

**AIRPORT GATEWAY PROJECT
New Providence, Bahamas**

Segment One

John F. Kennedy Drive from Windsor Field Road to Bethel Avenue

ENVIRONMENTAL IMPACT ASSESSMENT

Prepared for



**Government of the Commonwealth of The Bahamas
Ministry of Works and Transport**

Prepared by



Blue Engineering Ltd.
PROFESSIONAL CIVIL, STRUCTURAL
& ENVIRONMENTAL ENGINEERING CONSULTANCY

For further information please contact
Michelle Lakin (242) 324-7850
650 East Bay Street, P. O. Box SS 6328
Nassau, Bahamas

September 29, 2010

Segment One
John F. Kennedy Drive from Windsor Field Road to Bethel Avenue

ENVIRONMENTAL IMPACT ASSESSMENT

Prepared by
Blue Engineering Ltd.
September 24, 2010

The contents of this report reflect the view of the authors, but not necessarily the official view or policy of MOWT. This report doesn't constitute a standard, specification or regulation.

This report has been prepared only for the titled project and only for the person by whom it was commissioned. Any other project using this report shall get the prior written approval or authority from Blue Engineering Ltd.

Blue Engineering Ltd. accepts no responsibilities for the consequences of this report being used for a purpose other than the purpose for which it was commissioned.



Airport Gateway Project - Segment One – John F. Kennedy Drive from Windsor Field Road to Bethel Avenue

Environmental Impact Assessment

	Page
Executive Summary	i
1.0 INTRODUCTION	1
1.1 Project Background	1
1.2 Project Introduction	4
1.3 Objectives	4
1.4 Methodology	4
1.5 Project Sphere of Influence	7
2.0 ENVIRONMENTAL POLICY, INSTITUTIONAL AND LEGISLATIVE AND REGULATORY FRAMEWORK	10
2.1 Policy Aspects	10
2.2 The Environmental Institutional Framework	11
2.3 National Environmental Laws and Regulations	11
2.3.1 The Town Planning Act (1961)	11
2.3.2 Water and Sewerage Act 1976	12
2.3.3 Environmental Health Act 1987	12
2.3.4 Bahamas National Trust Act	12
2.3.5 The Conservation and Protection of the Physical Landscape of The Bahamas Act and Regulations 1997	12
2.3.6 Wild Birds Protection Act 1987	14
2.3.7 Plants Protection Act 1987	14
2.3.8 Wild Animals Protection Act	14
2.3.9 Antiquities, Monuments and Museum Act 1998 and Regulations 1999	14
2.3.10 Acquisition of Land 1913	14
2.3.11 Other Legislation	16
2.4 International Environmental Conventions	17
3.0 THE PROJECT	18
3.1 Location	18
3.2 General Project Scope	18
3.2.1 Construction Works	20
3.3 Construction Aspects	31
3.3.1 Contractual Matters	31
3.3.2 Construction Arrangements	34
3.3.3 Construction Supervision	34
3.4 Land and Property Acquisition	34
3.5 Project Costs	34
4.0 ENVIRONMENTAL BASELINE CONDITIONS	35
4.1 Overview	35
4.2 Physical Aspects	35

4.2.1	Land Use	35
4.2.2	Meteorology and Climate	36
4.2.3	Geology and Soils	39
4.2.4	Hydrology and Water Quality	40
4.2.5	Air Quality and Ambient Noise	44
4.3	Biological Aspects	44
4.3.1	Vegetation and Wildlife	44
4.3.2	Protected Areas	58
4.3.3	Other areas of Environmental Importance	58
4.4	Social and Socio-economic Aspects	61
4.4.1	General Population Characteristics	61
4.4.2	Income and Poverty	62
4.4.3	Economic Activities and Employment	62
4.4.4	Social infrastructure	64
4.4.5	Utilities and Supporting Infrastructure	66
4.4.6	Accessibility and Transport	67
4.4.7	Gender and Development	79
4.4.8	Other Social Issues in the Project Area	79
4.4.9	Cultural Heritage and Archaeology	79
4.4.10	Aesthetics	80
4.5	Future Development in the Project Area	83
4.6	Trends in Baseline Conditions	83
5.0	IMPACTS, BENEFIT ENHANCEMENT AND MITIGATION MEASURES	84
5.1	Overview of Impacts	84
5.2	Impacts and Mitigation during Construction	84
5.3	Impacts and Mitigation during Operation	96
5.4	Key Potentially Beneficial Impacts	121
5.5	Key Potentially Adverse Impacts	122
5.6	Uncertainties in Impact Assessment	123
5.7	Overall Project Environmental Performance	124
5.8	Economic Assessment	124
5.9	Analysis of Alternatives	124
5.9.1	The “Do-nothing” Alternative	125
5.9.2	Alternative Transport Modes	125
5.9.3	Improvement of the Existing Carriageway	125
5.9.4	Other Alternatives	130
6.0	ENVIRONMENTAL MANAGEMENT AND MONITORING	132
6.1	General Considerations	132
6.2	Organisational Aspects	132
6.2.1	Government organisations	133
6.2.2	Design and Construction Supervision Consultants	133
6.2.3	Contractor	133
6.2.4	Others	134
6.2.5	Environmental Management Structure	134
6.3	Pre-construction Phase Activities and Responsibilities	136
6.3.1	Government Environmental Requirements	136
6.3.2	EIA, Detailed Design and Tender Document Aspects	136
6.3.3	Stakeholder Consultation	137
6.3.4	Land and Property Acquisition Aspects	138
6.4	Construction Phase Activities and Responsibilities	138
6.4.1	Environmental Review of Project Designs and Documentation	139
6.4.2	Environmental Briefing of Contractors	139

6.4.3	Environmental Monitoring and Reporting	139
6.4.4	Monthly Progress Meetings	142
6.4.5	Review and Updating of Procedures etc	142
6.5	Operational Phase Activities and Responsibilities	143
6.6	Environmental Management Plan	143
6.6.1	Objectives	143
6.6.2	Initiation Procedure	144
6.6.3	Scope	144
6.6.4	Environmental Management Framework	144
6.6.5	Checklist of Environmental Stipulations	145
6.7	Contractor Facilities, Plant and Operations	149
6.8	Environmental Management and Monitoring Costs	149
7.0	CONCLUSIONS	151
7.1	Feasibility/ Practical Utility of the Project	151
7.2	Various Options considered for the Project	151
7.3	Availability of Resources and Materials	151
7.4	Identification of the Main Issues and Concerns	151
7.5	Mitigation Measures proposed	152
7.6	Benefits of the Project	155
7.7	Environmental Management Plan (EMP)	160
8.0	RECOMMENDATIONS	156
9.0	REFERENCES	157
10.0	APPENDICES	160



Executive Summary

This report presents an Environmental Impact Assessment (EIA) for the first segment of the proposed Airport Gateway Project. The Airport Gateway Project consists of three segments. Segment One is John F. Kennedy (JFK) Drive from Windsor Field Road to Bethel Avenue. The extent and location of the other segments are still to be confirmed.

The reasons for the project include the following:

- 1) Reduce the existing traffic congestion on JFK Dr.
- 2) Re-align the route to reduce potential traffic accidents and satisfy the design speed requirement;
- 3) Be in conjunction with the on-going Airport Expansion Project to facilitate the transportation between airport and downtown for tourism growth;
- 4) To improve the beautification and landscaping of Airport Gateway to enhance the Bahamas as one of the best tourist destination.

The segment covered in this report involves the widening of JFK Drive from a two lane road to a dual twin lane divided highway with a design speed of 55 mph between the International Airport and Bethel Avenue.

In 2009, the Ministry of Finance approved receipt of a China Exim Bank 150 Million USD concessional loan, out of which the Airport Gateway project (AGP) is of a high priority. The Ministry of Public Works and Transportation and China State Construction Engineering Corporation Ltd. (CSCEC) later signed an agreement engaging CSCEC to perform the Design-Build Service for the Airport Gateway project. In August 2010, the Ministry of Public Works and Transport invited Blue Engineering Ltd. to implement the Environmental Impact Assessment (EIA) for the project.

This report provides an assessment of the likely overall impact of the project, through identification and evaluation of the potential beneficial and adverse impacts associated with implementation and subsequent operation. It also identifies appropriate benefit enhancement and adverse impact mitigation measures aimed at improving environmental performance. In this context, it should be noted that the term “environment” and its derivatives have been used in a wide sense, which covers not only physical and biological aspects, but also the human dimension.

This assessment was carried out mainly to provide relevant information as required by the Bahamian Government before project implementation can be sanctioned and early guidance on environmental aspects to be taken into consideration by those who will be involved in final design and preparation of contract documents.

Components of the EIA Report

This Assessment contains the identified environmental impacts and their mitigation measures. Besides, the Assessment also includes guidelines for the Environmental Management Plan to cover the mitigation measures, monitoring requirements and institutional responsibilities (during design, construction and operation phases of the proposed Project).

Existing Environmental Conditions in the Project Area

The project area lies between the International Airport and the capital city, Nassau, the most populated east end of the island and the major tourist areas. The corridor provides a major east west route for motorists and an access route to nearby areas that are currently developing. Alternative east west corridors exist north and south of JFK Drive, these are West Bay Street and Carmichael Road respectively.

New Providence is characterised by extremely high levels of car ownership and suffers from severe traffic congestion throughout the working day with traffic almost gridlocked at peak hours. The traffic flows on the east west corridors are nearing or at capacity due to the increased amount of traffic with little road improvement works having taken place over the years.

The project will directly impact a number of sensitive environmental areas including two Lakes and their associated wetlands.

The Project – Impacts and Mitigations

The widened JFK Drive has been developed, as far as is possible, to minimise conflict with human settlement and environmentally sensitive areas. By generally staying south of the existing road, the new alignment will avoid the majority of Lake Cunningham and a majority of private properties. This alignment will also make use of land owned by the electricity corporation by re-locating the high voltage cables underground.

In the absence of detailed information at this stage of the project, a broad land-use classification system has been employed to provide initial estimates of the quantity and type of land that may be required. It is estimated that the project will require approximately 110 acres of land, predominately existing road right of way, electricity corporation land and private properties in forest or wetlands. Initial estimates suggest that: there are ten buildings lying in the proposed project right of way (ROW).

The route corridor impacts on areas of particular ecological value and may threaten the area's biodiversity.

Constructing the road to highway standard with limited interchanges will serve to limit post construction environmental degradation.

Although a large number of other potentially adverse impacts have been identified, particularly in relation to the construction phase, all can be mitigated satisfactorily through adoption of specified mitigation measures and residual impacts can be reduced to acceptable levels, provided that the measures are fully adopted and/or enforced.

The beneficial impacts associated with the project are many and are largely related to local environmental improvements along JFK Drive, West Bay Street and Carmichael Road and to two-way accessibility benefits associated with vehicle operating cost and time travel savings.

It is considered that the long-term benefits of project implementation outweigh the largely short-term adverse impacts, mostly associated with construction, all of which can in any case be mitigated satisfactorily.

There are, however, two areas of major concern:

- It should be re-iterated that it will be vital that there is effective, two way consultation and liaison with local populations and stakeholders who are likely to be impacted, directly and indirectly by the project, especially in relation to land acquisition.
- Effective cross Ministry co-ordination will be vital if the true economic benefits of the project are to be obtained without long term environmental loss. This largely pertains to careful planned development and the enforcement of planning policy and guidelines.

If these two issues can be dealt with satisfactorily, from an environmental impact viewpoint, and the mitigation measures included in this report implemented, there are no grounds for concluding that the project, as currently envisaged, should not go ahead.

1.0 INTRODUCTION

1.1 Project Background

The Commonwealth of The Bahamas is a unique subtropical archipelagic nation. It is situated fifty miles east of the United States of America and a similar distance north-west of the island of Cuba (refer to Figure 1.1). New Providence Island is the main island of The Bahamas and contains the capital, Nassau. The island is some 20 miles long and 7 miles wide.



Figure 1.1 Regional Map

During the last decade the expansion of the road network capacity of New Providence Island has failed to keep up with the growth of vehicular traffic. As a result the island suffers from severe levels of traffic congestion, particularly throughout the eastern part of the island, and road users experience high transportation costs in the form of congestion delays and high vehicular operating costs.

Figure 1.2 shows the existing road network in New Providence Island.

Most residents use private cars or buses for transport, while tourists arriving on cruise ships docking in Nassau harbour, or by air at the international airport, use taxis and boats or simply walk around the downtown area of the capital Nassau.

The Eastern part of the Island is highly urbanised with new housing projects close to absorbing the few remaining rural areas. Peak travel period is between 7.30 am — 9.30 am when the average speed is less than a quarter of the normal. In central parts of the island the road network capacity is far from adequate for existing traffic let alone for the traffic volumes that can be expected when residential developments currently under construction are completed. As a direct consequence severe delays are currently experienced during peak periods and particularly during the morning school run.

The present problems of road congestion can only be overcome through a planned traffic management strategy and the implementation of a sensible road hierarchy. Deficiencies in the road network capacity in the less densely populated western part of the island are not as serious as yet.

The conceptual plan to improve the existing Airport Gateway, which links Lynden Pindling International Airport (LPIA) and Downtown Nassau, can be traced back to 2000 when the Ministry of Public Work and Transportation commissioned Mott McDonald to undertake a preliminary cost estimation for dualisation of John F. Kennedy (JFK) Drive. In 2008, the Export-Import Bank of China visited the Bahamas, and rendered its intention to provide a Concessional Loan to support Bahamian infrastructure improvements.

In 2009, the Ministry of Finance and China Exim Bank initialled the MOU for providing 150 Million USD concessional loan, out of which the Airport Gateway project (AGP) is of a high priority. On June 24th, 2009, the Ministry of Public Work and Transportation and China State Construction Engineering Corporation Ltd. (CSCEC) signed the MOU engaging CSCEC to perform the Design-Build Service for the Airport Gateway project. In August 2010, the Ministry of Public Work and Transport invited Blue Engineering Ltd. to implement the Environmental Impact Assessment (EIA) for the project.



Figure 1.2 Road Map of New Providence

1.2 Project Introduction

The Airport Gateway consists of 3 segments, Segment one is JFK Drive from Windsor Field Road to Bethel Avenue, running roughly 6.2 miles. The location and extent of the other segments are still to be confirmed. The main improvements include the dualisation of the existing road from a two-lane single carriageway to a four-lane dual carriageway, realignment of the existing route to satisfy the alignment requirements for the designated speed, reconstruction of junctions and landscaping, relocation of the storm drainage on the new alignment, relocation and/or restoration and/or upgrading of the existing utilities and facilities, such as overhead high voltage electrical lines, water mains and communication cables, as necessary as a result of the new alignment.

1.3 Objectives

The reasons for the project include the following:

- 1) Plan to reduce the existing traffic congestion on JFK Dr. resulting from an out of date infrastructure with growing traffic volume;
- 2) Re-align the route to reduce potential traffic accidents and satisfy the design speed requirement;
- 3) Be in conjunction with the on-going Airport Expansion Project to facilitate the transportation between airport and downtown for tourism growth;
- 4) To improve the beautification and landscaping of the Airport Gateway to enhance the Bahamas as one of the best tourist destination.

This report provides an assessment of the likely overall impact of the project, through identification and evaluation of the potential beneficial and adverse impacts associated with implementation and subsequent operation. It also identifies appropriate benefit enhancement and adverse impact mitigation measures aimed at improving environmental performance. In this context, it should be noted that the term “environment” and its derivatives have been used in a wide sense, which covers not only physical and biological aspects, but also the human dimension.

This assessment was carried out with two principal objectives in view:

- Provision of relevant information as required by the Bahamian Government and the Bahamas Environment Science and Technology Commission (BEST) before project implementation can be sanctioned.
- Early provision of guidance on environmental aspects to be taken into consideration by those who will be involved in final design and preparation of contract documents.

1.4 Methodology

An overview of the methodology which was adopted in the EIA is shown in the form of a schematic as Figure 1.3. This shows the principal activities undertaken and some of the more important linkages between them.

The environmental impact assessment (EIA) was conducted in accordance with the requirements of the BEST Commission’s *General Components of an Environmental Impact Assessment* and The Bahamian draft *Environmental Impact Assessment Regulations* (Draft May 18, 2005). The key elements of the environmental impact assessment are described below.

- Project definition
- Screening of the project and scoping of the assessment
- Stakeholder identification
- Identification and gathering of social and environmental baseline data

- Impact identification and analysis
- Development of mitigation and / or management measures and actions
- Public Disclosure

Further details of the methodology used and data collection are included in Appendix A.

1.4.1 Project Definition

Segment One of the Airport Gateway Project is John F. Kennedy (JFK) Drive from Windsor Field Road to Bethel Avenue, running roughly 6.2 miles. The main improvements include dualisation of existing road from a two-lane single carriageway to a four-lane dual carriageway, realignment of the existing route to satisfy the alignment requirement for a designated speed of 55 mph, reconstruction of intersections to provide the minimum number of all turning intersections, landscaping, re-location of the storm drainage on the new alignment and relocation, restoration or upgrading of the existing utilities, such as overhead electrical lines, water mains and communications lines, as needed by the new alignment.

Plan and Profile Drawings for the Project are provided in Appendix B.

1.4.2 Screening

The project was reviewed against applicable legal requirements and additional requirements imposed by the Ministry of Works and the BEST Commission (refer to Appendix C). Key stakeholders were identified and contacted during this phase. The results of the screening were used to identify potential adverse impacts and to identify further assessment.

1.4.3 Stakeholder Identification

The following organizations and individuals have been interviewed to identify environmental impacts. They were requested to identify any issues or concerns with the project, identify appropriate standards and identify further parties for consultation.

- The BEST Commission – Ms. Loraine Cox
- The Bahamas National Trust. Mr. Eric Carey
- Water and Sewerage Corporation - Dr. Richard Cant and Mr. Cyprian Gibson
- Antiquities, Monuments and Museum Corp. – Mrs. Ruth Forbes
- Department of Physical Planning – Mr. Michael Major, Director
- The Airport Authority – Mr. Kevin McDonald, Director, Maintenance & Engineering
- New Providence Roads Improvement Project – Mr. Joy Johnson, Mr. Henry Moxey and Ms. Shenique Albury
- Transportation Policy Unit – Mr. Albie Hope, Transportation Specialist
- Environmental Health Services – Melanie McKenzie, Director
- The Bahamas Electricity Corporation – Mr. Burlington Strachan and Mr. Ian Smith
- Bahamas Telecommunication Corporation – Mr. Augustine Brown
- The Royal Bahamas Police Force – Inspector Curtis and Garland Rolle

1.4.4 Identification and Gathering of Social and Environmental Baseline Data

Baseline data was gathered to describe the existing physical, biological and socio-economic conditions. The following technical studies were conducted to collect additional baseline data:

- **Baseline Assessment** – establish baseline conditions and compliance with requirements
- **Site Assessment** – establish nature and extent of contamination within the Project area

- **Flora and Fauna Assessment** – identify any risks within the Project area and collect information to determine necessary mitigation measures
- **Stormwater Considerations/Alternatives** – identify opportunities to improve existing drainage and accommodate additional drainage loads from future development.

1.4.5 Impact Identification and Analysis

All potential risks and impacts were documented and analysed. All phases of the project including design, construction, operations, and decommissioning were considered.

Table 1.1 is extracted from Canadian Environmental Assessment Agency guidance material on the Canadian Environmental Assessment Act and pertains to determining if an impact or risk is adverse or significant.

Table 1.1 Factors in Determining Adverse Environmental Effects

Changes in the Environment	Effects on People Resulting from Environmental Changes
Negative effects on the health of biota including plants, animals, and fish	Negative effects on human health, well-being, or quality of life
Threat to rare or endangered species	Increase in unemployment or shrinkage in the economy
Reductions in species diversity or disruption of food webs	Reduction of the quality or quantity of recreational opportunities or amenities
Loss of or damage to habitats, including habitat fragmentation	Detrimental change in the current use of lands and resources for traditional purposes by aboriginal persons
Discharges or release of persistent and/or toxic chemicals, microbiological agents, nutrients (e.g., nitrogen, phosphorus), radiation, or thermal energy (e.g., cooling wastewater)	Negative effects on historical, archaeological, paleontological, or architectural resources;
Population declines, particularly in top visual amenities (e.g., views)	Decreased aesthetic appeal or changes in predator, large, or long-lived species
Loss of or damage to commercial species	Loss of biodiversity
The removal of resource materials (e.g., or resources; peat, coal) from the environment	Foreclosure of future resource use or production
Transformation of natural landscapes	
Obstruction of migration or passage of wildlife	
Negative effects on the quality and/or quantity of the biophysical environment (e.g., surface water, groundwater, soil, land, and air)	

1.4.6 Development of Mitigation and/or Management Measures and Actions

The general contractor will be required to develop and implement an environmental management plan (EMP) in accordance with contract documents to ensure the mitigation outlined in this EIA is

performed. An independent environmental consultant will be retained to perform regular site monitoring to ensure compliance with the contractor's EMP and this EIA. Reports will be submitted to the Client for review. Monthly reports will be provided to the BEST Commission throughout the construction period.

1.4.7 Public Disclosure

It should be noted that consultation with the public and businesses in the project area, both those likely to be directly and indirectly affected, was restricted to informal interviews without disclosure of the project. At this early stage in project preparation it was not considered appropriate to undertake more extensive consultation and information dissemination, since discussions might inadvertently generate misconceptions, uncertainties and unrest on the part of the public, particularly on a project such as this, where land acquisition is likely to be a complex and highly emotive issue.

A public meeting shall be held that is extensively advertised in local newspapers.

1.5 Project Sphere of Influence

The concept of a sphere of influence, in relation to identifying the area over which significant potential environmental impacts might be anticipated, is notoriously difficult to apply to road projects. This is because a wide range of impact types is usually involved. Some are very localised (for example, many construction impacts), while others may be widely distributed geographically (for example, impacts associated with improvements in traffic flow), as a result of the project road being but one part of an extensive network.

In the case of the present project, attention has been concentrated mostly on an area extending laterally about 1500 feet from either side of the existing road corridor and the proposed corridor. However, consideration has also been given to more distant, off-site impacts (for example impacts associated with the extraction of naturally-occurring construction materials and their transport to site) as appropriate in the circumstances.

The definition of the study area or area of influence includes the area needed to assess direct and indirect impacts of the project. The area directly influenced by the upgrading, realignment or installation of a road is road specific. The direct area of influence has been taken to mean the projected width of the proposed road improvements including road surface, kerbing, paving, verges, shoulders, drainage channels, utilities, street lighting and earthworks. The worst-case scenario was assumed for the road unless otherwise known. The footprint of these works was determined from the preliminary plan and profile drawings, the typical cross sections and the proposed earthworks slopes.

The area of indirect influence has been defined as the areas of source material, haul routes necessary to access these sites and waste disposal for construction, plus the wider implications of future development adjacent to the road corridor as a result of improved access and the change of land use. Water bodies which may be affected by alterations to local drainage patterns are also considered in the area of influence, however, as there are no running watercourses on the island, there are limited opportunities for dilution. Potential contaminants and solid material may be mobilised after rainfall events. Community facilities that may be affected by altering routes to them are also considered.

The road design has been completed to preliminary design at this stage and the area of influence has been assessed to include:

- Limits of land disturbance (cut and fill lines).
- Known archaeological/cultural sites adjacent to the project.
- Areas where direct and indirect socio-economic impacts are anticipated such as by passed areas and areas where dislocations will occur.

- Lake Killarney, Lake Cunningham and wetland systems are included where any portion of the system is impacted.
- Ecological systems where intersection of an area will cause fragmentation of wildlife habitat.
- Geological systems outside the surface disturbance area (cut and fill lines) where altering slopes may lead to erosion of the newly cut surface.
- Quarries, disposal sites, borrow pits, and associated haul routes.
- Community facilities, such as school, hospitals and churches within the area.

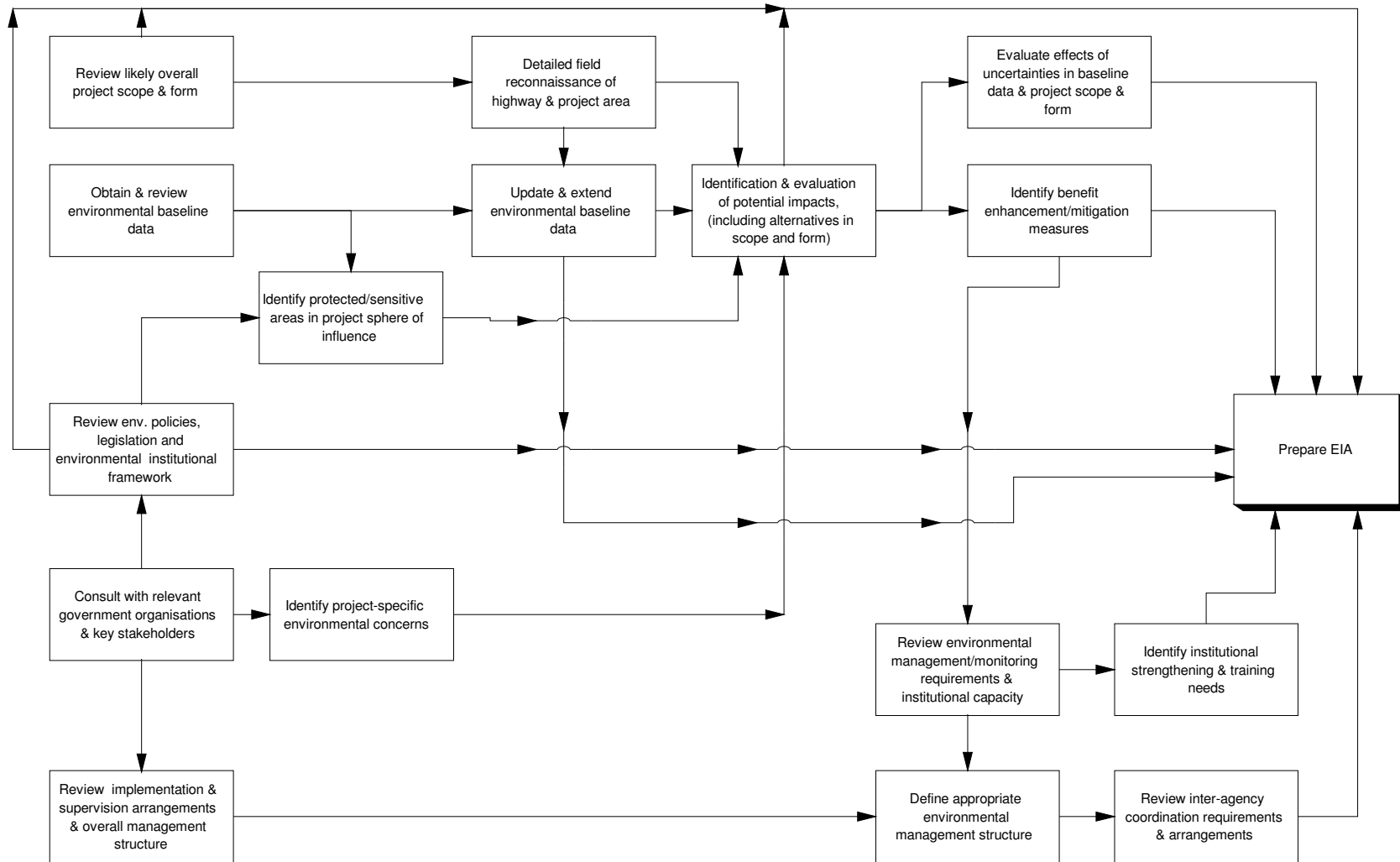


Figure 1.3: EIA Methodology

2.0 ENVIRONMENTAL POLICY, INSTITUTIONAL AND LEGISLATIVE AND REGULATORY FRAMEWORK

2.1 Policy Aspects

The current project is one deemed by the Government to be of public utility but nevertheless subject to environmental impact assessment. The Contractor and project staff will be responsible for complying with government legislation regarding opening of borrow pits and site development (including excavation, landfill operations and removal of protected trees) at all times. [Ref: The Conservation and Protection of the Physical Landscape of the Bahamas Act and Regulations 1997]. The Department of Physical Planning within the Ministry of Works and Utilities is responsible for approving applications for permits to carry out excavations or landfill operations, applications to quarry or mine and applications to harvest (or cut) a protected tree. Forms are submitted and permits given for a one year period under Section 7 of the 1997 Act other than for harvesting protected trees which is six months.

The Environmental Health Act (1987) makes provision for the prevention and control of pollution through The Department of Environmental Health. The Water and Sewerage Act (1976) established the Water and Sewerage Corporation for the grant and control of water rights, the protection of water resources, regulating the extraction, use and supply of water and the control of sewage. The Contractor will be required to adhere to existing and new government regulations of the Department of Environmental Health, including all statutory licensing and permitting requirements with respect to use of waste landfills and new occupational health legislation.

2.2 The Environmental Institutional Framework

The Bahamas Environment, Science, and Technology Commission (BEST) is mandated to manage a number of environmental responsibilities, including coordinating international agreements pertaining to the environment, formulating environmental policy, coordinating preservation and management of the environment throughout The Bahamas, and carrying out Environmental Impact Assessments (EIAs) for proposed development (BEST, 2008). BEST is the first government entity to be established for the purpose of protecting and preserving the environment as opposed to managing the environment with respect to human health issues.

Other agencies that have responsibilities regarding the environment include the Ministry of Health and Social Services and the Department of Environmental Health Services, which are concerned with environmental threats to public health; the Department of Lands and Surveys, the Ministry of Works and Transport, along with the Department of Public Works, constructs and maintains public infrastructure and drainage, including the storm drainage system in Nassau; the Department of Marine Resources and finally, the Water and Sewerage Corporation is a government mandated private entity that provides water and wastewater removal for the island of New Providence.

Dredging regulation is to some extent covered by the Town Planning Act 1961 since permission for development of land is required.

The decentralised responsibility of environmental affairs has complicated co-ordination, accountability, and responsible use of monetary and human capacity resources. In 2005-2006 there were efforts to address these issues. The National Environmental Management Action Plan was developed to place all agencies on the same page in regards to environmental management issues.

The Non-governmental organizations (NGOs) of relevance in existence at present include the Bahamas National Trust (BNT), The Nature Conservancy, BREEF, Friends of the Environment, Living Jewels, reEarth.. The Bahamas National Trust created under an act of the same name is responsible for making provision to promote the permanent preservation of lands, buildings and underwater areas

of beauty, natural or historic interest and the all uses on land owned or managed by the trust. No protected land or marine designated sites form part of the project zone to circumscribe developments proposed.

The proposed project will comply with all applicable Bahamian environmental standards and requirements, relevant legislation, and legal and regulatory statutes. Blue Engineering will work with the BEST Commission and designated agencies during the EIA process to meet these requirements.

Environmental Impact Assessments are conducted in The Bahamas under guidance from the BEST Commission. This assessment has been carried out in accordance with guidelines provided by the BEST Commission (see Appendix C).

2.3 National Environmental Laws and Regulations

The project will be designed, constructed, operated, and maintained in accordance with applicable Bahamian environmental laws and regulation, including the following;

The Town Planning Act (1961)
The Water and Sewerage Act
Environmental Health Services Act, 1987
The Conservation and Protection of the Physical Environment of the Bahamas Act, 1997
The Antiquities, Monuments, and Museums Act, 1999
The Public Works Act
The Wild Birds and Animals and Plants Protection Acts, 1952
The Bahamas National Trust Act
The Fisheries Resources Act
The Coast Protection Act
The Bahamas National Wetlands Policy 2007; and
The National Invasive Species Strategy for the Bahamas.
Declaration of Protected Trees Order, 1997

2.3.1 The Town Planning Act (1961)

Within The Commonwealth of The Bahamas the government has not adopted any form of long range planning of either land-use or infrastructure. Physical planning is essentially a development control process governed by the Town Planning Act.

The Town Planning Act is the legislation providing the statutory basis for land use planning on New Providence Island. The 1988 Planning Regulations prepared under Section 17 of the Town Planning Act provides the procedures for land development, land use planning standards, zoning standards, design and signage guidelines. A town planning committee has the final say on all land-use issues.

The Town Planning Act sets out the legal basis for planning. (Physical planning is a charge of the Minister of Works and Transport). The Minister is given very broad land-use control and zoning powers. These powers are interpreted and administered by the Town Planning Committee (TPC) — whose seven members are appointed annually by the Governor-General. In practice appointments are for a minimum of two years and often for the life of Government. Advising the committee is the Physical Planning Department and a 'special architectural committee' who deal with matters relating to the historical preservation of downtown Nassau. In general the Town Planning Committee has the final say on all land-use issues although it does not have total say on subdivision approval.

The Act is applicable to this project, as the project will effect material change of use to land. This act does not provide for public participation. However, the act does state that representatives or members of the general public may be invited to sessions of the Town Planning Committee to voice

their views or objections, thus ensuring that the members of the Town Planning Committee are made fully aware of public opinion.

Road design and construction as it relates to private developments is controlled by the Private Roads and Subdivisions Act. This act makes provisions for approval of the Minister of Works and Transport and the Town Planning Committee to the layout of a new road or subdivision. It also defines the procedures for obtaining approvals. Furthermore the Roads Act divides roads into two classes, minor and major, classified by width. It makes provision that the Minister of Works and Transport is responsible for roads and may therefore alter or close a road and ensures that land needed for public roads can be acquired under the Acquisition of Land Act.

The Environmental Health Act gives specific powers to the Director of Environmental Health Services to make sure that health related matters, i.e. contamination of drinking water is not allowed.

2.3.2 Water and Sewerage Act 1976

This was an act to establish a Water and Sewerage Corporation for the grant and control of water rights, the protection of water resources, regulating the extraction, use and supply of water, the disposal of sewage and for connected purposes. This act provides no guidance relating to the installation of drainage wells.

2.3.3 Environmental Health Act 1987

This act makes provisions for the prevention and control of pollution of any waters, measures for monitoring and ensuring the safety of water supplies and prevention of the supply and use of unsafe water for human consumption. But provides no guidance relating to the installation of drainage wells. The location and Approval of drainage wells is the responsibility of the Civil Design Section of the Ministry of Works and Transport.

2.3.4 Bahamas National Trust Act

It is The Bahamas National Trust's responsibility under The Bahamas National Trust Act to make provision to promote the permanent preservation of lands, buildings and underwater areas of beauty, natural or historic interest and the Trust regulates all uses on Trust held land. Fines can be levied for contravening provisions of the act.

2.3.5 The Conservation and Protection of the Physical Landscape of The Bahamas Act and Regulations 1997

The Department of Physical Planning under the Office of the Prime Minister is charged with the responsibility of regulating excavation, landfill operations, quarrying, mining and harvesting of protected trees in The Bahamas, for the purpose of providing for and ensuring the conservation and maintenance of the environment.

The Act in particular relates to control of:

- the physical landscape of The Bahamas for the purpose of preventing environmental degradation, flooding, denuding of hills, unnatural steep inclines and landslides
- the filling up of lands, wetlands and areas commonly referred to as "blue holes", "natural ponds" or "drainage basins"
- any excavation for the purpose of work which would affect any part of the coastline of The Bahamas
- the digging or removal of sand from beaches and sand dunes
- harvesting or cause or procure to be harvested of any protected tree as listed in the Schedule.

Applications for the grant of the relevant permits will be required to be made to the Director of Physical Planning.

Excavation and Landfill

Excavation refers to preventing environmental degradation, flooding, denuding of hills, unnatural steep inclines and landslides. In the form of removal of a hill or any portion of a hill, creation of a pit by reducing the natural ground level, creating a lake, a watershed or an area of the type commonly referred to as a 'drainage basin'.

Landfilling refers to the filling up of lands (such as natural or man made depressions, swamp, wetland or areas commonly referred to as 'natural ponds' or drainage basins') with soil, rock, quarry, fill or sand, exceeding seventy-five cubic yards in volume.

Permits are granted under Section 7 of the Act in relation to any excavation or landfill operation. Permits are valid for 12 months from the date on the grant unless otherwise stated. To apply for a permit to carry out excavations or landfill, stage one is to give details of the intended site by filling out the necessary forms. Excavations and landfilling made without the relevant permit will incur the following penalties:

- First offence, \$10,000 and the equivalent of five times the value of the material to which the offence relates, or to imprisonment for a term of 3 months or to both a fine and imprisonment.
- For a second or subsequent offence a \$20,000 fine and an amount equal to 20 times the value of the material to which the offence relates, to a prison sentence of six months or to a fine and imprisonment.

Further information may be required by the Director of Physical Planning including impact of excavation, including particulars on the wildlife habitat history of the location of the proposed site, however due to the nature of the excavation required for this project, the relevant information should be contained within this document. The director of Physical Planning is responsible for granting a permit subject to the payment of a subscription fee. If it appears to the director that the holder of the permit has failed to comply with any of its provisions or conditions, he may suspend or revoke the permit. The holder has ten days to make representations regarding the decision to revoke.

Tree Harvesting

The minister may by order declare any particular tree or any species of hardwood trees, rare trees, trees of remarkable growth or trees of historic significance to be protected trees for the purpose of this act. A license to harvest a protected tree is granted under section 23 of the Act. The permit is valid for six months.

No tree can be felled (harvested) unless in accordance with the provisions on the permit. Any persons harvesting a protected tree may be fined \$10,000 or imprisoned for three months or both. The following list details the trees currently protected under the act:

<u>Common Name</u>	<u>Botanical Name</u>
Beefwood	Guapira discolor
Black Ebony/Bullwood Brasileto	Pera bumelitifolia
Candlewood	Caesalpinia vesicaria
Caribbean Pine Horseflesh	Gochnatia ilicifolia
Lignum Vitae	Pinus caribaea var. bahamensis Lysiloma sabiou var. bahamensis Guaiacau sanctum
Rauwolfia	Rauwolfia nitida
Red Cedar	Juniperus bermudiana
Silk Cotton	Ceiba pentandra

Application for a permit to remove protected trees will require a walkover by a qualified person to identify the protected trees. Again this will be possible when the detailed design has been drawn up.

Permits require 7/14 days for processing. Failure to produce the relevant license
Every holder of a license shall at all reasonable times produce for inspection of the minister, the director or any person authorised by the director, or any police officer, any license granted to him. Failure to produce such a license may be liable to a fine of \$500 or to imprisonment for a time of one month or both.

2.3.6 Wild Birds Protection Act 1987

This act makes it an offence to kill, capture or attempt to kill wild birds or take the eggs of wild birds during the closed season. However, the habitat of these birds is not protected.

2.3.7 Plants Protection Act 1987

This act relates to the diseases of plants and prohibits the importation of plants or their packaging into The Bahamas unless subject to the rules made by the Minister. The rules govern importation, detention and examination, removal and treatment of plants and their packaging. This is of significance if plants and topsoil will need to be imported as part of the landscape planting along the side of the road.

2.3.8 Wild Animals Protection Act

This act only applies to wild horses on Abaco, Agouti or Hutia and the Iguana.

2.3.9 Antiquities, Monuments and Museum Act 1998 and Regulations 1999

This act regulates the discovery and excavation of antiquities and gives powers to the Minister to declare any place, building, site or structure which the Minister considers to be of public interest by reason of its historical, anthropological, archaeological or palaeontological significance to be Monuments. No person shall excavate, carry on building or other work, plant or fell trees or deposit earth or refuse on, in or near a Monument or demolish, remove, obstruct, deface or interfere with a Monument except in accordance with a permit granted by the Minister. Any person who discovers, or knows of the discovery of an antiquity or supposed antiquity shall forthwith report the discovery to the Minister and a person who discovers an antiquity or supposed antiquity shall take all reasonable measures to protect it.

2.3.10 Acquisition of Land 1913

The Bahamian Acquisition of Land Act comprising various regulations published between 1913 and 1987 will regulate the process of lands acquisition once the Office of the Prime Minister has approved the alignment of the roads and other detailed plans. The Office of the Prime Minister, advised by the Lands and Surveys Department, is responsible for publishing and otherwise posting public notices and notifying interested parties of the Government's intentions both to survey and acquire land. The Lands and Surveys Department is then responsible for valuations.

A further Act, the 'Quieting of Titles Act' will apply in cases that tenants are occupying the land and where proprietors cannot be located.

Acquisition of Land Procedures:

Whenever it appears to the Minister that land in any locality is likely to be needed for any public purpose a notification to that effect shall be published in the Gazette. Public notice will be given at a convenient place in the district. The notice will state the district of the required land, and the particular purpose for which it is to be acquired. This notice will also state where it will be possible to view any prepared plans. All persons interested in the land have 30 days from the publication of the notice within which it is possible to state the nature of their interest in the land and the amounts and particulars of their claims to compensation. If a mortgagee or person interested in the property is absent from the Bahamas, and their address known, notice will be sent by registered airmail post. Notice will then be served upon all occupiers of the land, the letter being conclusive evidence that the land is needed for public purpose.

Selected land may be acquired in either of the following ways:

- a) by private agreement for purchase
- b) by compulsory purchase

It is then up to the promoters of the project to agree compensation. If an agreement cannot be reached the promoters then apply to the Governor General to appoint an assessor to make an assessment of the selected land.

If part of the selected land is leased, and there are a number of years unexpired, the rent payable in respect of the land within the lease shall be apportioned between the selected land and the unselected land. Such apportionment may be settled by agreement between the lesser and the lessee. If the apportionment is not settled, it will be settled by a magistrate. Where the land is in the possession of a tenant with short term or annual leases, if the tenant is required to move out before the end of the lease he shall be entitled to compensation for the value of the unexpired term. If the persons interested in the selected land is absent from the Bahamas or cannot be found after diligent enquiry the purchase money will be put in the hands of the Treasurer and the Treasurer shall carry it to the credit of the person interested in the land, estate or interest. If the owner of the land is not known then the payment will be subject to the order, control and disposition of the court.

If there is a wooden house standing on the selected land, compensation will be paid to the owner to cover the expense of moving the house to another site and payment for any damages caused.

In determining the amount of compensation to be awarded under this act the following aspects shall be taken into consideration:

- i) the market value of the selected land at date of declaration;
- ii) the damage (if any) sustained by the persons interested at the time of awarding compensation by reason of severing such land from other land of the persons interested;
- iii) the damage (if any) sustained by the persons interested at the time of awarding compensation by reason of the acquisition injuriously affecting other property belonging to him whether real or personal in any other manner or his actual earnings;
- iv) if in consequence of the acquisition he is compelled to change his residence or place of business, the reasonable expenses (if any) of that change;
- v) any accommodation works offered by the promoters and the execution of which is to the satisfaction of the magistrate or of the court sitting with or without assessors secured to the person's interests;

In addition to the amount of compensation awarded under this act the magistrate or the court shall award a further ten percent on top of the market value of the selected land. It must be noted at this stage that all residents who will be affected by the acquisition of occupied properties have not been contacted by the Ministry of Works and Transport.

The Act appears to be limited in its scope regarding the sensitivities involved in the implementation procedures for any compulsory purchase or involuntary resettlement of individuals or families that may be required. Government practice will be relevant in this respect. The Surveyor General referred to the Grants Town Urban Development Project (1981-1988/9) as a model in this respect. The Project required resettlement of low income and destitute families.

Issues arising from implementation of regulations

- Matters relating to public consultation and community involvement in planning are discussed below.
- The Surveyor General mentioned that the Social Services Department and even, where necessary, the Police may be involved where agents from Lands and Surveys must serve notices on individual households.
- Community severance and disruption can have a wide range of impacts, some of which can be negative even where new housing is initially considered, by the authorities, to be of better quality than previous housing. It will be important to avoid resettlement where this may lead to impoverishment. Aspects of life and well being that may be disrupted following resettlement include:
 - Difficulty of access to place of employment and other sources of income, especially in the informal sector
 - Difficulty of access to services including public transport
 - Social and family networks and support networks, especially for women and those with lowest mobility, may be severed
 - A change of school for children may be disruptive

For contaminated site related standards, the State of Florida regulations will apply.

Coral reefs are intended to receive protection under the Fisheries Resources Act 1977. The Bahamas is a signatory to the Ramsar Convention protecting mangroves and wetlands.

2.3.11 Other Legislation

Parts of many other pieces of legislation are, in theory at least, applicable to various aspects of environmental management of the project. These include:

- Chapter 201 – Roads
- Chapter 220 – Road Traffic
- Chapter 194 - Electricity

However, in view of the generally lax enforcement of many provisions of the existing laws, the derisory financial penalties for infringements which are specified in many laws, and the cumbersome nature of the legal process in relation to securing conviction of offenders, it is concluded that existing laws will not be of much use in effective control over many of the adverse impacts which might arise during implementation of construction works. Much more effective impact control is possible through proper enforcement of environmental protection clauses incorporated in a construction contract.

A new planning and subdivision bill is understood to be in the final stages of drafting, which will require further consideration be given to land use planning and a more formal consultation process as well as address other issues. It is considered unlikely that this bill will have a direct impact on the project however it will serve to ensure that future development is carried out in a manner best suited to the proposed road infrastructure.

2.4 International Environmental Conventions

The Bahamas is a signatory to a number of international conventions relating to various aspects of the environment, a high proportion of which are concerned with nature conservation matters. These include:

- The Convention on International Trade in Endangered Species of Wild Flora and Fauna (the CITES Convention)
- The Convention on Wetlands of International Importance especially as Wildfowl Habitat (the Ramsar Convention)
- The United Nations Convention on Biological Diversity (the Biodiversity Convention).
- United Nations Framework Convention on Climate Change;
- United Nations Convention to Combat Desertification;
- Vienna Protocol for the Protection of the Ozone Layer;
- Montreal Protocol on Substances that Deplete the Ozone Layer;
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal;
- International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC);

Ramsar convention

The Bahamas signed onto the Ramsar convention on the 7th June, 2007. The Bahamas presently has one site that has been designated a Ramsar site, Lake Rosa of Great Inagua. As the Ramsar convention only requests that one site is designated a Ramsar site, the Bahamas is not required to designate any more.

CITES

This convention was signed on the 20th March, 1979. This treaty is only concerned with the trading of species across international borders that it deems are at risk of being over exploited and may cause the species to become endangered. In the Bahamas, the CITES convention helps to protect a host of different plants and quite a few species of animals also.

United Nations convention on the Law of the Sea

Signed onto on the 16th of January, 1997.

Convention on Biological Diversity

This convention was ratified on 2nd Sept, 1993. The CBD is concerned with the preservation of biological diversity and its genetic resources, for the health of the environment but particularly as they pertain to human needs, e.g. food, medicine and other such resources.

The CBD also discusses the guidelines for integrating biological diversity into Environmental Impact Assessments (EIA) and how they should be used in planning. The CBD also discusses the removal or control of alien species.

Convention to combat desertification

Signed on the 10th November, 2000. This convention is concerned with areas that have arid-like conditions that could be intensified by human activities.

3.0 THE PROJECT

3.1 Location

The Airport Gateway Project which extends along JFK Drive, Thompson Boulevard and Poinciana Road is located in the northwest of New Providence Island. With its starting point at Nassau Airport (CH 0+000), this highway runs adjacent to Killarney and Cunningham lakesides, then converges with the Gladstone highway and passes through to the College of the Bahamas to the end at the Poinciana Road and Baillou Hill Road intersection. The total length is 8.2 miles. This corridor generally runs from the west to the east (see Figure 3.1).

The portion of the project covered in this assessment involves widening the existing JFK Drive to four lanes (rather than two as exists) from the western most intersection of Lynden Pindling International Airport and Windsor Field Road (CH 0+000), to the intersection of JFK Drive and Bethel Avenue (CH 326+20.44). The recommended route will basically follow the existing JFK Drive. The total length covered in this assessment is 6.2 miles.

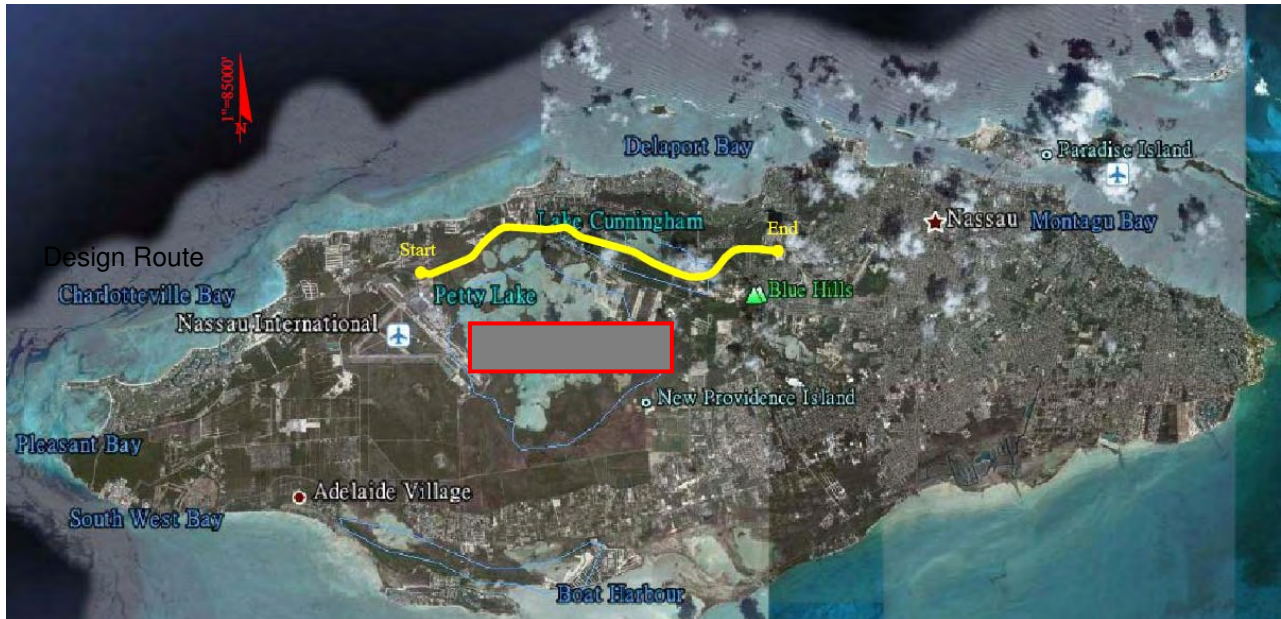


Fig. 3.1 Route of the Bahamas JFK drive from Nassau Airport to the College of the Bahamas

The proposed alignment generally lies within the existing JFK Drive Right of Way (ROW) or reserved land and also a number of adjacent properties. The full extent to which the proposed alignment lies within adjacent properties can not be determined at this time. It is necessary to complete detailed topographical survey and detailed design in order to determine the footprint of the project on property ownership plans.

3.2 General Project Scope

JFK Drive is the major trunk road connecting the Lynden Pindling International Airport with the urban area via intersects with multiple roads. The proposed project will widen the existing JFK Drive to four lanes from the western most intersection of Lynden Pindling International Airport and Windsor Field Road, to the intersection of JFK Drive and Bethel Avenue to increase capacity and improve road safety.

There will be nine (9) roundabouts on this segment, excluding the one connecting Thompson Boulevard at the end of the segment, which will be beyond the scope of the project and is currently

under construction. The High-Voltage (132KV) power cable along the south side of JFK Drive from roundabout 3 to roundabout 6 will be buried underground within the median, and the Low-Voltage (11KV) power cable, Cable TV, Telecommunication line and water main will also be buried underground. The whole route will be dual carriageway with 4 lanes, with 3 different cross-sections as shown in Figure. 3.2.

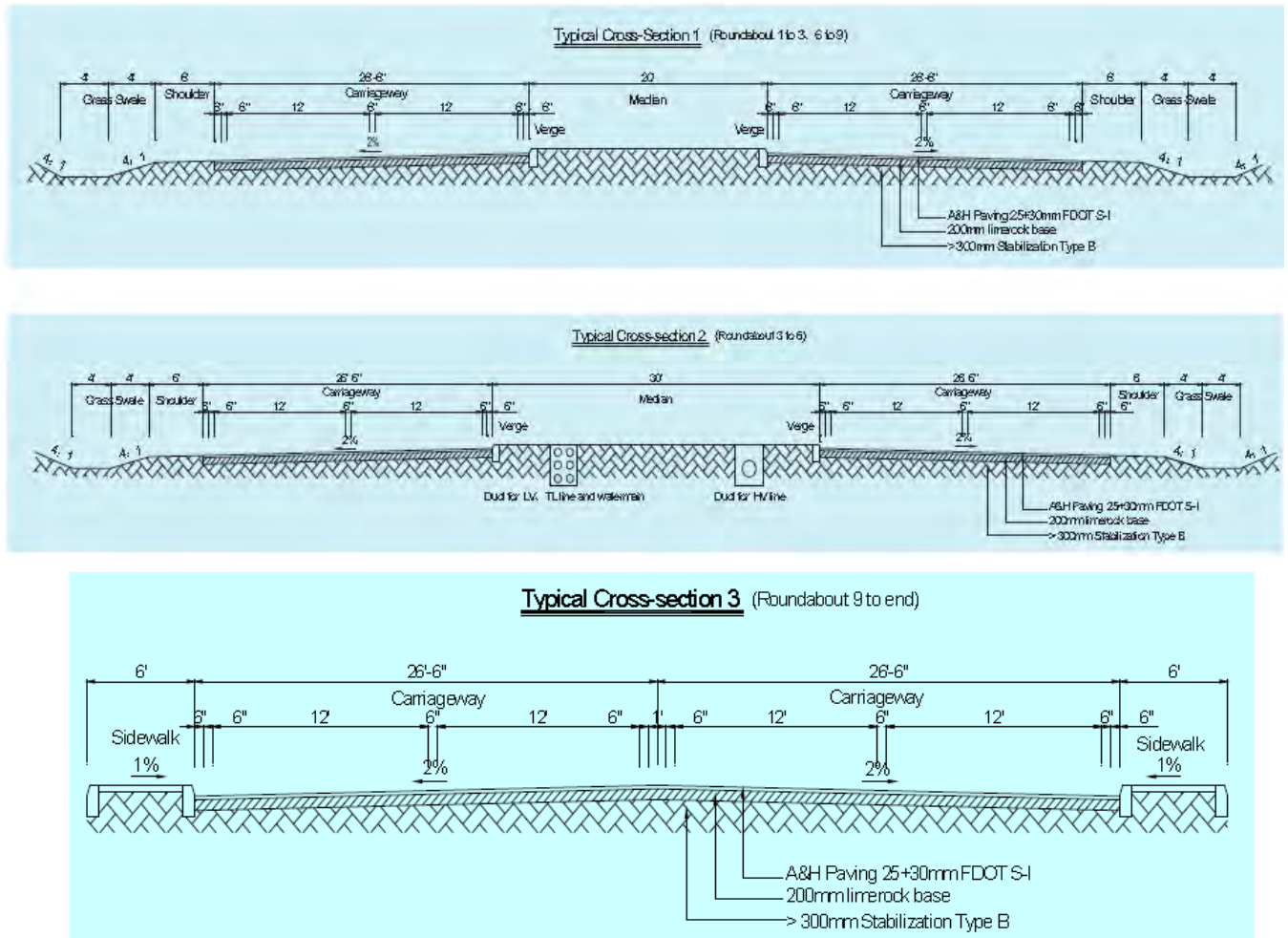


Fig. 3.2 Standard Cross Section of Roadbed

To meet the requirements of effective transition of traffic flow along the entire route the at-grade intersections of this project are to be designed in accordance with the following principles:

1. The design speed of 55mph is a governing parameter, and considering the traffic capacity and requirements of safe driving, at-grade intersections capable of all-around turning are to be minimalised as much as possible;
2. The type and scope of at-grade intersections are to be properly determined according to the grade and topography of the intersected road;
3. For relatively dense developed residential and business areas, essential footways will be constructed, including sufficient signage and traffic marking to ensure safety;

The following Table 3.1 indicates design parameters for the design of the proposed JFK Drive.

No.		Unit	Indices	
I	Roadway Type		Arterial (Major)	
II	Design Speed	mph	55	
III	Sight Distance			
1	Min. Stopping Sight Distance	ft	495	
2	Min. Passing Sight Distance	ft	1985	
IV	Horizontal Alignment			
1	Min. Radius of Horizontal Curves	ft	880 (Rural)	
2	Max. Degree of Curvature		6° 30' (Rural)	
V	Vertical Alignment			
No.	Item	Unit	Indices	
1	Max. Grade	%	4	
2	Min. Length	ft	250	
3	Min. Radius of Vertical Curves	Crest	ft	14765
		Sag	ft	9840
VI	Pavement	Pavement Width	ft	26'-6"
		Pavement Cross Slope	%	2

Table 3.1 Design parameters for the proposed JFK Drive.

The main control points for the project are the starting point Lynden Pindling International Airport, Windsor Field Road, the existing John F Kennedy Drive, the Airport Station & Airport Access & Exit Blake Road, Lake Killarney & Westridge Subdivision Access, Gladstone Road, Tonique Williams-Darling (TWD) Highway & Prospect Ridge (main arm), Prospect Ridge (east arm), Harrold Road, access road to the Building of the Ministry of Works & Transport and finishing at Bethel Avenue.

Refer to Appendix B drawings which indicate the proposed roadworks in plan and profile. There are no proposed bridges, culverts or tunnels.

3.2.1 Construction Works

The description of the construction works which follows is not intended to be either comprehensive or definitive. It has been prepared solely for the purpose of background information relevant to the EIA and more specifically, for providing context to the identification and assessment of environmental impacts during the construction and operational phases. All quantities and dimensions are approximate, and are intended to do no more than indicate an order of magnitude which is sufficient to allow preliminary identification and evaluation of impacts with a reasonable degree of confidence.

3.2.1.1 Site Clearance

Site clearance will be required along the proposed route's right of way (ROW). Principally this will involve clearance of vegetation and surface soil to allow construction. There are also significant sections of existing pavement which will need to be broken and removed/re-used. Primarily this relates to the existing JFK Drive and other roads where new intersections are proposed. In addition, there are the utilities that are to be re-located, including overhead utilities that will be buried and buried utilities that will be relocated. That infrastructure that can not be utilised in the re-location will need to be cleared.

3.2.1.2 Earthworks

The overall balance between cut and fill required during construction of the widened JFK Drive has yet to be fully determined. However, initial estimates suggest that overall, the construction of the widened road will result in a net balance of approximately 150,000 cubic yards. This is a function of 475,000 cubic yards of cut in comparison with 625,000 cubic yards of fill.

Earthworks will be required along the edge of Lake Cunningham and Killarney potentially impacting on their shorelines.

3.2.1.3 Bridge Works

There are no proposed bridge works on the project due to there being no principal watercourses crossing the project area.

3.2.1.4 Drainage Works

The median will be kerbed and thereby raised and will be protected by planting grass on the surface course which will drain by means of infiltration or run-off onto the road. The pavement will drain by surface run-off to the shoulders and swales. The shoulder will be six foot wide and graded away from the road. The swales will be eight foot wide with slopes of 4:1. The shoulder and swales will be grassed.

Where the road is in the heavily developed area at its east end (i.e. from the MOWT roundabout to Bethel Avenue) footpaths will replace the shoulders and swales and drainage will be provided via a connected catch pit, drainage well and connecting pipe system as required. In the wetlands and lake sections sedimentation basins will be established at the outlet of swales to collect water and drain through natural evaporation instead of through discharge to a natural water body.

3.2.1.5 Intersection Works

The technical standard for this project refers to Florida, United Kingdom and Bahamas specifications. All intersections are of at-grade intersection type, and all intersected main utility pipelines are set underground. In accordance with above principles and considering the features of this project, 9 roundabouts capable of all-around turning along the entire route by merging and relocating intersected roads are proposed as indicated in Table 3.2 below. There will be no openings in the median due to safety concerns.

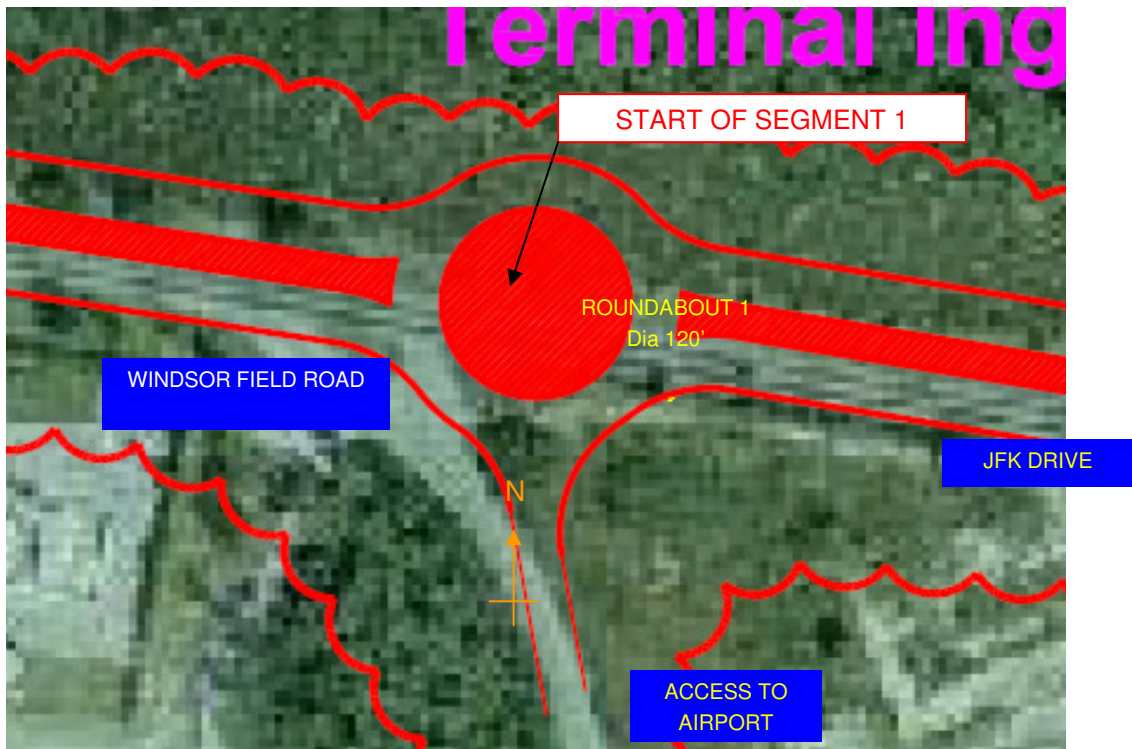
Table 3.2 List of Roundabouts Setting

Location	Intersection Type	Space (ft)	Intersected Road
CH00+00	T-shaped		Entrance of Airport
CH08+18	T-shaped	818	Exit of Airport
CH13+45	T-shaped	527	Entrance and Exit of Airport
CH47+35	+ -shaped	3390	BLAKE Road
CH108+79	+ -shaped	6144	Access to LAKE
CH242+21	+ -shaped	13322	GLADSTONE Road
CH272+89	+ -shaped	3068	TWD HWY
CH291+26	T-shaped	1837	
CH305+10	T-shaped	1384	Access to MOTW

Roundabouts will be introduced in the above order below. All existing and proposed junctions are at grade.

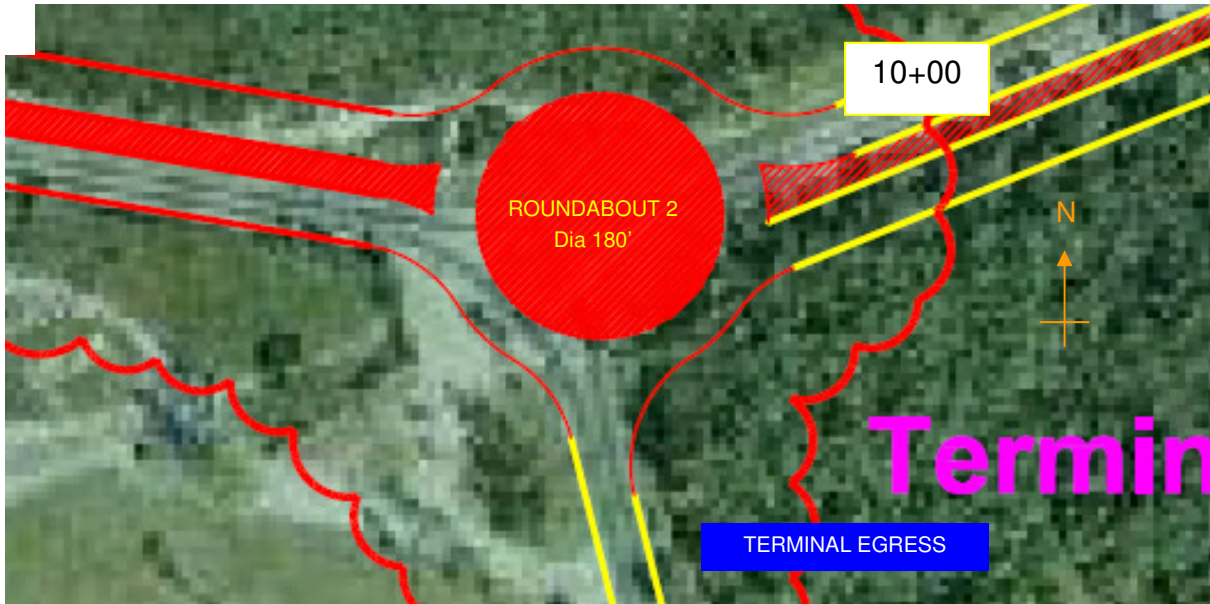
No. 1 Roundabout

This junction is currently a T junction intersection between JFK Drive, Windsor Road and the access & exit of the International Airport. According to Airport Authority, all the current accesses & exits of the International Airport will be changed to one-way roads. There are a total of three access roads to the Airport. On the basis of the actual situation of these three roads, a standard roundabout intersection with a 120ft diameter is proposed at this location.



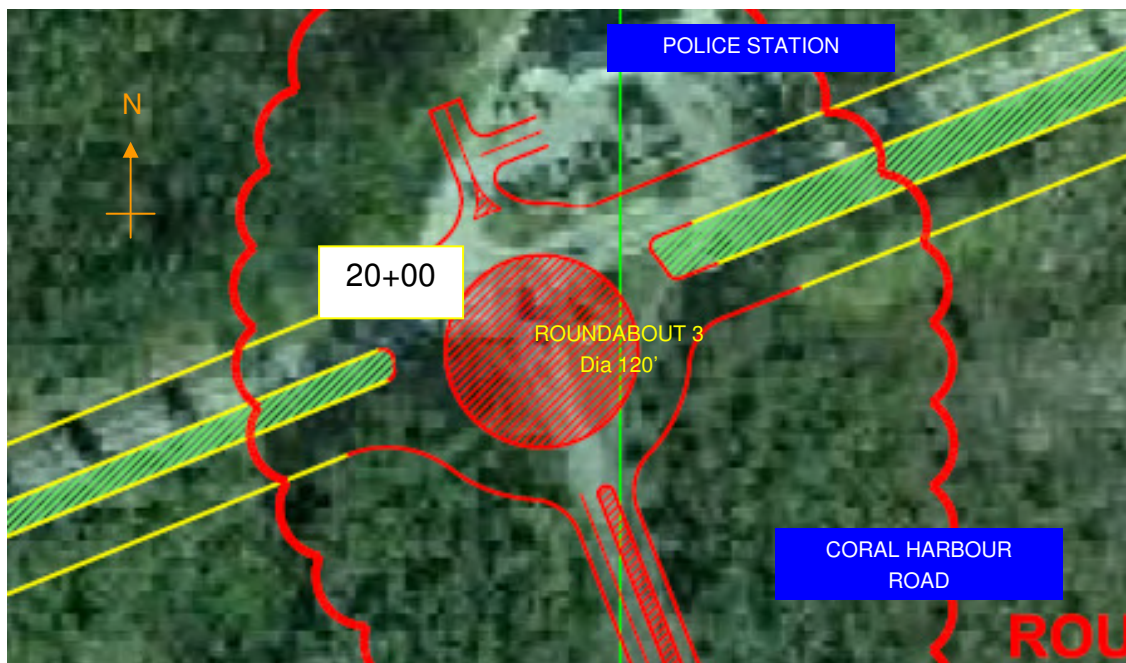
2. No. 2 Roundabout

The existing intersection between JFK Drive and the access & exit of the U.S. Departures Terminal of the International Airport is a roundabout, with a 50ft diameter. According to the Airport Authority, all the three current accesses & exits of the International Airport will be changed to one-way roads. This intersection will provide a terminal egress to the Airport. On the basis of the actual situation of these three roads, a standard roundabout with a diameter increased to 160ft is proposed at this location.



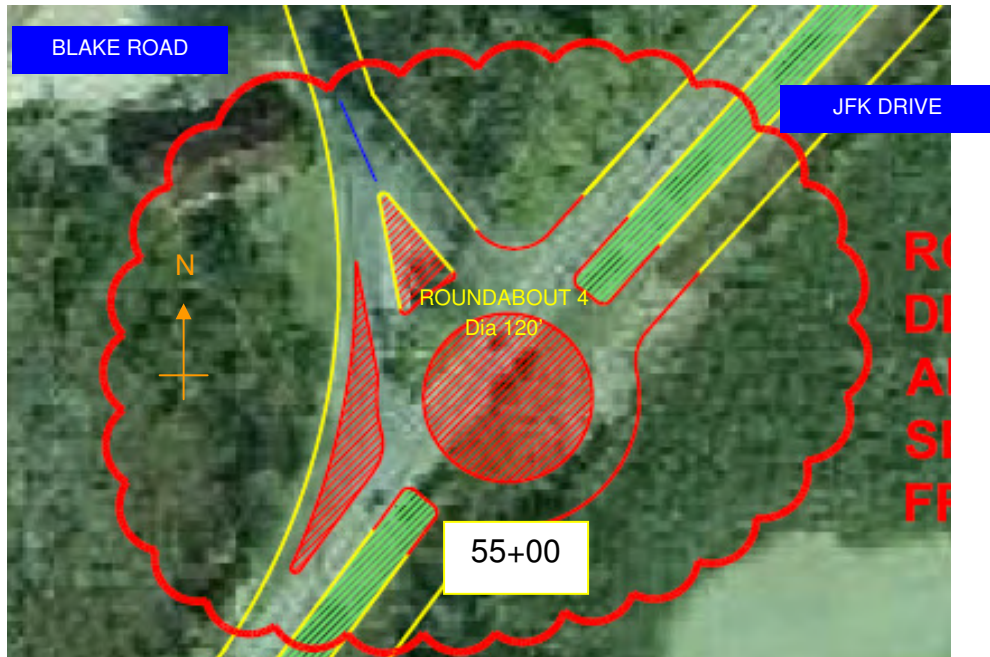
3. No. 3 Roundabout

This intersection is currently a staggered cross roads junction which provides access to the Police Station to the north and the access and exit of the Domestic Flight Terminal of the Airport. On the basis of the actual situation, a 120 foot diameter roundabout is proposed to meet the traffic demand and facilitate the access and exit of vehicles to/from the Police Station. The access for the Police Station is altered to be in line with the existing Coral Harbour Road. A median is provided along Coral Harbour Road for 150 feet south of the roundabout. As stated earlier according to the Airport Authority, all the current accesses & exits of the International Airport will be changed to one-way roads. The purpose of providing three lanes and a median at this location is therefore questionable.



4. No. 4 Roundabout

Currently, this intersection is a partially channelised T junction intersection between Blake Road and JFK Drive. A 120 foot diameter roundabout is proposed to be installed with a segregated north bound lane from JFK Drive to Blake Road. A triangular traffic island will be provided at Blake Road at the roundabout.



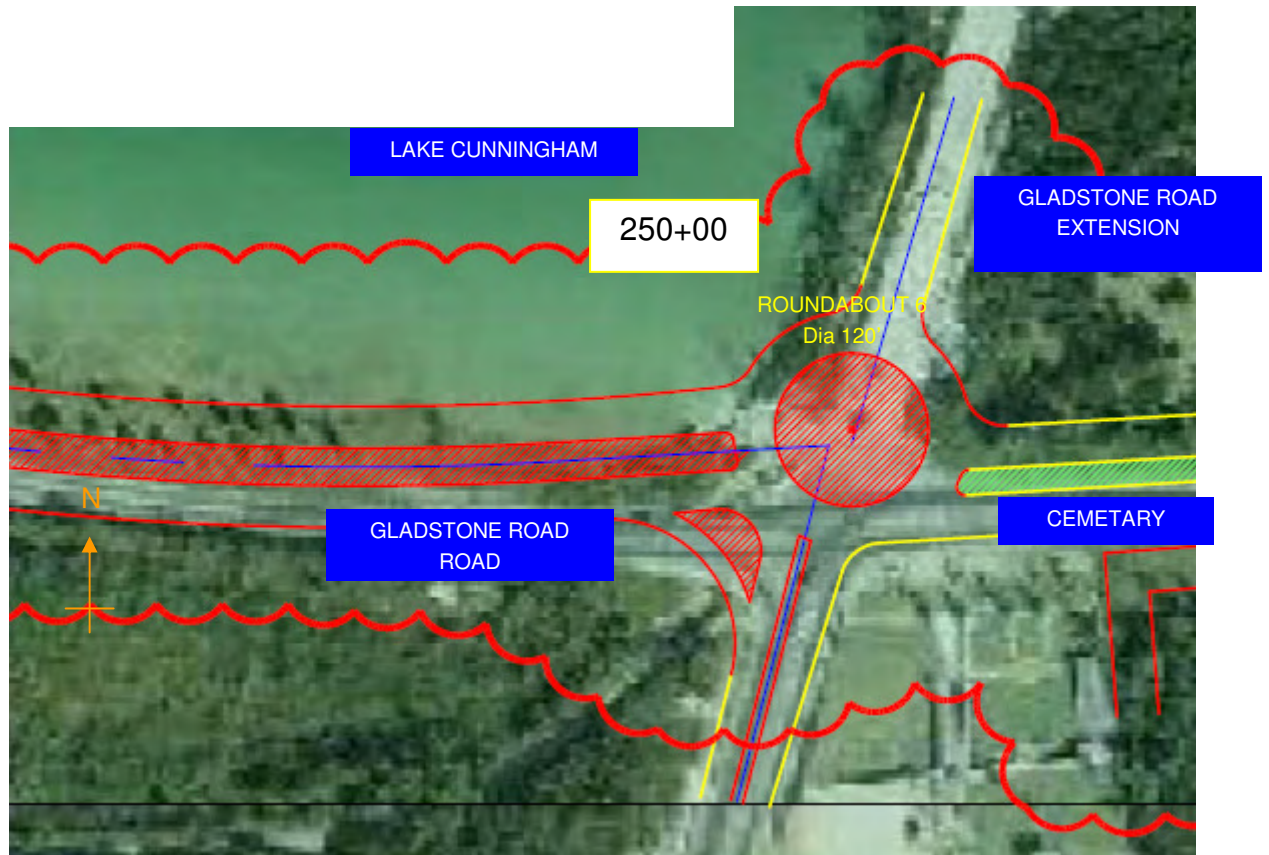
5. No. 5 Roundabout

There are two existing T junctions approximately 180 feet apart at this location. At the northern T junction the road (Westridge Road) accesses the subdivision of Westridge and eventually ties into West Bay Street. The south road accesses Lake Killarney and other residential properties. The south road will be re-aligned to join the proposed 120 foot diameter roundabout east of its current location opposite Westridge road. No medians are proposed for these north and south roads.



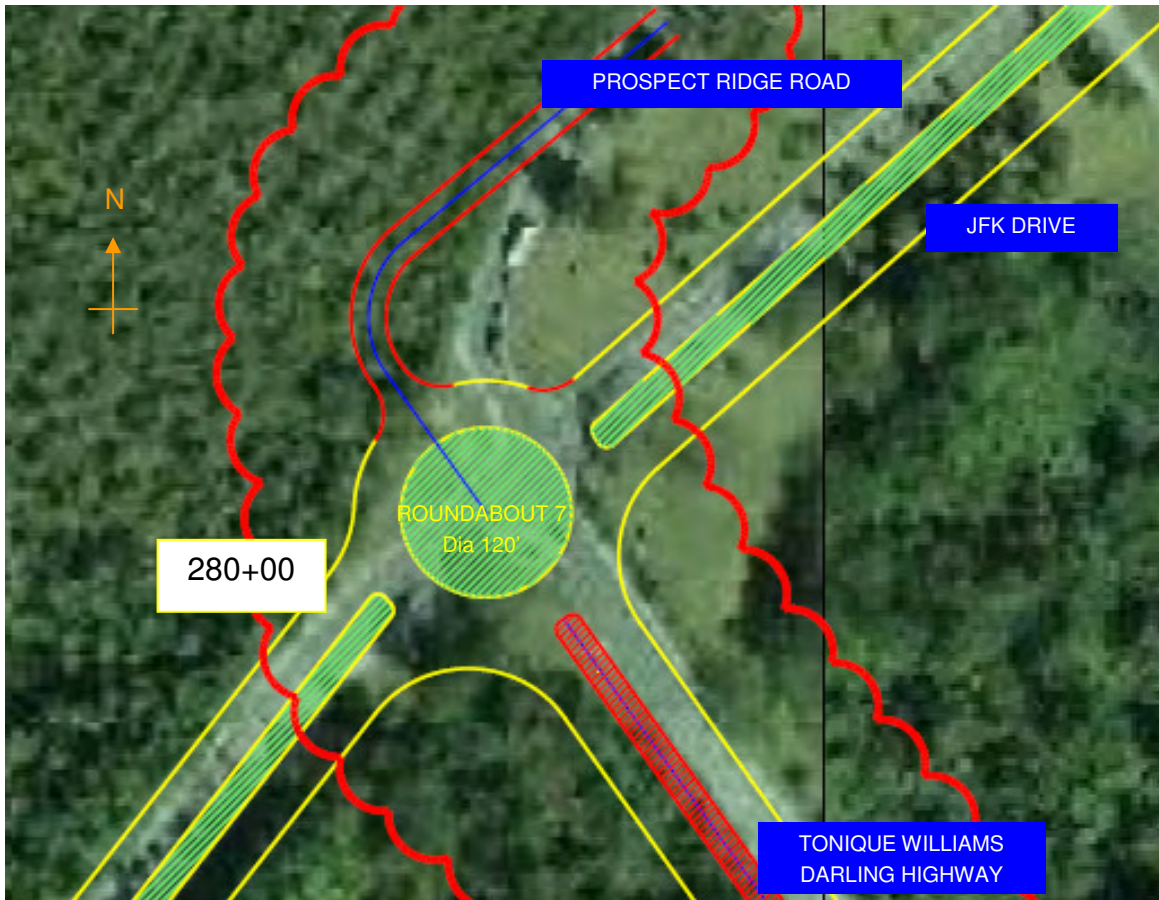
6. No. 6 Roundabout

This intersection is at present a signalised T junction joining JFK Drive and Gladstone Road. It is proposed to extend Gladstone Road to the north to join West Bay Street therefore it is necessary to provide an intersection which will accommodate four arms. There are a number of restrictions due to the existing alignments, a cemetery at the south east quadrant, Lake Cunningham at the north west quadrant, wetlands at the north east quadrant and high end real estate at the north west quadrant. In order not to encroach onto the cemetery it is proposed to locate a 120 foot diameter roundabout as indicated below. This will require reclamation of land within the Lake covering an area of approximately 0.4 acres.



7. No. 7 Roundabout

At present there is a signalised cross road intersection between JFK Drive and the TWD HWY and Prospect Ridge Road with two lanes on all approaches other than Prospect Ridge Road. It is proposed to expand the western portion of TWD Highway to a four-lane road in future so that the complete length is four lanes. It is proposed to install a 120' diameter roundabout in place of the signalised junction at this location. As a result Prospect Ridge Road will be re-aligned to provide an approach to the roundabout. A 300 foot long 20 foot wide taper median will be provided on TWD Highway. This will taper to meet the existing carriageway width.



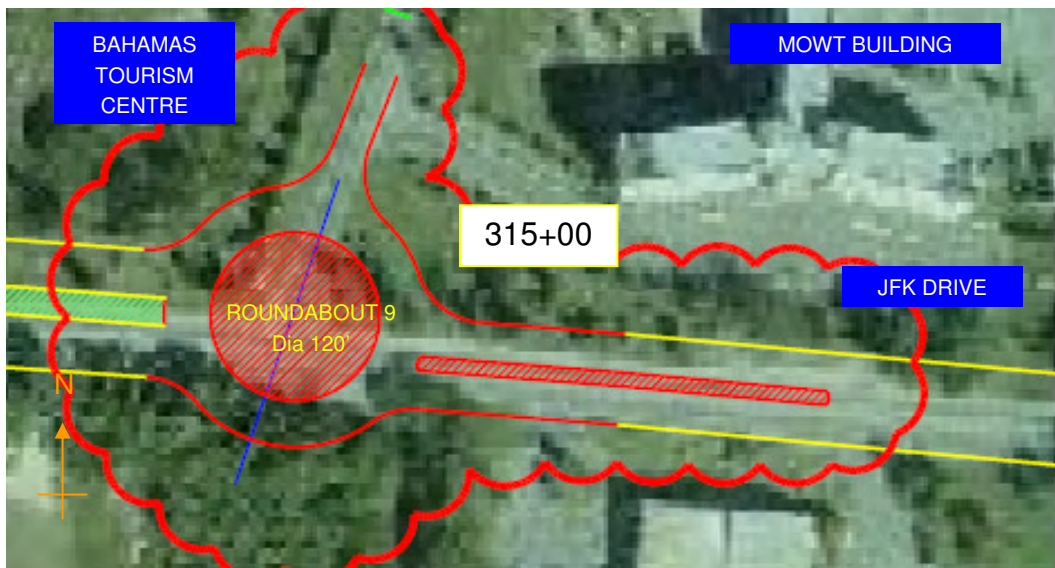
8. No. 8 Roundabout

This junction is at present a T junction which accesses Christie Avenue which provides access to the residential area south of JFK Drive at this location and an alternate access to TWD Highway. It is proposed to provide a 120' diameter roundabout at this location.



9. No. 9 Roundabout

This T junction intersection is located in a more developed urban area to provide access and egress to the MOWT Building. Further development is currently near completion on the Bahamas Tourism Centre which is to also be accessed from the same road as the MOWT road. In order to accommodate the traffic flows onto this access road it is proposed to install a 120 foot diameter roundabout.



All the roundabout diameters have been considered to be appropriate as 120 foot diameter roundabouts other than roundabout 2 at the Airport which is proposed to be a 160 foot diameter roundabout. This has been determined based on a general overview of traffic flows.

Apart from installing roundabouts at the above intersections, 5 T-shaped at-grade intersections limited for left turning are set along the road. Thus, vehicles needing to turn right shall U-turn at the next roundabout.

The 5 T-shaped at-grade intersections include;

- Access for Esso at the west end of the project
- Track access west of Police Station
- Theodora Lane merge lane (CH 257+00), exit lane (CH 265+00)
- Prospect Ridge (CH 290+00), merging lane
- Junction East of Christie Avenue (CH 305+00) T-junction

3.2.1.6 Pavement and Associated Works

The project will have dual 2-lane carriageways 26.5 feet wide for 12 foot driving lanes separated by a grassed median strip separating the east and west bound carriageways. There will be no inner shoulders and no outer shoulders in the developed portion of the project where the shoulder is replaced with footpaths.

Design of Sub-grade Cross-section

This project shall conform to the standard specified in AASHTO's Geometric Design of Highways and streets for highways with speed limitation for rural trunk route (major) with a design speed of 55 mph. There are three kinds of subgrade widths, which are as follows:

- Common section: the sub-grade width is 95', in which the carriageway pavement covers 26'6" in two sections which includes 6" wide traffic markings, the median covers 30' and the shoulder covers 2x6', and width of others refers to side slope and swale. The right-of-way covers 111'.
- The Airport to the Police Station and Gladstone Road to Harrold Road: the subgrade width is 81', in which the carriageway pavement covers 26'6" in two sections which includes 6" wide traffic markings, the median width covers 20', the shoulder covers 2x6', and width of others refers to side slope and swale. The right-of-way covers no more than 101'.
- At the route end: the subgrade width is 65', in which the carriageway pavement covers 26'6" in two sections which includes 6" wide traffic markings, and the footpaths cover 2x6'. The right-of-way covers 65'.

The cross-fall of the carriageway, pavement with marking and shoulder is 2% and the median is of raised type.

Sub-grade Depth

The sub-grade height mainly depends on the terrain, horizontal alignment of route, longitudinal gradient of route, etc.; the design elevation of sub-grade refers to the height of outside edge of median; the design flood frequency of sub-grade is 1/100; the region covered by this route is of plain and rolling terrain, which is featured by good penetrability of sub-grade and large evaporation capacity. In order to limit the likelihood of flooding and meet the design standard requirements of the MOWT the minimum elevation of the road must be 5 foot above MSL .

Sub-grade Side Slope and Its Protection

1. Grade of Side Slope
 - i. The applied grade of excavated soil side slope is 3:1, while that for side slope of limestone rock is not more than 6:1.
 - ii. The applied grade of fill embankment slope is not more than 1:4.
2. Protection of Side Slope
 - i. Cutting slope: soil side slope to be protected by planting grass and shrubs. For rock slope, the applied protection is of natural exposure type, namely matching with natural conditions or planting climbing plants.
 - ii. Embankment slope: protected by grass planting.
 - iii. Immersable embankment: protected by spreading mortar rubble.

Special Sub-grade Treatment

The special sub-grade here mainly refers to sub-grade of wetland section. All unsuitable and deleterious material will be removed to a stable base (bed rock) and replaced by suitable back filling.

Pavement Works

Design Principle

The pavement is subject to design complying with the principle of adapting to local conditions, proper material selection, feasible technologies, convenient construction, economical rationality and long service life.

Pavement Structure

1. Pavement Structure
 - Existing road
The existing two lane JFK Drive was constructed in the 1950's. The road has been repaved and maintained many times due to defects such as pits, cracks and longitudinal splits. It is proposed to construct the new widened road to a high standard therefore it is recommended to uproot the existing pavement structure to base top, and pave a new gravel base and bituminous surface in accordance with the new design.
 - New road
In accordance with the experiences in this region, it is recommended that the pavement structure will be composed of three layers, namely the surface course consisting of two bituminous layers; the base consisting of limestone gravel and the sub base consisting of sandy soil.
2. Design Basis and Pavement Depth

Based on the standard road construction used by the Government, the recommended thicknesses of each layer are:

- Carriageway
- Upper surface: bituminous concrete (FC3) with depth of 1 inch. Medium surface: bituminous concrete (Type S) with depth of 1.2 inches. Prime coat: apply emulsified bitumen.
- Tack coat: apply pure bitumen (RS-1 grade).

- Base: thick graded gravel (limestone) with depth of 8 inches. Sub base: sandy soil with depth not less than 70 inches.

Footpaths

Reinforced concrete with depth of 4 inches

Bridge and Culvert Works

In accordance with the investigation of the water system along the route, it appears no significant quantities of water flow through the sub-grade from either side of the existing highway at present. A drainage study as part of the detailed design is necessary in order to determine whether it will be necessary to install bridges or culverts to allow flows across the proposed highway.

Utilities

Pipe and Line Design Plan in New Project

In the new project, it is proposed and recommended that all pipes and lines should be buried in the median. The design shall comply with the principle of utility separation and the requirements of the relevant utility companies.

Lighting Design Plan

It is proposed to adopt a staggered arrangement for the lighting lamps on both sides of the road and at the median. The lamp posts and lamps to be used shall be of distinct Bahamian character. The design shall comply with the requirements of BEC.

Traffic Engineering

Road signs and road markings will be provided as necessary along the highway in order to facilitate safe passage of traffic and in the interests of accident minimisation.

In order to perform the fast, comfortable, safe and efficient transportation functions of this project, it is required to install fully functional traffic safety devices, service facilities, etc. based on traffic volume and an evaluation of service level. The construction standard and implementation procedures shall be as per the Highway Code for the Bahamas.

(1) Safety Devices

The safety devices to be utilised include traffic signs, road markings, guard rails, anti-glare lighting facilities, etc.

- Traffic signs and road markings; include information signs, warning signs and regulatory signs, etc. According to the location of the road and the technical standard applied. All traffic signs and road markings are to be installed in accordance with the Traffic Signs and Regulations and General Directions, 1994 and the Traffic Signs Manual, UK
- Guard Rails: For this project, w-beam guard rails will be applied for some local sub-grade sections.
- Anti-glare: For general sections, trees will be planted for anti-glare.
- Street Lighting: Generally, it is required to install lighting facilities at the median divider and both sides of sub-grade.

(2) Service Facilities

The service facilities mainly include bus stops. There is also a public telephone in the southern road verge directly west of the JFK Drive/TWD junction and west of the Blake Road/JFK Drive junction and a post box in front of the Ministry of Works and Transport building.

Landscaping

In the interests of minimising the blight and featurelessness often associated with new highway construction, landscaping and road beautification works will form an important element of the project. This is important from both the perspective of road users and those who live close to the proposed highway. In addition to reducing the visual and noise impact of the project, landscaping works can serve to reduce driver monotony and thereby improve driver concentration.

The design objective of the landscaping design is to improve the quality of landscape along the road and show the local historical culture and natural scenery in accordance with a number of design principles. The design principles are as follows;

- Integrity principle;
- Principle of safety and comfort;
- Principle of adapting to local conditions;
- Principle of pursuing natural and harmonious effects;
- Principle of environmental protection.
- Ease of maintenance

No details of the proposed landscaping are available however it will be necessary to provide overall vegetation coverage to the medians, shoulders, swales and embankments. The landscaping arrangement will vary in different sections in terms of form, colour and variety to remove the sense of monotony.

Sectional arrangements will be designed by regions (median divider, embankment area, slope toe area, swale area, centre of roundabouts, etc.) with trees, bush, flowers and grass integrated. The median divider shall be covered with trees and grass; the embankments shall be covered with two rows of trees and grass; a shade barrier shall be formed between the right-of-way boundary and the swales; vegetative protection shall be applied for side slope protection as much as possible and hanging and climbing landscaping coverage shall be provided for side slopes on excavation sections.

The landscape design of the roundabouts shall be elaborately planned, creative and with pleasant landscape effect.

Environmental Protection Design

The environmental protection design of this project mainly consists of design for sensitive scenarios such as acoustic environment and water environment.

- a) where noise seriously exceeds the limit, necessary remedial action will be required.
- b) a buffer green belt between the road and residential districts will be required;
- c) sound insulation window or sound barrier at sensitive locations adjacent to the route will be required.

There are various different types of sound barrier that can be used including wood acoustic filter board, colour steel plate, acoustic filter brick with planting, etc. The specific form of sound barrier to be used will depend on its location.

3.3 Construction Aspects

3.3.1 Contractual Matters

The project is still in the early phases of feasibility and construction arrangements have, therefore, not yet been seriously addressed. However, the construction contracts will be based on existing MOWT

documents for this type and scale of works, which are themselves based on FIDIC documents. It is expected that standard contract documents which were prepared in connection with recent construction works, will be adopted as the basis for preparing documentation for this project.

It is likely that a design build contract will be awarded to the China Construction for the construction phase. Figure 3.3 indicates the proposed schedule for the works.

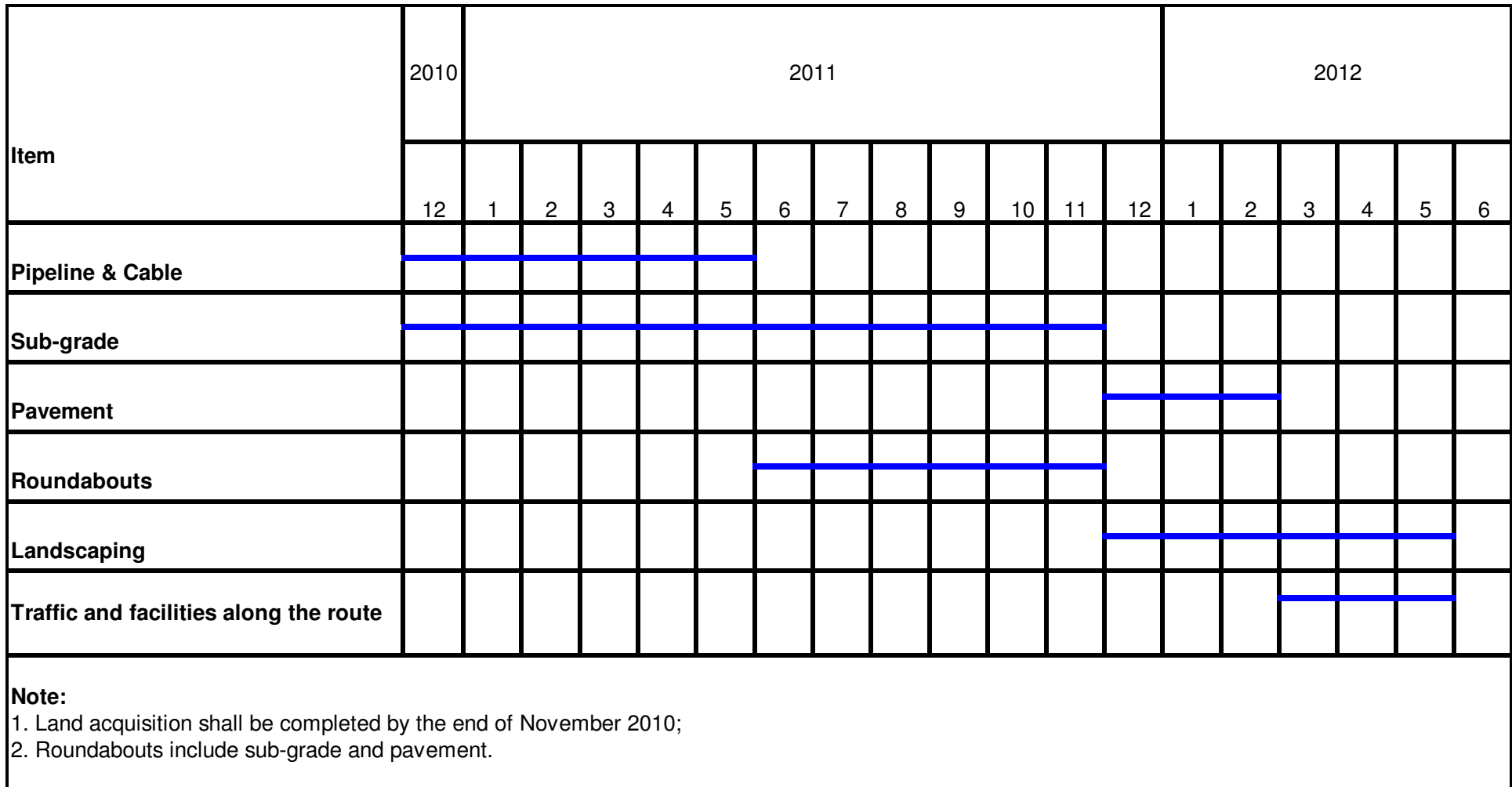


Figure 3.3 Proposed Construction Schedule

3.3.2 Construction Arrangements

It is anticipated that the contractors will establish centralised facilities at suitable locations within the area covered by the works package. These will comprise temporary office accommodation for site staff and the MOWT staff, together with laboratory facilities and plant and material storage areas. No residential accommodation for the workforce will be included, since contractors transport the workforce to sites on a daily basis. Arrangements for temporary use of land for the contractors' field bases will be made directly with the landowner concerned. Contractors normally obtain asphalt and bulk concrete from batching plants which are already installed at permanent sites in various locations. Given the reasonable haulage distance from several asphalt and concrete plants, it is considered unlikely that temporary installations would be required at the base or elsewhere in the immediate vicinity of the works.

It is expected that plant-intensive construction methods will be adopted, given the nature and scale of the works.

Conventional road building plant will be deployed for the construction and may include bulldozers, graders, excavators, dump trucks, water tankers, vibrating, static and pneumatic-tyred rollers, and a sensor-controlled asphalt paver, together with small plant such as concrete mixers and trucks for material transport.

3.3.3 Construction Supervision

Day-to-day construction supervision and contract administration is expected to be the responsibility of the Ministry of Works and Transport for this purpose. The Engineer, as defined in the construction contract will probably be a senior member of the MOWT staff. Higher level contract administration and oversight of the work will also be provided by the Ministry of Works and Transport, who will act as the Employer's Representative under the terms of the construction contract.

3.4 Land and Property Acquisition

Problems being experienced at present in connection with other projects forming part of the New Providence Roads Improvement Project demonstrate how vital it is to secure an alignment with minimum impact on local communities in order to avoid costs associated with the delayed start up of civil works or dealing with the civil unrest and conflict which inadequate consultation or consideration can cause.

The private land areas have strongly influenced the determination of the route corridor. Extensive field reconnaissance has supplemented information on the location of housing and other property derived from topographic maps and aerial photography, in order to minimise the impact on existing property. However, the use of the existing ROW and local road design parameters for an appropriate design speed coupled with providing an economic design thereby minimising the impact on the Lakes and wetlands and privately owned property makes it very difficult not to conflict with private residential and commercial properties.

3.5 Construction Costs

Construction costs are estimated to be \$66,945,086. Utilizing 132KV and 11KV underground electrical cable, 20" water main pipe and street lighting from China has been found to be cost competitive, and can reduce construction cost by nearly 9 million dollars. Land acquisition is not included in this estimate and must be accounted for by the Government.

4.0 ENVIRONMENTAL BASELINE CONDITIONS

3.6 Overview

This section describes existing baseline conditions for the project. Baseline conditions are described for the following:

- Land Use
- Meteorology and Climate
- Geology and Soils
- Hydrology and Water Quality
- Air Quality and Ambient Noise
- Resource Consumption
- Hazards and Hazardous Wastes
- Biological Aspects
- General Population Characteristics
- Income and Poverty
- Economic Activities and Employment
- Social infrastructure
- Utilities and Supporting Infrastructure
- Accessibility and Transport
- Gender and Development
- Other Social Issues in the Project Area
- Cultural Heritage and Archeology
- Aesthetics

3.6.1 Physical Aspects

4.2.1 Land use

Bahamian soils are thin, coarse-textured and fragile, and quickly become exhausted. Various attempts at commercial agriculture have been tried, and some have had some success. Land use has changed dramatically on New Providence over the past thirty years with the building of several large resort hotels, and large tracts of land have been cleared for housing, business complexes and roads.

The Commonwealth of the Bahamas does not have a national plan for land use or physical infrastructure development. Physical planning is therefore by default reliant on reactive forms of development control which has been a difficult planning tool to use successfully for rational land management. The Town Planning Act (1961) is the legislation providing the statutory basis for land use planning resources and has produced mixed success in outcomes.

The route extends from the Lynden Pindling International Airport to Bethel Avenue and provides a major east-west corridor for New Providence. It provides access to the Airport at its west end, intersects with a number of roads along its length and ties into a new road arrangement currently under construction at its east end. The roads which it intersects along its length include Windsor Field Road, an access road to the Police station, Blake Road, Westridge Subdivision Road, Lake Killarney Road, Gladstone Road, TWD Highway, Prospect Ridge Road, Christie Avenue, a road east of Christie Avenue and an access road to the Ministry of Works & Transport building.

The existing right of way (ROW) width for JFK Drive is 75 feet with width reserved to 105 feet. It is understood that adjacent land for portions of the length are BEC wayleave where the BEC utility overhead lines are accommodated. Other land use along the length of the road varies but in general terms encompasses residential properties (undeveloped and developed), commercial properties (mainly developed), water bodies, Airport property, a Police station, old Prospect well fields, churches, Hope College, Red Cross building, the Ministry of Works and Transport office building, the Bahamas Tourism Centre, Bahamas Telecommunications Company office building, Galleria Plaza, Customs Warehouse and Butler and Sands liquor store.

Furthermore it is understood that there is crown land on the south side of Lake Cunningham and that the north side of JFK Drive at the lake shore is designated as no build area. The south side of JFK between South Westridge and the Airport is also designated no build area.

There are a number of residential areas which are adjacent to the project area. The most high end residential area is that around Lake Cunningham which is one of high class residential use. Lake Cunningham Subdivision, an area currently being developed for high-class residential properties, is situated along the northern bank of Lake Cunningham. There are also a large number of well established large properties along the north shore of Lake Cunningham which are very high class residences. Other residential areas include the Westridge subdivision which is located West of Lake Cunningham and the Oakridge and Niven Heights subdivisions on the ridge along the southern side of Lake Cunningham. The northern portion of Westridge is now well developed however south Westridge and other subdivisions are in early stages of development. The only other remaining residential areas are the three properties on the east side of the Lutheran church and the residential area at Christie Avenue. It should also be noted that in our field surveys we came across homeless people living in the old Prospect well fields not far into the forest opposite Christie Avenue.

There is also a new sports stadium under construction at the Queen Elizabeth Sports Centre approximately one mile east of Bethel Road. Tourism chiefs are hoping that the new National Stadium can help give their industry and the country a much-needed economic boost. When complete, the stadium will meet the standards of international bodies such as the International Association of Athletics Federations (IAAF) and FIFA (Federation Internationale de Football Association). This could open the way for the Bahamas to host a number of different international events and competitions. It is expected that the stadium will be turned over to the government in June 2011, when it will have a seating capacity of 23,000, a 2,500 vehicle capacity parking lot and a dedicated lane leading to the complex.

Most of the east end of the island is developed whereas most of the west end of the island is not very developed. In discussions with the Director of the Department of Planning we were advised that there are a number of subdivisions planned for the west of the island. These include a number of subdivisions in South Westridge, subdivisions the length of Munnings Road, Westwinds, West Place, Lyford Hills, Serenity, Love Estates, Stoakes Estates (now overtaken by other developers), Emerald Coast and Gallaney Shores to name a few. It is also considered likely that the new hospital that is proposed would be located on Gladstone Road.

4.2.2 Meteorology and Climate

The Bahamas has a tropical maritime climate, which makes for generally year-round good weather. The Bahamas does not experience extremes of temperatures. There are two seasons: summer which is from May through September and winter which is from October through April. In centrally situated New Providence, winter temperatures seldom fall much below 60F degrees and usually reach about 75F degrees in the day. In summer, temperatures usually fall to 78F degrees or less at night and seldom rise above 90F degrees during the day. Relative humidity is fairly high averaging 78% yearly. The rainy season lasts from May thru October with most of the precipitation occurring during brief summer showers. The hurricane

season spans from the 1st June through to 30th November when the islands may occasionally be interrupted by the threat or presence of a tropical storm or hurricane. Tables 4.1 to 4.3 present monthly mean values for temperature, precipitation and wind speed, respectively.

Table 4.1 Temperature Degrees Fahrenheit

	J	F	M	A	M	J	J	A	S	O	N	D
Max	77.0	77.0	80.6	82.4	84.2	87.8	89.6	89.6	87.8	86.0	82.4	78.8
Min	62.6	62.6	64.4	66.2		73.4	75.2	75.2	75.2	71.6	68.0	64.4

Mean value for each month. Sampling period 1961-1990 (Weather Network)

Table 4.2 Precipitation Inches

J	F	M	A	M	J	J	A	S	O	N	D
1.85	1.57	1.57	2.13	4.57	9.17	6.22	8.50	6.73	6.93	2.24	2.05

Mean value for each month. Sampling period 1961-1990 (Weather Network)

Table 4.3 Wind Speed – Miles/Hour

J	F	M	A	M	J	J	A	S	O	N	D
18.0	19.3	19.9	18.6	17.4	16.2	16.2	15.5	13.7	16.8	18.0	17.4

Mean value for each month. Sampling period 1961-1990 (Weather Network)

4.2.2.1 Wind

The wind conditions for the Caribbean Islands are dominated by trade winds which blow across the southern part of the north Atlantic Ocean (south of the Azores high pressure area). These winds approach with great constancy, primarily from the northeast and southeast directions. Some seasonal changes occur within this pattern, as a result of the relative position of the sun and the earth's surface. In general, these seasonal changes in the annual wind regime may be described as follows:

- a. December to February: Winds are primarily from the NE to ENE.
- b. March to May: Winds are mainly from the east.
- c. June to August: Winds are primarily from the E to ESE.
- d. September to November: Winds are mainly from the E to SE.

Wind speeds are influenced by the location of the Inter-tropical Convergence Zone, or ITCZ. The ITCZ is formed as a result of the convergence of north-east and south-east winds in a belt around the equator. This belt migrates north and south of the equator, in tandem with the sun's motion. Since the ITCZ is characterised by wind uplift (as a result of convergence), surface wind speeds tend to be low in the vicinity of this feature. The ITCZ is closest to the Caribbean Islands between June and November. These months, therefore, have the lowest average wind speeds, compared with the rest of the year.

Mean wind speeds in Nassau are typically 8.1 mph (7 knots) with maximum wind speeds averaging 9.3mph (8 knots) for March. Maximum wind velocities are experienced during hurricanes which are further discussed below.

The Department of Meteorology website, www.bahamasweather.org.bs, describes winds as predominantly easterly with a tendency to become north-easterly from October to April and south-easterly from May to September.

4.2.2.2 Storms

New Providence is located within the Atlantic Tropical Cyclone basin. The number of storms per year is variable in both the short and long term. Table 4.4 shows the number of storms per year passing within 200 miles of Nassau Harbour. The average number of storms is 1.5 storms per year (based on the data from 1980 to present).

Storm surge occurs due to the onshore movement of water from onshore wind, and from the rise in the mean sea level as a result of low pressures in the centre of a storm. In Nassau, storm surge is typically related to the passing of a tropical storm or hurricane.

Storms near Nassau (deepwater) have had a characteristic wave height of as much as 35 feet. This is approximately equal to the significant wave height (average of the highest one-third of the waves) in deep water. These storms or hurricanes usually bring the extreme wind conditions with winds as great as a category 5 hurricane (135 knots/155.4 mph) having been measured in the Bahamas in the past (such as the hurricanes named 'the Bahamas' and 'Fort Lauderdale' in 1932 and 1947 respectively).

Year	Number of Storms	Year	Number of Storms	Year	Number of Storms
1980	0	1990	1	2000	0
1981	4	1991	2	2001	1
1982	0	1992	1	2002	0
1983	1	1993	0	2003	0
1984	2	1994	1	2004	3
1985	5	1995	2	2005	4
1986	0	1996	3	2006	1
1987	1	1997	0	2007	1
1988	2	1998	4	2008	2
1989	1	1999	3	2009	0

4.2.2.3 Waves

Offshore Deep-water Waves

From wave data from the Bahamas grid between 1983 and 2008 it is clear that for conditions in water approximately 1500 feet deep north of New Providence the majority of waves are from the NNE through the NE. Waves are usually below 3 feet in height however waves as high as 14 feet have been recorded.

Inshore Coastal Waves

Given the extremely well protected nature of New Providence, the prevailing wave and swell wave climate does not generally result in waves greater than 50% of the offshore wave height at most of the coast.

Inland Waves

The two Lakes in close proximity to the project area include Lake Cunningham and Lake Killarney. Lake Cunningham is generally 10 to 30 feet from the existing JFK Drive for a length of 2 miles. The shape of the lake and the presence of mangrove or land masses within the area reduce the length of fetch in the direction onto JFK Drive to 4,300ft in this instance. The depth of the Lake is approximately 12 feet maximum and is protected from high winds by a maximum of 90 foot high and 55 foot high ridges to the south and north respectively. This coupled with the limited depth and fetch means that there is very little opportunity for significant waves to build on this Lake.

Lake Killarney is approximately 200 feet from the existing JFK Drive at Blake Road. This is the closest this Lake is to JFK Drive. This Lake is made up of smaller Lakes and land masses reduce the length of fetch to 1,600ft in this instance. The depth of this portion of Lake is approximately 3 feet maximum and is protected from high winds by a ridge to the north and approximately 6 miles of relatively flat land mass to the south. This coupled with the limited depth and fetch means that there is very little opportunity for significant waves to build on this Lake.

4.2.2.4 Tides

The tides at the nearest coast are semi-diurnal (12.42 hour periods). The mean tide range is 2.6 feet, and the spring tide range is 3.1 feet.

4.2.3 Geology and Soils

The project area and its immediate vicinity is generally flat with elevations of an average 5-10 feet above mean sea level. The project area as it extends in a generally eastwards direction from Windsor Field Road runs alongside the two major Lakes and associated wetlands of New Providence for most of its length. These two Lakes are located near the centre of New Providence island. Generally it runs at the base of an east-west ridge, on the south side alongside Lake Killarney and along the north side along Lake Cunningham. The surrounding ridges are steep and reach elevations of 90 feet to the south of JFK Drive and 55 feet north of JFK Drive. The road has a maximum elevation in the order of 30 feet where it crosses a ridge. The road elevation also increases at the eastern end where it extends away from the Lakes into higher ground.

The general drainage of the project area is towards the Lakes, i.e. to the south along the west portion of the project and to the north along the eastern portion. In general, water levels drop very rapidly after rainfall ceases. Lake Killarney and Lake Cunningham have a maximum depth of approximately 3 and 12 feet respectively. The water level of these lakes are approximately 2 feet above mean sea level.

The site is located in the Bahamas Archipelago, which is a group of islands, discontinuous sand bars and coral reefs. The upper sediments consist of oolitic sands, aragonite sands, eroded coral and a relatively porous calcareous limestone. The upper portions of the limestone consist of fairly thin layers, strata and lenses of debris. This debris exists in the form of broken coral, flinty chert inclusions, distinct calcite or aragonite crystals or nodule-like inclusions of other limestone formations.

According to soils information provided by the Department of Agriculture, Bahamian soils are classified into three basic physical classes, sand, silt, and clay, graded by the size of the soil particle size in decreasing order. All soils, except organic soils that are derived from peat, are one of these classes or some combination. The typical nature of soils occurring in The Bahamas is that of an alkaline reaction dominated by the bedrock or parent material, which is limestone. The pH is often 7.9 to 8.4, except for organic soils occurring in marshes. In the vicinity of the project, soils and substrate generally consist of limestone bedrock and sandy loams of the pine forest and marls or limestone mineral clays of the wetlands areas.

Along the shoreline of Lake Cunningham there are soft marl soils for depths of 1-6ft. North east of the lake dense limestone with considerable deep surface pockets and cavities exist. At the proposed northern extension to Gladstone Road dense limestone with occasional small solution pits were typically encountered at the surface along the existing right of way. Partial road construction has occurred in this area.

4.2.4 Hydrology and Water Quality

There are no rivers or streams in the Bahamas. There is, however, some fresh water in lenses found close to the surface, resting on underlying salt water. If wells are drilled too deep they produce brackish or salt water. Resources on New Providence are insufficient to meet the demands of the population (which is about two-thirds of the total population of The Bahamas), and water is brought in by barge from the island of Andros some 30 miles to the west.

There are several lakes on the island, but without streams to replenish them these are shallow and brackish. Average annual rainfall is about 55 inches at Nassau airport in the western part of the island, with a slight reduction on moving east, to about 45-50 inches at Nassau town. Because of the high rates of evapotranspiration only a small proportion of the rainfall will actually recharge the aquifers; observations of well fields in The Bahamas suggests not more than 12 inches per year. Over the whole island (area 80 square miles) the total potential recharge would be about 13,700 million imperial gallons. However, fresh water lenses only occur in parts of the island, and consequently the available resource is only a small fraction of the total potential recharge. In 1990 well fields in New Providence contributed 1930 million gallons to the island's water supply, with a further 1060 million gallons being imported from Andros.

Water supply in New Providence comes under the control of the Water and Sewerage Corporation who manage a number of well fields across the island using a combination of rainfall collection in a network of open trenches and pumping of the freshwater lens. In general the well fields suffer from pollution caused by dumping near or within the well field catchment.

Surface water run-off from the project area drains to surrounding wetlands, Lake Cunningham and Lake Killarney. Lake Cunningham and Lake Killarney are large shallow brackish water lakes adjacent to the airport. These lakes are frequented by waterfowl.

The existing JFK Drive drainage generally enters open swales that allow infiltration with excess water draining to the Lakes. The eastern end of JFK and (parking lots) drain to the edges of the roads and relies on seepage into the ground or evapotranspiration. Other nearby roads and ridgeland drains in a similar way. Whilst the road is generally very low lying and flat it is not overly prone to flooding.

The Water and Sewerage Corporation operates the Windsor Well Fields (a potable water source) located near the airport. Only older 1960 vintage drawings exist for the well fields. Much of the original well fields are reported no longer in service.

A seawater reverse osmosis plant, operated by the Waterfields Company Limited (a consortium consisting of Bacardi Company Limited and a reverse Osmosis Engineering Group from Bermuda) began operation in February 1998. Approximately 2,400,000 US gallons is purchased everyday from the Waterfields Company and mixed with approximately 1,000,000 US gallons pumped from the Windsor Well Fields to reduce the salinity of the Windsor Well Field Water. The blended water is chlorinated. The distribution area for this water includes: Love Beach, Gambier, Delaport, Cable Beach Strip, and Prospect Station. From Prospect Station, the water is further distributed to: Stapledon Gardens, Oaks Field, Bain Town, Nassau

Street, Centreville, Palmdale, Pyforms Addition, St. James Road, and other areas including Paradise Island.

In addition to Windsor Well Fields, the Water and Sewerage Corporation owns and operates other well fields on New Providence:

- Old Southwest
- Southwest One
- Southwest Two
- Perpalls
- Prospect
- Bluehills

Approximately 4.3 million gallons of water a day is shipped from Andros Island to Arawak Cay for distribution on New Providence. A new reverse osmosis plant is proposed for Arawak Cay.

Three-dimensional lens-shaped bodies of freshwater overlie deeper brackish and saline waters due to a difference in densities (Figure 4.1). Ninety percent of the fresh water is reported to be within five feet of the surface. All fresh groundwater comes from rainfall. The salinity is reported to be rising in freshwater due to over extraction.

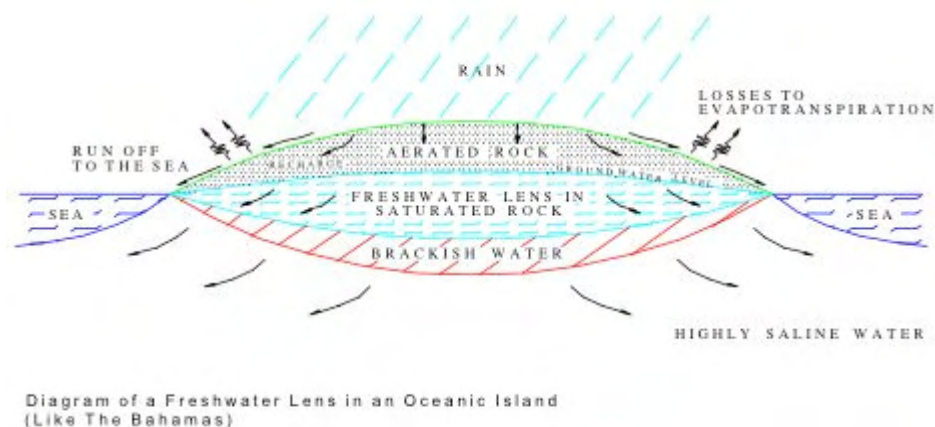


Figure 4.1 Diagram of Freshwater Lens in an Oceanic Island

Lake water quality

Lake Killarney is a very shallow lake and has been known to double in size during heavy rain seasons (2,000 acres to 4,000). Chloride levels in this lake also vary greatly as a result (between 8,000 and 11,000 ppm between 1975 and 1978).

Lake Cunningham is a permanent, shallow brackish lake, with some fringing mangrove swamps, mangrove covered islands and low lying swampy areas. The water level is dependant on rainfall and there is some drying out to the east end during dry periods. The principle vegetation is mangrove swamp with *Conocarpus erectus* and *Rhizophora mangle* and some brackish marshes. This lake is state owned and has private properties bordering the lakes shorelines. There has been recent removal of fringing mangroves as a result of development of Lake Cunningham on the northern bank which has resulted in a loss of habitat for bird species in particular.

The lake has been designated as a Wild Bird Reserve, although it is periodically used for powerboat racing and sailing as well as by seaplanes. Lake Cunningham also contains the Bahama pupfish (*Cyprinodon laciniatus*), which is endemic to Lake Cunningham and Lake Killarney (Campbell.D, 1978).

Lake Cunningham covers approximately 330 acres and occupies an internal drainage basin of 13,000 acres. The lake results from a topographically low area and exposure of groundwater. Geologically it occupies the valley between two Pleistocene (Ice Age) eolianite ridges, though there are relatively younger lagoonal marine deposits exposed on the northern shore. These are also Pleistocene age. Recent marsh deposits occur on the eastern end. The bottom of the lake is predominantly rock, thinly covered in places by carbonate mud and vegetable matter. Growing over this combination is a variable cover of saline water algae.

The contoured lake depth is shown in Figure 4.2. The maximum depth appears to be about 12 ft. Approximately 700 to 800 million gallons (Imperial) of water are contained in the lake. A number of study attempts have been made on Lake Cunningham's water level; earlier observation made in 1976 indicated a seasonal variation of as much as 2.5 ft. but the highest levels are short-lived and the water level was observed to fall at a rate of 1 ft. in 10 days after heavy rain and flooding.

A more common rate of water level change is 0.03 feet per day when the lake is reasonably full, but this falls off as the dry season proceeds. Water level changes are caused by rainfall, seepage, evaporation, tidal effects, and possibly barometric effects. Tidal fluctuations of about .017 ft. have been recorded. The mean lake water level is probably 1 to 2 feet above mean sea level. More data is needed to pin point this elevation.

Lake Cunningham is groundwater to which large quantities of run-off are added during heavy rains (June to October). This recharge raises the water level and induces seepage into the surrounding rock. High water levels can result in seepage losses of as much as 9 million gallons per day. A more common seepage rate is 1.4 million gallons per day, and this, combined with evaporation losses of about 1.2 million gallons per day, causes a constant decline in water level through November, December, and January. Between February, March, and April the water level stabilizes and evaporation losses; are countered by seepage into the lake. This results in a definite rise in salinity. It is not known when the seepage direction changes and at what chloride level it occurs. Further data is required to calculate the salinity of the ground water that enters the lake. The maximum and minimum chloride levels recorded are approximately 11,000 and 7,000 ppm respectively, and the mean about 8,500 ppm. Table 4.5 gives information on the chemical quality of Lake Cunningham. The organic content has yet to be investigated.

Table 4.5 Analysis of water from Lake Cunningham

	Clement ('67)
pH.	8.1
Electrical conductivity	14,000
Chloride	5,500
Total Hardness	145
Calcium	125
Magnesium	385
Sodium	1,500
Potassium	300

Sampling date 17/2/67.

Note: 1966 was the wettest year on record and the lake was 'fresher' than normal when sampled.



Figure 4.2 Lake Cunningham Depth Contours

4.2.5 Air Quality and Ambient Noise

No information on air quality in the project area appears to be available. Aircraft and road traffic account for the largest source of noise near the project area. At present, there are no zoning restrictions on New Providence Island that prevent residential development in areas impacted by the arriving and departing flights at the airport. Work is underway to develop a land planning strategy for New Providence Island.

The noise level due to the current traffic is estimated to be 58 dB at 100 feet away based on existing at peak traffic flow times (between 6-9am and 3-6pm). This traffic also affects the air quality as a result of poorly maintained vehicles emissions due to un-burnt fuel.

There are currently no air quality issues in the Project Area.

There are a number of receptors in the Project Area which are indicated in Appendix D, plans indicating the location of project receptors.

4.2.6 Resource Consumption

The main natural resources of the Bahamas are salt, aragonite, timber (forestry and conservation lands), arable land, wetlands, freshwater resources, agriculture, mangrove forests, fruit crops (especially citrus), vegetables for export and livestock for local markets.

The Bahamas has not held a policy discussion on consumption at the national level, but emphasis is placed on the reduction of waste and increasing energy efficiency in the transport sector.

4.2.7 Hazards and Hazardous Wastes

There are no known areas affected by solid and hazardous waste in the Project area.

Hurricanes are the major natural hazards affecting the project area. The construction activities could be affected as they will be carried out during the hurricane season. There are no records of earthquake activity or tsunamis for the area.

Technological hazards associated with the area include oil spills, fires, accidents, and polluted discharges from vessels.

There have been a total of 5 aircraft accidents recorded at or near Nassau International Airport to date since 1969 (ASN safety database).

4.3 Biological Aspects

4.3.1 Vegetation and Wildlife

The description of terrestrial biological resources characterised within this document focuses on the vegetation communities, wildlife, threatened and protected flora and fauna, and important habitat for local and migratory species.

The island of New Providence is dominated by three different terrestrial habitats as follows;

- A. Pine forest - These forests are dominated by the Caribbean pine (*Pinus caribea var. bahamensis*). The Caribbean pine is protected under Bahamian law due to its historical use for building material. There are a wide variety of plants and animals that are associated with these habitats, including Silver top palms, Wild guava and endemic birds such as the Bahama swallow tail. These forests are only associated with the more wet islands in the North namely Grand Bahama, Abaco, Andros and New Providence.
- B. Coppice forest - This is the broad leaf forests of the Bahamas. There are two main types, Black land coppice and White land coppice. These forests are very diverse with many valuable hard woods such as Mahogany (*Swietenia mahagoni*), Lignum vitae (*Guaiaicum sanctum*) listed as Endangered IUNC 2007, Red cedar (*Juniperus barbadensis*) listed as Vulnerable IUCN 2007, Cascarilla (*Croton eluteria*), Brasileto (*Caesalpinia vesicaria*) as well as many others. The particular mentioned species are also protected under Bahamian law due to their historical use. The Black land forests are usually older forests but also grow on more humus type soils and therefore found further inland. The White land coppice are less dense and are often associated with being of a close proximity to the shore line and therefore with the sandier soils.
- C. Wetlands – Considered to be either inland, or coastal; permanent or seasonal. The inland wetlands are considered “fresh water wetlands”, however, due to the nature of limestone and the limited size of the islands of the Bahamas; most of these wetlands are not truly fresh but rather brackish. These inland wetlands are particularly important for their function of collecting flood waters, filtering it and recharging the ground water table. These wetlands are particularly important for a large variety of avifauna particularly for the migratory species.

These wetlands are also important in their function as storm surge protection, land reclamation, and preventing sedimentation and pollutants reaching the sea from the land.

There are several permanent wetlands on New Providence and they are well documented. The seasonal wetlands also known as ephemeral wetlands are not so well understood or documented. These seasonal wetlands often only appear during the four rainy months of the year and completely dry up during the other parts of the year.

There are four species of mangrove trees that are typical of the wetland landscapes. Each species prefers a slightly different amount of water submersion and salinity. Below is a description of the different mangrove species in the order that one would encounter them when travelling from the sea into the land.

- Red Mangrove (*Rhizophora mangle*) – This is the most water loving of all the mangrove trees and is usually but not exclusively associated with coastal wetlands. These plants have a complex root structure that is effective in dispersing wave energy and therefore protecting the shore line from eroding. The roots are also a favourite hide-out for immature marine species and therefore they are important as a fisheries nursery. These plants in particular are known for their rapid growing and dropping of leaves making these ecosystems some of the most productive ecosystems in the world.
- Black Mangrove (*Avicennia germinans*) – Less water loving than the Red mangrove but is the most salt tolerant of all the mangrove species. The Black mangrove is particularly common in wetlands where the evaporation rate is very high making the pond hypersaline. The roots of this mangrove are particularly good at stabilizing sediment and controlling runoff into the sea.
- White mangrove (*Laguncularia racemosa*) – Even less water loving than the Black mangrove, the White mangrove is found further inland and is the least tolerant of salt compared to the other mangroves. This mangrove is associated mostly with, but not exclusively to, the fresher inland wetlands. Their root system is

similar to those of the Black Mangrove, though not as dense. The root system is still very good at stabilizing the soil.

- Buttonwood (*Conocarpus erectus*) – This is the least hydrophilic, or water-loving, of all the mangrove trees as it does have a regular root system. Though often not considered a true mangrove it is regularly associated with wetland habitats. However, the buttonwoods are extremely salt tolerant and are found in a range of different types of wetlands including the hypersaline. This mangrove plant is probably the most common of all the mangroves on the island of New Providence.

Other plants that are associated with wetland areas include:

- Leather fern (*Acrostichum aureum*)
- Saltwort (*Batis maritima*)
- Wild coral (*Salicornia virginica*)
- Seashore rush grass (*Sporobolus virginicus*)
- Sea purslane (*Sesuvium portulacastrum*)
- Tall sea blight (*Suaeda linearis*)
- Saltweed (*Caraxeron vermicularis*)
- Pond apple (*Annona glabra*)
- Cattail (*Typha domingensis*)

Birds

The lake has been designated as a Wild Bird Reserve, although it is periodically used for powerboat racing and sailing as well as by seaplanes. Waterfowl, which have been recorded on Lake Cunningham, include Phalacrocorax species (almost certainly *P. auritus*), many Ardeidae, *Anas discors*, *Aythya* cattails, *A. Affinis*, *Fulica Americana* and many shore birds. *Oxyura jamaicensis* has occurred in small numbers in recent years (Scott.D.A & Carbonell.M, 1986). Lake Cunningham also contains the Bahama pupfish (*Cyprinodon laciniatus*), which is endemic to Lake Cunningham and Lake Killarney (Campbell.D, 1978). The following table lists all of the bird species that have been spotted around JFK Drive.

Table 4.6 Birds spotted in wetland areas around JFK Drive

Scientific name	Common name
<i>Chen caerulescens</i>	Snow Goose
<i>Anas americana</i>	American Wigeon
<i>Anas platyrhynchos</i>	Mallard
<i>Anas discors</i>	Blue-winged Teal
<i>Anas clypeata</i>	Northern Shoveler
<i>Anas bahamensis</i>	White-cheeked Pintail
<i>Anas acuta</i>	Northern Pintail
<i>Anas crecca</i>	Common Teal
<i>Oxyura jamaicensis</i>	Ruddy Duck
<i>Tachybaptus dominicus</i>	Least Grebe
<i>Podilymbus podiceps</i>	Pied-billed Grebe
<i>Eudocimus albus</i>	White Ibis
<i>Plegadis falcinellus</i>	Glossy Ibis
<i>Ixobrychus exilis</i>	Least Bittern
<i>Nycticorax nycticorax</i>	Black-crowned Night-heron
<i>Nyctanassa violacea</i>	Yellow-crowned Night-heron
<i>Butorides virescens</i>	Green Heron
<i>Bubulcus ibis</i>	Cattle Egret
<i>Ardea herodias</i>	Great Blue Heron
<i>Casmerodius albus</i>	Great Egret
<i>Egretta tricolor</i>	Tricoloured Heron
<i>Egretta caerulea</i>	Little Blue Heron
<i>Egretta thula</i>	Snowy Egret
<i>Phalacrocorax brasilianus</i>	Neotropic Cormorant
<i>Falco sparverius</i>	American Kestrel
<i>Falco columbarius</i>	Merlin
<i>Falco peregrinus</i>	Peregrine Falcon
<i>Pandion haliaetus</i>	Osprey
<i>Circus cyaneus</i>	Northern Harrier
<i>Rallus longirostris</i>	Clapper Rail
<i>Porzana carolina</i>	Sora
<i>Porphyrio martinica</i>	Purple Gallinule
<i>Gallinula chloropus</i>	Common Moorhen
<i>Fulica americana</i>	American Coot
<i>Aramus guarana</i>	Limpkin
<i>Himantopus mexicanus</i>	Black-necked Stilt
<i>Recurvirostra americana</i>	American Avocet
<i>Pluvialis dominica</i>	American Golden Plover
<i>Pluvialis squatarola</i>	Grey Plover
<i>Charadrius semipalmatus</i>	Semipalmated Plover
<i>Charadrius wilsonia</i>	Wilson's Plover

<i>Charadrius vociferus</i>	Killdeer
<i>Gallinago gallinago</i>	Common Snipe
<i>Limnodromus griseus</i>	Short-billed Dowitcher
<i>Tringa melanoleuca</i>	Greater Yellowlegs
<i>Tringa flavipes</i>	Lesser Yellowlegs
<i>Tringa solitaria</i>	Solitary Sandpiper
<i>Actitis macularius</i>	Spotted Sandpiper
<i>Catoptrophorus semipalmatus</i>	Willet
<i>Arenaria interpres</i>	Ruddy Turnstone
<i>Calidris pusilla</i>	Semipalmated Sandpiper
<i>Calidris minutilla</i>	Least Sandpiper
<i>Calidris melanotos</i>	Pectoral Sandpiper
<i>Steganopus tricolor</i>	Wilson's Phalarope
<i>Larus delawarensis</i>	Ring-billed Gull
<i>Larus argentatus</i>	Herring Gull
<i>Larus atricilla</i>	Laughing Gull
<i>Sterna nilotica</i>	Gull-billed Tern
<i>Sterna caspia</i>	Caspian Tern
<i>Sterna maxima</i>	Royal Tern
<i>Sterna sandvicensis</i>	Sandwich Tern
<i>Patagioenas leucocephala</i>	White-crowned Pigeon
<i>Streptopelia decaocto</i>	Eurasian Collared-dove
<i>Zenaida macroura</i>	Mourning Dove
<i>Zenaida aurita</i>	Zenaida Dove
<i>Columbina passerina</i>	Common Ground-dove
<i>Coccyzus americanus</i>	Yellow-billed Cuckoo
<i>Coccyzus minor</i>	Mangrove Cuckoo
<i>Crotophaga ani</i>	Smooth-billed Ani
<i>Chordeiles gundlachi</i>	Antillean Nighthawk
<i>Calliphlox evelynae</i>	Bahama Woodstar
<i>Ceryle alcyon</i>	Belted Kingfisher
<i>Sphyrapicus varius</i>	Yellow-bellied Sapsucker
<i>Tyrannus dominicensis</i>	Grey Kingbird
<i>Tyrannus caudifasciatus</i>	Loggerhead Kingbird
<i>Myiarchus sagrae</i>	La Sagra's Flycatcher
<i>Vireo crassirostris</i>	Thick-billed Vireo
<i>Vireo altiloquus</i>	Black-whiskered Vireo
<i>Tachycineta cyaneoviridis</i>	Bahama Swallow
<i>Progne subis</i>	Purple Martin
<i>Stelgidopteryx serripennis</i>	Northern Rough-winged Swallow
<i>Hirundo rustica</i>	Barn Swallow
<i>Dumetella carolinensis</i>	Grey Catbird
<i>Mimus polyglottos</i>	Northern Mockingbird

<i>Sturnus vulgaris</i>	Common Starling
<i>Vermivora ruficapilla</i>	Nashville Warbler
<i>Parula americana</i>	Northern Parula
<i>Dendroica petechia</i>	Yellow Warbler
<i>Dendroica magnolia</i>	Magnolia Warbler
<i>Dendroica tigrina</i>	Cape May Warbler
<i>Dendroica caerulescens</i>	Black-throated Blue Warbler
<i>Dendroica coronata</i>	Yellow-rumped Warbler
<i>Dendroica dominica</i>	Yellow-throated Warbler
<i>Dendroica discolor</i>	Prairie Warbler
<i>Dendroica palmarum</i>	Palm Warbler
<i>Dendroica striata</i>	Blackpoll Warbler
<i>Mniotilta varia</i>	Black-and-white Warbler
<i>Setophaga ruticilla</i>	American Redstart
<i>Protonotaria citrea</i>	Prothonotary Warbler
<i>Helmitheros vermivorum</i>	Worm-eating Warbler
<i>Seiurus aurocapilla</i>	Ovenbird
<i>Seiurus noveboracensis</i>	Northern Waterthrush
<i>Seiurus motacilla</i>	Louisiana Waterthrush
<i>Geothlypis trichas</i>	Common Yellowthroat
<i>Agelaius phoeniceus</i>	Red-winged Blackbird
<i>Dolichonyx oryzivorus</i>	Bobolink
<i>Tiaris bicolor</i>	Black-faced Grassquit

Table 4.6 Birds spotted in wetland areas around JFK Drive

With regards to the IUCN redlist status of these birds the *Tachycineta cyaneoviridis* (the Bahama Swallow) is considered vulnerable and the *Patagioenas leucocephala* (White-crowned Pigeon) is near threatened otherwise all others are not a concern.

Reptiles/Invertebrates/Reptiles/Mammals

The project area was not found to contain any large mammals, except for domesticated pets. It is also considered likely that introduced rodents exist in the area although none were seen. No wild mammalian species were observed. Reptiles (snakes and lizards) and Amphibians (Frogs) within the Bahamas are largely endemic species or subspecies. All native reptiles and amphibians are at risk from loss of habitat or competition/predation threats from introduced species. Some of these were found in the project area. No snakes were cited, but are very likely and would be extremely threatened during development. Many labourers will kill a snake on sight based on its Biblical representation. The snake is not appreciated for its useful role in eating rats and mice!

There are also a few species of freshwater fish and turtles that are native to these inland wetlands around New Providence, including the Caribbean Gambusia (*Gambusia puncticulata*), the endemic Bahamian mosquitofish (*Gambusia manni*), the Bahama pupfish (*Cyprinodon laciniatus*) and the vulnerable Cat Island Slider (*Trachemys terrapin*). However, these are very rare now in New Providence as most have been replaced or hybridized with closely related exotics namely the Guppy (*Poecilia reticulata*), Tilapia (*Oreochromis mossambicus*) and the Red-eared slider (*Trachemys scripta elegans*).

Descriptions of each site:

The Project Area has been divided into thirteen (13) separate areas as follows which are indicated on Figure 4.3;

- a. West of Airport (PF)
- b. East of Police Station (PF)
- c. Wetland area on South side (MPWH)
- d. Area before West Ridge (CF)
- e. Area opposite West Ridge (CF)
- f. Along road travelling East before bend (CF)
- g. Coppice opposite Lake Cunningham (CF)
- h. Eastern end of Lake Cunningham (WL)
- i. Northern strip just East of Lake Cunningham (WL)
- j. Tonique Williams Darling Highway and Prospect Ridge Junction North end strip (CF)
- k. Tonique Williams Darling Highway and Prospect Ridge Junction South end strip (MDA)
- l. East of Prospect Ridge (CF)
- m. East of Prospect Ridge closer to Bethel Avenue (DA)



Key

- | | | | |
|---|------------------|---|---------------------------------|
|  | - Road |  | - Mixed Pine Forest and Wetland |
|  | - Coppice Forest |  | - Mixed Disturbed Habitat |
|  | - Pine Forest |  | - Developed Area |
|  | - Wetland | | |

Figure 4.3. Map showing the biological sites for descriptive purposes

Each of these areas is described below;

a. West of Airport (PF)

This area is dominated with Pine Forest including species such as Five finger (*Tabebuia bahamensis*), Wild Guava (*Tetrazygia bicolor*), Purple Bletia Orchid (*Bletia purpurea*), Star Sedge (*Dichromena floridensis*), Poison Wood (*Metopium toxiferum*) and Gum Elemi (*Bursera simaruba*). The Pine Forest is relatively healthy with some ornamentally displayed trees such as Wild Tamarind (*Lysiloma bahamensis*) and Pink Poui (non-native).

b. East of Police Station (PF)



Figure 4.4 Pine Forest just East of Police Station

This area is Pine Forest, dominated by the Bahamian Pine (*Pinus caribea var. bahamensis*), Five finger (*Tabebuia bahamensis*), Wild Guava (*Tetrazygia bicolor*), Purple Bletia Orchid (*Bletia purpurea*), Star Sedge (*Dichromena floridensis*), Poison Wood (*Metopium toxiferum*) and Gum Elemi (*Bursera simaruba*). The Pine Forest is relatively healthy with the occasional Casuarina (*Casuarina equisetifolia*) dotted within.

c. Wetland area on South side (MPWH)



Figure 4.5 Lake Kilarney extremities on Southern side of JFK.

This area is a transitional Pine Forest/Wetland area represented by the plants associated with both habitats. Species include Bahamian Pine (*Pinus caribea var. bahamensis*), Saw Grass (*Cladium jamaicense*), Red Mangrove (*Rhizophora mangle*), Leather Fern (*Acrostichum aureum*), Mangrove Vine (*Rhabdadenia biflora*), Gum Elemi (*Bursera simaruba*), Wild Tamarind (*Lysiloma bahamensis*), Cocoplum as well as the exotic invasive Casuarina (*Casuarina equisetifolia*) and road side ornamentals. As you travel towards the West there is an increase in number of Yellow Poui ornamental plants.

d. Area before West Ridge (CF)

This area is broad leafed coppice forest. Plants include Poisonwood (*Metopium toxiferum*), Mahogany (*Swietenia mahagoni*), Satin Leaf (*Chrysophyllum oliviforme*), Featherbed (*Diospyros crassenevis*), Pigeon Plum (*Coccoloba diversifolia*), Bahama Buttercup (*Turnera ulmifolia*), Five Finger (*Tabebuia bahamensis*), Willow Busic (*Sideroxylon salicifolia*), Gum Elemi (*Bursera simaruba*), Cinnecord (*Acacia choriophylla*) and Strong Back (*Bourreria ovata*). Relatively healthy forest. Also spotted with Silk Cotton Trees (*Ceiba pentandra*).

e. Area opposite West Ridge (CF)



Figure 4.6 Opposite West Ridge.

Area is dominated with Coppice forest including Joewood (*Jacquinia keyensis*), Wild Tamarind (*Lysiloma bahamensis*), Poison Wood (*Metopium toxiferum*), Willow Busic (*Sideroxylon salicifolia*), Satin Leaf (*Chrysophyllum oliviforme*) and Pigeon Plum (*Coccoloba diversifolia*). However it is mixed with species associated with other habitats. Plants associated with Pine Forest such as Bahamian Pine (*Pinus caribea* var. *bahamensis*), Star Sedge (*Dichromena floridensis*) and the Purple Bletia Orchid (*Bletia purpurea*). Plants associated with wetlands are also present including Saw Grass (*Cladium jamaicense*). And the occasional Casuarina (*Casuarina equisetifolia*) mixed within.

f. Along road travelling East before bend (CF)

This area is broad leafed coppice forest. Plants include Poisonwood (*Metopium toxiferum*), Mahogany (*Swietenia mahogani*), Satin Leaf (*Chrysophyllum oliviforme*), Featherbed (*Diospyros crassenevis*), Pigeon Plum (*Coccoloba diversifolia*), Bahama Buttercup (*Turnera ulmifolia*), Five Finger (*Tabebuia bahamensis*), Willow Busic (*Sideroxylon salicifolia*), Gum Elemi (*Bursera simaruba*), Cinnecord (*Acacia choriophylla*), Strong Back (*Bourreria ovata*), Paradise Tree (*Simarouba glauca*) and the Thatch Palm (*Thrinax morrisii*). This is a relatively healthy forest.

g. Coppice opposite Lake Cunningham (CF)

The Coppice Forest area opposite Lake Cunningham is very healthy and very diverse. Species include Satin Leaf (*Chrysophyllum oliviforme*), Featherbed (*Diospyros crassenevis*), Pigeon Plum (*Coccoloba diversifolia*), Bahama Buttercup (*Turnera ulmifolia*), Five Finger (*Tabebuia bahamensis*), Willow Busic (*Sideroxylon salicifolia*), Mahogany (*Swietenia mahogani*), Wild coffee (*Psychotria nervosa*), Gum Elemi (*Bursera simaruba*), Cinnecord (*Acacia choriophylla*), Strong Back (*Bourreria ovata*), Paradise Tree (*Simarouba glauca*), Snake bark (*Colubrina arborescens*), Lancewood (*Nectandra coriacea*), Wild Mamee (*Clusia rosea*) among many others were encountered in this area. There were many bromeliads (*Tillandsia* sp.) and orchids (*Encyclia* sp.) in this forest also. This forest had many birds present including the Red Legged Thush, American Mockingbird, Bahama Woodstar,

h. Eastern end of Lake Cunningham (WL)



Figure 4.7 South side of Lake Cunningham.



Figure 4.8 Eastern boarder of Lake Cunningham.



Figure 4.9 Land East of Lake Cunningham.

This area looks to be an artificially filled in part of the lake where past attempts to expand the road are evident. A thin canal lines the Eastern edge of the lake most likely as a drainage catchment for the past construction. The drier and disturbed parts were populated with the exotic disturbance species such as Casuarina (*Casuarina equisetifolia*), Brazilian Pepper (*Schinus terebinthifolius*) and Jumbey (*Leucaena glauca*). Closer to the actual lake the plants are dominated by typical wetland plants such as Saw Grass (*Cladium jamaicense*), Buttonwood (*Conocarpus erectus*), Seagrass (*Coccoloba ulmifolia*), Coco plum (*Chrysobalanus icaco*) but is dominated by the Red Mangrove (*Rhizophora mangle*).



Some birds seen in the area, such as the Least Grebe (*Tachybaptus dominicus*) and a Little Blue Heron (*Egretta caerulea*).

A quick snorkel of Lake Cunningham revealed that the lake was populated mostly by Guppies (*Poecilia reticulata*) - an intentionally introduced mosquito controlling fish; a very rare and endemic fish, the Bahama Pup fish (*Cyprinodon laciniatus*) (Hubbs & Miller, 1942); as well as the Sheepshead minnow (*Cyprinodon variegatus*).

Figure 4.10 Man made canal running along side Lake Cunningham.



Figure 4.11 Area further East of Lake Cunningham.



Figure 4.12 Red Mangroves found in wetland area East of Lake Cunningham.

i. Northern strip just East of Lake Cunningham (WL)

This area is obviously the extremities of Lake Cunningham. Species include Saw Grass (*Cladium jamaicense*), Cattail (*Typha domingensis*), Leather Fern (*Acrostichum aureum*), Red Mangrove (*Rhizophora mangle*), Buttonwood (*Conocarpus erectus*), Seagrape (*Coccoloba ulmifolia*), Coco plum (*Chrysobalanus icaco*) and some Wild Tamarind (*Lysiloma bahamensis*) in drier spots. Evidence of past disturbance to the area is evident with modification to the landscape and the invasion of typical exotic disturbance species including Casuarina (*Casuarina equisetifolia*), Brazilian Pepper (*Schinus terebinthifolius*) and Jumbey (*Leucaena glauca*).

Birds like the Common Moorhen (*Gallinula chloropus*) were seen with males conducting usually territorial battles indicating this area is used for nesting for the species.

j. Tonique Williams Darling Highway and Prospect Ridge Junction North end strip (CF)



Figure 4.13 Area just West of Prospect Ridge.

This area is already being impacted by a development further up the ridge. But none-the-less comprised of a relatively diverse broad leafed coppice forest dotted with the occasional Bahamian Pine (*Pinus caribea* var. *bahamensis*). Other species include Satin Leaf (*Chrysophyllum oliviforme*), Featherbed (*Diospyros crassenevis*), Pigeon Plum (*Coccoloba diversifolia*), Bahama Buttercup (*Turnera ulmifolia*), Five Finger (*Tabebuia bahamensis*), Willow Busic (*Sideroxylon salicifolia*), Gum Elemi (*Bursera simaruba*), Cinnecord (*Acacia choriophylla*), Strong Back (*Bourreria ovata*), Paradise Tree (*Simarouba glauca*) and the Thatch Palm (*Thrinax morrisii*). As you travel further West the area has been more disturbed and therefore become dominated by Casuarina (*Casuarina equisetifolia*) mixed with some Sea Grape (*Coccoloba uvifera*).



Figure 4.14 South Western side of the Harrold Road and Prospect Ridge junction.

k. Tonique Williams Darling Highway and Prospect Ridge Junction South end strip (MDA)

This area is dominated by large non-native plants with some typical broad leafed coppice mixed within. There is evidence of disturbance to the area in the past as the soil appears to have been bulldozed and re-colonized by vegetation. Plants in this region include Poinciana (*Delonix regia*), West Indian Almond (*Terminalia catappa*), Woman's Tongue (*Albizia lebbek*), Mother-in-law's tongue (*Sansevieria trifasciata*), Wild Coffee (*Psychotria nervosa*), Satin Leaf (*Chrysophyllum oliviforme*), Pigeon Plum (*Coccoloba diversifolia*), Wild Tamarind (*Lysiloma bahamensis*), Wild Guava (*Tetrazygia bicolor*) and Willow Busic (*Sideroxylon salicifolia*). As you travel West the mix of plants goes from being dominated by the non-natives and becomes more dominated by the native coppice plants, eventually becoming a residential area with typically associated landscape non-native species with the occasional Bahamian Pine Tree (*Pinus caribea var. bahamensis*).

I. East of Prospect Ridge (CF)



Figure 4.15 Coppice forest East of Prospect Ridge.

Healthy Coppice Forest interspersed with some Bahamian Pine (*Pinus caribea var. bahamensis*). Species include Satin Leaf (*Chrysophyllum oliviforme*), Pigeon Plum (*Coccoloba diversifolia*), Poison Wood (*Metopium toxiferum*), Willow Busic (*Sideroxylon salicifolia*), Gum Elemi (*Bursera simaruba*), Strong Back (*Bourreria ovata*), Cinnecord (*Acacia choriophylla*), Rams Horn (*Pithecellobium keyense*), Wild Tamarind (*Lysiloma bahamensis*) and Wild Coffee. Both the North and South side of the road are similar.

m. East of Prospect Ridge closer to Bethel Avenue (DA)

Area is heavily urbanized there are a few native trees used as ornamentals such as Wild Tamarind (*Lysiloma bahamensis*) and Mahogany (*swietenia mahogany*) along with non-natives such as Pink Poui and Weeping Fig.

4.3.2 Protected Areas

Established by an Act of Parliament in 1959, the Bahamas National Trust is mandated with the conservation of natural and historic resources of The Bahamas. This responsibility is achieved primarily through in-situ protection. These protected areas are outside the influence of this project other than Lake Cunningham which has been designated as a Wild Bird Reserve, although it is periodically used for powerboat racing and sailing as well as by seaplanes.

4.3.3 Biological Diversity of the area and species of special importance

Generally, biodiversity within small island nations such as the Bahamas is considered low in relation to larger continental nations with greater habitat variation or tropical zones containing ecosystems such as tropical

rainforest, although islands may support a greater degree of endemism. Within the Bahamas, biodiversity of flora and fauna is highest within broad-leaved evergreen communities and coral reefs. The Bahamian Archipelago, which includes the Turks and Caicos, is listed as having 1,370 species of vascular plants of which 125 are endemic (9.0%) (Correll and Correll 1982). Vegetation surveys at the site revealed a large number of species some of which are invasive species.

Parts of the Project Area are in degradation now with the invasion of alien plant species, and without management or stewardship, biological diversity is in jeopardy. The Conservation and Protection of the Physical Landscape of the Bahamas Act, No 12. of 1997 provides a list of species of trees, which are protected in the Bahamas.

4.4 Social and Socio-economic Environment

4.4.1 General Population Characteristics

Nassau is the capital, largest city, and commercial centre of the Commonwealth of The Bahamas, which functions much like a federal district. While there is no local government, it is governed directly as an administrative division of the national government. The city has a population of 260,000 (2008 census), nearly 80 percent of the entire population of The Bahamas (330,000). It is estimated that the annual growth rate is 1.41% (1997 est.). Tens of thousands of illegal economic refugees from Haiti account for 20 to 25 percent of the population. About 85 percent of Bahamians are of African ancestry, and most of the remainder are of European descent. People of Asian ancestry constitute a very small segment of the population. Some racial mixing has occurred. Approximately 60 percent of the population is urban, a proportion that is growing rapidly as young adults migrate from out-island settlements to the urban areas of Nassau and Freeport.

Nassau's modern growth began just over 200 years ago with the influx of thousands of American Loyalists and enslaved Africans to The Bahamas following the American War of Independence. Many of them settled in Nassau (the then and still commerce capital of The Bahamas) and eventually came to outnumber the original inhabitants.

As the population of Nassau grew, so did the built-up areas. Today the city dominates the entire island and its satellite, Paradise Island. However, until the post-Second World War era, the outer suburbs scarcely existed. Most of New Providence was uncultivated bush until the loyalists came in the 1780s and established several plantations such as Clifton and Tusculum. When the British abolished the international slave Trade in 1807, thousands of liberated Africans freed from slave ships by the Royal Navy were settled on New Providence (at Adelaide, Gambier, Carmichael and Sandiland) and other islands.

New Providence has an area of 80 square miles or 207 square kilometres and it is the eleventh largest island in the Bahamas. Other settlements on the island include Grants Town, Bain Town, Fox Hill, Adelaide, Yamacraw, South Beach, Coral Harbour, Lyford Cay, Sea Breeze, Centreville, The Grove, Delaporte, Gambier, Love Beach, as well as the popular Paradise Island and the resort's Cable Beach area.

Each year, visitors and overnight guests bring in excess of 1.5 billion dollars to the local economy. From January to October 2007, there were 2.3 million foreign visitors to New Providence. It is estimated that on average there are 3.6 million visitors to the Bahamas each year.

Lynden Pindling International Airport, the major airport for The Bahamas, is located about 9.9 miles west of Nassau city centre, and has daily flights to major cities in the United Kingdom, United States, Canada and the Caribbean.

4.4.2 Income and Poverty

The Bahamas enjoys a high per capita income of US\$14,920 (World Bank, 2005). The United Nations *Human Development Report 2000* ranks the Bahamas high in human development, placing it at number 33 in the world. This ranking is based on a combination of per capita income, standard of living, and access to health care, education, and so forth.

4.4.3 Economic Activities and Employment

4.4.3.1 Economic Activities

The Bahamas is one of the wealthiest Caribbean countries with an economy heavily dependent on tourism and offshore banking. Tourism together with tourism-driven construction and manufacturing accounts for approximately 60% of GDP and directly or indirectly employs half of the archipelago's labor force. Steady growth in tourism receipts and a boom in construction of new hotels, resorts, and residences had led to solid GDP growth in recent years, but tourist arrivals have been on the decline since 2006. Financial services constitute the second-most important sector of the Bahamian economy and, when combined with business services, account for about 36% of GDP.

Manufacturing and agriculture combined contribute approximately a tenth of GDP and show little growth, despite government incentives aimed at those sectors. Agriculture and fisheries industry together account for 5% of GDP. The Bahamas exports lobster and some fish but does not raise these items commercially. There is no large-scale agriculture, and most agricultural products are consumed domestically. The Bahamas imports more than \$250 million in foodstuffs per year, representing about 80% of its food consumption. The government aims to expand food production to reduce imports and generate foreign exchange. It actively seeks foreign investment aimed at increasing agricultural exports, particularly specialty food items. The government officially lists beef and pork production and processing, fruits and nuts, dairy production, winter vegetables, and Mari culture (shrimp farming) as the areas in which it wishes to encourage foreign investment.

Overall growth prospects in the short run rest heavily on the fortunes of the tourism sector. Tourism, in turn, depends on growth in the US, the source of more than 80% of the visitors.

Tourism

Tourism dominates the Bahamian economy. In 2008 the total number of foreign visitors arriving in New Providence by port was 213,000 of which 82,000 were by air and 131,000 by sea. This represents approximately 60% of the total foreign arrivals to the Bahamas. Revenue from tourism makes up approximately 60 percent of the nation's GDP. In 2009 the average tourist spends US\$958 while vacationing in the Bahamas, and tourist spending overall amounted to US\$1.5 billion. In 2000, there were about 81,700 people employed in the tourist industry. Most visitors are from the United States (83 percent in 1999). The largest resort in the island is the 2,340 room mega-resort Atlantis, which is owned by Sun International. It employs 5,500 people and is the second largest employer in the nation after the government.

All major cruise lines operate services to the Bahamas.

The existing JFK Drive forms part of principal road link for people travelling from the Airport to their accommodations on Paradise Island, Downtown Nassau and Cable Beach to the east of the airport. The largest hotels on the island are located in these areas. A new development named Albany is currently under construction on the south western end of New Providence. Scheduled to open in 2010, Albany will feature a

luxury boutique hotel, a variety of residences, a mega-yacht marina, an 18-hole championship golf course, an equestrian centre, a beach club, a full-service spa and fitness complex and a family water park. Another resort development that is planned for the island is Baha Mar which would be located at Cable Beach. This resort would incorporate hotels by some of the worlds leading brands, the largest casino in the Caribbean, a golf course, a retail, dining and entertainment village and residential condominiums. Baha Mar is scheduled to open in 2014 however it is currently experiencing difficulty obtaining Government and bank approvals.

There are currently limited accommodation options for tourists west of the airport other than Compass Point in Gambier, north west of the airport and the Albany project south west of the airport.

Tourist attractions on New Providence are largely located north (Cable Beach) and east of the project area (Downtown Nassau and Paradise Island). Tourist attractions west of the project area include diving outfits, Commonwealth brewery, beaches and a heritage park.

Agriculture

As mentioned earlier, although many Bahamians have been brought up in a farming community, there has been a tendency for immigration from the more rural areas into the City of Nassau and its suburbs, thus resulting in as apparent shortage of farmers or farm labourers. However, there is a general feeling that more land should be farmed and more people should work in agriculture. Land which is used for farming will be unaffected.

Forestry

There are two different forest types in New Providence, the broad-leaved coppice, which has now been virtually depleted, and the pine forest. The pine forests have been used historically for building and boat timber and to supply turpentine and charcoal. However, none of these uses could be considered commercial forestry. The remaining coppice trees do provide some wood for carving, although collecting cascarillas bark is the most profitable activity.

The systematic exploitation of the forest, has however, been confined to the pine forests and took place over a period of 6 years, from 1923-29, following the granting of timber cutting licenses on Crown Land. In 1956 there were 4,900 acres of forest, which covered 9% of the island however, this has reduced considerably as a result of urban and agricultural expansion and future commercial exploitation has recently had further interest.

Fishing

The fishing industry plays an important role in the economy of the Bahamas and has good potential for growth, there having been a steady expansion of the industry during past years. The fishing industry makes a significant contribution to the Bahamian economy resulting from the export of crawfish, scalfish, sponge and edible marine products.

In the Bahamas, the greatest proportion of the catch is currently landed in New Providence. It is estimated that in the Bahamas as a whole, approximately 3,500 fishermen are employed on commercial fishing vessels. In addition to the commercial exploitation of the fisheries, a number of the Bahamians undertake occasional fishing expeditions as a means of supplementing their living standard.

Mineral Extraction

New Providence Development Company owns a rock-crushing plant in New Providence which supplies building sand and aggregate for use in their building construction activities and road-building. The island of New Providence is based on limestone rock, however, due to the low lying nature of the island, and the great demand for construction materials, there are very few supplies of construction material available, save a few quarries which are within private hands.

Other Manufacturing Industries

At Clifton Pier, the Commonwealth Brewery has been in operation since 1987 and produces beer and malt tonic. It is a relatively large operation by Bahamian standards and employs about 60 persons. Similarly, Bacardi have a factory located just off the main road leading to Clifton Pier, via the South Ocean Beach Hotel and imports molasses to New Providence from which it then produces Bacardi rum.

There are furniture, mattress, plastic bottle and garbage container manufacturers and two Nassau canneries. These products are manufactured for the local market since they are bulky or heavy to transport and by avoiding transportation space and costs, they can compete with the equivalent imported goods on price. There is also some local production of perishable goods such as bread, cakes and pastries, milk or ice-cream and an ice-cream-making plant, also located in Nassau.

Certain Bahamian clothes and designs, unique to the islands, also tend to be manufactured on a small scale, for the local and tourist markets, as are leather, cosmetics, jewellery, novelties, arts and crafts.

4.4.3.2 Employment

About half the working population is employed in the tourist trade assisting the 3.6 million visitors who arrive in the Bahamas each year. The other major employers are in the financial and business services.

Approximately 5,000 workers are employed at the airport at the various businesses and government agencies that operate at the airport.

The unemployment rate was reported to be above 14% in 2009. In April, 2009, the National Insurance Board (NIB) introduced an interim phase of an Unemployment Benefit, to provide income-replacing benefits that replace a portion of wages lost when contributors to National Insurance lose employment income for specified reasons. At December 31, 2009, NIB had paid out unemployment benefits nationwide to 14,071 Bahamians, totalling some \$20.833 million.

4.4.4 Social Infrastructure

Education

Education is available to all segments of the Bahamian population and is compulsory to age 14 years. There are 213 schools in the country, 163 of which are in the public sector. Enrollment for state primary and secondary schools is 50,332, with more than 16,000 students attending private schools and the teacher-to-student ratio is 1:18. Some public schools lack basic educational materials and are overcrowded.

As of 2003, the school attendance rate was 92%. Among the population aged 15 years and over, literacy was 95.8% in 2005; male literacy was 95.0% and female literacy, 96.7%.

Tertiary education is provided at the Government-owned College of the Bahamas, established in Nassau in 1974 which offers both associate's and bachelor's degrees in the arts and sciences.

There are also a number of privately run institutions that also offer associate degrees and are affiliated with tertiary educational institutions in the United States of America. Technical and vocational training is also available at the Bahamas Technical and Vocational Institute.

There are a number of educational facilities near the project area. The most notable being the College of the Bahamas located approximately 1.5 miles east of Bethel Avenue, the Police Training Centre on Thompson Boulevard, St. Johns College off of Bethel Avenue, H. O. Nash Junior School and Stapledon School on Dolphin Drive and Aquinas College which is recently being re-located to Gladstone Road.

Health

In 2005, life expectancy at birth was 74.3 years for women and 67.9 years for men. 10 Recent demographic estimates found that both sexes continue to make gains in life expectancy and that the gap between men and women is sizeable: 6.3 more years for women than men in the 2005 quinquennium.

Diseases such as hypertension, diabetes, myocardial infarction, stroke, and cancers are major concerns for the population of the Bahamas. These diseases are among the leading causes of mortality and account for nearly 45% of all deaths in the country. These diseases also cause more morbidity than any other group of problems.

The public sector operates three hospitals, the two largest of which are located on New Providence. The Princess Margaret Hospital, with 436 beds, provides general acute and specialized services including intensive care, hemodialysis, cardiology, and urology. The Sandilands Rehabilitation Center provides both psychiatric/mental health care on an inpatient and outpatient basis (352 beds) and geriatric care (130 beds). The third institution, the Rand Memorial Hospital, is in the nation's second largest city, Freeport, on Grand Bahama. It provides general acute care as well as basic levels of specialized services, and has a bed complement of 82. Public Health Services are delivered through a network of 57 community clinics and 54 satellite clinics in New Providence and the Family Islands.

The private sector operates two hospitals, Doctor's Hospital in downtown Nassau and Lyford Cay Hospital near the entrance to Lyford Cay. Lyford Cay Hospital provides an outpatient cardiology and internal medicine facility with basic emergency facilities but is without an operating room at present. Private clinics near the project area include the Western Medical Plaza on Blake Road.

For major surgery and specialist medical conditions and emergency care, downtown Nassau remains the principal medical facility for the project area. These facilities are approximately 6 miles east of the east end of the project.

Places of Religious Worship

Religion in the project area appears to offer a form of recreation for the population and there are places of worship located in most of settlement areas, reflecting the mix of cultures and religious practice.

There are three churches that are located directly on JFK Drive. These are the Lakeside Memorial cemetery, the Lutheran church of Nassau and New Life church at Hope College. There is also the New Providence Community Church which is located just off JFK Drive on Blake Road.

4.4.5 Utilities and Supporting Infrastructure

Water

The groundwater resources of the Bahamas are comprised of the fresh, brackish, saline and hypersaline water found in the shallow and deep subsurface, and in the lakes and ponds that occur on the surface. The freshwater resources occur as three dimensional lens-shaped bodies which float on and overlie brackish and saline water. These lenses do not occur in subterranean lakes, rivers, or ponds. Groundwater permeates the rock and all its pores, fissures and interconnected cavities to form these lenses. More than 90% of the freshwater lenses are within five feet of the surface.

Groundwater resources in the Bahamas have always been easy to exploit, and regular usage dates back to the earliest settlers. Today, water is still privately obtained by bucket from shallow hand-dug wells; public supplies are obtained from mechanically cut trenches, pits and seasonal freshwater marshes.

Concerning water supplies, World Health Organization (WHO) Water Quality Guidelines are used to measure water quality. Persistent Organic Pollutants have not been identified as a concern in The Bahamas. There is capacity to treat waste water and capacity for recycling waste water however this is very limited. Approximately 15% of urban sewerage is treated.

Most of the water on New Providence is barged in from Andros (a nearby family island). The Water and Sewerage Corporation (who provide all public water and sewerage services) also run a number of RO plants and continue to expand this capacity. Wellfields in Nassau are currently being phased out due to their cost inefficiencies as compared to RO plants mainly due to maintenance costs. The Water and Sewerage Corporation has a water main along the existing JFK Drive route. It is understood that this existing main needs to be increased in size in order to provide an adequate water service to the West of the island.

Sewerage

In The Bahamas there are sewer collection systems serving approximately one fifth of Nassau; on the other islands these are limited to a few small subdivisions and some private developments and hotels. Septic tanks are used most commonly on the major islands though these do not always conform to the Building Code and therefore may not function in the manner that they should. In the less developed areas pit latrines may be used and there are some places where direct discharge to the sea is still used as a means of disposing of wastes. The use of septic tanks is usually combined with a drain field or disposal wall. Where sewerage mains exist the wastes are normally treated to primary or secondary levels, and the effluent is then disposed of in a deep disposal well. Many different types of deep disposal wells are utilized discharging a wide variety of liquid wastes. The wells that are used to dispose of large volumes of effluent are normally cased down to about 100 feet and are open below this depth. Tourist areas usually include golf courses, and these require considerable volumes of irrigation water. In such situations the wastewater from the hotels is usually treated and reused on a nearby golf course. The waste disposal methods used in The Bahamas are presently far from satisfactory, and studies have shown that the groundwater underlying urbanized areas shows relatively high levels of pollution. There is also evidence of sea-water pollution, particularly in some enclosed harbours which are important tourist destinations or may be involved in the seafood industry.

The water and sewerage corporation has also advised of plans that have been existence for a number of years to install a sewerage treatment plant in the west of the island. The preliminary plans for this treatment plant indicate the infrastructure for this plant to be west of the Airport and therefore does not require infrastructure within the proposed JFK Drive.

Electricity

Bahamas Electricity Corporation (BEC) operates generation, transmission and distribution systems throughout The Bahamas. BEC delivers electricity through a network of high voltage transmission lines up to 132kV, and delivers to consumers at a minimum voltage level of 120V / 60Hz. The Corporation serves approximately 85% of all electricity consumers in the nation. It was established as a Government-owned public Corporation by the Electricity Act of 1956. The Corporation employs a workforce of over 1000. Altogether, BEC operates 29 generating plants at 25 Island locations. The peak load in 2008 was 235 megawatts served by two power stations, one at Clifton Pier, the other at Blue Hills Power station.

The existing utilities and facilities of the city are distributed on both sides of the road, mainly including 132 kV high-voltage wires (overhead), 11 kV high-voltage wires (overhead), lighting wires (overhead and underground), street lamp facilities (on ground), TV signal and cable lines (under ground), telephone transmission lines (under ground), water main (under ground), etc. They are 0 - 43 feet away from the existing road.

Communications

Bahamas Telecommunications Corporation (BTC) are responsible for all public telephone transmission lines and Cable Bahamas are responsible for most public TV and internet cable lines.

4.4.6 Accessibility and Transport

4.4.6.1 Background to the Road Network Hierarchy

Transport History

The modern history of transportation on the island has centred on the mobilisation of the population. This mobilisation has been consumer led and is reflected by the increasing car ownership figures over the last 10 years. At the same time, public transportation provision has fallen away (in both reliability and safety terms) and is now seen as a last resort to many of the local population. Cycling is almost unheard of and only undertaken by the foolhardy given the local driving behaviour, while walking is equally as hazardous given the limited number of sidewalks.

Previous Highway Improvements

Many of the recent road building programs on the island have been as the result of new housing projects. These new housing developments have generally provided good quality internal distributor roads with several connections onto the existing road network. This has led to increased pressure on the existing road network, while very few improvements have been undertaken on these roads.

Over recent years, increasing signalisation of junctions and improved traffic management have been used to provide extra network capacity. This has allowed large-scale road building in the urban areas to be avoided. The reversal of the one-way system on Bay Street and Shirley Street made a significant improvement to the downtown area. Traffic now flows relatively freely in both the morning and evening peak periods.

A new bridge to Paradise Island has relieved congestion in the area of downtown

Nassau. Previous Transportation Studies

Over the past 10 years, a number of transportation studies have been conducted on the island. Each of these studies has suggested a series of strategies aimed at improving transport in some way. Many of the studies have concentrated on localised junction improvements that will add extra capacity to an already heavily congested road network. The remaining studies have looked at a wider picture and tried to develop a series of staged improvements for the island. These studies have considered student transport, public transport, traffic management and road building.

Traffic Growth

The predicted levels of traffic growth are quite substantial and are not sustainable even with far greater road building than is currently planned. Therefore some practical assessment of the predicted growth must be made.

Although substantial growth is likely to take place, it is just as likely that many journeys will be suppressed and not actually occur. It is also likely that some peak spreading of trips will occur with the peak periods becoming longer.

In any event, traffic will continue to grow until the level of congestion experienced becomes unbearable. This has been the experience in most other countries around the world. When this occurs and hopefully before, alternative transport methods are made available.

Car Ownership

Car ownership levels for New Providence Island are considered to be extremely high. This should be taken in the context of the size of the island, and the number of people who live in New Providence. These figures have continued to grow rapidly over recent years, and if current trends continue, car ownership levels could become amongst the highest in the world.

The availability from local banks of low down payments for the purchase of vehicles has generated an influx of new vehicles onto the island that will remain in service for at least the next 15 years.

Another factor effecting car ownership figures is the existence of driver only insurance, which will legally allow you to drive a vehicle on the public highway. This effectively extends the life span of many vehicles, as they become available for use by the very low-income families.

The other main reason for such a high level of car ownership is the lack of a safe and reliable public transport system, and the fact that the car provides the only safe method of travelling after dark. This means that for many Bahamians, the car is a necessity of life rather than an expensive luxury (as is often the case in many other countries).

Travel to School

A major cause of the island's traffic problems is the 'school-run'. This is the trip to and from school both in the morning and in the evening. The effects of the school-run can be seen in the traffic flows where a peak appears in the afternoon when the schools close. This peak is not as distinguished in the morning as many school-runs are combined with the journey to work.

Although the additional trips involved on the school-run are seen as a considerable problem, the larger problem is associated in the vicinity of the schools when the drop off or pick up occurs. There is very little control and practically no enforcement on parking in the vicinity of schools, and as such, parents park in any available space. This causes considerable disruption to the flow of traffic around the area, the effects of which often remain for long periods of time.

Commercial Importance

Transportation needs of commercial organisations can range from the local grocery store through to the shopping mall and government offices. All of these businesses and organisations rely on transportation for their businesses to survive and prosper.

Looking first at large retail developments, one of the key considerations here is access. The more people they can get into the car parks, the more shoppers there will be and thus more turnover. Therefore congestion in and around these areas is seen as a deterrent to potential shoppers, who will often choose to attend an alternative location where traffic conditions is less of an issue.

On the smaller scale, the local traders will probably see congestion as a good thing, provided it is not excessive. Passing trade is seen as a large proportion of their business and thus slow moving traffic in heavy quantities is desirable. However, so too is access to parking, particularly direct access parking.

Looking at office developments, traffic generation is often concentrated around the peak periods when people arrive or leave work. For these developments, access onto the main road network is seen as desirable. However, unlike in other countries, the prospect of relocating the business to another town with better traffic conditions does not exist.

Finally, there is the commercial driver. This may be a small van, a heavy goods vehicle or a taxi. The drivers of each of these vehicles has one simple aim, to reach their destination as quickly as possible so as to maximise their earning potential. Thus for these drivers, uncongested fast moving roads are desirable.

Tourism

A large proportion of the government's revenue is generated from the tourism industry. Although traffic from the international airport to the east will increase, it should be remembered that this would have little effect on peak traffic volumes.

Tourists also rarely have access to cars when they are on the island. This means that most of the drivers on the island will be locals, and therefore know the best route between two places. However, tourists do have a tendency to shop, and explore and thus they will interact with the traffic as pedestrians. Therefore, the provision for pedestrian access must be a consideration when looking at any road changes/improvements.

Tourists mainly rely on taxis and on occasion rent motor scooters. Tourists driving motor scooters are often seen as a traffic hazard as they usually have little or no experience driving scooters and are often more occupied with looking at their surroundings rather than concentrating solely on driving. Therefore safety on roads should also be considered when looking at any road changes/improvements.

4.4.6.2 Road Network

The island has 1,600 kilometers of road, the majority of them paved and in adequate condition, but the network's capacity is insufficient for its growing volume of traffic. It was reported in 2008 that there are

between 170,000 and 180,000 licensed vehicles and some 176,000 licensed drivers and in 1996 it was estimated that there were 203.5 vehicles per 1000 people. The roads system is very inefficient however and traffic congestion is a major problem in New Providence.

The project area is dominated by the existing JFK Drive which acts as an east-west artery for the island, providing the main link into the existing Airport, Gladstone Road, Tonique Williams Darling Highway and the East West Corridor to Nassau. Figure 4.3 provides an outline of the road network on New Providence.

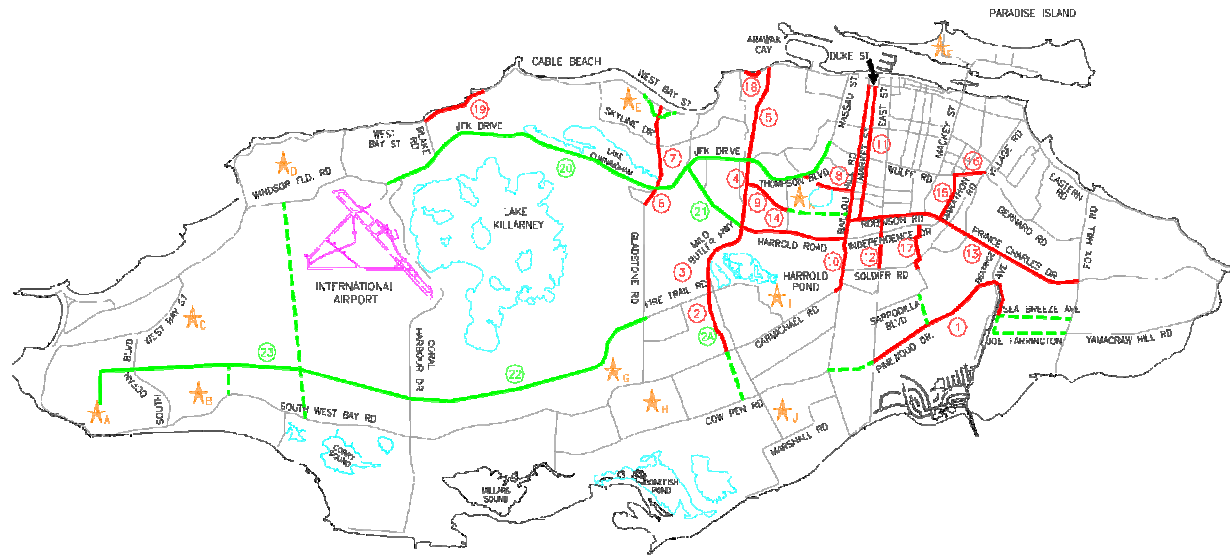


Fig. 4.3 Road Network Map of Nassau

Table 4.7 provides a summary of the main roads in the project area and their relationship with the proposed JFK Drive.

Road	Approx. Location	Interaction with proposed JFK Drive	Comments
Windsor Field Road	Western extension of proposed JFK Drive	New Intersection layout (larger roundabout)	Principal access to the west end of the island.
Lynden Pindling Airport Roads	West end of project	New Intersection layout (larger roundabout)	Principal access to and from the International Airport. Also principal access to the south of the island and Carmichael Road.
Blake Road	Opposite Lake Killarney wetlands	New Intersection layout – roundabout (was T junction)	A principal access to the north coast road (West Bay Street)
Westridge Subdivision Road	CH 110+00	New Intersection layout – roundabout (was T junction)	Access to residential properties as well as an access to the north coast road (West Bay Street)
Lake Killarney Road	Near Westridge Subdivision Road	New Intersection layout – roundabout (was T junction). Portion of road to be re-aligned.	Main access to Lake Killarney and properties surrounding the Lake
Gladstone Road	East end of Lake Cunningham	New Intersection layout – roundabout (was signalised cross road junction).	Main arterial road provides north-south access. North portion not existing but proposed as part of New Providence Road Improvement Project as well as Baha Mar Resort development
TWD Highway	Opposite Prospect Ridge Road	New Intersection layout – roundabout (was signalised cross road junction).	Provides principal access to the east end of the island via the East-West Highway
Prospect Ridge	Opposite TWD Highway	New Intersection layout – roundabout (was signalised cross road junction).	Provides principal access to the north coast road (West Bay Street). Merging side road for traffic travelling south on Prospect Ridge Road onto JFK Drive in an easterly direction to be re-aligned.
Christie Avenue	CH 300+00	New Intersection layout – roundabout (was T junction).	Provides access to communities living south of JFK Drive and an alternate route to access the TWD Hwy.
East of Christie Avenue	CH 306+00	New Intersection (T junction to remain)	
Building of the Ministry of Works & Transport Road	CH 313+00	New Intersection layout – roundabout (was T junction).	Provides access to the MOWT building as well as the Bahamas Tourism Centre.
Bethel Avenue	Termination point of proposed JFK Drive	Tie in to existing	Road providing access to TWD Highway and Milo Butler Highway

Table 4.7: Principal Roads Traversing the Project Area

The posted speed limit for the roadway will not change (it will remain as 45 mph JFK Drive from Airport to TWD Highway, and 35 mph to Bethel Avenue.

Annual motor vehicle fees have been increased to better reflect the impact of vehicles on the Nation's roadways and to cover the cost of street lighting, for which the Government will in future make payments to BEC. To simplify the taxation of vehicles and to promote the use of more fuel-efficient vehicles, the number of excise tax rates on cars and trucks has been reduced to two: a rate of 65 per cent on passenger vehicles with an engine of 2000 c.c. or less and a rate of 85 per cent for all other passenger vehicles and trucks.

The New Providence Road Improvement Project (NPRIP) was conceived to address the inefficiency of the roads and congestion and is currently under construction. The NPRIP is the largest civil works project with the intention to improve transportation on New Providence. The Government is injecting some \$119 million into the project which is co-funded by the Inter-American Development Bank. When completed new corridors will be constructed, existing corridors will be renovated, and major inter-sections improved. The project includes the construction of 11.6 miles of roads, and comprises nine new and 10 existing corridors. Among the roads to be improved are Baillou Hill Road south, Market Street, East Street between Robinson Road and Soldier Road, West Bay Street/Saunders Beach, Robinson Road and Prince Charles Drive, Marathon Road, Wulff Road, the Milo Butler extension to Cowpen Road, the new Bethel Avenue phase I and the new Bethel Avenue phase II. There will be a four-lane 1.2 miles stretch from Milo Butler Highway across the Tonique Williams-Darling Highway to a six-legged roundabout at the junction of JFK/Thompson Boulevard/Farrington Road.

It is also hoped that the New Providence Transport Programme will, among other things, cut down on the number of traffic accidents that occur on the streets of New Providence. In 2008, 11,573 traffic accidents happened in The Bahamas, according to statistics compiled by the Royal Bahamas Police Force. In New Providence alone there were 10,351 accidents.

Traffic surveys were conducted throughout New Providence by Mott McDonald in 2005-2006 as part of the CNPRIP Traffic Survey Report. Included in the study are observed journey times, vehicle type configurations, travel purpose, traffic capacity and traffic capacity and traffic volume, the existing speed and in-situ vehicle speed. Another study was conducted in 2007 local to the Airport as the LPIA Expansion Project Traffic Impact Study. The Feasibility Study carried out in 2009 analysed the available information to carry out traffic forecasting and provide quantitative supporting data for the future development and design model of the area. Data from these surveys and analyses has been utilised to provide a better understanding of the traffic in the Project Area.

JFK Drive is a 2 lane road without a median which runs in an east west direction through a relatively undeveloped area at the centre of the island. This area is mainly high end residential properties although at the eastern end near Bethel Avenue the properties adjacent to the road are commercial. The posted traffic speed is 45 mph for cars and 30 mph for trucks and buses. The traffic volume on JFK Drive is at present approximately 13,000 vehicles per day. The alignment of JFK Drive has four substandard curves along its length. These are located as follows;

Location (chainage)	Radius (feet)	Safety Barrier (Y/N)
80+00	1100	Y
130+00	1200	Y
260+00	500	Y
300+00	220	N

Table 4.8: Existing Sub-standard horizontal radii on JFK Drive

The minimum radius for a design speed of 45mph is 8,140 feet (MOWT Design Guidelines). It is not considered appropriate for the design speed to be the same as the posted speed due to the likelihood of motorists exceeding the speed limit. A higher design speed would increase the required radii however no additional curves would be substandard as a result. The listed curves simply provide a poorer scenario.

There are safety barriers provided at all of the substandard curves other than at Prospect Ridge Road west merge lane (the smallest of all of the curves) all of which have been damaged by traffic accidents. There is also a safety barrier along the south side of JFK Drive east of the Gladstone Road junction for approximately 250 feet.

On the basis of the above information east west traffic travels either on West Bay Street (the north line), JFK Drive (this project) or Carmichael Road (south line), the majority of the traffic utilising JFK Drive possibly due to its location which is central and possibly due to perceived shorter travel times. In 2005 the total east west traffic ADT was 31,033 of which JFK Drive represented 42%, West Bay Street 32% and Carmichael Road 26%. The average annual growth rate between 1999 and 2005 was 4.20%.

West Bay Street (WBS) is a 4 lane road with a median constructed in a densely developed area. The road runs along the north shoreline (in an east west direction) for portions and is otherwise parallel to the shore with mainly high end private residential properties or hotel resorts between the road and the shore. There are also some commercial properties along the route. The posted traffic speed is 45 mph for cars and 30 mph for trucks and buses with 25mph in the heavily pedestrianised tourist locations. Space on this road is generally limited mainly due to the older nature of this road and the cost of shoreline properties and therefore lanes are relatively narrow. The traffic volume on WBS is at present approximately 23,000 vehicles per day.

Carmichael Road is a 2 lane road without a median which runs in an east west direction through a newer developed area on the southern side of the island. This area is mainly low end residential properties though properties adjacent to the road are mainly commercial. The posted traffic speed is 45 mph for cars and 30 mph for trucks and buses. The traffic volume on Carmichael Road is at present approximately 13,000 vehicles per day.

Blake Road is a commercial area with large shopping centre 'Caves Village' located at its northern end where it meets West Bay Street.

The Tonique Williams-Darling (TWD) Highway runs from JFK Drive and meets the east/West Highway to provide a major four lane east west corridor at the centre of the island. This corridor is all four lanes other than the western most 1.5 miles. There are a number of roundabouts as well as the rare T junction along its length to tie it into areas north and south of its length.

Gladstone Road is a north-south corridor which ties into JFK Drive at its northern end and Carmichael Road at its south end. There are proposals to extend this road north to West Bay Street.

Traffic is heaviest on the segment of JFK Drive west of the Tonique Williams Darling (TWD) Highway. The total combined peak hour traffic for both directions being 3,253 vehicles per hour during the morning peak and 3,483 vehicles per hour during the afternoon peak hour. East of this location the traffic volumes do not drop significantly however further west the traffic volumes decrease to 1,135 vehicles per hour during the peak east of Blake Road and 1,551 vehicles per hour during the peak west of Blake Road (a reduction of at least 50%). This is a good indication that the majority of the traffic that is on JFK Drive just west of TWD Highway is accessing Gladstone Road and Westridge Estates.

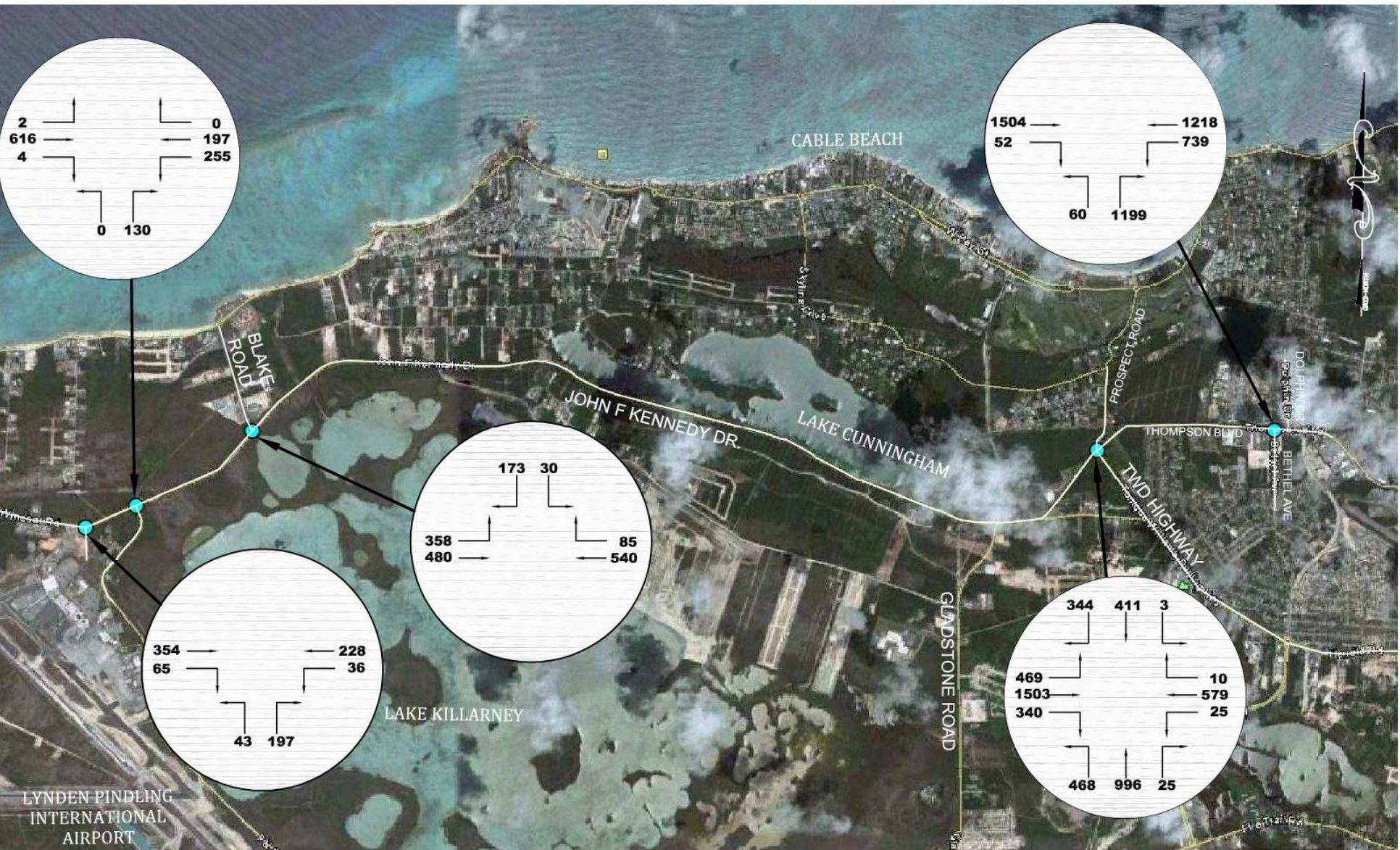


Figure 4.4 AM Peak hour traffic volumes at some of the major intersections along JFK Drive.

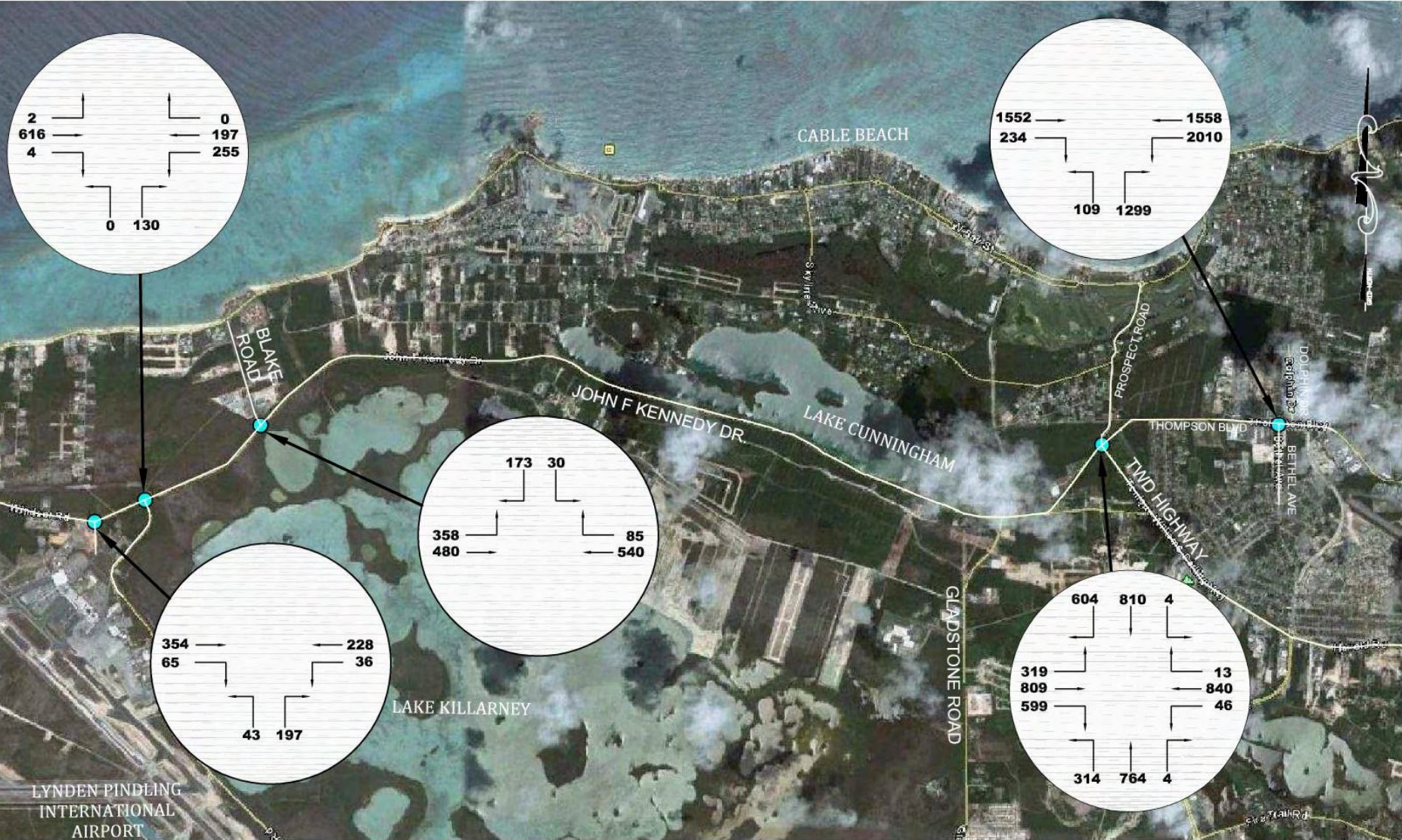


Figure 4.5 PM Peak hour traffic volumes at some of the major intersections along JFK Drive.

Comparison of these existing traffic volumes against the theoretical capacity of the road indicates that traffic on JFK Drive between Blake Road and Bethel Avenue is nearing the road's capacity threshold (ADT of approximately 14,000), leading to routine congestion and unreliable journey times for vehicles. However it is clear that capacity has been exceeded west of TWD at peak hours when traffic is practically at a stand still.

Traffic volumes on JFK Drive between Blake Road and Windsor Field Road are within capacity limits. However, the level of service at JFK Drive and Blake Road is poor with a 35 to 50 second controlled delay being experienced per vehicle.

Properties along JFK Drive west of Gladstone Road are not permitted access directly onto JFK Drive. There are a few properties along the road that have been known to access directly onto the road however. This is an unsafe manoeuvre due to the high speed that traffic on JFK Drive is travelling at.

There are a number of commercial properties at the eastern end of JFK Drive between Bethel Avenue and the MOWT access road which have direct access onto JFK Drive. A central lane is located in the majority of this area in order to better facilitate turning traffic without causing delay to other traffic.

4.4.6.3 Other Forms of Transport

Airport Infrastructure

There are a total of 55 airports in the Bahamas serving 18 islands. On New Providence there is one International Airport (Lynden Pindling Airport) and two small domestic airports at the same location.

Through the policy goals originally set in the Airport Authority Act 2000, and through the subsequent airport management and development agreements that have been entered into, the Government of The Bahamas has recognized the importance of the Airport as a vital piece of the country's economic infrastructure and the imperative of upgrading the airport in order to meet national objectives. That imperative is based on the following considerations:

- About 50% of the Gross Domestic Product (GDP) of The Bahamas stems directly from tourism, and another 10% of the GDP is driven by tourism-related construction.
- Job creation for Bahamians and government revenues from tourism are crucially dependent on delivering new, quality resort destination projects.
- Accessibility is one of the four key factors being used by the Ministry of Tourism to promote The Bahamas as a premier destination. LPIA is the arrival and departure point for nearly 98% of all stopover visitors to New Providence Island, which is significantly higher than the 88% of stopover visitors to The Bahamas as a whole who arrive by air. Cruise ship passengers generally do not qualify as stopover visitors, unless they stay 24 hours or more and do not use the ship as accommodation. Therefore, ensuring a welcoming, quality airport experience is vital to delivering on the tourism promotion strategy as it affects New Providence Island.
- In a 2005 survey carried out by the Ministry of Tourism, a very high number (42%) of the passengers had one or more complaints about the airport. Dissatisfaction of these levels very likely indicates travel decisions are now being negatively affected, especially among potential return visitors whose last impression of The Bahamas is created at their departure through the airport.
- 2700 hotel rooms are anticipated to be added to the available room inventory in the next couple

years. The \$1 billion Atlantis Phase II development was recently completed, including a new 600-room hotel, and several other high-profile tourism projects are in progress such as the reconstruction of the South Ocean Golf & Beach Resort. In addition, the \$1.6 billion Baha Mar Project is in the planning stage, which includes a 1,000-room Caesars Resort Hotel and the largest casino in the Caribbean. Also, the proposed Albany House resort development, backed which will include 500 homes, an 18 hole championship golf course, a Club House, a marina and specialty shops, and a new beachfront hotel.

Buses

The obvious alternative to private car is the bus. There is some dependency on the bus system that is centred on downtown Nassau. The service is predominantly provided by private-sector buses whose services are highly influenced by population densities, which strongly discriminate against rural non-car owning households. Bus service is generally from early morning (about 6:30 a.m.) until about 7:00 p.m. Fares vary, depending on the route, and exact change is required. Bus stops are marked. The basic fare is \$1.25 per person though out of town zones in New Providence could cost up to \$2.25. No public transport is provided to the airport.

Reasons quoted by individuals for being unwilling to switch from car to bus include; the fact that a car will take you from A to B, door to door, buses on the other hand are often late, and are often full and dirty. To encourage individuals to change from car to bus a number of changes are required. These changes will include an improvement in the quality of busses available, along with some form of traffic constraint. This may be in the form of parking charges in the centre of town, or even at the place of business. Further enhancements would also be required in the speed and reliability of the bus services and thus bus priority measures may need to be seriously considered on some routes.

Taxis

Households located away from the main bus service corridors generally do not receive a taxi service. Taxis basically operate a service to tourists, running along the JFK Drive or West Bay Street to access the hotels in Cable Beach, Downtown Nassau and Paradise Island. A taxi can be called or flagged on the street in New Providence however many do not serve certain areas. Taxi stands are also conveniently placed at most hotels and at the airport. Although metered rates vary by island, they are reasonable and are fixed by law.

Nassau International Airport to:

- Cable Beach..... \$18.00
- Downtown..... \$27.00
- Paradise Island..... \$32.00

Cable Beach to:

- Downtown..... \$15.00
- Paradise Island..... \$22.00

Generally a 5 mile taxi ride is approximately \$12.00.

Cycling

On a flat island of this size and the distribution of the population, cycling is an ideal alternative to the car. At present there are very few cyclists on the roads, due to two main reasons. These include the erratic

driving behaviour of the New Providence drivers and the generally poor quality of the edge of the road carriageway and potholes that are present in most roads. It would probably be a public lead initiative rather than governmental to bring about change in this area.

There are no existing cycling facilities in the Project Area and very few cyclists use this route most likely due to the unsafe nature of this route. The Bahamas is however gaining awareness as a cycling location internationally. New Providence recently held the 2010 Tour of the Bahamas an International Caliber Cycling Racing Weekend.

Walking

The lack of sidewalks and the poor street lighting along a number of roads, combined with the intense heat experienced during the summer months means that walking is an option which is not regularly taken up. Improving safety with appropriate crossings and well-maintained sidewalks would encourage more pedestrians, particularly amongst tourists who do not have access to cars.

The existing facilities provided for pedestrians along the route are mainly focussed at the more developed eastern end of the route. There are sidewalks on both sides of the road at this location. There is also a pedestrian crossing near the MOWT and BTC boundary or the Galleria Plaza entrance. Pedestrian flows are not particularly high and most pedestrians are accessing buses or crossing the road from the BTC and MOWT offices for lunch.

4.4.6.4 Air traffic

Currently, the capital's only international airport (Lynden Pindling International Airport) has 2 runways, more than 30 gates and 482,000 square feet of terminal space. With more than 3 million passengers and 92,000 takeoffs and landings in 2008, the airport has reached its capacity and its facilities are outdated and insufficient. In 2006, Nassau Airport Development Company (NAD) entered a 10-year management agreement with YVR Airport Services Ltd. (YVRAS) to manage, operate and redevelop the airport. The redevelopment aims to update the airport facilities to world-class standards and expand terminal capacity. It is being carried out in three stages. The first stage includes the design and construction of a new 247,000-square-foot U.S Departures Terminal. This stage is currently underway and has a budget of \$198.1 million. Stage 2 consists of the complete renovation of the current U.S terminal, to serve as the new U.S/International Arrivals Terminal, with a budget of \$127.9 million. Stage 3 involves the design and construction of a new 112,000-square-foot domestic arrivals and departures terminal, as well as an International Departures Terminal at the location of the existing International Arrivals Hall. This last stage will cost \$83.5 million.

Once complete, the \$409.5 million invested will result in 585,000 square feet of terminal space, a 21% increase, as well as the ability to accommodate 50% more passengers. It will also include the addition of 34 gates, including one capable of handling the Airbus A380. In all, this will provide the airport with a capacity to serve more than 5 million passengers annually.

There is also a plane hangar on the north shore of Lake Cunningham where seaplanes are housed (one or two maximum). These utilise the lake to take off and land.

4.4.6.5 Other Ideas

There are numerous other transportation options which could be considered to improve the traffic situation on the roads at present and in the future including; car sharing, high occupancy lanes, road charging

(electronic toll roads) and pedestrianised areas. Each of these should be considered when the long-term plans for the transportation of the island are reviewed in more detail.

4.4.7 Gender and Development

Legally, women have equal status under the law other than their ability to transfer their nationality to their children if they are married to foreign men. However, men tend to dominate the higher-income and higher status positions in the public and private sectors. Men dominate fishing and other maritime endeavors, the building trades, and the transportation industry. Urban women have many career opportunities and are not discriminated against in obvious ways. Women dominate fields such as nursing, elementary school teaching, and office work. Out-island women tend to be farmers, shopkeepers, craft specialists, and domestics when they are employed. Many self-identify as "housekeepers."

4.4.8 Other Social Issues in the Project Area

Recreational Activities

Recreational activities within the project area of significance include activities on the lakes which are mainly at Lake Cunningham but also at Lake Killarney. Activities at Lake Killarney are mainly limited due to the limited depth of this lake however kayaking is done at both lakes. Sailing, remote motor boating, water skiing and seaplane landing and take off all take place on the lake. The water skiing and motor boat control act restricts these activities 200 feet from the shore. The lake is also frequented by bird watchers and others who relax beside the lake. Recreational activity at the lake will increase in the future.

As mentioned above very few cyclists use this route at present. Other recreational activities on the route include visiting the sacred space 'welcome' at the corner of Blake Road and JFK Drive. Also, the Bahamas Police Band is known to congregate at the TWD/JFK Drive intersection prior to starting processions. Also, at the eastern more developed end of the route recreational activities include visits to the cinema and restaurants at Galleria Plaza.

HIV/AIDs

It is estimated that around 3% of the adult population of the Bahamas are infected with the HIV/AIDs virus (Population Reference Bureau & UNAIDS 2007). This is one of the highest in the Caribbean and one of the highest rates outside sub-Saharan Africa. The primary mode of transmission in the Bahamas is unprotected sexual intercourse between men and women.

4.4.9 Cultural Heritage and Archeology

The Bahamas's cultural heritage and archaeology is important. The Lucayan Indians have reportedly occupied several islands from as early as 700 A.D. The current airport came about when the United States entered the Second World War in 1941. Because of The Bahamas strategic position, New Providence Island was chosen for a joint training base and to support the Royal Air Force Transport Command. Construction of Windsor Field began in May 1942 by the American company Pleasantville Inc. under the supervision of the U.S. Corps of Engineers. Windsor Field was abandoned after the war in 1946. It was reopened in 1957 as Nassau International Airport.

Cultural heritage features in the project area are far more recent and include the various monuments at the airport intersections with JFK Drive. No other cultural heritage features were identified on the route.

4.4.10 Aesthetics

The Project Area is relatively undeveloped with very few developed lots being adjacent to the road however development of the area, in particular along the south side of JFK Drive along Lake Cunningham and at South Westridge is underway. Figure 4.6 is an aerial photograph of a portion of JFK Drive along Lake Cunningham. This figure indicates the location from which the photograph in Figure 4.7 is observed from. As can be seen from the figures the road is surrounded by forest for the majority of its length other than its northern edge at the lake where there is a thin margin between the road and the Lake and motorists have views of the Lake. Figure 4.8 also shows JFK Drive where there is dense vegetation and wetlands.



Figure 4.6 Aerial view of JFK Drive along Lake

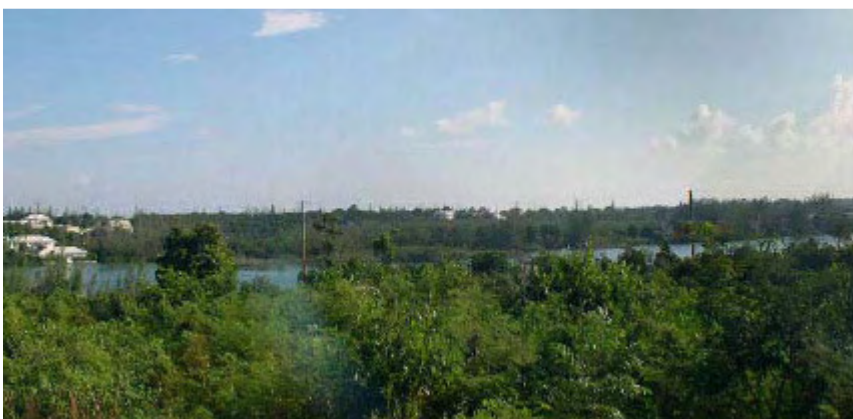


Figure 4.7 Panoramic view of Lake from ridge south of the Lake

Many of the properties along the south side of JFK Drive along Lake Cunningham sell themselves on the key feature of the lot being the beautiful view of Lake Cunningham, the Cable Beach hotels and Atlantic Ocean in the distance (see Figure 4.7).

Generally the views along the road are of wide grassed swales which have minimal landscaping by way of lines of palm trees. Views of forest edge, wetlands, across Lake Cunningham and at the eastern most end of the project of densely developed area with some landscaping.

At Lake Cunningham there is a wide grassed shoulder and swale on the south side of the road with a number of established trees. On the north side there is generally a narrow margin between the road and the Lake which has generally not been landscaped and casuarinas have grown in areas. The Lake is known to provide a very picturesque view, often, due to its protected nature providing a glass mirror image on its surface.

The eastern end of the route is developed and provides a very different view of various commercial buildings (see figure 4.9) however this is a relatively short portion of the route. On the north side of the road there are three large buildings which are three or four storeys high and somewhat set back from the road. These buildings have grassed margins between them and the road with large ornamental trees (other than the Bahamas Tourism Centre which is still somewhat of a construction site). On the south side of the road the buildings are one or two storey buildings with little vegetation.



Figure 4.8 JFK Drive east of Blake road looking west



Figure 4.9 Developed Eastern end of project looking south east

A sacred spaces entitled ‘Welcome’ on the corner of Blake Road and JFK Drive was opened in 2007. Greatly influenced by the sacred space at Clifton Pier, "Welcome" is an attempt to bring the same visual expression of the Bahamian journey alive in a very public and easily accessible setting. The monuments such as the Bird at the Blake Road and JFK Drive intersection and the conch shell at the Airport and JFK Drive junction provide interest and some insight into Bahamian culture to road users at these high tourist traffic junctions.



Figure 4.10 A sacred space entitled ‘welcome’ on the corner of Blake Road and JFK Drive at night

Generally the views along the route are pleasant and of water bodies or vegetation though somewhat monotonous in stretches. The various overhead cables and utility poles are something of an eyesore along the majority of the length of the road however (see Figure 4.8).

4.5 Future Development in the Project Area

There is a principal plan that has been prepared by the Government which provides the strategic planning/development context for New Providence on very general terms. Although this plan is dated, it is assumed it still broadly reflect Government policy and strategy regarding development.

In broad terms the plan indicates that a large amount of the undeveloped land in the project area is planned for development, there is a necessity to improve the road network to accommodate this development and the main corridors that will serve the west end of the island will be JFK Drive, Gladstone Road, Adelaide Road, Frank Watson Boulevard, Carmichael Road, Coral Harbour Road and a north south road west of the airport currently referred to as the 'rock plant' road.

Further developments that will be necessary for the project to have full benefits include the dualisation of the eastern extension of JFK Drive towards downtown Nassau. This includes Thompson Blvd from Farrington Road to Oakes Field Roundabout, running roughly 1.5 miles and Poinciana Drive from Oakes Field Roundabout to Baillou Hill Road., running roughly 0.5 miles. This will provide relief to these congested roads and an improved road network in particular for the Airport to downtown Nassau as well as access to the Queen Elizabeth Sports Centre and the new stadium, the Passport office, Customs Offices and the College of the Bahamas.

The Bahamian Government overall programme is to improve aviation and sea transport in the near future and lay emphasis on reconstructing and improving road infrastructure on New Providence Island to further promote the country's social and economic development and in particular tourism expansion.

However, on New Providence Island, the existing road network and main roads cannot meet the increasing transportation needs. In light of this situation, the Bahamian Government has decided to reconstruct the Lynden Pindling International Airport in the capital Nassau in 2007 to meet increasing tourist needs, and to extend the road between the airport and the downtown area predominated by the JFK Drive.

4.6 Trends in Baseline Conditions

The principal non-highway related change in environmental conditions which can be anticipated in the project area is that more of the land in the vicinity of the road and the west will be developed, probably mainly for housing. This will result in a loss of low-value habitat and an increase in surface run-off, which will be reflected in increased flows and flashiness in watercourses. New large-scale development now has to have sewage treatment facilities provided before planning permission can be obtained, so a major change in water quality seems unlikely, provided that the treatment works actually function properly, and have adequate capacity.

As far as ambient noise and air pollution are concerned, there are likely to be adverse changes from the present situation with a worsening of conditions due to the forecast traffic increase. Vehicle registrations in the Bahamas have increased annually by about 5% for the three years to 2003 and this trend shows no signs of reducing. Recent changes in customs and duty rates on the import of vehicles to increase these rate significantly is likely to have some impact on traffic however this is only likely to be realised with time. Traffic noise and traffic-generated air pollution levels are likely to increase, as a result of both regional organic growth in traffic and growth which is more specifically associated with development in the project area and its environs.

5.0 IMPACTS, BENEFIT ENHANCEMENT AND MITIGATION MEASURES

3.7 Overview of Impacts

Table 5.1 in Appendix E provides a summary and overview of potential direct and indirect, on-site and off-site impacts associated with the project, subdivided into groups according to the phase (pre-construction, construction, post-construction) in which they may occur. In the case of the pre-construction and construction phases, impacts are further subdivided into groups associated with component activities. The benefit enhancement and mitigation measures which will be adopted are also indicated in the table.

The table identifies:

- Impacts which are unlikely to occur, or are unlikely to be significant, because the nature and scope of works and/or the operational characteristics of the highway are such that the causal agents responsible for impact are either absent or of negligible magnitude, or sensitive receptors do not exist.
- Key beneficial and adverse impacts, subdivided into those which are of moderate or high significance and are likely to have a major influence on the overall environmental performance of the project.
- Minor beneficial and adverse impacts which are either not significant or are of low significance.

The significance level of potential impacts was assessed subjectively, taking into account such factors as area and extent and/or numbers of separate locations/persons which might be affected, duration, reversibility, likelihood of occurrence and severity: the latter referring to the degree of change from the baseline state and taking into account the value ascribed to the environmental component or components likely to be affected.

Significance assessment relates to the project as a whole, and disregards any local variation in environmental setting. Comments in Table 5.1 point out significant local variations where these are relevant.

It should be noted that evaluation of potential impact significance is based on the assumption that no specific action will be taken to prevent an impact occurring or to minimise occurrence. In this respect, the assessment presents a “worst case” scenario.

As is the case for many road improvement projects, the number of potentially adverse impacts is considerably greater than the number of potentially beneficial impacts. This reflects the rigorous approach which has been taken to impact identification, as well as the fact that construction works of the type proposed involve a wide range of activities, many of which are potentially damaging to the environment. It should not, in any way, be construed as indicating that the project is environmentally unacceptable. Conclusions regarding the overall environmental performance of the project are set out in Section 5.7. and take into account residual impacts, assuming full adoption of the specified benefit enhancement and mitigation measures.

In the interests of enhancing overall environmental performance of the project, benefit enhancement and adverse impact mitigation measures have been specified in relation to all significant impacts, even in cases where a low level of impact can be anticipated.

5.2 Impacts and Mitigation measures during Construction

Construction activities have specific short term Environmental Impacts. Consideration of the effects on the local environment during the construction period is essential to minimise adverse impacts and disruption to local traffic. Due to the nature of the contract there are no details available relating to the choice and source of materials to be used for construction. This section therefore puts forward constraints on the choice of materials and working procedures. As the island is remarkably low lying and flat the options for obtaining construction materials are limited. This also puts further emphasis on the need to recycle and reuse materials and keep environmental considerations at the top of the agenda.

Special attention must be paid to construction near open water and run-off and sediment control, on-going maintenance of sediment control barriers should be given special attention.

Landscaping requires a high level of maintenance especially whilst establishing itself. Maintenance shall be detailed in the contract during and after construction.

5.2.1 Land Use and Character

The construction of the road will result in the permanent removal of the existing surface soil and upper levels of the underlying subsoil geology to provide suitable formation levels for the road foundations and also to form drainage channels. There will also be partial removal of oolitic ridges for road cutting in order to achieve the required road gradients through areas of higher ground. A permit will need to be obtained prior to excavations under the 'Conservation and Protection of the Physical Landscape of The Bahamas Act'. The cut depth will be limited to approximately 13 ft. It is likely that the road cut will have slopes of 6 in 1 to minimise land take.

Although the oolitic ridges are a physical landscape feature that will be damaged and exposed when cut, of equal importance are the indirect impacts of sediment being washed from the exposed cut and into nearby water bodies such as Lake Cunningham thereby resulting in loss of aquatic flora and fauna. This adverse effect can be mitigated through hydro-seeding of the exposed face to help stabilise the cut surface and reduce sediment creation from erosion, minimising the cut where possible, avoiding construction during the rainy season or the provision of erosion controls.

Bare embankments must be planted with stabilising vegetation to minimise soil erosion and silt runoff. Re-vegetation of bare soils must occur as soon as possible after construction of each section of the corridor. This will ensure that the risks of soil erosion and associated problems are kept to a minimum. Vigilance during supervision is required to ensure that the rapid re-vegetation plan is adhered to.

As the extent of the organic soil cover and depth is limited across the island it would be a significant waste of a natural resource if it were to be disposed of at a landfill. It is therefore important that uncontaminated soil is first stripped and stored correctly prior to excavation of the underlying subsoil rock and then this soil reused as topsoil for landscape planting works.

The Contractor must undertake a quantity analysis of the requirements for fill material. Some portions of the road will require cutting, others will require substantial quantities of fill. It may therefore be possible to take more material from some areas to be used in others. This is essential due to the fact that fill material in the low lying islands of the Bahamas can be difficult to source. Some of the milled pavement may be usable elsewhere on the project. However, the suitability of this material for available purposes is questionable and the matter will need to be investigated during the detailed design stage. Also, the use of

this material would only reduce fill requirements slightly. Other projects that may be able to provide fill material include the Nassau Harbour Dredging Project which has produced large volumes of material which is stored at Arawak Cay.

The Project Yearly Schedule provided does not show time for land acquisition. Without further design details and identification of land owners etc., it is hard to imagine the project moving forward. Land acquisition is a time consuming major component.

The Contractor shall mark the edges of the proposed ROW and maintain these markers so that the Right of Way (ROW) is clearly visible and work outside the ROW is avoided.

Natural vegetation removal must be kept to a minimum along all road corridor. Fencing in the vicinity of Prospect's Water Works shall be implemented to prevent illegal dumping, disturbance to wildlife and encroachment.

5.2.2 Protection of Fauna

The road widening will have an adverse impact on the local fauna. Measures to minimise direct disturbance to wildlife particularly birds and fish include:

- Construction activities near Lake Cunningham, Lake Killarney, associated wetlands and Prospect's Water Works must be carefully monitored between July and September to limit the impact of construction on birds. This timing should also be calculated to minimise disturbance to fish populations along these corridors.
- Prevention of entry of workers into sensitive areas including coppice woodland, and the lakes and wetlands
- Where possible prevention of construction during sensitive lifecycle stages e.g. breeding season.
- Retention of maximum habitat area during construction and immediate re-vegetation.
- Noise minimisation techniques should be applied in sensitive areas.
- Transplantation of individuals to suitable alternative locations where possible in cases where habitats are to be lost. e.g. at the lake or specific wetland areas.
- Siltation or pollution of water bodies during construction must be prevented.
- Prevention of workers fishing in the lakes and wetlands

5.2.3 Protection of Flora

Maximum vegetation should be retained along all proposed corridor. Where there is a real risk of potential damage to existing flora during construction a number of measures can be implemented to minimise that damage, these include:

- Minimisation of the working width of the corridor
- Temporary fencing must be placed around vegetation to be retained, particularly broadleaf coppice to protect from encroachment, illegal dumping and damage from machinery.
- Hand excavations required around the roots of street trees. Interfering branches must be pruned and treated with an approved dressing. Preferably one year in advance of construction works.
- Any roots damaged must be treated immediately with an approved tree paint.
- Off-road driving outside the immediate process areas must be prevented.
- Groundcover is to be restored by the contractor as soon as the earthworks permit. Vegetation should be replaced immediately after earthworks when sections of the corridor are complete. The full revegetation

schedule is attached as Appendix G.

5.2.4 Source Materials

The contractor should be environmentally responsible when making a choice relating to the use of construction materials. Sources of construction materials are limited within New Providence. The main source of aggregate comes from quarried limestone from the ridges and borrow pits. Sand sources on land are also limited. On New Providence, sand banks offshore to the north east of the island are the main source of sand, however continuous removal of this source without proper management will have indirect effects on beach replenishment rates on the beaches on the northern side of the island, which is an important area for tourism. Soils removed for road construction can be reused for landscape planting; soils will also need to be imported. This is necessary due to the limited amount of soil available on the island. It should be noted that quantities of limestone, sand and soil excavated from sources on the island are subject to limitation under the Conservation and Protection of the Physical Landscape of The Bahamas act 1997.

It is estimated that approximately 150,000 cubic yards of material is required for earthworks for the project. This is a significant quantity of material. It is therefore considered important that the alignment of the proposed road be re-examined in order to better balance the earthworks quantities.

It is essential that materials are sourced from non-sensitive areas or from sustainable sources to ensure that indirect impacts do not occur. It is likely that the majority of source materials can be gained from sensitive design of the road to balance the overall amount of materials cut for road construction with the amount of fill required. The contract should include a requirement for the contractor to undertake a thorough analysis of quantities, to balance the cut and fill requirements for the project as a whole and to ensure removal of the need to obtain alternative source fill materials from elsewhere.

The dredging of wetlands and coral reefs solely for source materials shall be prohibited in the contract.

Most material can be sourced locally although some may need to be purchased from the US or alternatively China such as the high voltage cable. It should also be further noted that pre-cast concrete catchpits etc. can now be obtained from Freeport rather than the US as has been done in the past.

5.2.5 Borrow Pits and Haul Roads

These features have the potential to have significant environmental impacts and their use should be minimised by balancing cut and fill quantities as best as practicable. The location of borrow pits and haul roads should be exactly defined and assessed by the Government before being approved. The location of borrow pits and construction roads will be exactly defined by the Contractor's Representative. Borrow pits should be subject to a detailed re-vegetation plan, drainage plan and restoration/fencing proposals.

Guidelines for the location of such areas include the following requirements:

- i) To prioritise the use of areas near the road alignment/ work to minimise the transport of materials.
- ii) To preferably use areas which have already been cleared and are of a degraded nature.
- iii) Not to use areas within floodplains.

Borrow pits and haul roads must be restored after construction. This includes final cleaning of the area, restoration of soil horizons, and planting of native species, preferably arboreal species. The contractor shall comply with the current permit process for the excavation of borrow pits.

5.2.6 Landfilling

Where Landfilling is required a permit for landfilling is necessary (depending on the quantity of material involved) under 'The Conservation and Protection of the Physical Landscape of the Bahamas Act 1997'. When infilling of wetland systems, e.g. Wetlands adjacent the Lake Cunningham, care must be taken not to cause disruption or excessive siltation of the main water body, i.e. Lake Cunningham itself.

5.2.7 Equipment Fuelling, Maintenance and Storage

Any equipment fuelling, maintenance and storage shall be performed in such a manner that no fuels, oils, lubricants, chemicals or other toxic materials can gain access to the soils, groundwater and/or surface water. A detailed plan shall be submitted by the contractor, detailing proposed construction routes, access routes and fuelling areas. Suitable fuelling and maintenance areas shall be established and all such activities performed in these areas. The locations of such areas are subject to the approval by the Employer's Representative.

To ensure preparedness for any spills on land or water, the contractor shall be required to submit a contingency fuel plan, for the containment and rapid clean-up and disposal of any spills, for approval by the Engineer. Clean-up materials are to be stored in a readily accessible and useable state on site, in sufficient quantities to handle the maximum volume of liquid that may be spilled. Small quantities of waste from equipment servicing are to be disposed of at disposal sites designated for such materials. Proof of proper disposal may be required by the Employer's Representative.

5.2.8 Air Quality, Dust, Dirt and Noise

Measures shall be taken to minimise the production of dust and noise through good practice techniques and ensuring equipment is functioning correctly and is performing within the permitted noise levels for the device. Preference shall be given to machinery producing the least noise for the activity. Dust control measures may include the application of water or calcium chloride in accordance with FDOT

All dust creation activities should be located as far as practicable from local residential areas in order to minimise any potential dust nuisance. Measures shall be taken to minimise the production of dust and noise through good practice techniques and ensuring equipment is functioning correctly and is performing within the permitted noise levels for the device. Preference shall be given to machinery producing the least noise for the activity. Dust control measures may include the application of water, wood chips or gravel applied to dust problem areas. Temporary seeding or restriction on vegetation removal may be used as dust control measures.

Public roadways shall be kept clean and as free of mud as possible. Construction should be timed to avoid the rainy season (summer - which receives twice as much rainfall as winter (Sealy, 1994)) where possible. Vegetation removal during construction should be kept to an absolute minimum, and replanting should occur as soon as construction of individual sections is complete. Bare embankments should be planted with stabilising vegetation to provide protection from soil erosion and runoff.

Construction sites in close proximity to residents shall be carefully monitored to minimise impacts from noise and dust. All equipment shall be equipped with effective muffling devices. Noise attenuation devices, such as barriers may be required around stationary sources of loud noise. Residents and business owners shall be notified of construction activities, hours of operation description of services and potential noise levels prior to initiation of construction. Working should be restricted on Sundays and will be subject to the approval of the Employer's Representative in consultation with The Government of The Bahamas.

In the absence of noise regulations in the Bahamas, for the purposes of this document, an average daytime noise level of 70 dB(A) or higher is considered a good indication of a significant noise impact on sensitive land uses when the noise source would not operate at night. When both daytime and night time operation of a noise source is anticipated, then a CNEL level of 60 dB(A) or more would indicate a significant noise impact.

Clearing of vegetation is likely to cause the most significant noise during construction due to the nature of this activity and the amount and extent of vegetation to be cleared. The clearing of vegetation can cause noise of 95dB within 50 feet of the source. This reduces to 70dB at approximately 900 feet and 60 dB at 2,000 feet. Refer to Figure 5.1 which indicates the likely areas of different levels of noise impact. It should be noted that these figures make no allowance for the presence of the ridges within the area of noise impact therefore noise impacts would be less than that indicated nor does it account for areas where there is little or no clearing of vegetation (i.e. at the east end of the route) therefore this figure indicates a worst case.

A number of various types of equipment would be utilised in the construction of the road including bulldozers, backhoes, concrete mixers and pumps, earth tampers, compactors, pavers, trucks and generators all of which emit noise levels between 70 and 85 dB at 100 feet. Some other louder equipment that is louder that is unlikely to be required for short periods of time include jackhammers and pile drivers (up to 98 dB at 100 feet). The noise level due to the current traffic is estimated to be 58 dB at 100 feet at peak traffic flow times (between 6-9am and 3-6pm). Given that development that is close to the works is limited to a few houses, a church, a college and a few commercial properties and that work will be limited to daytime (7am to 6 pm) the noise generated will have a moderate impact.

The acoustic impedance of fish nearly matches that of water, so much of the sound energy will enter their bodies if they are in the vicinity of the source. Studies show that fish suffer damage to their auditory system as well as other parts of their bodies and may even die when exposed to sufficient sound pressure levels underwater for relatively short periods of time. High levels of mortality have been found in fish exposed to 177dB of sound and the threshold for internal injuries to fish is around 160dB. On the basis of available data and the variable response of fish to noise sources, typically a sound pressure level of 150dB is adopted as a maximum threshold for bony fish, below which direct harm is unlikely to occur (Hastings 1991). It is anticipated that the level of noise from any pile driving activities (if necessary) would not exceed 150 dB and therefore fish would not be adversely affected other than in moving away from the area. Whilst pile driving is unlikely on the project if it is necessary it should be kept to a minimum given the presence of the rare Bahama pup fish..

All feasible measures to keep noise levels to a minimum should be adopted by the Contractor. Blasting is not to be permitted without obtaining approval from the BEST Commission.

The areas of main concern with regards to noise during operation are the existing developed areas, in particular those adjacent to the road including the Lutheran church and other properties near chainage CH 265+00, properties either side of Christie Avenue and properties in the developed area at the east end of the route. It is considered likely that noise will have a major impact on these properties due to the nature of the construction and the length of time works will be carried out. Construction works near the Lutheran church should be restricted to all other days of the week other than the day of worship at the Lutheran church. Otherwise no night time working is to be permitted and work is to be carried out between 7am and 6 pm. Should a significant number of complaints be received with regards to noise the Contractor shall take such action as is necessary to reduce noise levels to an acceptable level and a noise monitoring programme shall be instigated to warrant complaints and ensure noise levels do not reach unacceptable

levels. Unacceptable levels shall be considered to be an average daytime noise level of 70 dB(A) at the receptor. The affects of noise can be minimised by restriction on working hours and choice of machinery.

Where construction work is to be carried out within 50 feet of buildings where there is no protection to noise or dust a 6 foot high plywood wall or similar should be erected in order to reduce the affects of noise and dust at the building. Driveways will however need to be maintained. Such arrangements will be necessary at the Lutheran church, one of the residential properties to the east of the church and at Hope College. Consideration should be given to installing any permanent noise abatement features prior to construction to avoid the necessity of temporary structures (this may include early planting of vegetation).

Noise will affect wildlife, most noticeably birds. Due to their mobile nature and availability of similar habitat nearby this impact will be insignificant and wildlife is expected to return after construction.

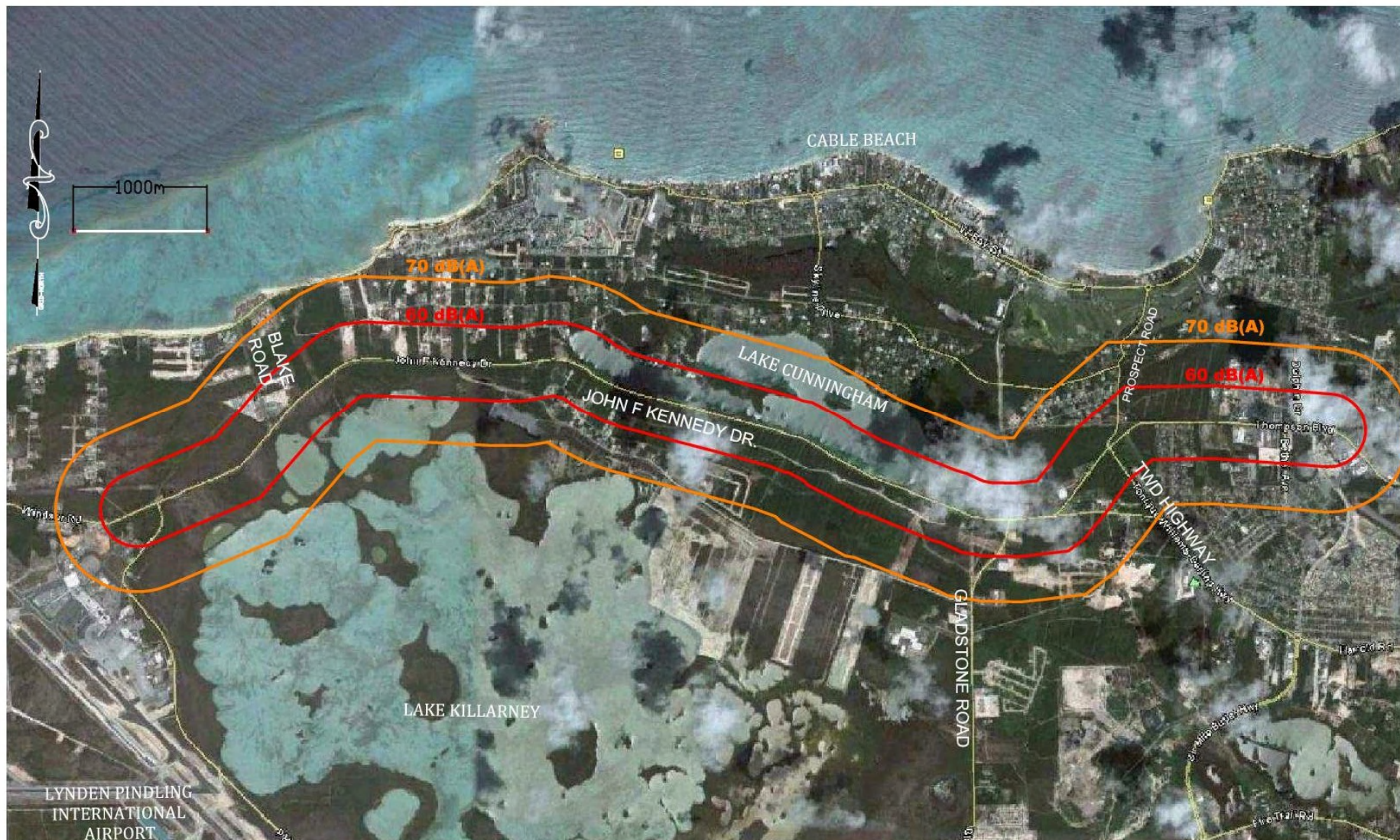


Figure 5.1 Noise levels at the Project Area resulting from Vegetation Clearing

5.2.9 Disruptions

Typical construction impacts are for the most part localised and include dirt, vibration and possible loss of amenity due to the presence of heavy construction traffic. Those affected can include people in their homes or places of work, people visiting shopping centres or community facilities and pedestrians, cyclists or vehicle travellers. Longer journey times and temporary increases in the amount of traffic using alternative local roads are all potential results of road improvement activities. Disruption as a result of vibration caused by heavy plant machinery can be minimised by restriction on working hours and choice of machinery. Temporary disruptions to private landowners may include temporary loss of or restricted access to property.

Communications with nearby residents and business is important. Communications protocol including receiving and resolving complaints needs to be established in the contract.

5.2.10 Traffic

There will be temporary direct and indirect impacts relating to traffic during road construction. Construction activities including local roads to and from quarries, borrow pits, and disposal sites will temporarily impact access to driveways and intersections in the immediate vicinity of the highway construction. Driving hazards such as detours and increased construction vehicle and truck traffic will be present. Impacts are expected to be:

- delays to traffic
- detours to traffic
- blocking of driveways and road accesses

The amount of material necessary for the earthworks portion of the works would necessitate in the order of 7,500 truck loads of fill material. Based on the estimated earthworks schedule of 12 months this equates to approximately 21 trucks per day however flows are likely to be greater and total construction traffic even greater. This impact on traffic further emphasises the importance of balancing of cut and fill quantities.

A traffic assessment will be required to assess traffic using the construction route and to incorporate procedures to minimise journey times and reduce congestion as a result of construction activities.

Traffic management (i.e. signing etc.) should be designed per UK standards and should be submitted to the Engineer for approval. Too often in New Providence are road works carried out with insufficient warning of hazards ahead. Hazards should be protected where possible, signed and well lit at night.

The Contractor's arrangements for managing construction traffic will be continually reviewed. Local communities will be forewarned of any unavoidable temporary restriction to traffic access. The Contractor will make arrangements where instructed by the Engineer's Representative (E.R.) for plant wheel washing to ensure that mud is not deposited onto public highways.

The E.R. will be alerted to the possibility of construction traffic causing pavement and structure damage due to overloading, increase in congestion and any road safety hazards. Care shall be taken to minimise damage to pavement being saved. The Contractor will be responsible for any damages caused to the roadway by poorly maintained or overloaded equipment. Use of tracked equipment will be limited to areas adjacent to sheet piling construction

5.2.11 Site Compound and Stock Piles

The location of site compounds and stockpiles shall be exactly defined and assessed by the Government or its Consultant before being approved. The proposed locations are unknown at this time. It is recommended that fuel/oil storage areas are located at this location within appropriately bunded facilities. Construction documents shall state that compounds and stock pile areas be restored after construction.

No direct drainage to wetlands is permitted, hydrocarbons and sediment must be prevented from entering the wetlands.

5.2.12 Soil Erosion / Silt Runoff Problems

Exposed embankments can cause soil erosion and silt runoff especially during a heavy rainfall and given the presence of the nearby ridges. Bare embankments shall be planted with stabilising vegetation which is easily available and quickly establishes creating a vegetative ground cover which will minimise soil erosion and silt runoff. Replanting as soon as possible after construction of individual sections is complete should be included in the contract to minimise risks of erosion and silt run off as well as for aesthetic purposes. Provision shall be made to intercept and divert site drainage, at short distance intervals, into natural channels, infiltration ditches, settling ponds, or areas of suitable and stable ground cover.

5.2.13 Waste Generation and Spoil Disposal

Spoil generation will occur primarily where existing roads are being taken up and where cut and fill levels are being achieved. The Contractor should explore opportunities for recycling inert material removed from the existing roads. All waste material which cannot be recycled should be stored in a safe manner and disposed of at the government owned landfill off Harrold Road. Illegal dumping of building materials is a common problem on the island and waste disposal should be carefully monitored to ensure that sensitive habitats are not being indirectly impacted.

In locations where topsoil preservation is required, (e.g. natural lands), the topsoil should not be stripped in a wet condition. Topsoil and subsoil should be piled separately to avoid mixing.

Cleared vegetation shall be chipped and disposed of to the government landfill site. It may also be stacked along the right of way for wildlife habitat enhancement. Body wood should be cut in appropriate lengths and stacked along the right of way.

5.2.14 Pollution of Drinking Water and Other Water Bodies

There is a great risk of pollution from construction materials and activities where work is to be carried out near Lake Cunningham, Lake Killarney and the associated wetlands including the wetlands north east of the JFK Drive/Gladstone Road junction. It is essential that sediment or hydrocarbons do not enter these areas and construction activities are controlled and monitored to ensure the risk of water pollution is minimised and controlled. Special emergency procedures should be devised for construction working within Lake Cunningham to ensure that spillages or pollution incidents are appropriately controlled. The contractor shall submit to the Employer's Representative for approval an Emergency Procedures Plan for the above before commencing with work in the areas listed above.

Facilities that could give rise to pollution (such as fuel tanks) shall be located away from water bodies, and should be appropriately bunded. Where such measures are necessary and siltation of water bodies is possible, containment devices, perimeter ditching or contour ploughing shall be employed to prevent erosion.

During construction there is a risk of pollution from construction materials and activities particularly as construction of the road will require reclamation of portions of the lakes and wetlands. Construction

activities should be tailored so as to minimise disturbance to sediment within these water bodies and turbidity barriers shall be deployed in order to restrict the extent of sedimentation. Where turbidity barriers are necessary these shall be deployed as per manufacturers instructions at locations that will limit sedimentation as much as possible. It must be a requirement of the Contractor to maintain these turbidity barriers on a regular basis.

Work on the water main could lead to pollution of drinking water should the system not be well cleaned prior to returning to service. Thorough testing of all lines will be necessary to ensure only clean unpolluted water is distributed.

5.2.15 Water Abstraction

The Contractor will be required to make suitable arrangements for his own supply of water and, as necessary, to provide an alternative supply to any users affected by his water abstraction. The location of wells dug for water supply will conform to local permitting arrangements and in no circumstances shall he allow his abstraction requirements to affect the quality of freshwater lenses on the island or have any other deleterious effect on natural resources.

5.2.16 Fire Control Measures

- All incineration is banned along road corridors.
- Temporary storage of vegetation shall be in open areas.
- An emergency fire-fighting plan shall be drawn up. Fire extinguishers must be available on site.

5.2.17 Sensitive Areas

Due to the sensitive nature of portions of this corridor, the following guidelines should be adhered to as a matter of good practice:

- Detailed contract specification and drawings for any works that directly impact lakes or wetlands and sensitive area should be included as part of the general specifications and drawings.
- The time from excavation to restoration should be kept to a minimum. Maximum construction times for all elements of the works within the lakes and wetlands should be detailed in the contractor's schedule and procedures.
- The locations at which vehicles and heavy equipment may cross the area adjacent to Lake Cunningham should be identified in the specifications. At no time should the Lake area be used as a vehicle or equipment store.
- The removal of vegetation from the right-of-way should be kept to a minimum width for construction.
- Aquatic weeds uprooted or cut prior to, or during construction operations, should be contained and adequately disposed of on land.
- Contract to prohibit all construction workers from fishing in the Lake.

It has been proposed to protect immersed embankments at the lakes and wetlands by spreading mortar rubble. Mortar is a workable paste used to bind construction blocks together and fill the gaps between them and is typically made from a mixture of sand, a binder such as cement or lime, and water. Details of this permanent form of protection are unknown however this solution is considered too hard for the edge of these water bodies. An alternative solution which utilises 4:1 slopes and a temporary sediment control measures at the embankment base in the form of a geotextile fence or similar until vegetation of a stabilising nature has taken are considered more appropriate and should be used in place of spreading mortar rubble.

5.2.18 Utilities and Supporting Infrastructure

Utilities will be restored and/or relocated. This will require the digging of utility trenches and their re-filling. It is important that trenches are backfilled shortly after excavation for safety purposes as well as problems associated with ponding. Re-location of the electricity lines provide the majority of work with regards to utilities owing to the existence of an overhead 132KV cable which is to be buried underground. BEC lines will need to be installed at a depth of approximately 8 feet. The nature of working with high voltage electricity lines as well as working at depth poses a major safety concern. Work will need to be conducted in a safe manner. The contract should require a detailed safe working practise methodology for working with high voltage lines and working in excavations. All measures necessary to protect the workers and the public from excavations shall be provided. All workers are to be equipped with relevant personal protective equipment. The Contractor shall be required to produce a health and safety plan for the project. One team manager shall be responsible for site safety and regular safety meetings are to be held.

Disruption to utilities is likely due to construction and may mean some areas of the island are without service for periods. It is important that these periods are well planned and quantified and communicated to the public in order to cause least disruption. The contractor shall be required to provide a utilities work methodology with detailed schedules and a requirement to advertise utility disruptions in the local media (at least two major newspapers). The contractor shall also be required to work closely with all utility companies to ensure work is co-ordinated and carried out with the least amount of delay. Lead times for electricity cables etc. must be considered in scheduling sequence for the project as this could potentially delay works for long periods.

The road is designed between CH 12+00 to 56+00 with a minimum elevation of 5 feet above MSL in accordance with the current MOWT requirements for roads in subdivisions in order to restrict flooding. These low lying areas have necessitated the road to be flat. Usually a gradient of 0.5% is considered a minimum for drainage purposes. It is therefore very important that the road is constructed with adequate cross fall and super elevation. The site supervisor must be educated in methods of determining their adequacy during construction.

5.2.19 Cultural Heritage and Antiquities

It is unlikely that any items of value will be unearthed during the construction works however the contract should stipulate coordination with the Antiquities, Monuments and Museums Corporation (AMMC) on historical resources. The conch shell and the bird at the Airport and Blake Road intersections respectively and the post box in front of the MOW building should be relocated as agreed with the AMMC.

5.2.20 Aesthetics

Visual impacts relating to the presence of construction traffic will occur along portions of the road that are developed. However these impacts will be temporary. The base camp should be located where it will have little visual impact and vegetation used to reduce visual impact where necessary. Where appropriate, fencing shall be erected to reduce visual impacts of the construction site. All street trees and garden vegetation which is to be retained should be clearly identified and protected from construction traffic.

5.2.21 Potential Impacts Associated with Emergencies and Disaster Management

To prepare for, and respond to, the emergencies and disasters that could potentially affect the proposed project, the Contractor will prepare appropriate emergency response plans and policies. The purpose of the emergency response plans and policies will be to identify the actions that will be taken to reduce or eliminate long-term risk to people and property from the affects of emergencies. The EMP will identify

other emergency response plan elements that the Contractor will implement for the resort project, including:

- Emergency Management Program and Equipment;
- Explosion and Fire Prevention, Monitoring, Response, and Control;
- Emergency Management Training and Testing;
- Accident and Incident Documentation and Reporting;
- Emergency Communications; and
- Coordination with local, area-wide, and Mutual Aid Emergency Response.

5.2.22 Potential Impacts Associated with the Possible Failure of Process and Environmental Control Systems

The potential impacts associated with possible failure of processes and environmental control systems are considered moderate. The nature and amount of the material handling for the project is large. The EMP will identify emergency response plan elements that will be implemented in the event of a failure of process or environmental control systems for the project, including a Spill Prevention, Control and Countermeasure Plan and a Stormwater Pollution Prevention Plan.

5.2.23 Site Safety and Health

The Contractor shall be required to appoint a designated Site Safety Officer. There shall be a fully equipped First Aid Box at all work sites at all times and a list of emergency telephone numbers in case of accident. Minor and major accidents shall be recorded in an accident log book.

Personal protective equipment (PPE) shall be worn in areas designated for their use. When working alongside or over water, where there is a risk of drowning, the Contractor shall take appropriate measures to prevent falling (e.g. use of harnesses) and rescue equipment shall be readily to hand (e.g. use of life jackets, life lines/rings and a safety boat). Work shall be halted in dangerous weather conditions. At all times work sites shall be maintained in an orderly, safe and tidy state. Precautions against fire accident shall be taken and appropriate fire safety equipment supplied and clearly indicated at work sites.

The Contractor shall, as required, arrange for safe road use while adjacent construction activities (e.g. stockpiling) are in progress and impeding the highway. Construction zone signage shall be in place for each works operation. Hazardous areas such as excavations will be delineated with construction cones (with lighting where instructed by the E.R.). This shall include but not be limited to the following: *temporary works; pre-stressing/post-tensioning works; pile driving; batching plants/crushers; working near water; working at height; working in confined spaces; interaction with the general public, especially road users and adjacent property owners/occupiers and traffic management.*

The Contractor's Safety Officer will inspect sites for compliance with approved working methods and these contractual requirements under the oversight of the E.R. Government of Bahamas labour laws and occupational health and safety policies shall be applied at all times.

5.2.24 Works Site Restoration

Upon completion of implementation of project works, the Contractor shall restore all work sites, borrow sites (and any other land occupied or used by the Contractor during the course of the project) to the approval of the E.R. In particular his obligations shall include the requirement to:

- a) restore borrow sites with conserved top soil, to the approval of the E.R. and local landowners. The Contractor shall obtain a written release from each affected landowner;
- b) re-shape embankments and re-establish vegetation in restored areas according to original method statements or as otherwise indicated by the E.R. using locally prevalent non-invasive species to provide cover against erosion from rainwater;
- c) clean-up of all construction sites, work areas and any facilities installed by the Contractor.

5.2.25 Consultation and Legal Requirements

The Contractor shall co-operate, as required, with local government administrations and the MOWT, and staff of the Bahamas Environment Science and Technology Commission (BEST). It is the responsibility of the Contractor to ensure compliance at all times with existing and new government regulations, including all statutory licensing and permitting requirements.

National Laws and Regulations

The project will be designed, constructed, operated, and maintained in accordance with applicable Bahamian environmental laws and regulation, including the following;

The Environmental Health Act
The Conservation and Protection of the Physical Environment of the Bahamas Act
The Antiquities, Monuments, and Museums Act
The Public Works Act
The Wild Birds and Plants Protection Acts
The Bahamas National Trust Act
The Fisheries Resources Act
The Coast Protection Act
The Water and Sewerage Act
The Bahamas National Wetlands Policy 2007; and
The National Invasive Species Strategy for the Bahamas.

The Contractor shall conform to all these and other current legislation. Prior to the commencement of construction activities local communities will be informed of the implementation schedule for contracted works and local requests incorporated as reasonable, where at no extra cost, subject to approval by the E.R.

5.3 Impacts and Mitigation during Operation

5.3.1 Land Use and Planning

Most of the land required for the widened new road corridor is existing right of way (ROW), BEC wayleave or privately owned. Removal of some vegetation on either side of the road will mean a new forest edge is exposed, pre-stressing and clearing should be performed in sufficient time prior to actual construction of the road to minimise impacts to wildlife (monitoring of the area would also be required to ensure that it is not used as a waste site).

The exact extent of the works (i.e. the footprint of the works) is unknown and has not been identified on plan. Plans have been produced which indicate the outside edge of the pavement only and do not account for shoulders, swales, embankments, footpaths and the like. This assessment has tried to account for these measures in its assessment however the land take needs need to be identified as it will involve significant costs not accounted for in previous cost estimates, numerous land owners and time to acquire.

Land acquisition will be necessary and as such land owners must be advised accordingly and compensated at full like-for-like replacement cost. The compensation assessment must be fully transparent and rapid payment procedures must be adopted. As requested by The Bahamas Government, land acquisition and resettlement shall be executed by the Bahamas Government.

Re-examination of the alignment is necessary and is to be carried out once detailed survey information is available. The footprint of the works must be indicated on plan and re-alignment of the road made where possible in order to minimise land take as far as is feasible given the circumstances with priority given to existing buildings. One area in particular which should be re-examined is at the houses on the southern side of JFK east and west of Christie Avenue. Re-alignment north to eliminate the need to acquire these properties and demolish buildings and to provide a buffer or noise protection measures should be considered. As indicated in the above table the value of the buildings themselves total \$2,300,000 which does not account for demolition costs. It is considered very feasible that this expense can be reduced by re-aligning the road north at this location and utilising less of the private land to the south and more of the well field land to the north.

Even with a reduction in the cost of the buildings indicated above removed the cost of acquiring land is substantial (13% of construction contract). Whilst only an estimate of land costs this exercise indicates how important it will be that these funds are allowed for in the project budget and that land acquisition matters are dealt with effectively. It will be necessary to re-assess the economics of the project with land acquisition under consideration once further details thereof are available.

The importance of public consultation at this early stage can not be stressed enough especially in light of recent issues that have arisen as a result of improvement works being carried out on the Ballou Hill Road / Market Street One Way Couplet. People on these roads formed an association and managed to get a court injunction to stop the roadworks. This has subsequently been withdrawn but the case is still going to court primarily on the basis of lack of consultation with the people (business owners) and the MOWT. Depending on the outcome of the court case this could have repercussions on future road projects. It is therefore considered necessary for the Government, prior to construction, to put into place a public consultative plan to ensure that they listen to peoples concerns. In the United Kingdom a Public Enquiry process is in place which eliminates most if not all of the possible issues that may arise on projects such as this. It is not suggested that a Public Enquiry system is necessary in the Bahamas however a more formalised consultation than the Town Meeting that allows individuals/groups to formally raise their concerns.

A new planning and subdivision bill has been drafted which will require further consideration be given to land use planning and a more formal consultation process as well as address other issues. Whilst this will have some impact on the way in which major roads are dealt with a more formal consultation process for major roadworks should be incorporated into the Roads Act.

The alignment should also be re-examined to consider a service lane on the south side of JFK Drive between the MOWT roundabout and the existing Bethel Avenue with physical restriction to crossing the centerline of the road to maintain flow along the road in a safe manner. Consideration should also be given to a reduction in the speed limit east of the MOWT building roundabout. This alignment should also include for the provision of bus lay-bys on both the north and south side of the road to replace the existing bus stops as well as pedestrian crossings.

Due to the loss of parking spaces at the BTC building the re-design of the parking layout at BTC will be necessary to better accommodate parking spaces and to construct additional parking spaces to account for the loss of parking spaces. Also, disabled parking spaces should be provided near the entrance to the building.

Intersections

All the roundabout diameter have been considered to be appropriate as 120 foot diameter roundabouts other than roundabout 2 which is proposed to be a 160 foot diameter roundabout. This has been determined based on a general overview of traffic flows. The traffic impact assessment report produced by the Lynden Pindling Airport Authority suggests a 160 foot diameter roundabout at Blake Road. It is therefore considered necessary to re-examine the capacity of this roundabout as proposed.

Roundabout geometry should be determined by using the UK design standards and design programmes such as RODEL, ARCADY etc. By designing the roundabouts in this way adequate flare, deflection, weaving, capacity, etc. is provided and the roundabouts will be able to operate to their full potential in a safe manner. Designing the roundabouts in this manner could also increase or decrease land take and in the instance of the roundabout at Gladstone Road the impact on the Lake.

At the proposed roundabout at Gladstone Road the deflection angle of the JFK eastern approach is shallow and will allow traffic to speed through the intersection. By realigning the approach median northwards, the safety aspect could be improved. In addition, in order to reduce land reclamation and reducing the problem of constructing the roundabout in Lake Cunningham, the possibility of utilising a signalised junction to provide a similar capacity has been considered. The roundabout does however; deal with traffic wishing to travel east along JFK from Theodora Lane as it allows a nearby U-turn. A roundabout at this location also allows better access to the properties along the north side of JFK Drive between Gladstone Road and TWD Highway. This roundabout will also allow traffic travelling on the future northern extension to Gladstone Road to make U-turns and access properties on the opposite side of the road (this road has been proposed as a 4 lane highway with a median along it's length). Otherwise this traffic will need to locate an alternative turning location which may require longer distances be travel and could lead to safety issues where drivers try to turn in inappropriate locations. For these reasons the traffic signalised junction has not been further considered.

Depending on the actual footprint of the proposed Gladstone Road tie in it may be necessary to re-build the walls of the cemetery on Gladstone Road. It will be important to provide sufficient roadway width to accommodate drainage along this portion of the road (which is on a steep slope).

Generally the intersections as proposed are likely to provide adequate capacity however it will be necessary to model flows in order to better determine their adequacy. The roundabouts will also reduce speeds along the route as drivers are forced to reduce speed in order to negotiate the roundabouts.

5.3.2 Meteorology and Climate

The proposed improvements to the road corridors will not have any direct impacts on the climate. However, it is known that vehicular emissions do have an indirect long-term effect on the climate through global warming. As the improvements to the road system are designed to relieve congestion and therefore increase engine efficiency it is likely that the pollution from vehicular emissions will be improved. As the widened road relieves congestion it will cause vehicles to operate in ways that produce fewer emissions, so reducing overall pollution levels. This will occur because vehicles operate most efficiently and produce least pollution when they are driven in freely flowing traffic at moderate speeds.

In areas where traffic has been re-routed the locations where pollution levels are highest will change, whilst addition of new lanes to improve the flow rate of traffic should reduce localised air pollution hotspots. The overall impact of the road scheme should act to improve air pollution levels around residential developments as traffic becomes more free flowing. Nevertheless, it is appreciated that if the

road scheme should encourage further traffic onto the roads, or increase the appeal of road travel in the long term, air pollution from car exhausts shall show an increase.

The widened road will raise the existing JFK Drive where it is below 5 feet above mean sea level. This will reduce the impact of any flooding. We must also consider the long term life of this road and therefore the likely impact of sea level rise as a result of climate change. This road is designed to 2040 over which time we can expect to see a sea level rise of one foot which will not have a noticeable impact on the road however the road will be affected in time if the climate continues to change as it is doing as will much of New Providence.

Long-term mitigation measures should concentrate on the form of policies to increase the appeal of public transport and alternative transport methods to the general public.

5.3.3 Geology and Soils

See Land Use and Character section in Impacts during Construction.

5.3.4 Hydrology and Water Quality

5.3.4.1 Drainage

As the locations for future drainage wells and surface water storage areas along the road corridor is unknown at this stage it is difficult to assess the extent of impacts other than in general terms.

It is essential that the drainage wells are designed, located, constructed and maintained correctly in order to reduce the risk of flooding and contamination of the fresh water lens and sensitive ecological areas. This is particularly important near the Prospect Water Works area.

The design of surface water drainage must ensure that the following sensitive habitats are not used as storage areas or for direct discharge:

- Lake Killarney
- Prospect Water Works
- Lake Cunningham and wetlands and mangroves to the east

The proposed road will be built on the existing drainage basins between the ridges and the road, many of which provide large capacities at present. It will be important that drainage measures provided are adequate to accommodate not only the existing drainage flows but the increased drainage flows that will result from the construction of the widened road and the future development of the area.

It is necessary to design this road in a sustainable manner and provide adequate drainage to accommodate the future development in the area in particular those areas which have started to be developed and are on the steep ridgeland which slopes toward JFK Drive. Development has started along the north side of JFK Drive east of Blake Road. This development comprises a number of subdivisions on steep ridgeland which slopes toward the proposed widened road. The layout of these areas is such that the subdivision layout requires roads to run perpendicular to JFK Drive. These roads must be cut into the ridge due to the topography of the area. It will therefore be necessary for these subdivisions to provide drainage for the subdivision and as a result do not pose as much of a concern as the development south of Lake Cunningham, west of Gladstone Road whose layout includes a road that runs parallel to JFK Drive near the top of the ridge. These properties are part of the Oakridge Estates and Niven Heights subdivisions which are accessed off of Gladstone Road.

Preliminary drainage calculations have been carried out in accordance with the 'Design and Construction Guidelines and Plan Preparation Manual for Subdivisions in the Commonwealth of the Bahamas' (i.e. a 1 in 5 year storm for duration of 6 hours) for the Oakridge Estates and Niven Heights area by ourselves.

These calculations assume single family lot development of the north side of this ridge (i.e. a runoff coefficient of 0.35). These calculations indicate that an 8 foot wide swale with slopes of 4:1 will be inadequate and would only accommodate approximately 1/30th of volumes. However actual volumes would be greater as these calculated flows do not reflect actual developed flows which would have a greater runoff coefficient due to the presence of roofs, asphalt driveways, concrete patios etc. It is very important that drainage calculations are reflective of the likely development of the area in order to ensure that the road is not subject to flooding in future.

The provision for drainage via a connected catch pit, drainage well and connecting pipe system would be very costly and is not considered feasible at this time although this type of system would better serve to treat pollution from the road surface.

Dry detention areas similar to those that exist at present are considered appropriate along JFK Drive however they require large land masses. Natural grades should be utilised where they provide a depressed area for the detention of storm runoff.

Ponds designed to remain wet should also be considered although it will be necessary to check that there is adequate tidal movement so that water does not become stagnant. These ponds should have a minimum bottom elevation of -3 ft below the low water mark for movement of water. They should have slopes of between 3:1 and 20:1 which shall be protected where required. This arrangement would require less land mass. Planting will be important in these areas to maintain aesthetics and reduce loss of water due to evapotranspiration during the dry season.

All areas affecting drainage of the proposed widened road must be accommodated and a detailed drainage study will be necessary prior to final drainage design. All calculations must be submitted to the MOWT for review. Detailed drainage design is required including calculations to determine the extent of additional land acquisition required in order to accommodate additional drainage features above and beyond 8 foot wide swales.

Even with careful drainage design there remains a possible risk of contamination of the fresh water lens and sensitive aquatic habitats from spillages caused by road accidents. In the case of Lake Cunningham, this habitat is likely to manage to recover from contamination incidences as it will have done so to an extent in the past. However, the contamination of Prospect's Water Works could have significant adverse consequences on the production of drinking water in the future (these well fields are currently unused).

The Prospect well fields will be directly impacted by the proposed project however they are not currently in use. These provide good quality water however not in volumes that make them economically feasible. Reverse osmosis plants (or RO plants) are more cost effective than well fields therefore it is unlikely that the well fields at the airport or those at Prospect will be utilized however it is considered necessary to continue to protect these locations from development for the 'what if' scenario (i.e. economic downturn etc.).

It is also imperative that the drainage design in this area incorporates a system for the effective management of accidental spillages. It is necessary to prevent hydrocarbons and sediment from entering water bodies. Consideration should be given to lining swales and directing water from these swales into pollution control units.

It is important that the northern extension to Gladstone Road and the re-alignment of JFK Drive in this area does not indirectly cause the loss of a wider area of wetland by interference with the hydrological system and encroachment. Drainage studies have identified that Lake Cunningham and the wetlands to the east are not linked. The wetlands either side of the road should remain independent, therefore culverts underneath the roundabout and the future north expansion to Gladstone Road are not required. However, an overflow culvert to take excess water, particularly during flooding would be necessary to ensure that overflow from the wetland to the east should continue to flow freely into Lake Cunningham, therefore, culverts should be placed underneath the extended Gladstone Road. Surface runoff controls

such as kerbs and sediment traps, will be required to eliminate siltation of the lake and wetland area east of Lake Cunningham. Mitigation measures will also be required to avoid increased siltation of the wetlands and Lakes and to avoid further impacts to the wildlife within the mangrove swamp. Silt fencing should therefore be installed and maintained and as much of the natural vegetation maintained to create a buffer zone during construction. Lateral drains are also likely to be necessary to protect the pavement and earthworks from damage by water.

It will be necessary to utilise turbidity barriers where works are carried out at water bodies so that turbidity levels do not increase above existing levels in the lake other than in the direct vicinity of the work.

5.3.4.2 Lakes and wetlands

There are a number of locations where the proposed road will impact directly onto sensitive water bodies. The footprint of the project and thereby the extent of the impact that will be necessary has been determined based on preliminary information used to determine the direct footprint of the project and as such is an estimate only.

It is estimated that approximately 2,500 feet of the shoreline at Lake Cunningham could potentially be impacted and 1.8 acres of Lake Cunningham infilled at the southern edge of Lake Cunningham at a number of locations as a result of the roadworks. Roadworks would require the construction of manmade intrusions into what is otherwise a natural environment. Retaining walls at the edge of the lake at these locations would reduce the impact on the lake and the quantity of material required for earthwork purposes as well as loss of forest (at CH 140+00). Utilising retaining walls rather than earthworks embankments along the route at the following locations would reduce the area of the lake impacted to approximately 0.7 acres at one location (at the east end of the lake at the Gladstone Road/JFK Drive intersection).

The following Table 5.3 lists the extent of impacts where embankments or retaining walls would be required at the Lake.

Location	Length of shoreline impacted if embankment utilized (feet)	Length of wall required (feet)	Area of Lake impacted if embankment with 3:1 slope utilized (square feet)	Area of Lake impacted if wall utilized (square feet)
CH 137+50 – 141+50	350	400	6,000	
CH 165+00	50	50	N/A	
CH186+00 – CH 194+00	800	600	36,000	
CH 212+00 – CH 216+00	400	400	6,000	
East end of the lake at the Gladstone Road/JFK Drive intersection.	1,000	850	25,000	30,000

Table 5.3 Extent of embankments or retaining walls required at the Lake.

It will be necessary to either re-align the road further south or construct retaining walls at these locations instead of constructing earthworks embankments in order not to impact directly on the lake and reduce the requirement for fill material. A retaining wall solution must address safety issues and it will be necessary to install safety barriers. Safety barriers are considered in detail in later sections of this assessment.

The total area of the lake that will be infilled will therefore be 30,000 square feet or 0.7 acres which represents 0.2% of the total area of the Lake and approximately 560,600 gallons (Imperial) which represents 0.07% of the total volume of the Lake. This quantity is considered to have an insignificant impact.

Minimising the area required for infilling by installing retaining walls would result in a steep edge along the southern bank of Lake Cunningham, this would reduce the opportunities for landscape planting. Current plans for planting include trees and mangroves along the southern edge of Lake Cunningham. Further opportunities to be considered that will enhance the area include making provision for educational activities such as bird watching including the provision of information boards.

There will be a total loss of 8 acres of wetland, 0.6 acres of which is wetland habitat just east of Lake Cunningham (9.4 acres total area) and the remainder of which is along the edge of Lake Killarney as a result of the proposed road corridor. This represents 6% of the area of the wetlands east of Lake Killarney. This is considered a low impact and it will be important to provide adequate drainage in particular at this location especially given the low level of the road. It will also be important to provide a culvert across Gladstone Road Northern Extension so that any flood water can disperse into the Lake Cunningham after it has been allowed to settle in a basin.

This represents 0.25 % of the average area of Lake Killarney. There are no accurate calculations of the volume of Lake Killarney however it is shallower than Lake Cunningham and percentage of area is somewhat representative of percentage of volume. This quantity is considered to have an insignificant impact.

Government purchasing of the wetlands to the east of Lake Cunningham will ensure that development right up to the road does not occur, correct management will provide some compensation for the loss of wetlands caused by the installation of the road, and similar wetland losses along Lake Killarney.

Reclamation of Lake Cunningham and the wetland area to the east of the lake will (depending on the quantities of material involved) require a permit for landfilling under the Conservation and Protection of the Physical Landscape of the Bahamas Act 1997.

It is recommended that compensatory wetland establishment/management is investigated elsewhere around the shores of Lake Cunningham, Lake Killarney and the wetlands to the east of Lake Cunningham. This will require consultation with relevant bodies.

5.3.5 Air Quality and Ambient Noise

Long-term mitigation measures should concentrate on the form of policies to increase the appeal of public transport and alternative transport methods to the general public.

No data is available for the baseline air quality or ambient noise levels for the existing road corridor. As described above in the section on Climate the widening of the road will change traffic flows in a number of ways, with corresponding impacts on air quality and noise. In some cases the overall effect will be beneficial. As the road relieves congestion it can cause vehicles to operate in ways that produce fewer emissions, so reducing overall pollution levels.

5.3.5.1 Air Quality

In areas where traffic has been re-routed the locations where pollution levels are highest will change, whilst addition of new lanes to improve the flow rate of traffic should reduce localised air pollution hotspots. The overall impact of the road scheme should act to improve air pollution levels around residential developments as traffic becomes freer flowing. This is particularly so for West Bay Street (and the Cable Beach area) and Carmichael Road. Nevertheless, it is appreciated that if the road scheme

should encourage further traffic onto the roads, or increase the appeal of road travel in the long term, air pollution from car exhausts shall show an increase.

To simplify the taxation of vehicles and to promote the use of more fuel-efficient vehicles, the number of excise tax rates on cars and trucks has been reduced to two: a rate of 65 per cent on passenger vehicles with an engine of 2000 c.c. or less and a rate of 85 per cent for all other passenger vehicles and trucks. This is an increase from the previous rates of 45% for vehicles below \$20,000 value and 85% over \$20,000, the intention being to better offset road and road maintenance costs.

There are no issues with regards to air quality at present. Any issues that may arise would be due to suspended particulate matter (SPM) due to heavy dust. A lot of dust occurs due to dry atmosphere and the situation gets aggravated by human activity. SPM is generated when vehicles move (to overtake other vehicles) on unpaved shoulders. After the construction of the Project, SPM will be reduced due to the extra lane for vehicles to utilise when overtaking. Trucks, buses and other passenger vehicles passing on the existing JFK Drive are normally poorly maintained. Unburnt fuel also adds to the air pollution and can be expected to increase as a result of an increased traffic flow. Mitigation measures would involve improving standards of maintenance of vehicles through stricter requirements on vehicles by the road traffic department.

5.3.5.2 Ambient Noise

Traffic speeds are expected to increase as a result of the proposed widening however the change in speed is not considered likely to change noise levels significantly. According to traffic modelling, the ADT on JFK Drive can be expected to increase by 1,000 vehicles. This is considered an insignificant increase in terms of noise on a road with an ADT of approximately 12,000 vehicles. Also, according to forecast traffic data for JFK Drive traffic volumes can be expected to double from 2012 forecasts to 2040. A doubling of traffic volumes can generally be expected to increase noise by 3 dB. Increasing the road from 2 lanes to four lanes can be expected to increase noise levels by 2 dB. Therefore without consideration given to the loss of vegetation and the affect of re-alignment on the proximity of the road to properties the proposed road will experience an increase in noise levels of approximately 5 dB as designed to 2040.

Acceptable noise levels for picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals are 67 dB ($L_{eq}(h)$) and 70 dB ($L_{10}(h)$) for exteriors. A change in noise level that is of this order by 3 dB is generally only just noticeable. A change of noise level of this order by 11 dB is generally considered a moderate impact. This is in conformance with the Federal Highway Administration (FHWA) noise standards. Based on road characteristics and existing peak traffic flows noise levels of 70 dB and 60 dB are estimated to be experienced 26 feet and 111 feet away from the traffic respectively during peak hours.

There is no change in the distance to traffic at the Lutheran church as a result of the proposed alignment and changes to noise levels can only be expected as a result of the increase in the number of traffic lanes and traffic volumes as well as the travelling speed of vehicles (an increase in noise levels of 5 dB as designed to 2040). There is no form of noise protection existing at this location. Dense planting along the edge of the road in the vicinity of the church shall be provided to mitigate against noise.

Traffic will be approximately 30 foot closer to the existing Hope College as a result of the re-alignment of JFK Drive which represents an increase in the noise level of 3 dB to 66 dB. Allowing for the increase in noise for road widening and traffic volume increases to 2040 a total increase of 8 dB to 71 dB can be expected. 71 dB is not considered acceptable based on the FHWA standards however it is very close to meeting the requirements and does not exceed a change of 11 dB. There is no form of noise protection at present other than a few trees at this location. Again dense vegetation should be installed at the edge of the road in the vicinity of Hope College to mitigate against noise.

Traffic will be approximately 45 foot closer to the existing properties opposite Hope College as a result of the re-alignment of JFK Drive which represents an increase in the noise level of 4 dB to 66 dB. Allowing

for the increase in noise for road widening and traffic volume increases to 2040 a total increase of 9 dB to 71 dB can be expected. There are a large number of large trees that exist in front of these properties which provide noise protection to the properties which will be removed as part of the road re-alignment and reduction in buffer zone to the properties. This coupled with the above will cause noise levels at these properties to increase above acceptable levels. It is therefore necessary to provide noise abatement for these properties. Due to the lack of space in this area and not wanting to acquire more land than necessary from these properties it is suggested that an appropriate form of noise abatement would be in the form of a fence or wall. A wall or fence at the ROW would be limited in its effectiveness due to the need to provide openings for the driveways. A fence or wall at the median would reduce noise impacts to these properties from the east bound traffic as well as protection to Hope College from west bound traffic but would not be aesthetically pleasing therefore fencing along the ROW from the Lutheran church to approximately 400 feet east of the last property (CH272+00) on the southern side of JFK Drive coupled with dense vegetation in the form of landscaping in the median is considered most appropriate. Dense vegetation in the centre of the large median that will be introduced at Theodora Lane should also be incorporated to mitigate against noise and aesthetics. This dense landscaping at the median will also provide protection to Hope College from noise which would also be increased as a result of introducing a fence or wall on the southern side of the road due to reflection.

Traffic will be approximately 10 foot closer to the existing properties either side of Christie Avenue as a result of the re-alignment of JFK Drive however traffic will also have lower speeds due to the presence of the roundabout. As a result noise levels can be expected to increase by 2 dB to 67 dB. Allowing for the increase in noise for road widening and traffic volume increases to 2040 a total increase of 7 dB to 72 dB can be expected. 72 dB is not considered acceptable based on the FHWA standards however it is very close to meeting the requirements and does not exceed a change of 11 dB. As the re-alignment is currently shown a margin of all properties on JFK Drive will need to be acquired including some buildings. It is strongly recommended that the alignment be re-examined and moved slightly north into the unused Prospect well fields so that there is adequate space to provide mitigation against noise in the form of vegetation to reduce noise by 2 dB or if necessary a wall or fence.. Fence. It is considered necessary to provide dense vegetation in order to mitigate against ...

Where noise barriers are to be used to reduce noise, a barrier must break the line of sight between the source and the receiver. A barrier that just breaks the line of sight can provide a reduction of 5 dB. The height of the barrier must be increased by two feet for each additional decibel of noise reduction desired.

Sound bends around and over barriers, so they must not have gaps. They must also go past the last receivers or wrap around them. Generally, the barrier must extend 400 feet past the last receiver for every 100 feet of distance to the barrier. This 4 to 1 rule of thumb usually means it is not feasible to build barriers along streets with numerous driveways and intersections.

Noise levels have been estimated for the purpose of the above assessment on noise impacts. In order to better determine the likely impact of the proposed road on noise, noise levels must be measured. The extent of noise impact is very limited to very localised areas. It is recommended that the above mitigation measures be put in place and any noise issues that might arise be dealt with as received.

As a result of the removal of traffic from West Bay Street and Carmichael Road – South West Bay Street these routes will experience a reduction in noise levels.

The above mitigation measures will result in an overall impact on noise is beneficial as noise is reduced in more developed areas of West Bay Street and Carmichael Road and slightly increased at the less developed JFK Drive.

Noise is likely to have an insignificant impact on wildlife during operation.

5.3.6 Hazards and Hazardous Materials

Four areas have been identified (Lake Killarney, Lake Cunningham, the wetlands to the east of Lake Cunningham and Prospect Well fields) as being at risk of contamination from surface water runoff and road accident spillages. These areas will require specific drainage designs to ensure that the risk is minimised. This issue is further considered in the section on hydrodynamics and water quality.

5.3.7 Vegetation and Wildlife

5.3.7.1 Removal of protected plant species

Three species that fall under the Conservation and Protection of the Physical Landscape Act, 1997. Bahamian Pine (*Pinus caribea* var. *bahamensis*), Mahogany (*Swietenia mahogani*) and Silk cotton (*Ceiba pentandra*) are found along corridor 1. Although these species are not considered especially rare and in the case of *C. pentandra* not even a native species to the Bahamas, they do require a special permit from Physical Planning.

The replanting of *P. caribea* var. *bahamensis* and *S. mahogani* along the new roadsides at a rate of 2:1 should be practiced during the development to compensate for the loss of these economically important trees.

5.3.7.2 Removal of habitat

Although the alignment of the road and associated structures are to be placed in areas that minimize impact upon the environment, there will be areas where portions of Wetland, Pine Forest and Coppice Forest will be destroyed or impacted. A few places for particular concern involve the Eastern end of Lake Cunningham, the southern shoreline of Lake Cunningham and the Coppice forest on the Southern side of the road adjacent. Lake Cunningham is crucial habitat to over 100 species of birds. Many of these birds also utilize the nearby Coppice Forest for food. Lake Cunningham is also home to an endemic and rare fish known as the Bahama Pup Fish (*Cyprinodon laciniatus*). Other areas of concern are the areas of healthy Coppice Forest along the road further West. Coppice Forest is rapidly disappearing from the island of New Providence and therefore the planting of Bahamian Coppice Forest species is important to help maintain biological diversity on the island.

There will be a total loss of 20 acres of forest as a result of the widening of JFK Drive. This represents 3% of the total forest area that lies within 1,500 feet of the route practically all of which is planned for development.

There will be a loss of approximately 1.2 acres of seasonal wetland to the east of Lake Cunningham. The total area of the wetlands to the east is estimated to be around 16 acres; however, this figure is likely to change as a result of current development to the east of the wetlands. Therefore the anticipated loss of seasonal wetland in this area as a percentage currently stands at approximately 7.5%. A further loss of approximately 1.2 acres of broadleaf coppice on either side of the cleared pole line tracks on Prospect Ridge is anticipated.

There are also a number of mangroves that will be lost; however, benefits will be derived from plans to soften the southern lake edge with landscape planting.

There will be a loss of vegetation/forest at the road which accesses Lake Killarney as a result of realigning the road to the east in order to meet the proposed roundabout at Westridge Estates Road.

5.3.7.3 Establishment of exotic invasive/nuisance species

After any clearing the ground will be exposed and vulnerable to the establishment of exotic species. Particular problem species include the Casuarina (*Casuarina* sp.), Brazilian Pepper (*Schinus terebinthifolius*), Melaleuca (*Melaleuca quinquenervia*), Scaevola (*Scaevola taccada*), Jumbey (*Leucaena*

glauca), Poinciana (*Delonix spp*), West Indian Almond (*Terminalia catappa*), Coral Vine (*Antigonon leptopus*) among many others.

This can be avoided by the complete removal and with a good post-construction maintenance program to keep these disturbance species at bay.

The non-native Pink Poui should be removed and is discouraged as an ornamental in the Bahamas as it has the potential to hybridize with the Bahamian native Five Finger (*Tabebuia bahamensis*) and therefore reducing genetic biological diversity. Instead the Five Finger should be used to encourage local biodiversity as stated by the Convention of Biological Diversity.

5.3.7.4 Decreased biological diversity

Across the island of New Providence the continued slow decline in biological diversity is an issue. The Government of the Bahamas can use Development as an opportunity to help increase biodiversity. Additional to the below mentioned recommendations, certain Bahamian native species should be used to beautify the road using species not necessarily encountered in the area. This should help to increase the over all diversity in the area. A good example of this would be the Red Cedar (*Juniperus barbadensis var. Lucayana*). This practice would keep in line with the Convention of Biological Diversity (CBD), as well as assist the Million Tree Campaign.

5.3.7.5 Mitigation Measures

The following mitigation measures are recommended for each of the different types of area along the route;

1. Pine Forest (PF)

Any mature Bahamian Pine trees that are removed should be replanted in convenient areas. The area should be beautified with various native ornamentals such as Cocoplum, Wild Guava (*Tetrazygia bicolor*), Purple Bletia Orchids (*Bletia purpurea*), Pine land Alamanda (*Angadenia sagraei*) and some Silver Top Palms (*Coccothrinax argentata*).

2. Coppice Forest (CF)

Any mature coppice forest trees should be salvaged and replanted as necessary. Including but not limited to the Satin leaf, Wild Tamarind, Willow Busic, Strong back, Paradise tree, Cinnecord, Gum Elemi, Feather bed, Five Finger and Thatch Palm could be planted. Smaller native plants could also be used as ornamentals such as Ram's Horn, Coco plum (*Chrysobalanus icaco*), Buttonwood (*Conocarpus erectus*), Wild coffee (*Psychotria nervosa*), Bahamas Buttercup (*Turnera ulmifolia*) and the Bay Lily (*Hymenocallis arenicola*). This should increase biodiversity as well as beautify the area. These are readily available at local nurseries.

3. Wetland (WL)

In the wet areas more Saw grass, Leather fern, Red mangrove and Pond apple can be planted. In the slightly drier regions White Mangrove and Buttonwood can be planted. In the most dry areas ornamentals such as Coco plum and Bay lily could be used.

4. Mixed Pine Forest / Wetland Habitat (MPWH)

Pine trees that are removed should be replanted in convenient areas. In the wet test areas more Saw grass, Leather fern, Red mangrove and Pond apple can be planted. In the slightly drier regions White Mangrove and Buttonwood can be planted. In the very dry areas some Cocoplum, Wild Guava

(*Tetrazygia bicolor*), Purple Bletia Orchids, Pine land Alamanda (*Angadenia sagraei*) and some Silver Top Palms (*Coccothrinax argentata*) are recommended.

5. Mixed Disturbed Area (MDA)

Once all exotic invasives have been removed, Coppice Forest plants as well as Fruiting trees can be planted in this area.

These include but are not limited to the Satin leaf, Wild Tamarind, Willow Busic, Strong back, Paradise tree, Cinnecord, Gum Elemi, Feather bed, Five Finger and Thatch Palm could be planted. Smaller native plants could also be used as ornamentals such as Ram's Horn, Coco plum (*Chrysobalanus icaco*), Buttonwood (*Conocarpus erectus*), Wild coffee (*Psychotria nervosa*), Bahamas Buttercup (*Turnera ulmifolia*) and the Bay Lily (*Hymenocallis arenicola*).

6. Developed Area (DA)

Once all exotic invasives have been removed, Coppice Forest plants as well as Fruiting trees can be planted in this area.

These include but are not limited to the Satin leaf, Wild Tamarind, Willow Busic, Strong back, Paradise tree, Cinnecord, Gum Elemi, Feather bed, Five Finger and Thatch Palm could be planted. Smaller native plants could also be used as ornamentals such as Ram's Horn, Coco plum (*Chrysobalanus icaco*), Buttonwood (*Conocarpus erectus*), Wild coffee (*Psychotria nervosa*), Bahamas Buttercup (*Turnera ulmifolia*) and the Bay Lily (*Hymenocallis arenicola*).

The important role that Lake Cunningham plays in providing habitat for numerous bird species (including natives and migrants) should be given greater weight. Native tree species (which are to be removed from the road corridor) should be transplanted to areas around the lake, to minimise disturbance to species present.

The area around Lake Cunningham and to some extent the broadleaf coppice on Prospect Ridge will be degraded by development in the future, this was confirmed on site and from consultation with The Bahamas Environment, Science and Technology (BEST) Commission and the Department of Physical Planning. Due to the risk of removal as a result of private development around the lake and seasonal wetland in the future the possibility of conservation and protection of even small fragments of forest is considered important in terms of habitat conservation. This will not only provide some mitigation for the loss of wetland and forest, but would also provide benefits for existing and future local residents.

As a comprehensive compensation package for habitat loss and fragmentation along the road it is strongly recommended that a portion of the land surrounding Lake Cunningham and the wetlands to the east is given a protected status and transformed into a wildlife zone or 'Greenspace'. Lake Cunningham is in a unique position owing to the fact it is an important wildlife resource on a route accessed by most tourists visiting the island.

Approximately two acres is considered an appropriate size for the wildlife zone or 'Greenspace'. Whilst the location of such measures will be somewhat dependant on the economics of land acquisition it is recommended that the package considers the following locations;

1. Two acres of property on the southern side of JFK Drive along Lake Cunningham preferably opposite the proposed recreation facility
2. Two acres of property surrounding Red Sound (this area is located to the north west of Lake Cunningham and currently has high ecological value), preferably the south east corner of the land surrounding this water body. More of this area should be considered simply due to its high ecological value.

3. Two acres of the undeveloped land mass that extends from the west into the centre of the Lake, preferably the eastern most end.

It is therefore recommended that the Government assess the land acquisition requirements along the corridor and in particular near Lake Cunningham. Where portions of parcels on the southern side of JFK Drive are required to be acquired some full parcels should be purchased to provide 'greenspace' reserves to protect forest for bird life in particular. Forest should also be planted on the substantial areas of land available that meet the southern shoreline of the Lake Cunningham north of JFK Drive. These three areas are the same as those identified for the recreational facility therefore re-planting will need to allow for this facility. The recreational facility will provide a parking area, a viewing platform, shade and toilet facilities. Locating the wildlife zone or 'Greenspace' near the recreational facility will allow future access to this area once a facility for pedestrians to cross the road is provided.

There will be a loss of vegetation/forest at the road which accesses Lake Killarney as a result of re-aligning the road to the east in order to meet the proposed roundabout at Westridge Estates Road. It will be necessary to treat the existing road that will become redundant so that it can sustain new forest which is to be planted in the old roadway (re-planted trees). Also, the entrance walls to Westridge Estates and Lake Killarney will be demolished. These will need to be re-constructed. It is also recommended that new road signs are erected at all new intersections. Native woodland planting in the water works area east of the TWD Highway roundabout should also be detailed in the contract documentation.

Tree removal around the lake and wetland should be limited to avoid an increase of sunlight reaching the surface waters. Planting will occur at the base of the rock cut face, this should be carried out as soon as possible after construction is complete for stabilisation purposes.

Wetland/mangrove establishment and management should be provided along other parts of Lake Cunningham to compensate for the wetland habitat lost as a result of the widened JFK Drive. Mangrove cuttings are to be planted along the toe of all embankments which meet a water body as well as additional mangroves along the southern shoreline of Lake Cunningham and new mangrove islands within Lake Cunningham and Lake Killarney to provide compensation for mangrove habitat lost to the road.

In addition to the existing wetlands, all opportunities for habitat creation within newly created drainage ditches and ponds should be investigated to compensate for the overall loss and infilling of the lake and wetlands along the route. Planting native species will assist in the revegetation process and long-term management is recommended.

Opportunities open up for environmental enhancement in the area of the wetland east of Lake Cunningham. Restoration of these wetlands by means of providing aesthetic benefits, which is of particular relevance due to its close proximity to the cemetery. The additional residential development which is likely to take the form of expensive, high class properties on the south side of the lake will overlook this area due to their positioning on the side of a hill. Government purchasing a portion of the wetlands to the east of Lake Cunningham will ensure that development right up to the road does not occur, correct management will provide some compensation for the loss of wetlands caused by the installation of the road.

It is important that the road does not indirectly cause the loss of a wider area of wetland by interference with the hydrological system and encroachment. The two sides are not linked hydrologically, therefore, culverts are not required. The installation of an overflow culvert underneath the new road is recommended. The wetlands to the east of Lake Cunningham will be affected and it would be beneficial to plant a native tree and shrub vegetative buffer between the wetland and the road. Monitoring the area will also reduce the risk of pollution and degradation from illegal dumping. Mangrove cuttings are to be planted along the toe of the embankment in this area as well as along the southern shoreline of Lake Cunningham, which will provide some compensation for mangrove habitat lost to the road.

Removal of dumped material and active management, including the installation of bird boxes, provision of island refuges, combined with sympathetic planting within the surrounding area is recommended. This will increase the areas appeal to wildlife and would also serve as a recreational and educational resource. Planting of native species on derelict land to the east of the lake is recommended to increase the biodiversity of the area, whilst the provision of foot or cycle paths would allow access for public enjoyment and should therefore be considered for the future.

Construction activities near to Lake Cunningham, Lake Killarney, Prospect's Water Works and the Broad leaf coppices must be carefully monitored between July and September to limit the impact of construction noise and disruption to birds. Birds are protected under the Wild Birds Protection Act.

Where the construction corridor passes through broadleaf coppice temporary fencing shall be erected to protect the existing vegetation from damage from machinery and illegal dumping. Hand excavations around the roots of street trees to avoid cutting of roots is recommended. Vehicles and equipment shall be prevented from entering fenced off areas, to prevent compaction of soil. Further preparatory measures should include:

- prune interfering branches and treat with approved dressing
- preprune a year in advance of construction
- do not cut major tree roots
- treat damaged roots immediately with an approved tree paint.

When transplanting vegetation proper planning is required. Specifications shall include; root ball size, soil mixtures, staking and guying, pruning, mulching, fertilizing, moisture loss retardants and root and crown pruning in advance of transplanting.

Specification for Landscape Design for the proposed corridors is attached as Appendix G.

5.3.8 General Population Characteristics

Changes to population characteristics as a result of the project are considered insignificant.

5.3.9 Income and Poverty

The direct employment content of the project after construction is negligible. Other changes to the income and poverty levels of the islands population as a result of the project are also considered negligible.

5.3.10 Accessibility and Transportation

5.3.10.1 Roads/Road Traffic

A comparison of the existing traffic volumes against the theoretical capacity of the road indicates that traffic on JFK Drive between Blake Road and Bethel Avenue is nearing the road's capacity threshold (ADT of approximately 14,000), leading to routine congestion and unreliable journey times for vehicles. Forecasting indicates that capacity will be exceeded at the east end of JFK Drive by 2015 and the centre of JFK Drive by 2020. However it is clear that capacity has been exceeded west of TWD at peak hours when traffic is practically at a stand still.

The construction of the wider JFK Drive will provide some much needed relief to congested traffic. Whilst traffic volumes will be increased marginally as a result of traffic that currently uses West Bay Street and Carmichael Road using the widened JFK Drive, the widened road will have a greater capacity. The capacity of the 4 lane road can be approximated at 35,000 ADT. If an average annual growth rate of that predicted for 2040 is used to predict traffic flows after 2040 it can be estimated that the capacity of the 4

lane road could be exceeded by 2055 however this will be dependant on many factors all of which are subject to change over time and can only be considered as a very approximate guide. This does however stress the importance of transportation planning for the country and the likely need to widen this road in future. Consideration should therefore be given to accommodating for future widening of this road to six lanes within this project.

A comparison of the existing traffic flows on Carmichael Road with those predicted with the project in place indicates that Carmichael Road without the project would exceed its capacity by 2015. With the project constructed Carmichael Road is unlikely to reach its capacity until 2035.

A comparison of the existing traffic flows on West Bay Street (WBS) with those predicted with the project in place indicates that WBS without the project would exceed its capacity by 2025. With the project constructed WBS is unlikely to reach its capacity until 2055.

As indicated earlier traffic volumes on JFK Drive between Blake Road and Windsor Field Road are within capacity limits. However, the level of service at JFK Drive and Blake Road is poor with a 35 to 50 second controlled delay being experienced per vehicle. The proposed roundabout at this junction should improve the level of service significantly however the LPIA Expansion Project Traffic Impact Study recommends a 160 foot diameter roundabout be installed at this junction rather than a 120 foot diameter roundabout as per the proposed project. It is considered necessary for the feasibility of installing a 160 foot roundabout at this location be further examined. Blake Road is a commercial area which is considered likely to continue to develop at a relatively fast pace as it has done in recent years. This road is also used heavily by taxis and others who utilise the West Bay Street coast road between the Airport and the touristy area of Cable Beach. It is suggested that consideration be given to further beautification of this road in future.

These projections do not take into account the impacts of traffic generated from planned development on the network. As stated earlier the eastern end of the island is already heavily developed. The west end of the island is far less developed however there are a large number of residential developments that are planned or currently under construction including the upgrade of the International Airport. There is also planned development on Gladstone Road commercially with the likelihood of a new hospital being located on Gladstone Road. This planned development will only serve to increase the traffic flows experienced on JFK Drive further emphasising the importance of this project.

Overall this project can therefore be expected to provide improved traffic conditions on Carmichael Road, WBS and JFK Drive to the year 2055 although development of the west end of the island an increase in visitors to the island as a result of the improved Airport may cause traffic flows to increase on JFK Drive more than has been predicted.

Overall, the relief from congestion can be expected to remove a number of negative effects as follows:

- Wasting time of motorists and passengers ("opportunity cost"). As a non-productive activity for most people, congestion reduces regional economic health.
- Delays, which may result in late arrival for employment, meetings, and education, resulting in lost business, disciplinary action or other personal losses.
- Inability to forecast travel time accurately, leading to drivers allocating more time to travel "just in case", and less time on productive activities.
- Wasted fuel increasing air pollution and carbon dioxide emissions owing to increased idling, acceleration and braking. Increased fuel use may also in theory cause a rise in fuel costs.
- Wear and tear on vehicles as a result of idling in traffic and frequent acceleration and braking, leading to more frequent repairs and replacements.
- Stressed and frustrated motorists, encouraging road rage and reduced health of motorists
- Emergencies: blocked traffic may interfere with the passage of emergency vehicles travelling to their destinations where they are urgently needed.

- Spillover effect from congested main arteries to secondary roads and side streets as alternative routes are attempted ('rat running'), which may affect neighborhood amenity and real estate prices.

Buses

The Government has been criticized for not providing adequate bus lay-bys on recently constructed dual carriageways. Although it is difficult, other than where bus stops/lay-bys exist, to determine the location of future bus stops/lay-by needs the provision of these will need to be addressed at some stage. Discussions with the Physical Planning Department and the Road Traffic Department (RTD) to determine where new bus stops/lay-bys will be needed have not identified additional bus stop requirements however it is considered appropriate to make spatial allowances in land acquisition considerations at all roundabouts for future bus stops.

All existing bus stops and pedestrian crossings are to be replaced. Pedestrian flows on the corridor are not considered high enough to warrant the installation of a signalized pedestrian crossing. Bus stops should be installed on both sides of the road; east of MOW building, east of Christie Avenue, at Gladstone Road intersection, at Theodora Lane (Chainage 262+00) and at TWD highway. Pedestrian crossings shall be installed at these roundabouts.

Lay-bys are to be provided at all bus stop locations as a minimum. Bus shelters should also be provided at all bus stops with bus shelter replacement as a minimum. Pedestrian crossings should also be located at all bus stops as well as all the required signs and roadmarkings as per UK standards. Allowance should be made for adequate space for the future installation of bus stop lay-bys at roundabouts with safe pedestrian crossing arrangements. The most relevant locations for future bus stop lay-bys is considered to be at Airport Roundabout 2, Westridge Subdivision/Killarney Lake Road and Blake Road. These will become relevant once the west end of the island is further developed and it is economically viable for buses to operate a route along a portion of JFK Drive.

Other traffic/road impacts and mitigation measures that are specific to the project include;

- a. Access to the opposite side of the road along JFK Drive will generally be restricted due to the presence of the new median. It will be necessary for drivers to enter traffic in the opposite direction to the desired direction and U-turn at the nearest roundabout. This will result in some journeys travelled being longer than that at present. This impact is considered insignificant however due to the relatively close spacing of most of the roundabouts and the safety implications of the project.
- b. Provide a service lane on the south side of JFK Drive between the MOWT roundabout and the existing Bethel Avenue with physical restriction to crossing the centerline of the road to maintain flow along the road in a safe manner. Consideration should also be given to a reduction in the speed limit east of the MOWT building roundabout.
- c. The horizontal curves of the proposed alignment are below standard at Chainage 81+00 and 134+40 (the west end of Lake Cunningham) without a super elevation of 6% (the maximum allowable super elevation allowed by the MOWT). It will therefore be important to provide super elevation correctly at this location so that the road is safe to travel at 55 mph. It should also be noted that the curve at the west end of Lake Cunningham is sharper than the existing curve in order to accommodate the wider width of the carriageway. This location is also where it is proposed to cut the road into rock by as much as 10 feet west of the lake and place the road in fill approximately 8 feet in height where it meets the lake. Where the road meets the lake and is in fill it will be necessary to place a retaining wall along its edge in order not to impact on the lake directly. Both of these situations produce a safety concern especially when coupled with the sharpness of this curve which lies in between long straight sections. It will

- therefore be necessary to install safety barriers at these locations. Reference must also be made to the UK signage standards to determine what if any warning signs are appropriate for this curve. Safety barrier from approximately CH 129+50 to CH 143+50 will be necessary on the north side of the road and in the median.
- d. The installation of nine new roundabouts will have a significant impact on the safety of traffic, especially if well designed in accordance with UK standards. This is likely to have a detrimental impact on pedestrian safety however although it is considered unlikely that there will be many pedestrians along this route. Pedestrian crossings will be necessary at Tonique Williams Darling Highway, Christie Avenue, Gladstone Road, Theodora lane, and at the MOWT building. Most notably to serve bus passengers. There are no facilities elsewhere along the route which would warrant pedestrian crossings at this time. Pedestrian crossings must be located sufficiently far away from junctions and have adequate sight distance to be negotiated safely. They should be well lit and sign posted. A pedestrian barrier should be installed where pedestrian flows are high. Whilst there are a significant number of roundabouts in New Providence drivers generally do not negotiate these correctly. The Government Transportation Department has been carrying out a programme to educate the public in the use of roundabouts. This initiative has been to help drivers negotiate roundabouts correctly
 - e. The design of the medians should be such that they are difficult to mount and cross (i.e. use of steep and high kerbs, plantings in the median) as driver behaviour has indicated in the past that drivers will cross medians where there is a desire if possible, even at pedestrian crossing points.
 - f. The proposed landscaping must be designed so as not to impede on street lighting and sight lines.
 - g. Adequate drainage will need to be provided at the road. Consideration should be given to utilising the wide median for drainage purposes by having half the pavement drain to the median and a swale within the median to reduce land take requirements elsewhere. Detailed drainage calculations will need to be submitted to the MOWT for review and drainage areas identified on plans.
 - h. Consult Baha Mar to determine whether the proposed roundabout at Gladstone Road and JFK Drive will be adequate based on their studies to date which include their projected traffic flows.
 - i. The alignment of the northern leg of TWD Highway has a sharp curve. This should be re-examined to adequately accommodate large HGVs without their having to utilise area outside of their lane.
 - j. There is a Plaza currently under construction north of the TWD/JFK Drive intersection which will provide 40,000 square feet of commercial space on the property. The provision of an adequate access arrangement to this property will need to be provided off of Prospect Road rather than JFK Drive. No details are available at this time.
 - k. It will be necessary to provide a turning facility at the end of the access road that is located between the church on the corner of Gladstone Road and JFK Drive and Theodora Lane.
 - l. Some property owners whose property shares a boundary with JFK Drive access directly onto JFK Drive although this is illegal. Consideration should be given to restricting such movements from properties that line the road. Preferred modes of restriction are landscaping however other methods to name a few that can be considered include the installation of bollards, fencing and ditches.

- m. During operation access arrangements to residential and commercial properties will be altered along the route. Tie ins should be reinstated to a condition that is equal or better in condition. These should be constructed to allow safe access and egress (i.e. adequate sight lines and radii).
- n. Consideration should be given to treating the road shoulder to limit the extent of damage as a result of over running and drainage eroding the edges of the road. A cement stabilised shoulder or similarly treated shoulder will eliminate rutting and drop off adjacent to the edge of the travelled way.

During operation the widening of the route and the installation of improved junctions will have the following impacts

- serve to keep pace with economic development
- satisfy the growing traffic demands in terms of quality and volume
- divert the existing traffic from parallel routes of West Bay Street and Carmichael Road – South West bay Street to the widened JFK Drive.

This project will provide relief to already congested portions of these roads. The impact on east-west traffic flows should be most positive for motorists. Forecast traffic volumes indicate that the Average Daily Traffic (ADT) on JFK Drive can be expected to grow at a rate of on average 3% per year between 2012 and 2040. This is slightly lower than that experienced between 1999 and 2005 however it does mean that this solution will only provide relief for a while especially with the level of development in the West taken into consideration. Further solutions are necessary to address traffic issues in New Providence as the island is limited in size and therefore the ability to increase road capacity is limited.

5.3.10.2 Traffic Management Issues Affecting Safety

The Project objectives contemplate road safety as a priority consideration. This policy has been reiterated by all stakeholders consulted for this Assessment.

Road Traffic Accidents in New Providence Island

The Royal Bahamas Police Force hold data on traffic accidents and incidents. A list of current accident records has been requested from the MOWT by the Environmental Consultant. No information was available at the time of writing this assessment. Once this information is received a revised report will be issued which addresses the issue of traffic accidents.

It is well known that a large number of traffic accidents have occurred on JFK Drive. It is suspected that the majority of these are as a result of motorists trying to overtake between Gladstone Road and the Airport.

The Traffic Division of the Royal Bahamas Police Force has recommended that a safety barrier be located along the Lake edge. This would restrict people from exiting and entering JFK Drive to/from the Lakeside however this would be costly due to the length of safety barrier that would have to be installed. A Safety barrier at this location would also have a negative impact on the beautification of the road. Safety barrier along the length of the Lake is considered likely to be unnecessary along the straight portions of the road where accidents in the past are most likely to have been due to overtaking vehicles and poor pavement conditions both of which will be relieved as a result of the new widened road. Traffic accidents along the road should be monitored however to ensure that traffic accidents are reduced as a result of the road construction and that vehicles are not entering the Lake as a result of accidents. Traffic accident data will be studied to determine the necessity for safety barrier at this location once received, especially in light of the fact that the road will be closer to the Lake in areas and retaining walls will also

be incorporated. It should be noted however that all retaining walls will need to have safety barrier installed at their locations.

Importance of Safety Barrier

Loss of control of a vehicle may be due to several reasons, some of which are hard to be rectified. Safety barrier can greatly reduce the severity of accidents. Its installation lowers accident frequency because of the improved delineation. Therefore apart from introducing other safety measures and improving the road geometry, it is often desirable to install safety barriers along stretches where chances of loss of control of vehicles are higher.

Criteria for Provision of Safety Barriers

In principle, the following three situations may warrant a safety barrier:

1. To protect vehicles from falling down a slope - this applies where there is a drop of 9 feet or more at or near the edge of the road and the slope is steeper than 1 in 4.
2. To protect vehicles from hitting a roadside object - this applies where there is a hazardous object, such as a bridge pier, large sign post or rocky face which is close to the edge of the carriageway. Conversely, protection of the object from damage by vehicles may also be a reason for installing safety barrier.
3. To prevent out-of-control vehicles from crossing over the central median - this applies on the known crossover-accident locations along a dual carriageway.

However, it is not economic to install safety barrier on every section of road that falls into these categories. There are a number of other factors that need to be taken into account, including:

1. whether there have been run-off-road or crossover accidents at the site - in the case of an existing road
2. whether the site is on a sharp bend - defined as a bend where the design speed (safe speed to negotiate the bend) differs from the approach speed 85th percentile speed by more than 10 mph.
3. whether it is a busy road - defined as a road with an ADT of >1,000
4. whether the traffic speed (85th percentile speed) approaching the site is greater than 30 mph.

If two or more of these considerations apply there is probably a good case for installing safety barrier. A bad record of casualty accidents involving run-off-road vehicles (3 or more a year) can also in itself be sufficient justification for safety barrier.

Some General Considerations for Safety Barriers

- A barrier that is too close to the edge of the carriageway can be a hazard in itself. If it reduces the effective carriageway width there will be a greater risk of collisions between opposing vehicles, especially on narrow roads. Sometimes however the risk of severe run-off-road accidents may be so great as to justify installing barrier close to the edge, even on the shoulder, if this is the only space available.
- Safety barrier should be placed so that it does not obstruct pedestrian movement. Where there has to be long sections of safety barrier close-to the edge of the running lines, a gap should be left in the safety barrier at least every 100 feet, so that pedestrians can take refuge in it.
- On sections of road where there is often rockfall, gaps should be left in the safety barrier to enable the road workers to push the fallen rock off the road.
- Safety barrier should not interfere with drainage of the carriageway. Solid barriers may need to have drains through them.
- Care should be taken to reduce the risk of a vehicle hitting the end of the barrier, as this can result in extensive damage to the vehicle and severe injuries to the occupants.

Probably the best way to reduce the risk is to flare the barrier away from the road edge, and, if possible, bury the end in an earth mound.

- Safety barrier should be located so that it is in front of as many roadside obstacles (signs, utility poles, utility cabinets, trees, open drains, etc.) as possible.
- Ends of barrier, and barriers that are located in high-risk situations, should be made more conspicuous by being painted with the yellow and black diagonal bar pattern (solid barriers) or marked with reflective paint (all types of barrier) or fitted with vandal-proof reflectors.
- Proper maintenance of barriers is essential if they are to continue being effective.

The Project Proposals

Engineering and traffic management aspects of road safety should be handled as a matter of priority by the technical inputs to this project. Further consideration is to be given to the safety of the proposed road once traffic accident data is made available.



Figure 5.2 Remains of a traffic accident at the edge of Lake Cunningham

5.3.11 Utilities and Supporting Infrastructure

Utilities will be restored and/or relocated as part of the proposed project. It is important that this work is carried out in a safe and appropriate manner. The following are some key issues that should be addressed;

- a. Re-location of the electricity lines underground will mean that the major electricity distribution lines that serve the east of the island from Clifton Power station will be less likely to be damaged during extreme weather conditions such as hurricanes. Underground the high voltage lines will also pose less of a hazard to motorists. The existing BEC overhead lines and pylons are very unsightly and visually intrusive. They destroy the look of the beautiful natural environment and surroundings. Placing these lines underground will help to beautify this route. People are concerned about their health and safety regarding electromagnetic fields (EMF) and its links to cancers particularly leukaemia in children. A recent report by the SCENIHR Committee (published May 2007) which was commissioned for the EU has confirmed a possible link between childhood leukaemia and living close to High Voltage overhead Power lines.

- b. It will be important to document the location of all utilities as re-located for maintenance purposes. As-builts shall be a requirement of the project as well as the installation of markers and wire tape where relevant.
- c. Disruption to utilities should be less likely due to their upgrade and the supply of water on the island will be improved as a result of the water main along the road being upgraded.
- d. All existing fire hydrants/fire wells shall be replaced and the fire department should be asked to review the proposed locations as well as the need for any additional infrastructure. All existing public telephones should be replaced. Their location should tie in with bus stop and pedestrian crossing locations as best as is feasible.
- e. It will be necessary to provide the proposed development at Cable Beach with sewerage treatment facilities. Current plans indicate this located on Gladstone Road and as such will require a sewer line along the length of Gladstone Road including along its extension to the north of JFK Drive and will therefore need to be accommodated at the Gladstone Road/JFK Drive intersection. Other utilities will also need to be accommodated across this junction. It is recommended that future utilities be accommodated across the junction where feasible in order to limit disruption to traffic, the necessity for reconstruction/reinstatement and safety hazards in future. This could be done by means of providing utility pipes/culvert/s as part of these works.
- f. The installation of new aesthetically pleasing street lighting will further enhance the visual appearance of the route.
- g. Manholes that are altered must be re-set at the correct elevation with respect to the road so as not to cause a hazard to drivers on the road.
- h. The utilities should be upgraded to allow for forecast development of the west end of the island and as a minimum should be designed inline with the road to 2055.

5.3.12 Other Social Issues in the Project Area

5.3.12.1 Recreation

The Lake is currently used for recreational purposes and it is common to find people parking on the south side of Lake Cunningham, in particular close to Gladstone Road. Most of the people that use this area are there to relax and partake in remote controlled boating. It is also common to find large vehicular traffic stopped on the south side of JFK along the portion which is adjacent to Lake Cunningham, most likely for rest breaks.

The level of use of the lake for recreational purposes is expected to increase. Netting has been placed at the edge of the lake in the shallows where remote control boaters wade into the water to launch and collect their boats. Other portions of the lakeside are generally not utilized by the public due to the limited space between the lake and the road. This location provides a wider flat area which is ideal for parking and recreational use.

Drivers entering onto JFK Drive from the verge at this location cause a safety hazard due to the necessity to enter speeding traffic from stationary through rough terrain. The proposed project will utilise the space that is currently used for recreational purposes and reduce the area available substantially. It is therefore considered necessary to provide mitigation by providing facilities which will allow recreational users of the lake to continue to access the edge of the lake. This should be in a form similar in nature to the recent works carried out for the improvement of Saunders Beach, north east of the project area.

Lake Cunningham has been earmarked as having the potential to become an important wildlife centre, which would provide opportunities for local residents to enjoy recreational activities. Widening JFK Drive

along the lake will have a significant negative impact on the amenity value of the lake due to infilling and due to segregation of the community from the lake. It is recommended that car parking and a footpath along the side of the lake is incorporated together with a soft landscaped edge to the lake to provide a local amenity space which will link sympathetically into wider plans for the area in terms of creating a park.

It is estimated that providing ten parking spaces would be adequate at this time with allowances made for expansion in the future. Suitable locations for providing parking and access to the edge of the lake will be limited as a result of the project without having greater impact on the lake mainly due to the lack of remaining land between the proposed road and the lake.

Locations for the provision of recreational facilities are at approximately chainage 145+00 or at CH 180+00 or at CH 230+00 where there will be a substantial area (1.9 acres, 0.8 acres and 1.8 acres respectively) between the southern side of the lake and the proposed road available as a result of the re-alignment of the road. It will be important to locate the access in a manner which allows the traffic to merge on and off of JFK Drive with some speed. It will also be important to locate the access/egress in a safe location especially with respect to sight distances.

At the lake a buffer will need to be provided to protect the public from traffic travelling on JFK Drive and bunding and or fencing may also be necessary. A raised deck should be provided along the lake so that people can access the lake without causing damage to the edge of the lake. Placement of educational placards (possibly provided by BNT) should be placed to educate the public accessing this area of the value of the area and signs and facilities to accommodate waste provided. Provision of shade by means of large trees and or a gazebo should also be provided.

Other recreational infrastructure that has been suggested for inclusion in the project includes a bicycle/running track along the route that could tie into the forest south of the airport and Carmichael Road.

The existing roadside around the JFK Drive/Gladstone Road intersection is currently used for parking by people attending the church on Gladstone Road. The church should be consulted so that attendees can make alternative parking arrangements prior to works. These drivers are also likely to use the proposed access road between the church and Theodora Lane to park. It will be necessary to install unmountable kerbs at the medians between Theodora Lane and the access road to the west and JFK Drive to prohibit drivers from traversing the medians to merge with JFK Drive traffic.

5.3.12.2 HIV/AIDS

Any impacts on the HIV/AIDS epidemic as a result of this project are considered to be insignificant during operation as this corridor currently exists although at a smaller scale.

5.3.13 Cultural Heritage and Archaeology

The cultural resources identified as the conch shell and bird monuments at the airport intersection and Blake Road intersection respectively will need to be relocated as agreed by the Antiquities, Monuments and Museums Corporation. No other cultural resources are expected to be affected however the AAMC is to be contacted should works unearth anything that may be of interest or value.

5.3.14 Aesthetics

The main visual impacts that will occur as a result of the project will be due to the nature of a construction site during construction however this is a temporary impact. The main long-term impacts will be as a result of the removal of approximately 20 acres of forest, landscaping that is applied to the route as well as the removal of the overhead utilities along the route. Little detail of that proposed for landscaping has been provided however overall vegetation coverage will be applied with spot-line and high-low combined layout and arbour, bush, flower and grass integrated to remove the current sense of monotony. The

current project budget has allowed \$1,500,000 for landscaping which when considered with the level of re-planting to be carried out should beautify the area significantly however the extent will depend on the management of this sensitive resource.

The other main visual impact will be as a result of the new lanes, the median, the new roundabouts, new street lighting and the landscaping along the route. Particular attention should be paid to the treatment of roundabouts and rock faces. The roundabouts should be elaborately planned, creative and with pleasant landscape affect whilst providing adequate sightlines as for the entire alignment. The view along JFK where it runs along Lake Cunningham will be altered slightly by the altered alignment which will take motorists closer and further from the Lake as well as raise and lower the motorist. This impact will be minimal other than at the west end of the lake where the view across the lake when travelling east will be somewhat reduced due to the road being lowered approximately ten feet. There will also be necessary to install safety barriers along the lake at this location as well as others due to the cut and fill arrangements of the proposed widening. These will have an adverse impact on the aesthetics of the route.

At the Airport the current area is a construction site and as such is unsightly at present. Landscaping should be designed to have a major beneficial impact as it will be many tourist's first impression of the Bahamas. The roundabouts in this area should become major features with impressive plantings. Sponsorship for the planting of these roundabouts should be sought from the Airport Authority. Seeking sponsorship for all of the roundabouts on the new route should be sought to provide funding for vegetation and roundabout maintenance on the centre of the roundabout and possibly for statues/monuments.

The road may cause substantial visual intrusion to properties along JFK Drive, however, most of these properties are not yet constructed and it is therefore impossible to assess the situation fully. The impact will be somewhat limited due to the fact that a road exits at this location at present. The re-alignment further north at the Gladstone Road intersection is likely to make the road more visible to more of these high end properties. It is suggested that landscaping and beautification of the wetlands east of Lake Cunningham will mitigate against this impact.

Some of the houses that back onto JFK Drive at Christie Avenue have fences that block views of the road. These fences should be replaced where it is necessary to remove them. Re-alignment of the road should remove this necessity as discussed earlier. Dense vegetation should be planted in front of these properties and re-alignment to the north will aid in providing a buffer.

The properties east of Theodora Lane including the Lutheran church and Hope College are close to the proposed road and as such the aesthetics of their area affected. The properties whose gardens will need to be acquired will have the greatest impact. It will be necessary to replace trees and plants in front of these properties. Vegetation used should be of a type that will hide the noise barrier to be installed. Planting in the medians and either side of the road as well as enhancement of the wetlands between Lake Cunningham and Hope College should be dense and improve on that which exists at this location at present.

The landscaped area on the roadside in front of the MOWT and BTC buildings will be lost. A landscaped margin should be maintained in the proposed roadworks to address visual, air quality and noise issues that are related to the introduction of a wider road with higher traffic flows at this location.

Opportunities open up for environmental enhancement in the area of the wetland east of Lake Cunningham. Restoration of these wetlands and planting of relevant wetland plants could provide a valuable habitat to wildlife, as well as providing aesthetic benefits, which is of particular relevance due to its close proximity to the cemetery and the nearby properties at Oakridge Estates and Niven Heights. The additional residential development which is likely to take the form of expensive, high class properties on the south side of the lake will overlook this area due to their positioning on the side of a hill. Government purchasing of a portion of the wetlands to the east of Lake Cunningham will ensure that development right up to the road does not occur, correct management will provide some compensation

for the loss of wetlands caused by the installation of the road, and similar wetland losses along Lake Killarney.

The addition of mangrove along the realigned and landscaped banks of the lakes and wetlands to provide mitigation against loss of mangrove habitat will also mitigate against visual impacts to the edge of the Lake.

The provision of the recreational facility on the north side of JFK Drive will have something of a detrimental impact as it will take away from the natural environment however positive benefits can be realised from the provision of greenspace on the southern side of JFK Drive along the lake. Further positive benefits will be derived from the use of the remaining parcels of land on the northern shoreline of Lake Cunningham for mitigative planting.

The introduction of re-planted vegetation east of the Tonique Williams Darling intersection as mitigation measures for the loss of habitat and biodiversity as well as along the route will also have a major beneficial impact on the visual appearance along the route.

The severity of this impact will depend on how much of the existing vegetation can be retained which currently provides a good buffer for houses and gardens. Planting along the houses adjacent to the road is recommended to provide additional screening. Noise barriers will also be installed and will have a visual impact. Planting should be placed between these and the road where possible to mitigate against the adverse impact of the noise barriers. Vines should be considered where space is limited.



**Figure 5.3 View along
Lake Cunningham
southern shoreline from
Gladstone Road looking
west**

3.4 Key Potentially Beneficial Impacts

Key potentially beneficial impacts associated with project implementation are all related to the post-construction (operational) phase.

The main potentially beneficial impacts are as follows:

- Much improved road safety for all road users as a result of higher design standards on JFK Drive and the reduction in traffic on West Bay Street and Carmichael Road.
- Reduced vehicle operating costs and time travel savings will facilitate transportation between the airport and downtown Nassau and may give rise to improvements in the level of public transport provision in the project area. An increase in the frequency of taxis and public buses will improve access to employment opportunities and will improve access to secondary schools and medical facilities.

- Beautification and landscaping of the Airport gateway will enhance the experience of the Bahamas as a tourist destination. Re-location of electricity lines will improve the visual aesthetics of the route, make the route less hazardous and provide a more reliable service.
- Reduced vehicle operating costs and time travel savings could be particularly significant for taxi drivers in the project area, allowing a re-allocation of resources to income generating productive activities.
- Improved access to tourist/cultural heritage sites on the West coast, including the beach areas around at the west end of the island. If carefully managed there may be significant employment opportunities for local people in tourism related industries.
- Time travel savings and improved access to the economies of downtown Nassau may stimulate residential, agricultural and small scale industrial activity in settlements adjacent to JFK.
- The removal of through traffic, in particular HGVs, from the coast road may safeguard the island's competitiveness which is currently threatened by choking traffic congestion.
- A reduction in pavement damage and maintenance costs on the existing JFK Drive due to reduced traffic volumes per lane and improved construction technique.
- Noise reduction and improvements in air quality for residents, businesses and transport users on West Bay Street and Carmichael Road.

It is noted that owing to the low density of population in the project area that the number of likely beneficiaries may be low, however, this should not be considered a barrier towards the fulfilment of national commitments and the long term success of the region. As stated earlier this area is currently undergoing development.

Benefit enhancement measures are based on the incorporation of appropriate features in project designs, and adoption of a high standard of routine and periodic road maintenance, so that benefits are sustained in the long term.

5.3 Key Potentially Adverse Impacts

The experience of other sub-components of the New Providence Improvement Project (NPRIP) has illustrated a number of key potentially adverse impacts in the pre-construction phase. These are:

- Creation of public uncertainty regarding land and property acquisition arising from the presence of survey and investigation teams.
- Stimulation of land speculation giving rise to higher level prices which can adversely affect those in receipt of compensation who wish to purchase replacement land close to their existing homes.

The majority of potentially adverse impacts are, however, associated with the construction phase of the project and are as follows:

- Development of social friction between the contractor's workforce and local communities arising because the workforce will be brought in from outside the area where works will be carried out, rather than being hired locally.
- Health and safety hazards to the workforce, arising from participation in an inherently dangerous occupation.
- Land and water pollution arising from inadequate disposal of liquid wastes and spillages of contaminating materials at contractors' base camps and worksites.
- Land and water pollution, public health hazards and landscape amenity value degradation arising from inadequate disposal of solid wastes arising at contractors' base camps and worksites.
- Localised creation of dust nuisance during various construction operations.
- Land sterilisation, adverse roadside/landscape visual impact and public health and safety hazards, associated with inadequate post-construction site and base camp clearance.

- Demolition of, damage to and interference with public and privately owned infrastructure, arising during construction. This includes a significant quantity of properties which will be required to accommodate the new RoW. There may be severe short term impacts for households who lose access to existing income generating activities and small land holdings. (This is also a post-construction phase impact).
- Increased localised road safety hazards to road users and the workforce and inconvenience to the public associated with construction work in close proximity to existing roads.
- Inconvenience to the public caused by temporary blocking of property access and side roads during construction.
- Creation of dangers to the general public and road users arising from roadside storage of construction materials and inconsiderate roadside parking of construction plant and vehicles (very localised).
- Enhancement of erosion/sediment deposition following clearance of vegetation, prior to commencement of construction on cleared sites.
- Damage to road pavements and structures associated with haulage of materials to/from worksites.
- Increase in traffic congestion and road safety hazards associated with the haulage of construction materials and/or earthworks spoil to/from worksites.
- Erosion/sediment deposition effects associated with failure to re-vegetate earthworks slopes at the earliest opportunity after formation
- Increase in suspended solid content and bed load of watercourses associated with long-term erosion of earthworks faces.
- Increase in suspended sediment levels in watercourses arising from in-watercourse and bank works associated with reclamation construction, affecting water quality and sedimentation patterns.
- Pollution of watercourses arising from cement-containing material at reclamation site.
- Destruction of existing topography at borrow pit.

Construction phase impacts will be mitigated through the inclusion of specific environmental protection clauses in the contract documents and enforcing compliance with them during construction.

During the post-construction (operational) phase the following key negative impacts are anticipated:

- Loss of recreational area beside Lake Cunningham.
- Potential negative impact on the livelihoods of small businesses whose land is severed or touched on by the new ROW. This is also a fear for households who lose access to homestead gardens through compulsory acquisition.
- Altered hydrological arrangement, loss of lake and wetlands.
- There is a risk on this project of uncontrolled development in previously undeveloped areas leading to the localised destruction of very valuable habitat.
- Traffic likely to travel at higher speeds which could lead to safety implications.
- A reduction in area of particular ecological value.
- Loss of 'no build' land on southern shoreline of Lake Cunningham for recreational purposes.
- There will be a loss of vegetation/forest at the road which accesses Lake Killarney as a result of re-aligning the road to the east in order to meet the proposed roundabout at Westridge Estates Road.
- The entrance walls to Westridge Estates and Lake Killarney will be demolished.

Mitigation of these impacts will include the incorporation of appropriate considerations in formulating project designs. However, they will also require the effective co-operation of other Government agencies and ministries for any chance of success.

5.4 Uncertainties in Impact Assessment

This EIA was prepared during the feasibility stage of project preparation. Consequently, the precise nature and scope of works and the final highway alignment had not yet been fully defined. The EIA is

therefore inherently subject to a number of uncertainties. However, it is believed that the level of uncertainty regarding impact occurrence and magnitude is acceptably low and in terms of assessment of the effects on overall environmental performance of the project, is insignificant, because:

- A rigorous approach has been taken to impact identification, taking into account the likelihood of occurrence and other characteristics of a very wide range of potential impacts, based on experience of broadly similar projects elsewhere in the region and in other parts of the world, as well as on information regarding previous road improvement projects in the Bahamas, derived from field observations and consultation with a number of bodies with environmental interests.
- A rigorous approach has been adopted in relation to adverse impact minimisation and avoidance and to beneficial impact enhancement, such that effective control of impacts will be possible, regardless of the effect which present uncertainties regarding the precise location, nature and scope of the works may have on the predicted nature and extent of impacts.

5.5 Overall Project Environmental Performance

The preferred JFK Drive corridor has been developed, as far as is possible, to minimise conflict with human settlement and environmentally sensitive areas. By staying south of the existing JFK Drive for the majority of the alignment, the new alignment will avoid directly impacting Lake Cunningham for most of its length and make use of the BEC wayleave whilst placing the utilities within the new RoW.

The project area is limited in the extent of development that has occurred along its length. This is likely mainly due to the difficulties of constructing on the nearby terrain which is either low lying near wetlands or on steep slopes. Development of the area has started however and there are a number of residential properties that have been completed and others that have commenced along the north side of JFK Drive east of Blake Road and along the south side of JFK Drive where it runs along Lake Cunningham on the north side.

It can never be considered desirable to clear natural vegetation for man made construction, the route corridor will impact Lake Cunningham and wetlands which are areas of particular ecological value and could potentially threaten to the area's biodiversity.

Constructing the road to highway to freeway standard with limited interchanges will serve to limit post construction environmental degradation.

Although a large number of other potentially adverse impacts have been identified, particularly in relation to the construction phase, all can be mitigated satisfactorily through adoption of the specified mitigation measures, and residual impacts can be reduced to acceptable levels, provided that the measures are fully adopted and/or enforced.

The beneficial impacts associated with the project are largely related to road safety and two-way accessibility benefits associated with vehicle operating cost and time travel savings.

It is considered that the long-term benefits of project implementation outweigh the largely short-term adverse impacts, mostly associated with construction, all of which can in any case be mitigated satisfactorily.

There are, however, two areas of major concern:

- It should be re-iterated that it will be vital that there is effective, two way consultation and liaison with local populations and stakeholders who are likely to be impacted, directly and indirectly by the project, especially in relation to land acquisition.

- Effective cross Ministry co-ordination will be vital if the true economic benefits of the project are to be obtained without long term environmental loss. This largely pertains to careful planned development and the enforcement of planning policy and guidelines.

If these two issues can be dealt with satisfactorily, from an environmental impact viewpoint, there are no grounds for concluding that the project, as currently envisaged, should not go ahead.

5.8 Economic Assessment

No economic appraisal or modelling has been provided. In order to obtain an approximate indicator of whether the project is economically feasible. A consumer surplus technique has been used whereby the benefits to road users of the improvements in terms of reduced vehicle operation travel time cost are compared with the construction and maintenance costs to determine whether the project is feasible.

The area on JFK Drive between Gladstone Road and Tonique Williams Darling Highway has been considered only as this location is known to get congested on a regular basis. The traffic flows during am and pm peak hour periods only have been considered. Based on all motorists journey's taking an additional 20 minutes during the peak hours only a total of 584,000 hours per year is wasted in congested traffic. Based on the average per capita income of \$21,000 or \$10 per hour this equates to \$5,840,000. On average vehicles in New Providence consume 0.75 gallons of petrol per hour in congested traffic. The total petrol consumption equates to 1684 gallons. Based on an average cost of \$4.20 per gallon this totals \$1,839,000 per year. Total wasted opportunity time costs and running costs therefore equate to approximately \$7,680,000 per year.

Based on the construction cost estimate and land acquisition estimate the project will cost in the order of \$68,500,000. Therefore based on the cost of congestion at JFK Drive between Gladstone Road and the TWD Highway only at the present time the project costs would be recouped in less than 9 years. Congestions costs will be recouped far sooner than this however due to the fact that traffic congestion would be worsen over time and would also be relieved on other roads (most notably West Bay Street and Carmichael Road). Also, traffic congestion is moderate in magnitude compared with other transportation costs, in particular traffic accidents which has not been considered above.

Traffic accident data has been requested from the Road Traffic Department however this was not available at the time of writing this assessment. This assessment will be revised to include reference to traffic accidents once this information is received. It is understood that there have been many traffic accidents along JFK Drive.

Traffic accidents cost drivers in medical care and productivity losses a significant amount. It is believed that the proposed road works will reduce the number of accidents significantly however this can be better determined from examination of traffic accident data.

The project is therefore considered to be economically feasible. It is considered likely that once traffic accidents are assessed this will be better identified.

5.9 Analysis of Alternatives

It is very important to evaluate different alternatives to arrive at the best possible option. Different alternatives that were evaluated are briefed as follow:

5.9.1 The 'Do Nothing' Alternative

From an environmental viewpoint, the "do-nothing" alternative has some merit in that the adverse impacts associated with construction and subsequent operation would not occur. However, from social, socio-economic and economic viewpoints, the benefits of project implementation would be foregone.

According to the Traffic Projection Survey the total average daily traffic (ADT) on the proposed JFK Drive is likely to increase at a rate of 3% on average per year to 2040. This rate is higher in the earlier years (close to 4%) and lower in later years (closer to 2%). It is estimated that in 2012, there will be approximately 12,905 vehicles per day travelling on JFK Drive with 27,329 in 2040. It is also estimated that there will be a significant reduction of traffic on West Bay Street and Carmichael Road – South West Bay Road as a result of the proposed JFK Drive. The average daily flows on West Bay Street and Carmichael Road – South West Bay Road are expected to reduce by 9,473 and 5,282 vehicles respectively for 2012

Without the proposed Project the existing West Bay Street and Carmichael Road – South West Bay Roads will continue to be the main transportation corridors in the area. Traffic volumes on these existing roads are anticipated to increase with the passage of time, as indicated from the traffic projections.

Traffic congestion is expected to increase in the future although at a lower rate than it has done in the past and road conditions are expected to deteriorate due to ever increasing traffic volume.

Therefore the “No Project” conditions will result in further worsening of the present environmental conditions and increased disturbance to residents of the area and the road users. Socio-economic conditions will also deteriorate due to lack of a proper link between the Airport and other areas on the island. The main effect of the “no build” alternative for JFK Drive would therefore result in longer travelling times and accidents due to the poor alignment and shorter width of the existing road.

Taken overall, the long-term beneficial impacts of the project far outweigh the mostly short-term adverse impacts associated with the construction phase, all of which can be reduced to an acceptable level through adoption/enforcement of the specified mitigation measures. It is therefore concluded that the “do-nothing” option is inappropriate.

5.9.2 Alternate Transport Modes

The alternate transport modes include air travel and other access roads. Air access is not feasible for such a small island (maximum 21 miles in length) and would require access to the airport which JFK Drive is a main contributor. Other access roads cannot be considered as an alternate keeping in view that the AGP ties into a major national roads project which is partially complete and has been determined the best solution for the island and given the traffic flows in the feasibility study, traffic pattern and connectivity with surrounding areas. Railway would be another alternative option although no railway is operational in the country and the costs of providing such infrastructure and maintaining it would far outweigh that of the proposed road. Also, the use of such a facility would require a change in a culture which has been heavily vehicle reliant for many years.

5.9.3 Improvement of the existing Carriageway

In terms of the movement of people and goods, road transportation facilitates the majority of travellers in the Project Area. Further improvement of the road system will enhance economic development by providing a reliable corridor for the movement of goods and passengers to and from the airport and other parts of the island. For this and other reasons, the implementation of the Project is the only viable solution for reducing traffic congestion and providing a safe and good quality route for movement of people and goods.

The basic requirements of the project are to provide a four lane carriageway to current standards at the required design speed and accommodate the necessary utilities and drainage by acquiring the least amount of land and with the least detrimental environmental impact (in particular on the Lakes and wetlands). With consideration given to these factors the major determining factors for the horizontal alignment for the road once the design speed of 55 mph was determined was how best to align the road and utilities with consideration given to land acquisition and whether to place some or all utilities

underground.

Different options for different portions of the proposed route were examined as discussed below:

The different portions of the route that were examined were as follows;

1. Section from start point to airport police station (CH00+00~CH 13+45, a total length of 1345ft)
2. Section from Airport Station to GLADSTONE RD (CH13+45~CH242+21, a total length of 22876ft)
3. Section from GLADSTONE RD to TWD HWY (CH242+21~CH272+89, a total length of 3068ft)
4. Section from TWD HWY to MOWT (CH272+89~CH305+10, a total length of 3221ft)
5. Section from MOWT to design end (CH305+10~CH326+20, a total length of 2110ft)

1. Section from start point to airport police station (CH00+00~CH 13+45, a total length of 1345ft)

This section is not long however 3 roundabout intersections will be required to best serve the airport and the Coral Harbour Road (a main north south corridor at the airport). The north side of JFK highway is private land which would require acquisition whilst the southern side is easier to acquire hence the program is to widen the south side of the existing road with a 20ft median.

2. Section from Airport Station to Gladstone Road (CH13+45~CH242+21, a total length of 22876ft)

Different options were examined as follows:

- A. burying the high-voltage (HV) cable,
- B. relocating the HV cable outside the right of road
- C. relocating the HV cable within the median



■ Option A (relocate the high-voltage cables outside the road with 20ft median)

This option was to remove the 132KV and 11KV high-voltage transmission cables away from the highway land, build a 20ft median beside the existing road and construct a new two lanes to the south of the existing road and accommodate the main water pipes and communication pipes etc. in the median. The main advantages of this option include less site area required and an enhanced road appearance without the major cost of placing the high voltage cables underground.

■ Option B (bury the high-voltage cables within the 30ft median)

Based on collected data, combined with the site exploration and taking the technical requirements of the relevant specialties it was determined that the expansion works would be best carried out on the south side of the existing JFK Drive (with a minor portion of the works on the northern side). A 30ft

median will be required to accommodate the high-voltage power line, main water pipes and any additional pipelines that need to be buried. A protective form of encasement shall be utilized where necessary to protect against water as a result of the proximity to wetlands and lakes. Studies have considered footpaths and platforms along the Lake and keeping the road a minimum of 30 feet from the lake however this has not been found to be feasible due to the high cost of obtaining land to do so (note allowance would also be necessary for access and parking)..

The main advantages of this option are improved safety as a result of a wider median, an improved highway landscape appearance and a reduction in the susceptibility of the high voltage cables to hurricanes; the disadvantage is the relatively higher proposed cost.

■ Option C (the electrical poles to remain as existing within the 46~56ft median)

This option is to build a new half road to the south of the existing JFK Drive and have all the electrical poles remain at their existing positions. The width of the median will need to be adjusted according to the positions of the 132KV high-voltage transmission electrical poles. According to the field measurement data, the median width must be at least over 45ft and the maximum width shall be up to 65ft. The main advantage of this option is that the existing high-voltage cables do not need to be removed. The disadvantages to this scheme are:

- a) More land encroachment
- b) Additional demolition
- c) Pole locations are close to the road creating a safety hazard
- d) Diminished beautification of the highway.

The most feasible option was selected by considering the following factors:

- Potential environmental and social impacts;
- Capital and recurrent cost;
- Environmental mitigation costs and benefits.
- Improvement to beautification along route
- Disturbance to traffic during construction

Option B was selected by considering the above mentioned factors and the road will now be constructed first on one side and then on the other side.

3. Section from Gladstone Road to TWD Hwy (CH242+21~CH272+89, a total length of 3068ft)

In this section, the roadside churches, cemeteries and other buildings, as well as the planned extension of Gladstone Road were considered. The horizontal radius of the JFK Drive in the existing section near the cemetery is 500ft, which does not meet the technical requirements of a major road with a design speed of 55MPH, thus the curve will be increased to a 1700ft radius. The location of the roundabout is such so as not to impact on the cemetery and to cause least impact on Lake Cunningham. Reclamation on Lake Cunningham is necessary in order not to impact onto the church and cemetery. This alignment does however introduce a design element that is not considered safe which is that of insufficient flare at the roundabout for vehicles travelling along JFK Drive in a westerly direction as they are not forced to slow down sufficiently on entry and exit to the roundabout. Further consideration is necessary for the deflection of traffic travelling this route (the majority of traffic).

A separate slip road will be provided on the south side of JFK to accommodate the two roads that converge west of the Lutheran church including Theodora Lane (CH 260+00). Alternatives to this arrangement would include a T junction at JFK Drive however this location is known for traffic accidents and the option suggested provides a far safer solution. Nearby roundabouts in both directions provide all around turning.



During the construction process, a phasing plan will need to be implemented to mitigate disruption to the traffic flow and residents. There are no further alternatives for this section due to the high number of constraints.

4. Section from TWD HWY to MOWT (CH 272+89~CH 305+10, a total length of 3221ft)

The main factors affecting the options in this area are the used lands and buildings along the road. The south side of the existing road is where the majority of the private land lies. The Prospect Road left turn lane will be realigned to merge onto JFK Drive where it will be important to ensure sight distances are maintained. The median is reduced to 20ft in width in this section and one roundabout will be created to facilitate the travel of residents on Christie Avenue and potentially the proposed hospital to the north. The existing road is in cut on the south side and fill on the north side at this location. The proposed alignment would require further cutting in this area in the order of 3 to 4 feet. Accounting for this and the proposed shoulders and swales this alignment would require land acquisition of a portion of 9 properties and the demolition of some of the ten buildings. A slight re-adjustment of the proposed alignment to the north to acquire more of the old Prospect well fields could remove the need to acquire the properties on the south side. The houses in this area are generally raised on top of the cut limestone, by further cutting in this area to provide the roundabout traffic noise pollution and aesthetics will be less of an impact on these properties.

A roundabout at the MOW building will serve traffic accessing the MOW as well as the Bahamas Tourism Centre which is currently under construction. The proposed alignment indicates the roundabout and the access to the parking on the south side of the MOW being too close. There ought to be an alternative arrangement for access to the parking area or a re-alignment of the roundabout in order for the roundabout to function well. The access to the Bahamas Tourism Centre is approximately 550 feet from the existing junction and 350 feet from the proposed roundabout which is adequate.



5. Section from MOWT to design end (CH305+10~CH326+20, a total length of 2110ft)

There are many commercial properties along the southern side of the existing road with numerous accesses onto JFK Drive. In order to accommodate the four lanes without directly impacting these properties the proposed road will not have a median and the expansion will extend to the north. In expanding to the north land will need to be acquired from the MOW and BTC. The main impact of this will be on the access to the MOW and the parking at BTC. The parking area at BTC is in cut, approximately 3 feet below grade supported by a low level concrete wall. The construction of the proposed widening will result in the direct loss of approximately 42 parking spaces at BTC. Alternatively the portions of the properties on the south side of the road would need to be acquired.

The proposed alignment would require the accesses to the southern commercial properties directly onto JFK Drive to be maintained. This is a total of seven entry and exit points directly onto the 55 mph road. Whilst some of these are close to the approach to the roundabout where traffic ought to be slowing in order to negotiate the roundabout vehicles generally do not slow down gradually on the approach to roundabouts in Nassau. This can be observed at many of the roundabouts in Nassau, in particular those along the Tonique Williams Darling Highway, especially when there is little or no queuing at the roundabout.

Whilst the spacing of the junctions at this location is such that there is only a short distance between junctions (approximately 1,300 feet if the Bethel Avenue junction is to be maintained, otherwise 1,970 feet to the new 6 legged roundabout) and therefore vehicles are less likely to be able to travel at high speeds however one of the objectives of the project is to provide a safe road with a design speed of 55 mph.

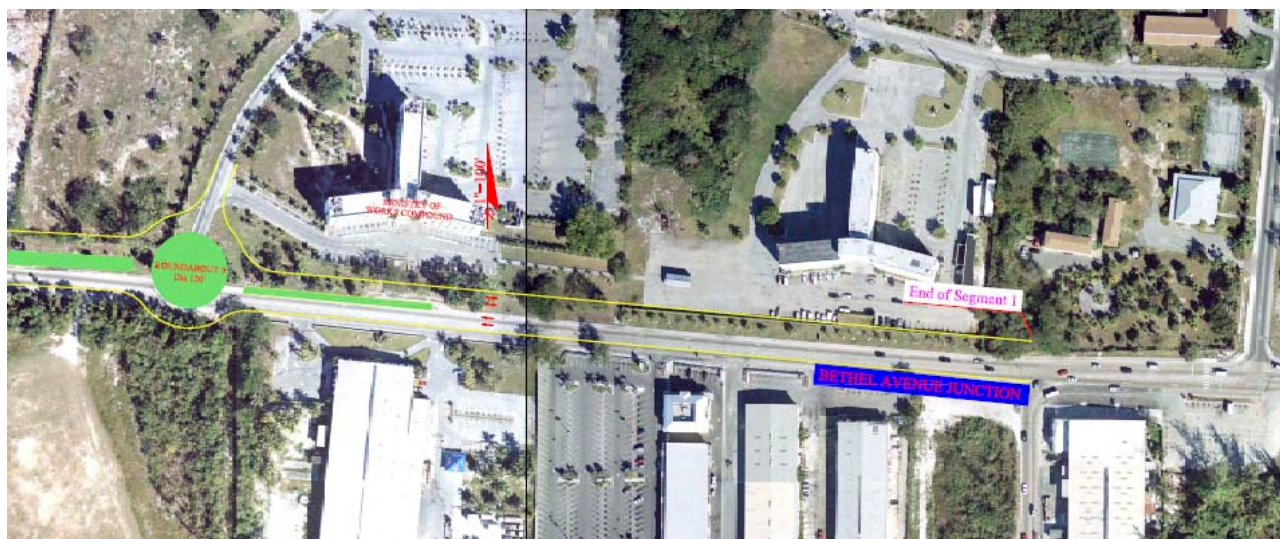
Also, the present arrangement at this location provides a central lane for vehicles to utilise in order to make turning movements to access the commercial properties on the south side of JFK Drive at this location whilst allowing traffic to continue in the main lanes without being delayed. It is proposed to provide a 10 foot wide median for a distance of 300 feet east of the MOW building roundabout otherwise no median is proposed for this area. The proposed median restricts movement from one of the exits across the road and this traffic must enter the roundabout to go in an easterly direction. For all of the remaining entry and exit points in the area there are no physical restraints to vehicles making turning movements from these access points across the two lanes of west bound traffic to enter the east bound traffic. This arrangement would also necessitate traffic stopping in the southern most east bound lane until they are able to cross the west bound traffic to enter properties. This arrangement is considered unsafe and a service road with physical restrictions to restrict movements across lanes is considered necessary for these properties.

A service road with physical restrictions to restrict movements across lanes could be accommodated by

re-aligning the road further north thereby utilising more of the BTC parking area and encroaching further onto the MOWT property or by removing the footpath along the proposed road on the south side and providing a pedestrian crossing point so that pedestrians utilise the north side of the road . Furthermore there is a need to provide a bus stop lay-by on both sides of the road in this location, in front of the Ministry of Works being the most appropriate location in terms of use of the bus stop.

A 140 foot long bus stop lay-by is currently provided on the north side of JFK Drive. There is no lay-by on the south side however buses stop in the existing traffic lane and delay traffic. The same is such for the bus stops on both the north and south sides at Christie Avenue. Additional space will be required to accommodate bus lay-bys at these locations. The parking area should be redesigned to make best use of the remaining space and additional spaces introduced and disabled spaces provided near the entrance.

Further consideration to the layout of the parking area at BTC and further detailed design will confirm the actual number of parking spaces that would be lost near the front entrance to the BTC building.



5.9.4 Other Alternatives

The project was envisaged as a mechanism for stimulating a more equitable pattern of economic and social development in the Bahamas, as well as improving road transport conditions within the project area. A number of principal alternatives have been briefly considered including upgrading West Bay Street and Carmichael Road – South West Bay Street.

5.9.4.1 West Bay Street

Portions of West Bay Street are already 4 lanes, upgrading this corridor would therefore require introducing four lanes for the remainder of the route. Whilst this corridor does run along the coast in sections and is therefore a more aesthetically pleasing route it is very limited in available space and the area is well developed and properties are at a premium. The cost of upgrading this corridor is therefore considered unfeasible.

It is possible that the Cable Beach portion of West Bay Street will be re-aligned with the introduction of a new resort, namely Baha Mar for which detailed plans have been produced. This project has been on hold since 2008 however due to a number of issues with the project, most notably a lack of funding for the project. It is understood that the project is awaiting approvals from the Government and a bridging loan from Scotiabank and hopes to start construction before the end of 2010.

The project would involve the re-alignment of approximately one mile of the existing 4 lane West Bay Street to the south with the introduction of 5 roundabouts as well as the extension of Gladstone Road north of JFK Drive. The project could reduce the cost of upgrading the corridor however it is considered unlikely to have a significant reduction in the cost of the upgrade due to this portion already being dualled.

It is also considered far more beneficial to remove traffic from this corridor to maintain the attractiveness of this route.

5.9.4.2 Carmichael Road – South West Bay Street

The existing Carmichael Road is a two lane road. The upgrading of this route as an alternative to the upgrading of JFK Drive is not considered feasible due to the inherent difficulties of beautifying this route to anything like that of the JFK Drive route. Also, this route would only serve to provide a very indirect route to downtown Nassau and would not meet the criteria of the project.

5.9.4.3 Alternative intersection layout

Roundabouts have been shown to be the preferred intersection layout where capacity will be adequate for the following reasons;

- Lower costs
- High capacity
- Low delay
- Fewer crashes
- High approval

However pedestrian movements are generally not very safe at roundabouts. Also, in installing medians in the proposed road it is important to provide all turning intersections for overall safety.

6.0 ENVIRONMENTAL MANAGEMENT AND MONITORING

6.1 General Considerations

This section of the EIA is based on a clear recognition of the primary objective of environmental management, which is efficient implementation of the measures necessary to avoid, minimise or offset adverse impacts and to promote beneficial impacts, so that the overall environmental performance of the project is enhanced.

Effective environmental management can only be achieved if it is carried out within a formalised framework which is based on a few fundamental general principles. These are:

- Environmental management should be fully integrated within, and co-ordinated with, the overall project management framework, which is itself directed towards achieving a properly designed and constructed project which meets its intended purpose, functions efficiently throughout its life, and results in minimal adverse environmental impact: that is to say, an environmentally sustainable project.
- Environmental management should not be considered as a matter which is separate from, and on top of, other activities relating to preparation, implementation and subsequent operation of the project, and which involves one or more additional layers of management.
- Individual management/monitoring responsibilities and functions need to be clearly defined, so as to ensure that there are no gaps which might prejudice environmental performance of the project.
- Procedures relating to environmental management should be set up in a way which causes minimum disruption to and is fully integrated with, other aspects of project management. In this respect, maximum use should be made of the usual management structure, reporting systems and meetings.
- Environmental management is not just the preserve of environmental specialists. Successful environmental management requires a strong commitment at all levels of project management and in all bodies concerned if it is to achieve worthwhile results. Effective and timely liaison between the various bodies concerned is also vital.
- Environmental monitoring is a basic tool to provide information for decision-making by project management. It should be organised in a manner which facilitates the early recognition of potential problems, so that appropriate remedial action can be initiated before matters have reached a stage where serious environmental damage, danger or inconvenience has been caused.

The environmental management and monitoring plan described in the sub-sections which follow, fully adopts these principles, and addresses all the relevant issues.

6.2 Organisational Aspects

Project environmental management and monitoring usually involves a number of bodies, both private and public, each with its own organisational structure, role and responsibilities and this project is no exception. These bodies need to work co-operatively, within a co-ordinated framework, if efficient and effective environmental management is to be achieved.

The general roles and broad responsibilities of the principal bodies concerned with various elements of both project and environmental management, are set out in Sections 6.2.1 to 6.2.3, in order to provide context for the overall management structure presented in Section 6.2.5. More detailed treatment of specific roles and responsibilities of individual organisations during the pre-construction (preparation), construction and operational phases of the project is presented in Sections 6.3, 6.4 and 6.5 respectively.

6.2.1 Government Organisations

6.2.1.1 Ministry of Works and Transport

The Ministry of Works and Transport (MOWT) is the project implementing agency, acting on behalf of the Government of the Bahamas in relation to the Airport Gateway Project, of which this project is an integral component. As such, MOWT has overall responsibility, at national level, for ensuring that all aspects of the project, including environmental aspects, are properly managed and implemented. During the construction phase, MOWT will be “The Employer” as defined in the construction contracts.

Within MOWT, the Civil Design Department is expected to be delegated overall responsibility for managing, overseeing and co-ordinating project preparation and subsequent implementation. This includes ensuring that environmental aspects are given due consideration in the preparation of project designs and contract documents, as well as during construction. During the construction phase, the MOWT will be the “Employer’s Representative” as defined in the construction contracts.

During the construction phase, the Project Manager of the Civil Design Department team will be the “Engineer” in terms of the construction contract and his team will take responsibility for day-to-day aspects of construction supervision and contract administration. These responsibilities will also include some, but not all, aspects of environmental management and monitoring.

The Road Maintenance Branch within the MOWT will be responsible for road maintenance matters during the operational phase, and as such will have responsibility for ensuring the continued sustainability of the project, through organising and overseeing the proper planning and implementation of maintenance.

6.2.1.2 Ministry of the Environment

The Ministry of the Environment (MOE) has a wide-ranging remit in relation to environmental aspects of the project. During the project preparation phase it is responsible for ensuring that all government agency environmental requirements are met and also for advising the MOW on environmental matters in general. During the construction phase the BEST Commission will be responsible for carrying out routine environmental check monitoring.

The Ministry of the Environment (MOE) may also carry out monitoring and investigation of matters arising from complaints by the public, in connection with implementation of the project. However the scope of the MOE remit in this respect is limited to matters which fall specifically within its jurisdiction.

6.2.2 Design and Construction Supervision Consultants

Blue Engineering Ltd. has been appointed by the MOWT to carry out this EIA as well as the EIAs for Segments Two and Three of the Airport Gateway Project. No other consultants are proposed for the Project.

6.2.3 Contractor

It is understood that China State Construction Engineering Corporation Ltd. (CSCEC) will be engaged to perform the Design-Build Service for the Airport Gateway project. The Contractor is responsible for carrying out studies and investigations related to preparation of detailed designs and contract documents for the project. During project preparation, their role and responsibilities related to environmental management are concerned with the incorporation of appropriate environmental elements in designs and contract documents.

During the construction phase, the overall responsibility for environmental matters will lie with the Contractor. A Contractor's Environmental Specialist will be responsible for overseeing environmental activities and performance on site. The Contractor shall provide the personnel for the role of Contractor's Environmental Specialist. The Contractor's Representative will also be responsible for overseeing environmental performance, and each site manager will have environmental responsibilities. Periodic auditing of the Environmental Management Plan shall be the responsibility of the Employer's Representative.

The Contractor's Environmental Specialist's roles is defined as two parts. One is to give overall advice and define the general procedures, which will include environmental reports. Secondly the Contractor's Environmental Specialist will be involved in the establishment of the day-to-day monitoring procedures. The Contractor's Environmental Specialist will be responsible for identifying and developing the following:

- the environmental management framework
- reporting and liaison requirements
- key environmental issues
- monitoring strategy
- data management
- environmental control procedures. Environmental audit of the project will be required which will include:
- identification of any deficiencies in environmental performance and advise on measures to address these.
- Assess the degree of compliance with the plan achieved on site.
- Review the continuing relevance of the plan in the light of experience and instigate changes where appropriate.
- Review the organisational and administrative frameworks for environmental management and the inputs of the environmental monitoring team.
- Review environmental monitoring data and its management.
- Review environmental problems which have arisen and how these have been dealt with.
- Propose changes to the environmental management procedures and framework and identify the need for additional measures to control environmental degradation.

The Environmental Specialist will also be required to:

- Provide advice on environmental issues to the site engineers.
- To establish an effective monitoring programme.
- To establish routine management, liaison and reporting systems, with close reference to the existing environmental database and background documents.
- To interpret initially the results of the monitoring programme and advise the responsible supervisor of action required.
- To train and support the members of the Contractor's staff, in particular during the initial period and during the occasional visits to site.

6.2.4 Others

Although the proposed route corridor for segment one of the project does not directly affect any buildings of historical merit or national interest, the Antiquities, Monuments and Museums Corporation (AMMC) is to be informed of project progress and performance.

6.2.5 Environmental Management Structure

The basic overall project management structure is shown in Figure 6.1, which also indicates the principal environmental management linkages between the several organisations concerned with various aspects of project preparation and implementation.

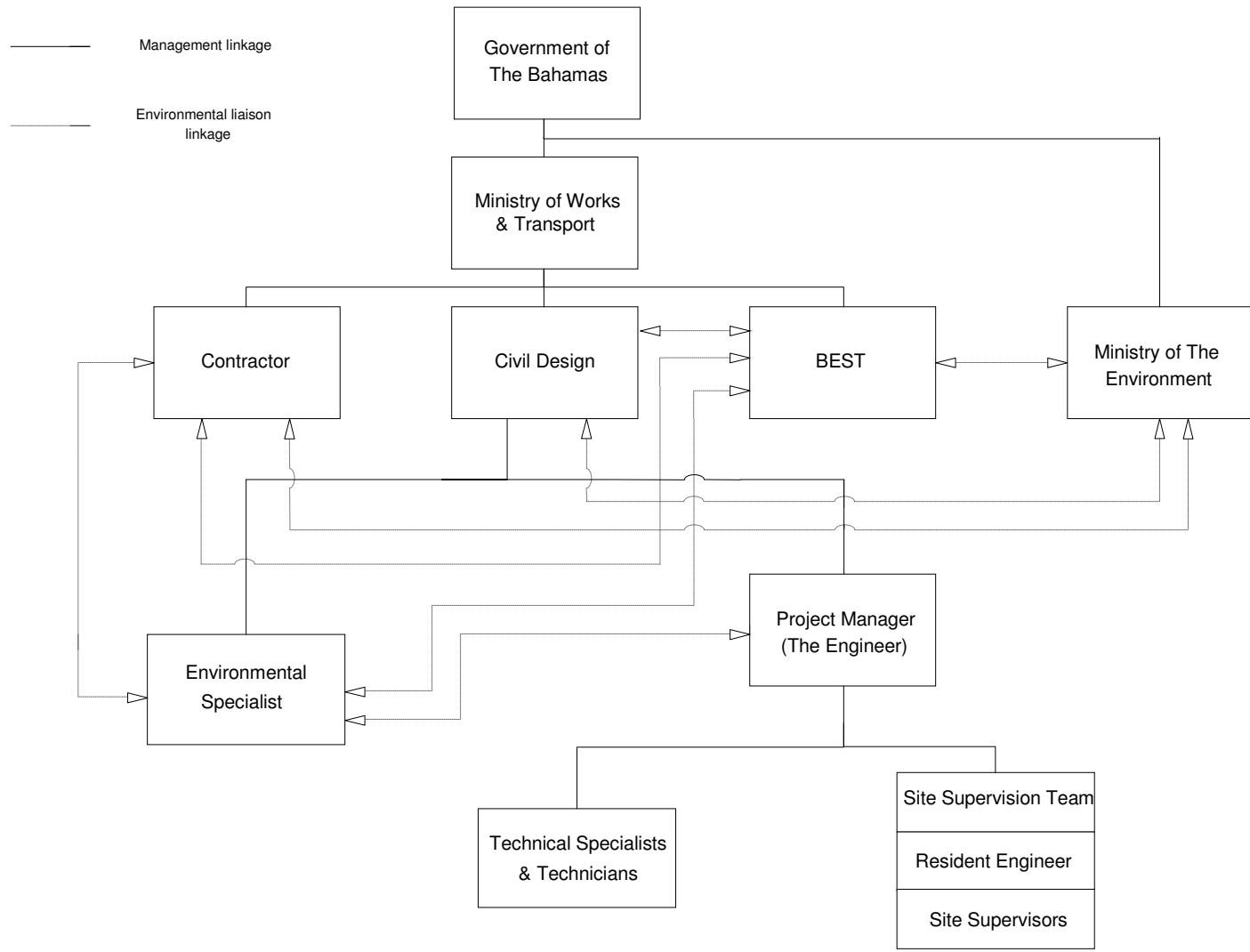


Figure 6.1 Project and Environmental Management Structure

6.3 Pre-construction Phase Activities and Responsibilities

For the purposes of environmental management, the pre-construction phase is considered to extend from the initial stages of project preparation to completion of final designs and contract documents. Environmental management activities during this phase comprise ensuring that:

- all government environmental criteria and procedures relating to environmental matters have been (or will be) complied with, prior to commencement of construction
- detailed designs incorporate (as appropriate) specific features aimed at minimising adverse impacts and enhancing beneficial impacts
- contract documents contain appropriate clauses to allow effective and efficient control of environmental impacts arising from construction activities

6.3.1 Government Environmental Requirements

The approval of this documents establishes many of the environmental requirements for the project. Other requirements will include;

- Compliance with government environmental legislation and nature conservation requirements
- Approval of final engineering designs to incorporate mitigation measures to prevent, correct and compensate for negative environmental effects
- Construction contract documents to incorporate general and particular environmental specifications.

This study has shown that, whilst potentially significant adverse impacts might indeed be anticipated, mainly during the construction phase, these can all be controlled to acceptable levels through the adoption of specified mitigation measures, provided that appropriate environmental management, monitoring and enforcement procedures are adopted. The capacity for effective environmental management, monitoring and enforcement within the various bodies concerned is adequate, provided that the training measures which are described below are implemented. There are therefore reasonable grounds for concluding that the project is environmentally feasible.

6.3.2 EIA and Detailed Design

Preparation of the EIA is the responsibility of the consultant (Blue Engineering Ltd.) appointed by the MOWT. Preparation of the detailed designs and contract documents is the responsibility of the Contractor.

The consultants' Project Manager has overall responsibility for preparation of the formal EIA in accordance with BEST requirements. However, it is the Employer's representative and the Engineer's responsibility to decide which of the recommendations are accepted and are actually incorporated in the designs and contract documents, having taken all relevant considerations into account.

The contractors' Project Manager has overall responsibility for day-to-day management, quality control and direction of all activities of his team during detailed design and contract document preparation. In addition, the contractors' Environmental Specialist has day-to-day responsibility for making recommendations for appropriate environmental considerations to be fully reflected in project designs and contract documents. However, it is the Employer's representative and the Engineer's responsibility to decide which of the recommendations are accepted and are actually incorporated in the designs and contract documents, having taken all relevant considerations into account.

General oversight, management and monitoring, and subsequent approval of these aspects of project preparation are the responsibility of the MOWT, who will be assisted in relation to environmental matters by the BEST Commission. The BEST Commission will have specific responsibility for reviewing and commenting on the EIA, as well as environmental aspects of designs and contract documents, and reporting on these matters to the MOWT.

6.3.2.1 *Designs*

Studies carried out by the Environmental Specialist in connection with preparation of the EIA, and a review of the design team's proposals and preliminary designs, have indicated the need for incorporation of minor additional design features, and specifically related to mitigating adverse environmental impacts, beyond those which are normally included in designs for projects of this type.

Provision will be made for the incorporation in the permanent works of the new dual carriageway of such features as adequate cross and lateral-drainage works, the grassing of earthworks slopes to minimise erosion and sediment deposition in watercourses, road safety features including signage, a median strip to separate the carriageways, inner and outer shoulders and sensitive junction layouts. Landscaping/highway beautification measures will form an integral part of the designs. Pedestrian access arrangements will also form part of the design process.

6.3.2.2 *Contract documents*

General and particular conditions of contract and the specifications which have been prepared for recent major road projects will probably form the basis for equivalent documentation for the present project works. These documents should contain a number of clauses specifically aimed at promoting environmental protection during construction, and/or improving specifications for various environmental aspects of the works, so as to enhance overall environmental performance of the project. Many of these had their origins in general specification clauses prepared for IDB funded projects (for example, those concerning quarries/borrow pits and construction noise).

Additional clauses should be incorporated to cover aspects which had previously not been considered and to reflect the requirements of this EIA.

6.3.3 Stakeholder Consultation

In the early stages of final design preparation, an extensive consultation exercise will be undertaken by the MOWT and the consultant and contractor, with the inclusion of all stakeholders. It is recommended that this is undertaken in conjunction with representatives of government bodies which will be involved in the land acquisition and compensation determination processes.

A series of public meetings should be held at strategic locations. These should be open to all and allow for meaningful discussion and comment. These meetings should be advertised on local radio and advertisements published in local newspapers at least 7 days in advance.

A further series of small workshops should be held at locations to be determined to allow project-affected people to articulate their concerns and hopes.

The outputs of these meetings should be discussed by the design team, the MOWT and the consultant and contractor. Designs and alignment should be amended as appropriate and information used to develop a fair and equitable compensation package for project affected persons.

Details of these discussions should be fed back via the MOWT to project affected people.

6.3.4 Land and Property Acquisition Aspects

The Minister responsible for the Acquisition and Disposition of Lands will be responsible for managing the acquisition of land required to accommodate the works. Land and property valuation in connection with compensation assessment will be the responsibility of the Ministry of Works.

6.4 Construction Phase Activities and Responsibilities

From the point of view of environmental management and monitoring, the construction phase is considered to extend from the signing of the contract to completion of the construction works, but excluding activities during the contractor's maintenance period.

Environmental management during the construction phase will cover three principal aspects:

- Final review of environmental aspects of designs and contract documents to ensure that they form a sound and comprehensive basis for addressing construction and operational environmental impacts.
- Ensuring that the appointed contractors are properly briefed in relation to the importance of environmental protection during construction.
- Managing environmental aspects of construction implementation in such a way that adverse impacts associated with the construction process are satisfactorily mitigated and reduced to an acceptable level.

High level project management during construction, including general oversight and direction, will be the responsibility of the MOWT. This body will be responsible for certain aspects of the construction contract process, and will act as Employer's Representative during construction. Advice and assistance in relation to environmental management will be provided by the Ministry of the Environment and the BEST Commission.

Overall primary responsibility for day-to-day construction supervision and contract management, and therefore for environmental management during construction, will lie with the Civil Design Department of the MOWT.

The MOWT Project Manager will be designated as the Engineer in terms of the construction contracts, and will have a team of support staff working under his direction and overall supervision. The MOWT team will include a Resident Engineer (RE), together with Site Supervisors, Technical Specialists and Technical Assistants. The RE will form the most senior level of construction supervision staff based in the field. The RE will be assigned one or more Site Supervisors, who will have responsibility for day-to-day site supervision at the lowest level, and will inspect and report to the RE on the works being carried out under the construction contracts.

Environmental management and monitoring support to the MOWT should be provided by a Bahamian Environmental Specialist.

6.4.1 Environmental Review of Project Designs and Documentation

An Environmental Review should be carried out by the Environmental consultant and/or the BEST Commission. It should form one of the earliest environmental management/monitoring tasks to be undertaken during the construction phase. The objective of the review would be to make a final check, prior to commencement of construction, that all relevant environmental matters have been adequately addressed in

the project designs and contract documents, taking into account any changes in project scope and form which have taken place since the EIA was prepared.

The review should also include a check to verify that all conditions attached to the EIA and EMP which should be completed prior to the start of construction, have in fact been complied with.

6.4.2 Environmental Briefing of Contractors

At the pre-construction meeting, time should be assigned to briefing on environmental matters and dealing with any questions that may arise. It is recommended that matters to be covered in the briefing should include the following:

- The background and context of the approach to environmental management which will be taken during the construction phase, drawing attention to the following points:
- MOWT is an organisation of a Government whose publicly stated policies include commitment to environmentally sustainable development and protection of the environment.
- The construction contracts contain a number of clauses whose intention is to control adverse impacts, in line with meeting the environmental policies of the Government.
- Contract clauses relating to environmental matters have equal standing in contract law with those relating to engineering matters and the contracts will be administered accordingly.
- Construction supervision will include monitoring of, and reporting on, environmental aspects, on a daily basis.
- Environmentally-friendly construction involves little more than the adoption of good construction practices
- A summary of key adverse impacts and the contractual obligations which will be imposed on contractors in order to minimise occurrence and severity of construction impacts.
- An outline of what will be required in the selected contractor's method statements and plans, submitted for the approval of the Engineer
- A reminder that opening of new quarries and borrow pits and establishment of new hot-mix plants has to be done in accordance with current environmental legislation. Compliance with the official procedures involved is likely to take several months, and any resulting delay to the works will not be entertained as a valid claim.

6.4.3 Environmental Monitoring and Reporting

Environmental monitoring is an essential tool in relation to environmental management as it provides the basis for rational management decisions regarding impact control. The monitoring programme for the present project will be undertaken to meet the following objectives:

- To check on whether mitigation and benefit enhancement measures have actually been adopted, and are proving effective in practice
- To provide a means whereby any unforeseen impacts can be identified, and to provide a basis for formulating appropriate additional impact control measures if these appear to be necessary

There are two basic forms of environmental monitoring:

- Compliance monitoring, which checks whether prescribed actions have been carried out, usually by means of inspection and/or enquiries
- Effects monitoring, which records the consequences of activities on one or more environmental components, and usually involves physical measurement of selected parameters or the execution of surveys, to establish the nature and extent of induced changes

Compliance monitoring is usually given more emphasis in the case of road construction projects than is effects monitoring. This is because the majority of impact controls take the form of environmental protection clauses incorporated in contract documents, and the extent to which these are complied with by contractor's plays a major part in determining the overall environmental performance of the project. Also, there is often a need for rapid response to construction impacts, and effects monitoring is more relevant to evaluating long-term and/or cumulative impacts, which are not anticipated in connection with the present project

The main objectives of the pre-construction and construction phase monitoring plans will be to:

- Monitor the actual impact of the works on physical, biological and socio- economic receptors within the Project corridor for indicating the adequacy of the EIA;
- Recommend mitigation measures for any unexpected impact or where the impact level exceeds that anticipated in the EIA;
- Ensure compliance with legal and community obligations including safety on construction sites;
- Monitor the rehabilitation of borrow areas and the restoration of construction campsites as described in the EMP; and
- Ensure the safe disposal of excess construction materials.

The main objectives of monitoring during the operation phase will be to:

- Appraise the adequacy of the EIA with respect to the Project's predicted long-term impact on the corridor's physical, biological and socio-economic environment;
- Evaluate the effectiveness of the mitigation measures proposed in the EMP and recommend improvements, if and when necessary;
- Compile periodic accident data to support analyses that will help minimise future risks; and
- Monitor the survival rate of plantations.

Project monitoring and field inspections will be required to ensure compliance with contractual agreements dealing with the environmental construction practices specified, and to assess the overall performance and effectiveness of the required environmental construction mitigation practices in the field. The general contents of a project monitoring and field inspection report designed to assess the performance of certain construction practices shall include the following:

- A definition of the objectives of a monitoring and inspection program.
- A clear indication of the predicted key impacts that are to be monitored during, and immediately following construction.
- An outline of the information required to assess the effectiveness of the mitigating environmental construction measures selected. This could include the frequency and timing of surveys for various environmental parameters, location of monitoring sites, methods of data collection, analysis and evaluation.
- The date of completion of the documentation.
- Summary of major findings.
- Where works are likely to have significant environmental effects, the identification of methods of minimising impacts and implementing monitoring procedures.

Monitoring of direct impacts will be carried out by the Employer's Representative and assistant environmental monitor. Monitoring shall include, but not be restricted to, the following concerns:

- Erosion along highway segments and borrow sites during and after construction.
- Silting and increased sediment loads to water bodies in the vicinity of the roads.
- Installation of erosion control and drainage works (including silt traps).
- Extraction and restoration works at borrow areas.
- Prevention of damage to undiscovered significant archaeological and historical findings.
- Verification that proper waste disposal at construction sites is done.
- Assurance that construction sites are cleaned up after construction.
- General contract compliance and environmental impacts inspections.
- Inspection of vegetation cover (removal and regrowth) on the basis of field examination.

The procedures for collecting and analysing data for the above shall be the responsibility of the Contractor in consultation with The Bahamas Environment, Science and Technology Commission or the Bahamas National Trust.

An Environmental Management Plan shall be prepared by the successful contractor. Section 9 details the requirements on the contractor.

6.4.4.1 Day-to-day Monitoring and Reporting

Day-to-day environmental monitoring will be carried out by the Site Supervisors, working under the supervision and immediate direction of the RE. The work of the Site Supervisors and the RE will comprise systematic observation of all site activities, as a check that the contract requirements relating to environmental matters are being complied with, and that no unforeseen impacts are occurring. The RE's inspections will also cover wider environmental matters not directly concerned with actual construction such as contractors' base-camps, off-site temporary storage and temporary work areas.

Monitoring will take the form of visual observations, carried out concurrently with the engineering monitoring activities. No instrumental monitoring will be carried out, since this is not appropriate in the context of controlling the range of potentially adverse impacts which may be anticipated during construction.

Site inspections will take place with the emphasis on early identification of any environmental problems and the initiation of suitable remedial action through instructions to the contractors issued according to standard procedures. Where remedial actions have been required on the part of the contractors, further checks will need to be made to ensure that these are actually being implemented to the agreed schedule and in the required form. As experience of the principal problem areas is gained, attention will be concentrated on locations and activities which are known to be the most troublesome, with a lower frequency of inspections at problem-free locations.

Site Supervisors will report to the RE on a daily basis, using conventional report forms whose coverage should be extended to include key environmental matters, in addition to the normal engineering observations. The Environmental monitoring forms to be used on this project are included in Appendix F. Assistance to the Engineer in developing the environmental component of these forms should be provided by the Environmental consultant.

The RE will decide on the appropriate course of action to be taken in cases where unsatisfactory reports are received from Site Supervisors regarding environmental matters. In the case of relatively minor matters, verbal advice to the contractor on the need for remedial action may suffice but, in all serious cases, the RE should recommend an appropriate course of action to the Engineer. The Engineer should have delegated powers and authority to order a stop to any aspect of the works in the event of an emergency situation

developing, and should use this power in relation to events where serious environmental damage or public nuisance/safety hazard is either imminent or has already been caused.

Weekly reports prepared by the RE for the Engineer will contain a brief section referring to environmental matters, which summarises the results of his and his Site Supervisors' daily site monitoring, remedial actions which have been initiated, and whether or not the resultant action is having the desired result. The reports will also identify any unforeseen environmental problems and will recommend suitable additional actions.

6.4.4.2 Routine Check Monitoring and Reporting

Routine check monitoring, in the form of inspections covering all sites, will be carried out at least once a week by an Environmental Consultant.

It is recommended that routine check monitoring:

- should include informal interviews with those who live along the roads in the vicinity of the works, and also with road users, as a means of establishing public perspectives relating to the effectiveness of impact controls.
- should be carried out on an unannounced basis at irregular times on different days of the week, so as to avoid the obvious problems associated with regular inspections.

There should be no delays in transmission of findings from check monitoring to the Engineer so that they are not unaware of the up-to-date situation. In cases where the Engineer needs to initiate immediate remedial actions, he may receive the relevant information too late to be able to prevent environmental damage occurring. Consequently, it is recommended that check monitoring reports should be submitted directly to the Engineer in a timely fashion. The Engineer should also copy weekly and monthly check monitoring reports to his team members for information and action as appropriate.

6.4.4 Monthly Progress Meetings

As a means of reinforcing commitment to environmental management, as well as a means of drawing the contractor's attention to, and assisting in the resolution of, outstanding environmental issues, it is recommended that the monthly progress meetings should include an agenda item which specifically covers environmental matters.

6.4.5 Review and Updating of Procedures etc

It is recommended that a review meeting should be held around 12 weeks from the commencement of site supervision activities, to identify any problems which are being experienced by those involved in environmental management and monitoring, and to initiate remedial actions.

In this respect, particular attention should be paid to reviewing:

- Whether the contractor is materially failing to honour his contractual obligations in respect of environmental protection, the reasons underlying non-compliance, and what further action needs to be taken to enforce compliance.
- Whether the monitoring and reporting procedures being adopted are proving to be easily applicable in practice and are effective, given the particular circumstances of the project, and what changes are necessary to improve them.
- Whether there are any gaps in procedures which need to be filled, and how best they should be filled.

- Whether monitoring reporting systems are functioning efficiently in terms of stimulating action at an appropriate management level to control impacts with the minimum delay between recognition of the need for action and that action being implemented.
- Whether adequate resources are available for effective environmental management and monitoring, and what steps should be taken to improve the situation, if this is required.
- Whether reporting is adequate in terms of both coverage and reliability, or is too detailed, or is not providing the type of information which is needed for management purposes, or is provided too late to be of use in early impact control, and how deficiencies are to be addressed.

6.5 Operational Phase Activities and Responsibilities

From an environmental management and monitoring viewpoint, the operational phase of the project commences at the point where construction works have been completed and both the newly-constructed and rehabilitated sections are open to traffic.

Continued enjoyment of the benefits arising from implementation of the project will only be achieved if effective routine and periodic pavement, earthworks, utilities and drainage system maintenance is carried out.

During the maintenance period following completion of the construction works, the contractor will be obliged, under the terms of the construction contract, to carry out maintenance of the completed construction works as and when necessary. Responsibility for overall management of this aspect, and therefore for any environmental management, will lie with the Ministry of Works. The focus of post-construction monitoring during this period should be on early recognition of potential problems such as incipient erosion and instability of earthworks slopes, failure of protective vegetative cover, and poor growth of trees and shrubs planted in connection with highway beautification.

6.6 Environmental Management Plan

This report provide guidance to the Contractor in preparing the Environmental Management Plan (EMP) for Segment One of the Airport Gateway Project (i.e. JFK Drive between the Airport and Bethel Avenue). The measures are intended to provide the environmental information necessary to ensure that adverse environmental impacts are discovered in time to prevent or repair any adverse effects.

The EMP is presented in Appendix C in outline form. It should be detailed and completed when the project action plan has been determined. The purpose of the EMP is to monitor or control the environmental effects of road widening process. It should be based on compliance, verification, feedback, and know-how. It is therefore suggested that the Contractor carries out the EMP.

6.6.1 Objectives

The broad purpose of the EMP is to ensure that the various protection measures identified in the EIA are incorporated and followed in the design and construction phases. The contractor will be expected to draw up a specific EMP following these guidelines.

Specific objectives of the EMP are:

- define the organisation and administration arrangements for environmental monitoring including definition of responsibilities of staff and the co-ordination, liaison and reporting procedure
- review the environmental assessment report, construction drawings, contract specification and other documents, in close liaison with the Designer and the Employer's Representative and elaborate on probable working practice with the site supervision staff, in order to anticipate those issues which are

- likely to require close environmental monitoring during construction, and identify ways of achieving this
- define requirements and procedures for environmental monitoring including equipment needs, frequency of monitoring, parameters to be monitored, analytical service requirements, data management and presentation etc.
- discuss procedures for pro-active environmental management with the site supervision staff, so that potential problems can be identified, and mitigation measures adopted prior to works being carried out
- define procedures for environmental control, in the event of pollution, fire or similar incidents

6.6.2 Initiation Procedure

An initial EMP meeting must be conducted to establish the management set up and to develop methods of identifying environmental impacts to ensure they are minimised as far as possible. Methods of minimising the use of resources and incorporation of recycling procedures must be established.

A general programme for environmental management in relation to the construction programme will need to be drawn up by the Contractor's Environmental Specialist once the Contractor has agreed his programme of work. This is anticipated to be the end of the year 2010. The first few months are critical, as it is in this period that the principles and systems for environmental management will be established. It is also a time when plans will be prepared and will need to be vetted in terms of pollution and erosion control, groundwater and water body protection.

6.6.3 Scope

This plan is intended to provide general information on the requirements of an EMP, and provide a set of guidelines which the contractor must follow. The plan is not intended to address occupational health and safety of construction workers (although some mention is made), which will be dealt with under the provisions of the contract.

6.6.4 Environmental Management Framework

The overall policy in respect of environmental monitoring and standards of the road improvements lies with the Ministry of Works and Transport. The environmental consultant's role is to monitor and supervise the activities of the contractor, and, where necessary take action under the terms of the contract to prevent and minimise environmental damage.

The EMP is to be developed by the contractor and approved and overseen by the Employer's Representative. The EMP must include the following documents and information:

- The contractor's environmental policy.
- Codes of good practice.
- Monitoring requirements.
- Mitigation and pollution prevention strategies.
- Details of the contractor's organisational framework, particularly designation of senior managers to take overall responsibility. The engineers to manage the project on a day to day basis, and liaise with the Employers Representative.
- Details of principal pollution control facilities, proposed contingency plans in event of failure of the facilities.
- Details of proposed environmental management procedures to ensure that facilities are operating satisfactorily and that operations are not causing undue stress.
- Details of environmental awareness training programmes proposed for the contractor's workforce.

- Requirement that all method statements include a section of environmental impacts and mitigation.
- Details concerning work camps, borrow pits, fill requirements including the overall analysis of cut and fill quantities.
- Details of the records to be kept to demonstrate compliance with the EMP.
- A formalised mechanism to audit the effectiveness of the Plan.

The Plan shall address the following issues inter alia:

- Noise and Vibration
- Water Pollution
- Waste Management
- Impacts on flora/fauna
- Visual Impact
- Air pollution, including odour, dust and fumes
- Storage and handling of hazardous materials
- Good housekeeping/vermin control
- Contaminated land
- Sites of Special Scientific Interest and other environmentally sensitive areas
- Archaeology and heritage issues
- Impacts on the Local Community

6.6.5 Checklist of Environmental Stipulations

At all times Contractors shall be required to conform with the following particular stipulations in implementing construction works:

1. Prior to the commencement of construction activities the Contractor is to inform local communities of the implementation schedule for contracted works and local requests incorporated as reasonable, where at no extra cost, subject to approval by the Engineer.
2. There shall be clear demarcation of the extent of Contractor's work site(s) including areas for material storage working yard and plant storage which shall be a way from locations close to the sensitive water bodies.
3. A detailed plan shall be submitted by the Contractor, detailing proposed construction routes, access routes and fuelling areas.
4. The method of construction shall minimise the length of shoreline site works opened up at any one time as much as is considered feasible to minimise any avoidable impacts on water quality.
5. Fuel storage sites shall be bunded by a small berm to confine and mitigate the effects of spillage. The capacity of the confined area to be 110% of volume of fuel stored and protected from rainwater.
6. The location of site compounds and stockpiles shall be exactly defined and assessed by the Government before being approved.
7. The EMP is to identify emergency response plan elements that will be implemented in the event of a failure of process or environmental control systems for the project, including a Spill Prevention, Control and Countermeasure Plan and a Stormwater Pollution Prevention Plan.

8. There will be no disposal of non-biodegradable materials on site without the express permission of the Engineer or local authorities. Oil collection traps will be in use in workshop areas.
9. Used oils shall be containerised and transported to an approved local agent for safe disposal or transported with other scrap equipment to an approved facility elsewhere.
10. No disposal of material in environmentally sensitive areas, e.g. mangroves, marshes, protected vegetation, and the aquatic environment.
11. Natural vegetation removal must be kept to a minimum along the corridor. Groundcover is to be restored by the contractor as soon as the earthworks permit.
12. Retention of maximum habitat area during construction and immediate re-vegetation.
13. Noise minimisation techniques should be applied in sensitive areas.
14. Transplantation of individuals to suitable alternative locations where possible in cases where habitats are to be lost. e.g. at the lake or specific wetland areas.
15. Siltation or pollution of water bodies during construction must be prevented.
16. The dredging of wetlands and coral reefs solely for source materials shall be prohibited in the contract. There shall be no removal of sand or dredged material without an official mining permit and written approval of the Engineer
17. Measures shall be taken to minimise the production of dust and noise through good practice techniques and ensuring equipment is functioning correctly and is performing within the permitted noise levels for the device. Preference shall be given to machinery producing the least noise for the activity. Discharge of dust and fumes shall be minimised and there will be no burning of toxic substances.
18. Construction sites in close proximity to residents shall be carefully monitored to minimise impacts from noise and dust. All equipment shall be equipped with effective muffling devices. Noise attenuation devices, such as barriers may be required around stationary sources of loud noise. Residents and business owners shall be notified of construction activities, hours of operation description of services and potential noise levels prior to initiation of construction. Working should be restricted on Sundays and will be subject to the approval of the Employer's Representative in consultation with The Government of The Bahamas.
19. All feasible measures to keep noise levels to a minimum should be adopted by the Contractor. Noise abatement on construction sites shall minimise avoidable inconvenience to local populations. Blasting is not to be permitted without obtaining approval from the BEST Commission.
20. Disruption as a result of vibration caused by heavy plant machinery can be minimised by restriction on working hours and choice of machinery.
21. Communications with nearby residents and businesses is important. Communications protocol including receiving and resolving complaints needs to be established in the contract.
22. Local communities will be forewarned of any unavoidable temporary restriction to traffic access. The Contractor will make arrangements for plant wheel washing to ensure that mud is not deposited onto

public highways. Dump trucks shall be equipped with tarpaulins or similar devices to prevent material spillage and roads will be kept clean of mud and construction debris.

23. A traffic assessment will be required to assess traffic using the construction route and to incorporate procedures to minimise journey times and reduce congestion as a result of construction activities. Construction traffic during peak traffic hours is to be minimised
24. Traffic management (i.e. signing etc.) should be designed per UK standards and should be submitted to the Engineer for approval.
25. The Engineer will be alerted to the possibility of construction traffic causing pavement and structure damage due to overloading, increase in congestion and any road safety hazards. Care shall be taken to minimise damage to pavement being saved. The Contractor will be responsible for any damages caused to the roadway by poorly maintained or overloaded equipment. Use of tracked equipment will be limited to areas adjacent to sheet piling construction
26. No direct drainage to wetlands is permitted, hydrocarbons and sediment must be prevented from entering the wetlands.
27. Bare embankments shall be planted with stabilising vegetation which is easily available and quickly establishes creating a vegetative ground cover which will minimise soil erosion and silt runoff. Replanting as soon as possible after construction of individual sections is complete should be included in the contract to minimise risks of erosion and silt run off as well as for aesthetic purposes. Provision shall be made to intercept and divert site drainage, at short distance intervals, into natural channels, infiltration ditches, settling ponds, or areas of suitable and stable ground cover.
28. The Contractor should explore opportunities for recycling inert material removed from the existing roads. All waste material which cannot be recycled should be stored in a safe manner and disposed of at the government owned landfill off Harrold Road. Illegal dumping should be carefully monitored to ensure that sensitive habitats are not being indirectly impacted.
29. Cleared vegetation shall be chipped and disposed of to the government landfill site. It may also be stacked along the right of way for wildlife habitat enhancement. Body wood should be cut in appropriate lengths and stacked along the right of way.
30. The Contractor will be required to make suitable arrangements for his own supply of water and, as necessary, to provide an alternative supply to any users affected by his water abstraction. The location of wells dug for water supply will conform to local permitting arrangements and in no circumstances shall he allow his abstraction requirements to affect the quality of freshwater lenses on the island or have any other deleterious effect on natural resources.
31. All incineration is banned along the road, temporary storage of vegetation shall be in open areas, an emergency fire-fighting plan shall be drawn up. Fire extinguishers must be available on site.
32. Detailed contract specification and drawings for any works that directly impact lakes or wetlands and sensitive area should be included as part of the general specifications and drawings.
33. The time from excavation to restoration should be kept to a minimum. Maximum construction times for all elements of the works within the lakes and wetlands should be detailed in the contractor's schedule and procedures.

34. The locations at which vehicles and heavy equipment may cross the area adjacent to Lake Cunningham should be identified in the specifications. At no time should the Lake area be used as a vehicle or equipment store.
35. The removal of vegetation from the right-of-way should be kept to a minimum width for construction.
36. Aquatic weeds uprooted or cut prior to, or during construction operations, should be contained and adequately disposed of on land.
37. Construction workers to be prohibited from fishing in the Lakes and wetlands.
38. Disruption to utilities to be minimised.
39. The Contractor to coordinate with the Antiquities, Monuments and Museums Corporation (AMMC) on historical resources.
40. To prepare for, and respond to, the emergencies and disasters that could potentially affect the proposed project, the Contractor is to prepare appropriate emergency response plans and policies.
41. The Contractor shall, as required, arrange for safe road use while adjacent construction activities (e.g. stockpiling) are in progress and impeding the highway. Construction zone signage shall be in place for each works operation. Hazardous areas such as excavations will be delineated with construction cones (with lighting where instructed by the Engineer. This shall include but not be limited to the following: *temporary works; pre-stressing/post-tensioning works; pile driving; batching plants/crushers; working near water; working at height; working in confined spaces; interaction with the general public, especially road users and adjacent property owners/occupiers and traffic management.*
42. The Contractor shall be required to appoint a designated Site Safety Officer with an acting safety officer always appointed in his absence. There shall be a fully equipped First Aid Box at all work sites at all times and a list of emergency telephone numbers in case of accident. Minor and major accidents shall be recorded in an accident log book. Personal protective equipment (PPE) shall be worn in areas designated for their use.
43. The Contractor's Safety Officer will inspect sites for compliance with approved working methods and these contractual requirements under the oversight of the Engineer. Government of Bahamas labour laws and occupational health and safety policies shall be applied at all times.
44. Upon completion of implementation of project works, the Contractor shall restore all work sites, borrow sites (and any other land occupied or used by the Contractor during the course of the project) to the approval of the E.R. The Contractor shall remove all construction equipment and scrap waste from his sites on completion.
45. The Contractor shall co-operate, as required, with local government administrations and the MOWT, and staff of the Bahamas Environment Science and Technology Commission (BEST). It is the responsibility of the Contractor to ensure compliance at all times with existing and new government regulations, including all statutory licensing and permitting requirements.

6.7 Contractor Facilities, Plant and Operations

Any facilities installed by the Contractor for the purpose of conducting construction works should meet appropriate standards of responsible environmental management and safety practice. Contractors will be required to present general Method Statements to show how they will implement construction plans to achieve:

- 1) legally approved and environmentally acceptable extraction of materials from borrow pits with proper restoration.
- 2) minimal clearance of natural vegetation and interference with natural drainage flows, avoidance of any significant degradation of freshwater lenses.
- 3) environmentally sensitive location of temporary construction yard sites and space for plant and materials storage.
- 4) safe location and protection of fuel facilities, safe storage of hydrocarbons and other chemicals, re-use/disposal of used oil at approved sites, including a Fire Plan.
- 5) adequate facilities for collection and treatment of wastewater (as required), storage and legally disposal of general construction waste, solid waste, chemicals etc.
- 6) appropriately restored and unencumbered work sites, yards, camps and other facilities at project completion.

6.8 Environmental Management and Monitoring Costs

All general costs associated with environmental management and monitoring will be an integral part of specific items which have already been, or will be, incorporated in overall project budgets, and no separate budget items are likely to be necessary to cover these aspects.

- The incorporation of environmental mitigation measures in project designs and contract documents will not result in any incremental costs, since this is an integral part of the normal design and contract document preparation process, to internationally-accepted standards
- Environmental management and monitoring carried out by the construction supervision consultant's staff will be an integral part of general supervision duties and will be covered by the construction supervision budget
- The costs of environmental monitoring carried out by the BEST Commission staff will be covered by existing government allocations for the operation of the organisation

Marginal costs of the Contractor incurred in complying with environmental protection clauses in the construction contract will be incorporated in unit rates and bill items, and will thus be included in the contract price. It should be noted that no significant increase in construction costs is expected in connection with requiring compliance with environmental protection clauses, since these merely require the contractor to behave in a responsible manner in relation to the environment, in accordance with modern, good, international construction practice.

The major mitigation costs that will be incurred will result from the following;

Description	Estimated cost (B\$)
1. Recreational facilities at Lake Cunningham (including safe access road, parking, footpaths, viewing platform, shaded area, toilet etc.)	200,000
2. Utilise retaining walls for a total length of 1,500 feet at 4 locations in order to restrict the extent of sensitive water bodies affected by the project and reduce the quantity of fill material required for earthworks for the project (including safety barriers) rather than earthworks (i.e. difference)	500,000
3. Provision of a reserved wildlife zone or 'greenspace'.	700,000
4. Provision of additional parking spaces at Bahamas Telecommunications Corporation Headquarters to account for any lost parking spaces and placing of disabled parking spaces near the front of the building.	100,000
5. Re-planting of trees and other vegetative matter.	
TOTAL	1,500,000

The costs indicated above provide a very rough estimate of possible costs and will depend on the details thereof therefore they should be treated in very general terms only. It should be noted that compensation packages to the affectees for land acquisition is not considered above as this is a requirement of the project. No value is given to the re-planting of trees and other vegetative matter above as the re-planting of protected trees is a requirement of the project and the re-planting of others is considered a saving to clearing and landscaping costs.

7.0 CONCLUSIONS

This section presents conclusions of the entire EIA Report. The Present Project has been conceived to provide fast and safe access to the traffic using JFK Drive that extends from the International Airport and Windsor Field Road through to Bethel Avenue. The conclusions are based on the findings of detailed environmental assessment. Traffic accident data has been requested of the Royal Bahamas Police Road Traffic Department but is still to be provided. This assessment will be revised on receipt of this data.

7.1 Feasibility/ Practical Utility of the Project

In order to check the feasibility of the Project, a feasibility study was carried out by China Construction America Inc.. After carrying out the study, it was felt that this Project will prove to be very beneficial in overcoming the problems being faced due to the single (non-standard) two lane carriageway.

7.2 Various Options considered for the Project

Various options have been considered for this Project that include “No project”, “Alternate transport modes” and “Improvement of the existing carriageway”. These have been discussed in detail in Section 5 of this Report. The last option has been selected because it fulfils the Project requirements in the best way.

Numerous alternatives were discussed for the improvement of the existing carriageway. These included the following;

- Re-locating the high voltage overhead lines elsewhere
- Allowing the high voltage overhead lines to remain in their current location and constructing two new lanes on the south side of these necessitating a very large median
- Placing all utilities underground and re-aligning the road to use land mainly on the south side with minimal impact on Lake Cunningham.

The third option was selected after discussing the associated benefits however maintaining a 30 foot buffer to the lake was found to be unfeasible due to the high cost of the land that would need to be acquired.

After the completion of this Project, a four lane dual carriageway will be available for the traffic moving between the Airport and Windsor Field Road and Bethel Avenue, which will increase safety and comfort of the travellers on JFK Drive as well as West Bay Street and Carmichael Road in particular and also reduce the travelling time.

7.3 Availability of Resources and Materials

Availability of resources and materials for the execution of present Project has been discussed in Section 3 of this assessment. All the resources are available in the vicinity of the Project Area, except reinforcement, asphalt and cement that will be purchased from the United States. Some items will be purchased from China in order to save approximately \$9 million.

7.4 Identification of the Main Issues and Concerns

During the field surveys, significant efforts were made to identify the main social, cultural and environmental issues related to the execution of this Project. Government departments and agencies were also contacted for obtaining salient information. Following is the list of main issues and concerns:

- Land acquisition of that land which falls within the design Right of Way (RoW) including impact on costs, management, noise, and impact on schedule;
- Impact on the ecology and recreational activities of the Lakes and wetlands, in particular Lake Cunningham
- Cutting of a large number of trees falling within the proposed corridor;
- Requirement for a large quantity of material for earthworks construction purposes.
- Due to the change in the hydrologic regime, flood water can cause damage to the local community and road;
- Disturbance to public movement during construction;
- Reduction in business activities during construction;
- Safety issues as a result of the proposed road layout between the MOWT building and Bethel Avenue.
- Noise and air pollution due to the operating of construction machinery during the construction phase and traffic during the operation phase of the Project;
- Solid waste generation during construction; and
- Oil spillages from construction machinery, resulting in soil and groundwater contamination.

7.5 Mitigation Measures proposed

In order to overcome the social, cultural and environmental issues discussed above, the following mitigation measures have been proposed (details available in earlier sections):

- Re-examination of the proposed road alignment to better balance cut and fill quantities.
- Removal of vegetation from the right of way should be kept to a minimum width for construction.
- Established trees that are within the corridor and have to be cut down should be compensated by planting new trees in a ratio 2:1 to the cut trees as close to the location of removal as is feasible.
- Monitoring of the woodland on either side of the road to prevent dumping.
- Pre-stressing of the vegetation in the area should occur to minimise the impact to wildlife and ensure that there is no illegal dumping.
- Retention of existing vegetation and planting near buildings is required to screen residents in particular from visual and noise impacts from the road.
- A walkover of the site is required to identify any protected tree species which will require a permit for removal under the Conservation and Protection of the Physical Landscape of the Bahamas Act 1997. Opportunities for protected tree transplantation should be fully investigated.
- Wetland management/habitat creation east of Lake Cunningham is required to mitigate loss of habitat. The potential for purchase of at least two acres of land in the vicinity of the lake should be investigated to mitigate for forest loss and an additional area at the east of Lake Cunningham for wetland loss. Creation of ponds and active management will also be necessary.
- Re-examine the road alignment at Christie Avenue to remove the need to acquire land and demolish houses at this location.
- All the affectees should be compensated for their properties falling in the ROW, through judicious compensation packages. For this purpose all such land and structures must be measured and evaluated for their costs estimation.
- A recreational area to be provided beside the Lake. This should include safe access and egress arrangements, a car parking area that restricts access to the lake area by car, a viewing platform, a shaded area, compost toilet facilities, footpaths and information boards.
- Re-design the layout of the Bahamas Telecommunications Corporation parking area, provide additional parking spaces to account for any lost parking spaces and place disabled parking spaces near the front of the building.
- Provision of a service road along the south side of JFK Drive between the MOWT building and Bethel Avenue.

- Provision of bus lay-bys at all existing bus stops and special allowance made for future bus lay-by installations at all remaining intersections.
- In order to minimise the disturbance to the public during construction, the road should be constructed in two parts (it should be widened on one side at a time). Informatory signs and warning boards should be displayed. Pedestrian Crossings should be provided at appropriate places which will help people safely cross the road even after the construction.
- Air and dust pollution can be controlled by equipping asphalt, hot mix and batching plants with fabric filters or wet scrubbers to reduce the level of dust emissions. Haul trucks carrying asphalt concrete mix and/ or aggregate fill materials should be kept covered with tarpaulin to help contain construction material being transported between sites.
- Noise pollution due to working machinery and equipment must be taken seriously. All the workers must be provided with suitable hearing protection like ear cap, ear muffs etc. Machines and equipment noise should be controlled by providing appropriate muffing devices to the construction workers. Construction to be carried out between the hours of 7am and 6pm with consideration given to limiting works near the churches during their hours of services.
- Solid waste generated during construction and in camp sites should be properly treated and safely disposed of in demarcated waste disposal sites. Aggregate waste material of existing road can be reused in up-gradation of road. Sanitary wastes generating from staff and labour camps must be disposed of in an environmentally friendly manner.
- No direct drainage should enter Lake Cunningham, Lake Killarney or wetlands, measures to prevent hydrocarbons and sediment entering these wetlands must be incorporated. The drainage of the wetlands east of the proposed Gladstone Road extension should remain independent of Lake Cunningham, however, an overflow culvert from the wetland is required to ensure that overflow from the seasonal wetland should still be able to enter Lake Cunningham.
- Detailed contract specification and drawings for each significant water body and sensitive area should be included in the general specifications and drawings.
- Time for excavation to restoration of the mangrove swamp should be kept to a minimum. Maximum construction times for all elements of the works within lakes and wetlands should be detailed in the contractor's schedule.
- Locations at which vehicles and heavy equipment may cross the area adjacent to Lake Cunningham should be identified in the contract documents. At no time should the lake be used as a vehicle or equipment store.
- Aquatic weeds uprooted or cut prior to construction operations should be contained and adequately disposed of on land.
- Siltation of the water bodies along the route of the corridor must be prevented. Care must be taken to ensure sediments in the remaining lake and wetland areas are not disturbed.
- The feasibility of installing catchpit/pipe systems underneath the road shall be investigated. No direct drainage to the lakes or wetlands is permitted, and hydrocarbons and sediment must be prevented from entering these water bodies.
- Construction workers are to be prohibited from fishing in any of the nearby water bodies.
- There are many Bahamians that are capable of carrying out work on this project. Foreign personnel working on the project are to be limited to approximately 200 persons, within specialized areas (burying of high voltage cables and supervision).

Table 7.1 summarises the overall findings and recommendations of the present EIA Study in matrix form.

Table 7.1 Findings and Recommendations of the EIA Study

No.	Main Findings	Recommendations
1	Project will cause resettlement of houses and electric poles etc. that fall within the design Right of Way (ROW)	Re-examination of alignment to reduce required land acquisition. Judicious compensation packages should be given to the affectees for their properties. Electricity lines should be accommodated underground to remove safety hazard and poor aesthetics associated with the overhead poles.
2	A large number of trees will have to be removed for widening the existing Road.	Protect trees as much as possible. Re-locate trees as much as feasible and plant new protected trees in a ratio 2:1 to the cut protected trees. Plant in a ratio of 2:1 established trees to be cut. Provide a reserved wildlife zone or 'greenspace'.
3	Due to the change in hydrologic regime, floods can damage road and local community.	Proper designing of drainage with consideration given to future development of the area and provision of adequate ponds can control flood damages.
4	A large recreational area will be lost beside the Lake	Create a new recreational area with safe access road, parking, footpaths, viewing platform, shaded area, toilet etc.
5	A portion of Lake Cunningham and the wetlands associated with lake Killarney will be lost to the new road area.	Utilise retaining walls in order to restrict the extent of sensitive water bodies affected by the project. Re-plant mangroves at a ratio of 2:1. Provide new drainage area within the Project area.
6	Parking area will be lost at the Bahamas Telecommunication Corporation (BTC) office headquarters	Re-design the layout of the parking area, provide additional parking spaces to account for any lost parking spaces and place disabled parking spaces near the front of the building.
7	Use of large quantities of fill material.	Re-examine the alignment to better balance cut and fill quantities. Utilise retaining walls in order to reduce the amount of fill material required for the project
8	Access and egress arrangements to commercial properties along JFK Drive between the MOWT building and Bethel Avenue will be altered to introduce an unsafe arrangement.	Provide a segregated service lane for these accesses and/or reduce the speed limit at this location.

9	The widened road will be more difficult for pedestrians to cross the road as they currently do.	Provide bus lay-bys at all bus stops with pedestrian crossings near all bus stops and intersections.
10	During the construction phase, public movement will be disturbed.	Construction of road will be done in two parts (it should be widened on one side at a time). Information signs and warning boards should be displayed. Pedestrian crossings and U turns should be provided at appropriate places.
12	Project activities (operating of construction machinery during construction phase of the Project) will increase noise and air pollution of the Project Area.	<ul style="list-style-type: none"> • Air and dust pollution can be controlled by equipping asphalt, hot mix and batching plants with fabric filters or wet scrubbers to reduce the level of dust emissions. Haul trucks carrying asphalt concrete mix and/ or aggregate fill materials should be kept covered with tarpaulin to help contain construction material being transported between sites. • For minimising the effects of heavy noise emissions from working machinery and equipment, all the workers must be provided with suitable hearing protection like ear cap, ear muffs etc. Machines and equipment noise should be controlled by providing appropriate muffling devices. Also, provide vegetative buffer zones and dense vegetation in the median where noise may be a problem. Also noise barriers where necessary.

7.6 Benefits of the Project

After the execution of the Project, people living in the Project Area and the travellers of JFK Drive and nearby roads as well as West Bay Street and Carmichael Road will benefit by the following:

- Overall safety of passengers will be increased.
- Less time and money will be required for travelling and reaching the destination.
- Improved driver comfort
- During the construction phase, local labour will be accommodated in the construction activities.

7.7 Environmental Management Plan (EMP)

This assessment provides guidelines for the Environmental Management Plan (EMP) which is to be produced in full by the Contractor. Section 6 of this assessment provides further details thereof. The EMP will facilitate in taking mitigation measures for potential environmental impacts of the Project. It will also enable the MOWT to enhance the Project's overall benefits and introduce standards of good environmental practices. Roles and responsibilities of functionaries have also been defined in the EMP for effective management of the Project components. An EMP Outline is provided in Appendix C.

8.0 RECOMMENDATIONS

It is recommended that the widening of JFK Drive between the Lynden Pindling International Airport and Bethel Avenue incorporating the mitigation measures detailed in this report be carried out.

In order for the project to progress and achieve the proposed schedule of start of construction 5th December, the following is recommended to be conducted by the MOWT promptly;

1. Obtain traffic accident data from the Royal Bahamas Police Force Road Traffic Department and revise this assessment to reflect the findings therein.
2. Carry out public consultations
3. Determine location for the proposed recreational facilities and wildlife zone or 'greenspace', Contractors base camp and borrow pit.
4. Obtain cadastral survey
5. Co-ordinate with all relevant utility companies to determine the best solution details in respect of utility re-location, upgrade etc.
6. Engage Design-builder in detailed design including but not limited to detailed alignment (including re-examination as described in this assessment), extent of works, drainage design (including calculations), landscaping drawings, embankment and pond treatments, proposed recreational facilities and wildlife zone or 'greenspace' and traffic management.
7. Review detailed design for approval.
8. Walk the route to identify protected trees, to apply for permits for their removal, and to optimise opportunities for use of individual trees for transplantation along the road or at other projects (i.e. at the new National Stadium and along NPRIP Corridors). This would not only increase the number of native species along the road corridor but would also decrease the volume of material going to landfill and increase recycling.
9. Engage in land acquisition procedures and compensation
10. Engage Design-builder in production of construction documents which address all issues contained in this assessment.
11. Engage the Contractor and an Environmental Specialist

9.0 REFERENCES

BEST Commission (2002) *Bahamas Environmental Handbook*. The Bahamas Environment, Science and Technology Commission, Bahamas.

BEST Commission (2003) *National Invasive Species Strategy*. The Bahamas Environment, Science and Technology Commission, Bahamas.

BEST Commission (2007) *The layman's guide to wetlands in the Bahamas*. The Bahamas Environment, Science and Technology Commission, Bahamas.

Campbell, D. G. (1978). *The Ephemeral Islands: A natural history of the Bahamas*. Macmillan education LTD., London and Basingstoke.

Correll, D. S. and H. B. Correll. 1982. *The Flora of the Bahama Archipelago*. A.R. Gantner Verlag KG., FL-9490 Vaduz.

Cutts, W. (2004) *Trees of the Bahamas and Florida*. Macmillan Publishers Limited. Oxford, UK.

Freid, E. H., L.R. Richey, T. Ferguson, and E. Carey. 2003. A proposed new system for the division of islands within the Bahamian Archipelago *Bahamas Journal of Science*. 11 (1) : 36-38.

Government of the Bahamas (1985) *Atlas of the Commonwealth of the Bahamas*. Kingston Publishers LTD, Jamaica.

IUCN (2010). <http://www.iucnredlist.org/> [accessed: 7/09/2010].

Kass, L. B. (2005) *An illustrated guide to: Common plants of San Salvador Island, Bahamas*. 2nd edition. Gerace Research center, San Salvador Island, Bahamas.

Nations Encyclopedia (2010) <http://www.nationsencyclopedia.com/Americas/TheBahamasINCOME.html> [accessed: 7/09/2010].

Nation Master (2010) <http://www.nationmaster.com/red/country/bf/bahamas/the/edu/education&all=1> [accessed: 7/09/2010].

Raffaele, H., Wiley, J., Garrido, O., Keith, A., Raffaele, J. (1998) *A guide to the birds of the West Indies*. Prince University Press, USA.

Roebuck, L. and Pochatila, J. (2004) *Water resources assessment of the Bahamas*. US army Corps of Engineers, USA.

Sealey, N. E. (2006). *Bahamian landscapes: An introduction to the geology and physical geography of the Bahamas*, Third edition. Media Enterprises LTD., Nassau, Bahamas.

The Bahamas Guide (2010) <http://www.thebahamasguide.com/facts/population.htm> [accessed: 7/09/2010]

Wood, K. (2003) *Flowers of the Bahamas and the Turks and Caicos Islands*. Macmillan Publishers Limited. Oxford, UK.

A policy on Geometric Design of Highways and Streets 2004, American Association of State Highway and Transportation Officials (AASHTO)

Design and Construction Guidelines for Subdivisions in the Commonwealth of the Bahamas 2004, Ministry of Works and Utilities

Bahamas National Trust. Endangered Species of The Bahamas. [Internet]. 2010. Nassau, The Bahamas. <http://www.bahamas.gov.bs/bahamasweb2/home.nsf/vContentW/E9EEA06FFD9904E506256F010071F8F0!OpenDocument&Highlight=0,endangered%20species> Accessed September 11, 2010.

U.S.A.C.E., September 2005 “Turbidity barriers as a Dredging Project Management Practice”, (ERDC TN-DOER-E21)

Bahamas Department of Meteorology. Climate of the Bahamas. [Internet]. 2008. Nassau, Bahamas. [http://www.bahamasweather.org.bs/climate/general climate/](http://www.bahamasweather.org.bs/climate/general%20climate/). Accessed December 2008.

Bahamas Environment, Science and Technology Commission (BEST). 1999. The Commonwealth of the Bahamas: National Biodiversity Strategy and Action Plan. The Bahamas: Bahamas Environment Science and Technology Commission.

BEST. 2002. Bahamas Environmental Handbook. The Bahamas: Bahamas Environment Science and Technology Commission.

Bahamas Reef Environmental Educational Foundation (BREEF). Status of Bahamian Fisheries. [Internet]. 2006. Nassau, The Bahamas. <http://www.breef.org/OurMarineResources/tabid/54/Default.aspx>. Accessed December 22, 2008.

Bahamas Water & Sewerage Corporation (WSC). New Providence Water. [Internet]. Nassau, The Bahamas. <http://www.wsc.com.bs/NPwater.asp>. Accessed September 13, 2010.

Birds of north America Online. [Internet]. 2007. Ithaca, New York. <http://bna.birds.cornell.edu/bn> Accessed December 3, 2008.

Currie, D., J. Wunderle, D. Ewert, and E. Carey. 2003. The most elusive bird in the Bahamas? World Birdwatch 25(4): 13-15. Available online: <http://www.birdlife.org/news/features/2004/01/kirtlands.html>. Accessed December 27, 2008.

Laws of the Bahamas <http://laws.bahamas.gov.bs/> Accessed September 2010.

Department of Statistics. 2007. The Commonwealth of The Bahamas: National Accounts 2007. The Bahamas; Ministry of Finance, Department of Statistics. Available online: http://www.centralbankbahamas.com/statistics_dos.php?cmd=view&id=16046. Accessed September 2010.

Etienne Dupuch Jr. Publications Ltd. 2009. Bahamas Handbook. The Bahamas: Etienne Dupuch Jr. Publications Ltd.

NOAA Coastal Services Center. Historical Hurricane Tracks. [Internet]. 2010. Charlestown, South Carolina. <http://maps.csc.noaa.gov/hurricanes/viewer.html>. Accessed September 2010.

NOAA. 2007a. Tides & Currents Pro Version 3.0. Nobeltec Nautical Software. east Central America, Bahamas. NOAA. National Data Buoy Center: Station 41046 - E Bahamas. [Internet]. 2007b. Stennis Space Center, Mississippi. http://www.ndbc.noaa.gov/station_page.php?station=41046. http://www.ndbc.noaa.gov/station_page.php?station=spgf1 Accessed December 20, 2008.

Sealey, K.S., B. Brunnick, S. Harzen, C. Luton, V. Nero, and L. Flowers. 2002. An Ecoregional Plan for the Bahamian Archipelago. Jupiter, Florida: Taras Oceanographic Foundation. Available online:

<http://henge.bio.miami.edu/coastalecology/BEP%20Final%20Report%20PDF.pdf>. Accessed January 16, 2009.

Bradley.D, Sorenson.L.G, 1999. Wetlands are Wonderful. A Resource Book on Caribbean Coastal Wetlands for Teachers and Educators.

Correll, D.S, and Correll, H.B, 1982. Flora of the Bahama Archipelago. Germany: J.Cramer, 692.pp.

Sealey, Neil, E. 1994 (Second Edition) Bahamian Landscapes, An Introduction to the Physical Geography of The Bahamas. Media Publishing.White. Anthony,W. 1998. A Birder's Guide to the Bahama Islands (Including Turks and Caicos). American Birding Association Inc.

10.0 APPENDICES

- Appendix A - Methodology
- Appendix B - Plan and profile drawings for proposed JFK widening
- Appendix C - Environmental Management Plan (EMP) Outline
- Appendix D – Plans indicating the location of project receptors.
- Appendix E Table 5.1 Impacts and Mitigation Measures
- Appendix F – Environmental Monitoring Forms
- Appendix G – Landscaping Specification

Appendix A - Methodology



Appendix B - Plan and profile drawings for proposed JFK widening



Appendix C - Environmental Management Plan (EMP) Outline

Appendix D – Plans indicating the location of project receptors.

Appendix E Table 5.1 Impacts and Mitigation Measures

Appendix F – Environmental Monitoring Forms



Appendix G – Landscaping Specification

