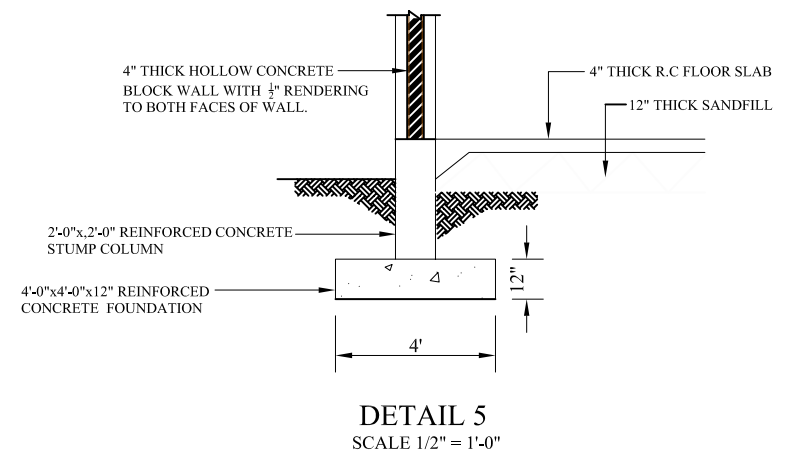
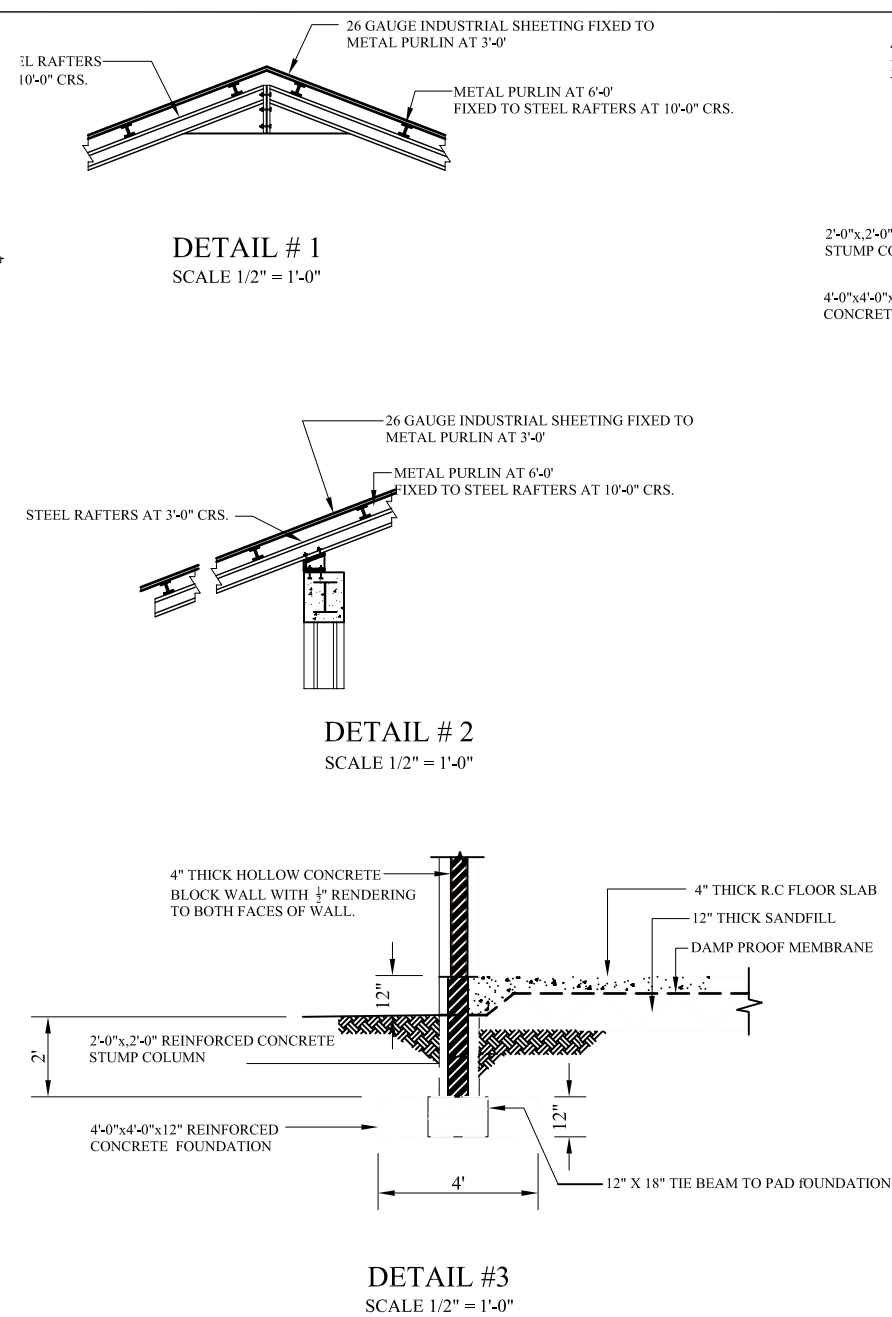
SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY

No	Revision	Date	Initial

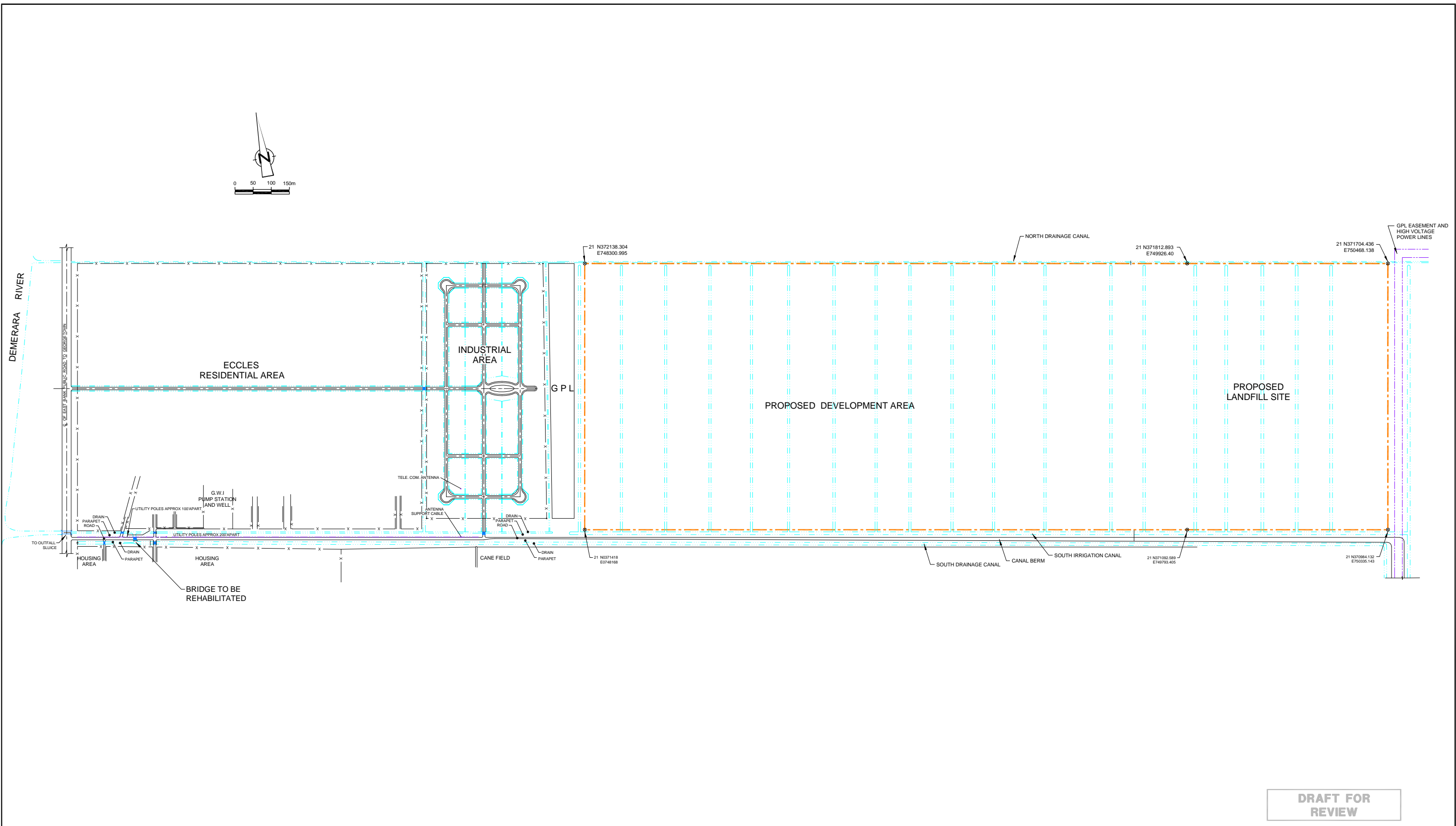
Approved

GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT  
CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH  
ADMINISTRATION BUILDING

					
Source Reference:				Date: OCTOBER 2004	
Project Manager: S. GONSALVES		Reviewed By: E. CHENG		Designed By: A. DHARRY	
Scale: AS SHOWN		Project No: 35919-30		Report No: 002	
				Drawn By: J. OUDKERK	
				Drawing No: C-39	



Source Reference:			Date: OCTOBER 2004
Project Manager: S. GONSALVES	Reviewed By: E. CHENG	Designed By: A. DHARRY	Drawn By: J. Oudkerk
Scale: AS SHOWN	Project No: 35919-30	Report No: 002	Drawing No: C-41



**LEGEND**

PROPERTY BOUNDARY

SITE BOUNDARY

CANAL

FENCE

BRIDGE

CULVERT STRUCTURE

DIRECTION OF FILL

PLACEMENT OF INTERIM COVER

LIMIT OF LANDFILL WASTE

UTILITY LINE

ACCESS ROAD

SCREENING BERM

P.S. 4

CONDENSATE TRAP/LEACHATE PUMP STATION

PROPOSED LANDFILL GAS HEADER

PROPOSED LANDFILL GAS BLIND FLANGE

PROPOSED LANDFILL GAS EXTRACTION TRENCH (FUTURE)

PROPOSED LANDFILL GAS LATERAL (FUTURE)

**NOTES:**

1) ALL MEASUREMENTS IN METRES UNLESS OTHERWISE INDICATED

2) NORTH AND SOUTH DRAINAGE CANALS DRAIN WEST TO THE DEMERARA RIVER.

SCALE VERIFICATION: THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.				
<div></div>				
No	Revision	Date	Initial	

Approved

GUYANA  
MINISTRY OF LOCAL GOVERNMENT  
AND REGIONAL DEVELOPMENT

CONSTRUCTION OF SANITARY LANDFILL IN HAGUE BOSCH

EXISTING CONDITIONS  
(OVERALL SITE AREA)

Source Reference:  
SITE PLAN AND SURVEY COORDINATES FROM:  
TROW INTERNATIONAL LTD. 2004

Date:  
OCTOBER 2004

Project Manager: R. MOSHER	Reviewed By: D. MILLAR	Designed By: D. HATRICK	Drawn By: I. ROBERTSON
Scale: 1:5000	Project No: 35919-30	Report No: 002	Drawing No: C-01

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