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1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

The Highway 2000 Project (H2K) is one of the Government of Jamaica's landmark Millennium Projects. It will link Kingston to Montego Bay, through the parishes of Kingston & St. Andrew, St. Catherine, Clarendon, Manchester, St. Elizabeth, Westmoreland and St. James. The Highway will also connect Bushy Park and Ocho Rios, traversing the parishes of St. Catherine and St. Ann. The total length of the highway is approximately 230 km, with an anticipated right-of-way of 100m.

A Strategic Environmental Assessment (SEA) was requested by the National Development Bank of Jamaica Ltd., the executing agency for the project. The SEA was conducted by Dessau-Soprin International Ltd. of Canada in association with the local firm, Environmental Solutions Ltd. The SEA recommended issues and areas for further study in detailed project-level EIAs which would be necessary to support the application for an environmental permit. Within the Kingston to Williamsfield corridor ten areas were recommended for EIA studies. These were Portmore, Portmore Causeway, Rio Cobre, Bushy Park, Freetown, Rio Minho, Milk River, Sandy Bay, Porus and Williamsfield. These areas were selected because of issues related to relocation, loss of economic activity, presence of interchanges, water resources, hazard vulnerability, hydrology, coastal dynamics and air quality.

On Tuesday, June 26, 2001, the Prime Minister of Jamaica announced that Bouygues Travaux SA of France was selected as the Preferred Bidder for Phase I of the Highway, which will run from Kingston to Williamsfield. Environmental Solutions Ltd. was contracted by TransJamaican Highway Ltd. (a subsidiary of Bouygues Travaux SA) to conduct the Environmental Impact Assessment of Phase 1A of Highway 2000 – Kingston to Sandy Bay.

A Permit Application was submitted to the National Environment and Planning Agency (NEPA) on December 21, 2002 with a request to phase the application and permit. The first phase would be the dualization of the recently completed Old Harbour Bypass (Bushy Park to Sandy Bay), including construction of an interchange and toll plaza. The second phase would be the permit for construction of the section from Kingston to Bushy Park, which would connect to the Old Harbour Bypass. NEPA, in a letter dated January 31, 2002 determined that an EIA was required for the construction of Highway 2000 for the section from Kingston to Bushy Park. This document is in response to that letter and details the findings of the EIA, which is being submitted to NEPA for approval.

1.2 THE STRATEGIC ENVIRONMENTAL ASSESSMENT

In 1999, a Strategic Environmental Assessment (SEA) of the Highway 2000 Project was commissioned by the National Development Bank of Jamaica Ltd., as part of the development of the functional planning design. An SEA is an assessment of policies, plans and programmes at the strategic level, enabling evaluation of environmental considerations at the macro level. At that time, as now, Strategic Environmental Assessments are not a requirement of the national permitting process in Jamaica. However, because of the nature and the scale of the proposed project, and the potential for far reaching impacts, the executing agency realized the need for such a study. The SEA report represented the first step in the environmental approval process and the National Environment and Planning Agency (NEPA, then the Natural Resources and Conservation Authority, NRCA) was consulted with respect to the approach and issues to be identified.

The SEA was conducted in two phases. Phase I comprised a Resource Assessment in which a multi-disciplinary, integrated approcah was used to achieve the following :

- Selection of appropriate approach and methodological techniques
- Identifiction of relevant existing legislation
- Overview of exising conditions along a 1 km wide corridor along the proposed alignment
- Investigation of specific issues along each segment of the alignment

Phase II focused on the impact analysis and consideration of mitigation measures, and incorporated the following aspects :

- Identification of areas of high priority
- Investigation of various options and alternatives for the alignment
- Identification of potential positive and negative impacts of the project
- Recommended mitigation measures to minimise negative impacts
- Recommendations for the project, other than mitigation measures

Data collection included field assessments, interviews with stakeholders, consultations with experts and constant dialogue with the design engineers. The SEA presented an overview of existing conditions within a 1 km wide corridor along the length of the alignment, including physical attributes, biological parameters and social issues. A more detailed description was then presented by section: Kingston to Mandeville, Mandeville to Montego Bay and Kingston to Ocho Rios. Potential impacts were identified and mitigation measures recommended, to minimise potential negative impacts (See Section 6.0). Several positive impacts were also identified including reduced travel time and costs for commuters and movement of goods, increased development opportunities and the provision of employment.

One of the roles of the SEA was to identify sites where specific project level EIA's were required. Within this segment (Kingston to Bushy Park) the areas where the highway crossed the Rio Cobre, Bushy Park and Bernard Lodge were identified. This Environmental Impact Assessment for the Kingston to Bushy Park segment is in response to these aspects.

The Highway 2000 Project leadership has been in continuing dialogue with NRCA/NEPA since the project first began in 1999, through to the completion of this Environmental Impact Assessment for Phase 1A: Kingston to Bushy Park.

1.3 PROJECT DESCRIPTION

Phase IA of the Highway 2000 Project includes construction of the highway from Kingston to Sandy Bay, incorporating the Old Harbour Bypass and the construction of the Portmore Causeway and Bridge and upgrade of the Dyke Road.

1.3.1 Alignment

The section from Kingston to Bushy Park requires the construction of a four lane, toll highway beginning with an interchange on the Mandela Highway in the vicinity of Caymanas Estates. The Highway will run just north of the railway line to cross the railway at Grange Lane. The Highway then travels through Bernard Lodge, south of Spanish Town and to the area of Hartlands. The Highway then follows the railway alignment, on the southern side, through the areas of Bridge Pen and Cherry Garden, to connect with the recently constructed Old Harbour Bypass at Bushy Park. The length of this section is approximately 22 km. An interchange, to facilitate commuters into and out of Spanish Town, will be constructed west of the Salt Island Road and Town Gully. A connection to the existing round-about will be provided, northerly through two settlements, and via a six-lane Toll Plaza. The alignment and the location of the Spanish Town Interchange are shown in Figure 1.1.

The Highway begins in the area of the Caymanas Estate, St. Catherine at chainage 0+000 with a connection to the existing Mandela Highway. It travels south-south west to the area of Christian Pen with an interchange in the Christian Pen area at chainage 1+500. This interchange will facilitate connection to the Portmore Causeway and Bridge, which will be upgraded under another phase of the Highway 2000 project. From the Christian

Figure 1.1: Alignment of Highway 2000: Kingston to Bushy Park (0+000 to 22+000)

Pen area the Highway travels south west to through the areas of Grange Lane (4+500) and Bernard Lodge (7+000), south of Spanish Town. At 8+500 the road goes westerly through Windsor Park and the area of Hartlands (13+000) then south westerly and parallel to the existing railway line to Bridge Pen (17+000) and Cherry Garden, to connect to the Old Harbour Bypass at 22+000.

1.3.2 Structures

There are several structures associated with the highway, including box culverts and bridges. Table 1.1 lists the box culverts, while Table 1.2 lists the bridges.

Table 1.1: Highway 2000 Structures: Box Culverts – Kingston to Bushy Park (0+000 to 22+000)

Bridge No.	Chainage km	Name	Type	Comments	Length m	Width m	Height m	Wall thickness m
B4	2+650	1 Box, Field Connector	BC	To Build	26	5.00	5.00	0.70
	4+950	1 Box, Railway	BC	To Build	26	13.00	7.00	0.70
B9	8+100	1 Box, Field connector	BC	To Build	26	5.00	5.00	0.70
B13	12+350	1 Box, Field connector	BC	To Build	26	5.00	5.00	0.70
16	17+100	1 Box Field connector	BC	To Build	26	5.00	5.00	0.70

Table 1.2: Highway 2000 Structures: Bridges – Kingston to Bushy Park (0+000 to 22+000) (OV = Overpass; UD = Underpass)

					Spacing in m 2.25		**BRIDGE**					
Bridge No.	**Chainage km**	**Name**	**Type**	**Structure**	**Prestr. Beams Qty**	**Prestr. Beams m**	**Length m**	**Width m**	**Piers Qty**	**Foundations Type**	**Piles Qty**	**Concrete m^3**
B1	0+300	Ramp	OV	Precast Beams	14	26	85	14	1	Piles	104	862
B2	0+800	Rio Cobre River	OV	Precast Beams	60	32	180	25	4	Piles	377	3,108
B3	1+800	Ramp	UD	Precast Beams	16	24	60	17	1	Piles	127	801
B5	4+800	Local Road	OV	Precast Beams	12	30	30	25	0	Piles	123	789
B7	6+250	Local Road	UD	Precast Beams	12	24	48	12	1	Piles	90	535
B8	7+400	Ramp	UD	Precast Beams	12	24	48	12	1	Piles	90	535
B10	10+000	Town Gully (small river)	OV	Precast Beams	12	15	15	25	0	Piles	123	619
B11	10+800	Local Road	UD	Precast Beams	12	25	48	12	1	Piles	90	540
B12	11+350	Salt Island Creek 1 (small river)	OV	Precast Beams	12	16	16	25	0	Piles	123	628
B14	13+180	Salt Island Creek 2 (small river)	OV	Precast Beams	12	15	15	25	0	Piles	123	619
B15	14+000	Local Road	OV	Precast Beams	24	16	31	25	1	Piles	187	949
B17	18+150	Cut Throat Gully (swamped area)	OV	Precast Beams	12	14	14	25	0	Piles	123	609
B18	18+500	Black River (swamped area)	OV	Precast Beams	24	15	30	25	1	Piles	187	939
	21+000	Bushy Park Intersection	UD	Precast Beams	12	24	48	12	1	Piles	90	535
B20	21+220	Coleburn's Gully (to be reconstructed)	OV	Precast Beams	18	14	42	13	2	Piles	126	957

1.4 PERMITTING

Under the Natural Resources Conservation Authority Act (1991), the Natural Resources Conservation Authority (NRCA, now the National Environment and Planning Agency, NEPA) is authorized to issue, suspend and revoke permits and licences. The Permit and Licence System was established in 1997 to ensure compliance with Sections 9 & 12 of the NRCA Act, which gives the NRCA the right to issue permits for new developments and request EIA studies where necessary. Highway construction is listed in the prescribed categories of projects requiring a permit. A Project Information Form (PIF) and a Permit Application (PA) have been submitted to NRCA/NEPA with the requisite application fee of J$ 1000 (December 20, 2001). NRCA/NEPA has determined that an EIA is required and Terms of Reference were submitted for approval on February 6, 2002, and wer approved with revisions on March 15, 2002.

NRCA/NEPA has been interacting with the Highway 2000 project since its inception. The NRCA through an Endorsement Statement (March 2000) conveyed its support for efforts made to ensure that Highway 2000 satisfied all the requisite environmental requirements. The NRCA received and reviewed the SEA and was invited to participate at various meetings and events. The NRCA/NEPA indicated that it was prepared to work with the preferred bidder in satisfying all the requisite environmental permitting requirements, so that the Highway 2000 Project could be successfully implemented.

1.5 TERMS OF REFERENCE

The TOR's were prepared in accordance with the NRCA's (NEPA's) "Guidelines for Conducting EIA's". They were submitted and approved by NEPA as detailed below:

1. Introduction – Identification of the development project to be assessed and explanation of the executing arrangements for conducting the Environmental Impact Assessment.

2. Background Information – A brief description of the major components of the proposed project, the implementing agents, a brief history of the project and its current status, including information the entire Highway 2000 Project, the establishment of the National Road Operating and Construction Ltd. (NROC) and selection of Bouygues construction Ltd. as the Preferred Bidder.

3. Study Area – Specification of the boundaries of the study area for assessment including the construction of a four lane highway between Kingston and Bushy Park, connection to the Old Harbour Bypass, as well as adjacent or remote areas that should be considered with respect to the project.

4. Scope of Work – Standard environmental impact assessment techniques including site reconnaissance, literature review, desktop research, field work, data analysis and interviews with appropriate personnel, will be utilized in order to satisfy the Terms of Reference. Reference will also be made to the extensive studies already carried out for the Highway 2000 Project including the SEA, Illustrative Design and Construction Solution, Drainage and Hydrology Report and other relevant studies. The following tasks will be performed:

Task 1: Description of the Proposed Project. A full description of the project and its existing setting using maps as appropriate. This is to include general layout, size, location, and physical characteristics and include major activities required. Photographs of the site, topographical survey maps, engineering designs and relevant plans will be included.

Task 2: Description of the Environment. Assemble, evaluate and present data on the relevant characteristics of the study area, including the following:

- Physical environment: geology, topography, soils, surface and groundwater hydrology
- Air quality: particulates (PM10, SOX and NOX) and noise assessment
- Natural drainage features: surface run-off and flood risk
- Biological environment: species of commercial importance, marine fauna, parks and protected areas, rare, threatened, endemic and endangered plant and animal species (terrestrial and aquatic)

- Socio-cultural environment: land use (identification of agricultural lands), traffic patterns, proposed developments, public health issues, demographics, solid waste management, sewage disposal
- Archaeological and cultural heritage

Task 3: Legislative and Regulatory Considerations. A description will be given of the pertinent regulations, standards and regulatory bodies governing environmental quality, health and safety, protection of endangered species, siting and land use control, and sewage and solid waste disposal, development and construction.

Task 4: Determination of Potential Impacts of the Proposed Project. Impacts will be determined as significant positive or negative, direct or indirect, short-term or long-term, unavoidable or irreversible. Special emphasis will be placed on:

- Flora and Fauna
- Plant and animal communities immediately outside the project corridor
- Noise and Air Quality
- Waste Disposal (construction spoil)
- Sourcing and Storage of Earth Materials
- Hazards and Risks (flooding, health and safety, accidents)
- Relocation/Resettlement
- Potential Loss of Economic Activity/Local businesses
- Loss of agricultural lands
- Community disruption
- Crossings and access
- Traffic Flow
- Interchanges and Toll Plazas
- Public Sentiment
- Existing Enterprises
- Proposed Developments
- Archaeological and cultural heritage
- Aesthetics and amenity

Task 5: Mitigation and Management of Negative Impacts. Recommendations will be made for feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels. Indicative costs of these mitigation measures will be provided. Alternatives to the project site will be investigated including the "no-action" alternative.

Task 6: Recommendations for the development of a Monitoring Plan. Recommendations will be made for the development of a Monitoring Plan to ensure implementation of the mitigation measures and long-term minimization of negative environmental impacts. Monitoring should begin at the start of the construction phase and continue through he operation phase.

Task 7: Assist in Inter-Agency Coordination and Public Participation. As, and if required by the NRCA/NEPA, ESL will assist in the public participation/review process through meetings with relevant governmental agencies, in obtaining the views of civil society and participation in a public hearing/consultation. ESL will represent Bouygues Travaux SA before the NRCA/NEPA and any other government agencies, as required.

5. Report – The Environmental Impact Assessment report will be concise and limited to the significant environmental issues. The main text will focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting those data. The report will be organized according to, but not necessarily be limited by, the outline below:

- Executive Summary
- Description of the Proposed Project
- Description of the Environment
- Policy, Legal and Administrative Framework
- Significant Environmental Impacts
- Analysis of Alternatives
- Mitigation Measures
- Recommendations for Monitoring Plan
- List of References
- Photographs, Maps and Plans as appropriate

1.6 STUDY TEAM

A multidisciplinary team was identified to conduct the study and comprised the following persons:

Mrs. Eleanor Jones, MSc – Environmental Management Specialist and Team Leader

Mrs. Jones has over twenty-five experience in the areas of environmental management systems, environmental risk assessment, disaster prevention planning, environmental and social impact assessments, watershed management and community consultations and participatory planning. Mrs. Jones lectured in the Geography Department of the University of the West Indies for 13 years, and has been consulting for fifteen years as President of Caritech Associates Ltd. and Managing Director/Founding Partner of Environmental Solutions Ltd. Mrs. Jones has much experience in road development

projects including work on the North Coast Highway, the Kingston Coast Road Upgrade, the Jamaica Bridges Development Program, and was extensively involved in the SEA for Highway 2000. Mrs. Jones will be responsible for overall management of the project including client liaison and consultations/dialogue with the NRCA/NEPA, as well as the social assessments, community consultations, hazard management, analysis of impacts and recommendation of mitigation measures.

Dr. Margaret Jones Williams, PhD – Ecologist and Deputy Tem Leader

Dr. Jones Williams is an Environmental Scientist with over thirteen years experience in terrestrial and marine ecology, coastal pollution studies, environmental impact assessments and natural resources inventory. Educated in Jamaica, Canada and the United Kingdom, she has worked at the Conservation Data Centre-Jamaica, a biodiversity unit, where she did extensive field work and mapping of Jamaica's endemic and endangered fauna as part of a Rapid Ecological Assessment of the island and to assist in the establishment of Jamaica's national parks. Dr. Jones Williams has been involved in several road development projects including the Kingston Coast Road Upgrade, the Jamaica Bridges Development Program and was extensively involved in the SEA for Highway 2000. Dr. Jones Williams will be responsible for the ecological assessments and identification of impacts and recommendation of mitigation measures.

Mrs. Sharonmae Shirley, BSc, MPhil – Environmental Chemist

Mrs. Shirley is an Environmental Chemist and has over five years experience in environmental chemistry, including water and solid waste studies, planning and execution of environmental monitoring programmes, occupational health and safety programmes and environmental audits. She has had years of practical experience in designing and implementing environmental monitoring programmes in Jamaica and Belize. Mrs. Shirley will be responsible for analysis of air quality and water quality, as well as preparation of the recommendations for the development of a monitoring plan.

Mr. Earle Wright, MSc – Hydrogeologist

Mr. Wright has over fifteen years experience in hydrogeology and water resources pollution and management in Jamaica. He has developed considerable expertise in surface and ground water assessment, flow modeling, pollution assessment and land resource management. His skills have been applied to policy development and technical applications in the Water Resources Authority and in private consulting where he has been actively engaged in environmental assessments. Mr. Wright is presently director of GEO TECHNICS Ltd., a locally registered consultant company, specializing in hydrological and geotechnical engineering. He also serves as associate consultant to a number of local engineering and environmental consultant companies and is a part-time lecturer in the Department of Geography and Geology at the University of the West Indies, Mona Campus, Jamaica. Mr. Wright worked extensively on the Highway 2000 Strategic Environmental Assessment and will again be responsible for analysis of geology and soils, surface and groundwater hydrology, and relevant aspects of climate and rainfall.

Technical assistance was provided where required.

2.0 APPROACH AND METHODOLOGY

2.1 DATA COLLECTION

Baseline data for the study area was collected using the following methods:

- Windshield Survey
- Site Reconnaissance
- Analysis of Maps and Plans
- Literature Review
- Desk Top Research
- Public Consultations
- Field Studies
- Laboratory Analyses

2.1.1 Physical Environment

Information was gathered on the existing physical environment, particularly as related to geology, topography, soils, hydrology and drainage, riverine water quality and air quality.

2.1.1.1 Geology, Topography, Soils

A review was conducted of relevant literature on the geology, topography and soils within the Highway corridor. However, extensive soil data is not presented here as soil borings have been conducted for the project (JENTECH Consultants Ltd., 2000).

2.1.1.2 Hydrology and Drainage

The hydrology of the Kingston - Bushy Park segment of the proposed highway was assessed based on analysis of rainfall, streamflow and other hydrologic data, and review of previous hydrological studies done in the general area. Rainfall and other climatic data were obtained from the National Meteorological Office and streamflow and other

hydrological data from the Water Resources Authority. The Hydrology and Drainage Report prepared by Dessau-Soprin International Inc. was the primary hydrology data source.

Field surveys were conducted to verify the findings and recommendations outlined in the previous studies.

2.1.1.3 Air Quality

The air quality assessment involved the determination of ambient levels of respirable particulates, PM10(<10? m). Particulates were measured using Sensidyne (BDX 530) personal vacuum pumps (suction 2-3 1/min), attached to pre-weighed Millipore filters. The pumps were placed at the approximate respiratory height of pedestrians for a specified period of time, after which the filters were stabilised and weighed to determine a Time Weighted Average (TWA) value for the particulates.

The pumps were placed at three sites (Figure 2.1). Table 2.1 gives the date of sampling and locations of the pumps.

Table 2.1 Date and location of air quality sampling stations

Date	Station Number	Location	Chainage
18/02/02	1	Four Way Intersection in Greater Portmore	1+500
18/02/02	2	Bernard Lodge Compound	6+250
18/02/02	3	Old Harbour Bypass adjacent to the Ackee Factory	21+250

2.1.1.4 Noise

Three (3) noise monitoring sites were selected to coincide with air quality measurements (Figure 2.1). Noise level readings, wind direction and any unusual local noise sources were recorded.

In addition, before and after the survey, each instrument was checked with a calibrator, which was pre-calibrated at the factory (see calibration certificate Appendix I).

Measurements were taken using Quest Electronics sound level meters, which conform with ANSI S1.4 - 1983, TYPE 2 and IEC 651 - 1979, TYPE 2 standards. The meter was calibrated before and after each set of readings.

Table 2.2: Station numbers and locations for noise measurements

Date	Station Number	Location	Chainage
18/02/02	1	Four Way Intersection in Greater Portmore	1+500
18/02/02	2	Bernard Lodge Compound	6+250
18/02/02	3	Old Harbour Bypass adjacent to the Ackee Factory	21+250

Figure 2.1: Air Quality and Noise Sampling Stations

2.1.1.5 Water Quality

In order to establish baseline conditions for some of the rivers being crossed by the Highway, water quality assessments were conducted at three sites. The baseline data would provide a quantitative measure of the existing conditions and also provide a comparative point for construction and post construction monitoring. The location of the sampling stations is given in Table 2.3 and shown in Figure 2.2. The samples were collected at a depth of 0.5m. They were then placed on ice and transported to the ESL Laboratory at 20 West Kings House Road, Kingston 10. The following parameters were sampled:

i) pH
ii) Conductivity
iii) Temperature
iv) Dissolved Oxygen
v) Secchi/Turbidity
vi) Total Suspended Solids
vii) Nitrate
viii) Phosphate
ix) BOD
x) Total and Faecal Coliform

Conductivity, temperature, and dissolved oxygen were measured *in situ* at the sampling stations.

The analytical methods used are based on established procedures in Standard Methods for Water and Wastewater Analysis.

Figure 2.2 Water Quality Sampling Stations

Table 2.2 Location of the Water Quality Sampling Stations

Date	Station Number	Location	Chainage
18/02/02	1	Rio Cobre	0+800
18/02/02	2	Black River	South of 18+400
18/02/02	3	Coleburn Gully	21+220

2.1.2 Biological Environment

The status of the flora and fauna of the study area were determined by a general assessment of both terrestrial and aquatic environments, review of literature relevant to the area, and identification of species of birds.

2.1.2.1 Vegetation

The vegetative communities were identified using the method of Grossman *et al* (1991) and classified into community types. Identification was carried out of dominant tree species, assessment of stage of growth (mature or sapling) and assessment of canopy cover.

2.1.2.2 Fauna

Information on fauna was gathered from existing literature on reported species as well as observations in the field. Observations also include on site assessments (in December 1999) when field work was conducted for the Strategic Environmental Assessment (Government of Jamaica, 2000 – Volumes I-IV). Current site assessments included data

gathering on January 22, February 15, and March 5, 2002. Observations were made of bird species occurring in several habitats including scrubland, cane fields, and overgrown shrub.

2.1.3 Social Environment

The consultants utilized a combination of desk research, field investigations, census data, parish profiles, structured interviews, maps, reports and aerial photo assessments to generate the data required for description of the existing social environment and assessment of the potential impact of Highway 2000. Mitigation measures have been suggested for negative impacts. Data was gathered on the following aspects of the social environment:

- Land-use, Zoning and Land Acquisition
- Demographics
- Traffic, Transportation and Access Roads
- Business Enterprise
- Solid Waste
- Proposed Developments
- Recreational Activities
- Archaeological and Cultural Heritage

3.0 NATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS

3.1 NATURAL ENVIRONMENT

3.1.1 Natural Resources Conservation Act (1991)

The Natural Resources Conservation Act was passed in the Jamaican Parliament in 1991 and created and established the Natural Resources Conservation Authority (NRCA) with primary responsibility for ensuring sustainable development in Jamaica through the protection and management of Jamaica's natural resources and control of pollution. Sections 9 and 10 of the NRCA Act stipulate that an Environmental Impact Assessment (EIA) is required for new projects and existing projects undergoing expansion.

3.1.2 Environmental Review and Permitting Process (1997)

The environmental Permit and License System (P&L), introduced in 1997, is a mechanism to ensure that all developments in Jamaica meet required standards in order to minimize negative environmental impacts. The P&L System is administered by NEPA, through the Applications Section (formerly the Permit and License Secretariat). Permits are required by persons undertaking new development which fall within a prescribed category. Under the NRCA Act of 1991, the NRCA is authorized to issue, suspend and revoke permits and licences if facilities are not in compliance with the environmental standards and conditions of approval stipulated. An applicant for a Permit or License must complete an application form as well as a Project Information Form (PIF) for submission to the NRCA.

3.1.3 Watershed Protection Act (1963)

The Watersheds Protection Act of 1963 provides for the designation of watersheds for conservation purposes to reduce soil erosion, ensure regular flow in rivers and streams, and to maintain optimum levels of groundwater. This Act has been incorporated into the

NRCA Act of 1991. More recently, the Natural Resources Conservation Authority in collaboration with the Ministry of Lands and the Environment (previously the Ministry of Environment and Housing) has produced a Watershed Policy for Jamaica (NRCA/MOEH, 1999) to assist in the management of Jamaica's watersheds. Management of the watersheds is done under Watershed Management Units. There are a total of 26 Watershed Management Units for the island.

3.1.4 Wildlife Protection Act (1945)

The Wildlife Protection Act of 1945 prohibits removal, sale or possession of protected animals, use of dynamite, poisons or other noxious material to kill or injure fish, prohibits discharge of trade effluent or industrial waste into harbours, lagoons, estuaries and streams, and Authorizes the establishment of Game Sanctuaries and Reserves. Protected under the Wildlife Protection Act are six species of sea turtle, one land mammal, one butterfly, three reptiles and several species of birds including rare and endangered species and game birds.

3.1.5 The Endangered Species (Protection, Conservation and Regulation of Trade) Act (1999)

This Act deals with restriction on trade in endangered species, regulation of trade in species specified in the schedule, suspension and revocation of permits or certificates, offences and penalties, and enforcement. Many species of reptile, amphibian and birds that are endemic to Jamaica but not previously listed under national protective legislation, or under international legislation, are listed in the Appendices of this Act.

3.1.6 The Natural Resources (Prescribed Areas)(Prohibition of Categories of Enterprise, Construction and Development) Order (1996)

The island of Jamaica and the Territorial Sea of Jamaica has been declared as a Prescribed Area. No person can undertake any enterprise, construction or development of a prescribed description of category except under and in accordance with a permit. The

Natural Resources Conservation (Permits and Licenses) Regulations (1996) gives effect to the provisions of the Prescribed Areas Order.

3.1.7 Water Resources Act (1995)

The Water Resources Act of 1995 established the Water Resources Authority (WRA) and authorizes this Authority to regulate, allocate, conserve and manage the water resources of the island. The Authority is also responsible for water quality control and is required under Section 4 of the Act to provide upon request to any department or agency of Government, technical assistance for any projects, programmes or activities relating to development, conservation and the use of water resources.

It is the responsibility of the WRA as outlined in Section 16 to prepare, for the approval of the Minister, a draft National Water Resources Master Plan for Jamaica. Areas to be covered in this Master Plan include objectives for the development, conservation and use of water resources in Jamaica with consideration being given to the protection and encouragement of economic activity, and the protection of the environment and the enhancement of environmental values.

Section 25 advises that the proposed user will still have to obtain planning permission, if this is a requirement, under the Town and Country Planning Act. In addition, Section 21 of the Act stipulates that if the water to be used will result in the discharge of effluents, an application for a license to discharge effluents will have to be made to the Natural Resources Conservation Authority or any other relevant body as indicated by the Minister.

With regard to underground water, Section 37 states that it is unlawful to allow this water to go to waste. However, if the underground water "interferes or threatens to interfere with the execution or operation of any underground works", it will not be unlawful to allow the water to go to waste in order to carry out the required works provided that there is no other reasonable method of disposing of the water. The Authority also has the power to determine the safe yield of aquifers. (Section 38).

3.1.8 The Natural Resources Conservation Authority Act (1991) – The Natural Resources Conservation (Portland Bight Protected Area) Regulations 1999

These regulations apply within the area declared to be the Portland Bight Protected Area and apply in addition to any other regulations relating to the area. Offences listed include extraction or mining of minerals, pollution of water in rivers or streams, or deposit litter, rubbish or refuse. Licences for particular activities may be granted if application is made to the Protected Area Manager.

3.1.9 Country Fires Act (1942)

Section 4 of the Country Fires Act of 1942 prohibits the setting of fire to trash without prior notice being given to the nearest police station and the occupiers of all adjoining lands. In addition, a space of at least fifteen feet in width must be cleared around all trash to be burnt and all inflammable material removed from the area. Section 6 of the Act empowers the Minister to prohibit, as may be necessary, the setting of fire to trash without a permit.

Offences against this Act include:

- Setting fire to trash between the hours of 6.00 p.m. and 6.00 a.m. (Section 5a);
- Leaving open-air fires unattended before they have been completely extinguished (Section 5b);
- Setting fires without a permit and contrary to the provisions outlined in Section 6 (Section 8);
- Negligent use or management of a fire which could result in damage to property (Section 13a);
- Smoking a pipe, cigar or cigarette on the grounds of a plantation which could result in damage to property (Section 13b).

3.1.10 Quarries Control Act (1983)

The Quarries Control Act of 1983 established the Quarries Advisory Committee, which advises the Minister on general policy relating to quarries as well as on applications for licenses. The Act provides for the establishment of quarry zones, and controls licensing and operations of all quarries. The Minister may on the recommendation of the Quarries Advisory Committee declare as a specified area any area, in which quarry zones are to be established and establish quarry zones within any such specified area.

Section 5 of the Act states that a licence is required for establishing or operating a quarry though this requirement may be waived by the Minister if the mineral to be extracted is less than 100 cubic metres. Application procedures are outlined in Section 8. The prescribed form is to be filed with the Minister along with the prescribed fee and relevant particulars. The applicant is also required to place a notice in a prominent place at the proposed site for a period of at least 21 days starting from the date on which it was filed.

3.1.11 The Pesticides (Amendment) Act (1996)

The Pesticides (Amendment) Act of 1996 amended sections of the principal act, which came into effect in 1975 and established the Pesticides Control Authority. This Act gives the Authority the responsibility of controlling the importation, manufacture, packaging, sale, use and disposal of pesticides. Section 11 states that the Authority is required to keep a register or record of all relevant information such as registered pesticides, restricted pesticides, pest control operators and persons licensed to import or manufacture pesticides. Under Section 16 of the Act, the Authority may also, with the approval of the Minister, make regulations which relate to areas such as:

- Aerial application of pesticides;
- Supervision required for the use of pesticides, the prescribed protective clothing to be worn and other precautionary measures;
- The permissible levels of pesticides to be used;

- The periods during which particular pesticides may or may not be used on certain agricultural crops;
- The disposal of pesticides and packages.

3.1.12 Air Quality Standards

The Federal Clean Air Acts which came into force in the United States in 1990 established air quality standards for six pollutants: ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), respirable particulate matter (PM10) and lead (Pb). An allowable level for each of these pollutants has been set by the United States Environmental Protection Agency (US EPA) whose objective is to protect the public from exposure to dangerous levels. National standards, known as the National Ambient Air Quality Standards (NAAQS), were established and they were categorized into two groups. In one group, there are the primary standards, designed to protect human health and in the other, there are the secondary standards designed to protect the environment and limit property damage.

3.1.13 Noise Standards

To date, Jamaica has no National legislation for noise, but World Bank guidelines are often used for benchmarking purposes. The NRCA is currently preparing a draft document for national Noise Standards.

3.1.14 Water Quality NRCA Act (1990)

The NRCA has primary responsibility for control of pollution in Jamaica's environment, including pollution of water. National Standards exist for industrial and sewage discharge into rivers and streams. WHO Standards for drinking water are used and these are regulated by the National Water Commission. There are no national standards for ambient water quality of riverine systems.

3.2 HUMAN, CULTURAL AND SOCIAL ENVIRONMENT

3.2.1 Town and Country Planning Act (1958)

Section 5 of the Town and Country Planning Act authorizes the Town and Country Planning Authority to prepare, after consultation with any local authority, the provisional development orders required for any land in the urban or rural areas, so as to control the development of land in the prescribed area. In this manner, the Authority will be able to coordinate the development of roads and public services and conserve and develop the resources in the area.

Any person may, under Section 6 of the Act, object to any development order on the grounds that it is:

- impractical and unnecessary;
- against the interests of the economic welfare of the locality.

However, if the Minister is satisfied that the implementation of the provisional development order is likely to be in the public interest, he may, under Section 7 (2) of the Act, confirm it with or without modification by publishing a notice in the Gazette. Section 8 of the Act also gives the Minister the authority to amend a confirmed development order.

Section 10 of the Act states that a development order must include:

- clearly defined details of the area to be developed;
- regulations regarding the development of the land in the area specified;
- formal granting of permission for the development of land in the area.

If the provisions of section 9A of the Natural Resources Conservation Authority (NRCA) Act apply to the development, the application can only be approved by the Planning Authority after the NRCA has granted a permit for the development. (Section 11 (1A).

The Authority may impose a "tree preservation order" under Section 25 of the Act if it considers it important to make provision for the preservation of trees and woodlands in the area of the development. This order may:

- prohibit the cutting down, topping, lopping or willful destruction of trees;
- secure the replanting of any section of the woodland area in which trees were felled during the forestry operations permitted under the order.

The tree preservation order is not applicable to the cutting down of trees which were already dead, dying or had become dangerous and the order can take effect only after it has been confirmed by the Minister.

The Minister can, under Section 26 of the Act, make regulations to restrict and regulate the display of advertisements in any area to be developed if he considers this to be in the interest of public safety. Section 28 of the Act empowers the local authority to require the owner or occupier of land in the development area to take the steps necessary to ensure its proper maintenance.

3.2.2 Land Development and Utilization Act (1966)

Under Section 3 of the of the Land Development and Utilization Act (1966), the Land Development and Utilization Commission is authorized to designate as agricultural land, any land which because of its "situation, character and other relevant circumstances" should be brought into use for agriculture. However, this order is not applicable to land which has been approved under the Town and Country Planning Act for development purposes other than that of agriculture. Among the duties of the Commission outlined in Section 14 of the Act is its responsibility to ensure that agricultural land is "as far as possible, properly developed and utilized".

3.2.3 The National Solid Waste Management Authority Act (2001)

The National Solid Waste Management Authority Act (2001) is “an act to provide for the regulation and management of solid waste; to establish a body to be called the National Solid Waste Management Authority and for matters connected therewith or incidental thereto”. The Solid Waste Management Authority (SWMA) is to take all steps as necessary for the effective management of solid waste in Jamaica in order to safeguard public health, ensure that waste is collected, sorted, transported, recycled, reused or

disposed of, in an environmentally sound manner and to promote safety standards in relation to such waste. The SWMA also has responsibility for the promotion of public awareness of the importance of efficient solid waste management, to advise the Minister on matters of general policy and to perform other functions pertaining to solid waste management.

3.2.4 Jamaica National Heritage Trust Act (1985)

The Jamaica National Heritage Trust Act of 1985 established the Jamaica National Heritage Trust (JNHT). The Trust's functions outlined in Section 4 include the following responsibilities:

- To promote the preservation of national monuments and anything designated as protected national heritage for the benefit of the Island;
- To carry out such development as it considers necessary for the preservation of any national monument or anything designated as protected national heritage;
- To record any precious objects or works of art to be preserved and to identify and record any species of botanical or animal life to be protected.

Section 17 further states that it is an offence for any individual to:

- willfully deface, damage or destroy any national monument or protected national heritage or to deface, damage, destroy, conceal or remove any mark affixed to a national monument or protected national heritage;
- alter any national monument or mark without the written permission of the Trust;
- remove or cause to be removed any national monument or protected national heritage to a place outside of Jamaica.

3.2.5 Land Acquisition Act (1947)

Section 3 of the Land Acquisition Act (1947) empowers any officer authorized by the Minister to enter and survey land in any locality that may be needed for any public purpose. This may also involve:

- Digging or boring into the sub-soil;

- Cutting down and clearing away any standing crop, fence, bush or woodland;
- Carrying out other acts necessary to ascertain that the land is suitable for the required purpose.

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The Minister is authorized under Section 5 of the Act to make a public declaration under his signature if land is required for a public purpose provided that the compensation to be awarded for the land is to be paid out of the:

- Consolidated Fund or loan funds of the Government;
- Funds of any Parish Council, the Kingston and St. Andrew Corporation or the National Water Commission.

Once the Commissioner enters into possession of any land under the provisions of this Act, the land is vested in the Commissioner of Lands and is held in trust for the Government of Jamaica in keeping with the details outlined in Section 16. The Commissioner shall provide the Registrar of Titles with a copy of every notice published as well as a plan of the land. The Commissioner will also make an application to the Registrar of Titles in order to bring the title of the land under the operation of the Registration of Titles Act.

3.2.6 Registration of Titles Act (1989)

The Registration of Titles Act of 1989 is the legal basis for land registration in Jamaica, which is carried out using a modified Torrens System (Centre for Property Studies, 1998). Under this system, land registration is not compulsory, although once a property is entered in the registry system the title is continued through any transfer of ownership.

3.2.7 Involuntary Resettlement Policy

Jamaica's experience in resettlement has come mainly as a result of urban renewal and bauxite mining but there are few records documenting the process. Proposed policy guidelines for involuntary resettlement were outlined in a draft report McHardy (1997).

The following measures were recommended as the principles and objectives of the policy:

- Avoid unnecessary displacement
- Give the population the option of selecting their choice among possible alternatives
- Prepare Rehabilitation Action Plans which will ensure that the project-affected people regain at least their "former standard of living and earning capacity after a reasonable transition period"
- All project-affected people should be entitled to benefit from the rehabilitation measures even if they are not holders of legal property titles
- Compensation money due to the persons being displaced should be paid well in advance of the date of their removal

Rehabilitation measures should include:

- Cost of moving to the new site
- Compensation for losses to be incurred
- Subsistence/maintenance allowance during the transition period
- Development programme to assist those resettled in regaining or improving on their previous living standards
- Considerations geared to minimize disruption during rehabilitation

3.2.8 Mining Act (1947)

It is the responsibility of the Commissioner of Mines to exercise general supervision over all prospecting and mining operations in the Island. Section 8 of the Act identifies lands excluded from prospecting or mining. These include:

- Land to be used for any public purpose (other than mining), for a burial ground or within 100 yards of such places;
- Any area located within any town or village;

- Land reserved for the purpose of a railway or situated within 100 yards of any railway (unless the railway is constructed by the mining lessee for use during operations);
- Any area which is the site or is within 100 yards of any building, works, reservoir or dam or occupied by the Government or a public authority;
- Any street road or highway or any land within 50 yards of the centre line of a street, road or highway other than one constructed on the mining lease by the mining lessee;
- Land within 100 yards of any building.
- Prospecting may proceed in these areas only with the consent of the Commissioner, or in the case of a building, the consent of its occupier.

According to Section 9 of the Act, the Minister may at any time declare an area closed to prospecting and mining. This excludes any lands to which a lessee has rights under a licence or mining lease.

3.2.9 Toll Roads Act (2002)

The Toll Roads Act was tabled in the House of Representatives in February 2002. The Act was passed into law by the end of the legislative year on March 31, 2002, but there will be some reprieve for motorists for at least two years. This is an Act to provide for the designation of specified roads as toll roads, the establishment of the Toll Authority, the operation and maintenance of toll roads, the collection and retention of toll, and for other connected matters. (1) The Minister may, by order - (a) subject to subsection (2) designate any road as a toll road for purposes of this Act; and (b) authorize any person, in return for undertaking such obligations as may be specified in an agreement with respect to the design, construction, maintenance, operation, improvement or financing of a toll road, to enjoy the rights conferred in the order, including the right to levy, collect and retain toll in respect of the use of the toll road. (2) No road shall be designated as a toll road under subsection (1) (a) unless in the area in which the toll road is to be established there is an alternative route accessible to the public by ferry, vehicular or other traffic.

4.0 INTERNATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS

4.1 CARTAGENA CONVENTION (CONVENTION FOR THE PROTECTION AND DEVELOPMENT OF THE MARINE ENVIRONMENT OF THE WIDER CARIBBEAN REGION)

Adopted in March 1983 in Cartagena, Colombia, the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, also known as the Cartagena Convention, is the only legally binding environmental treaty for the Wider Caribbean. The Convention came into force in October 1996 as a legal instrument for the implementation of the Caribbean Action Plan and represents a commitment by the participating governments to protect, develop and manage their common waters individually and jointly.

Ratified by twenty countries, the Cartagena Convention is a framework agreement which sets out the political and legal foundations for actions to be developed. The operational Protocols, which direct these actions, are designed to address special issues and to initiate concrete actions. The Convention is currently supported by three Protocols. These are:

- *The Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region* (The Oil Spills Protocol), which was adopted and entered into force at the same time as the Cartagena Convention.;
- *The Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region* (The SPAW Protocol), which was adopted in two stages, the text in January, 1990 and its Annexes in June, 1991. The Protocol entered into force in 2000.
- *The Protocol Concerning Pollution from Land-based Sources and Activities in the Wider Caribbean Region* (LBS Protocol), which was adopted in October, 1999.

4.2 BIODIVERSITY CONVENTION

The objectives of the Convention on Biological Diversity are "the conservation of biological diversity, sustainable use of its components and the fair equitable sharing of the benefits arising out of the utilization of genetic resources". This is the first global, comprehensive agreement which has as its focus all aspects of biological diversity: genetic resources, species and ecosystems. The Convention acknowledges that the "conservation of biological diversity is a common concern of humankind and an integral part of the development process". In order to achieve its goals, the signatories are required to:

- Develop plans for protecting habitat and species.
- Provide funds and technology to help developing countries provide protection.
- Ensure commercial access to biological resources for development.
- Share revenues fairly among source countries and developers.
- Establish safe regulations and liability for risks associated with biotechnology development.

Jamaica's Green Paper Number 3/01, entitled Towards a National Strategy and Action Plan on Biological Diversity in Jamaica, speaks to Jamaica's continuing commitment to its obligations as a signatory to the Convention.

5.0 DESCRIPTION OF THE EXISITNG ENVIRONMENT

5.1 PHYSICAL ENVIRONMENT

5.1.1 Climate

The Kingston - Bushy Park segment of the Highway 2000 alignment is located in the dry, St. Catherine plains between Caymanas Estate in the east and Bushy Park in the west. The average annual rainfall for the area is 987 mm and the seasonal rainfall pattern is bimodal with rainfall peaks in May and October. The dry season is from December to March. Rainfall data for the four stations in close proximity to the proposed alignment is presented in Table 5.1. Monthly rainfall data for Kingston and St. Andrew is given in Table 5.2, while data for St. Catherine is given in Table 5.3 and the estimated maximum 24-hour rainfall presented in Table 5.4.

Table 5.1: Mean Monthly Rainfall - mm (1951- 1980)

STATION	Months											
	J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Bernard Lodge	33	33	23	38	132	97	66	112	152	231	76	43
Amity Hall	30	33	22	71	114	89	66	102	127	198	76	41
Hartlands	30	33	25	51	112	89	69	102	122	203	76	41
Innswood	36	43	36	64	135	102	71	137	135	239	104	48
Bodles	39	42	49	53	116	99	58	97	159	201	90	53

Source: National Meteorological Service

Table 5.2: Monthly Rainfall Data for Kingston & St. Andrew 1996-2000 (mm)

YEAR	MONTH											
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
1996	34	115	35	73	118	78	70	107	113	189	165	12
1997	51	38	39	39	79	229	27	64	114	160	94	57
1998	82	39	149	39	56	76	158	183	230	317	299	232
1999	101	129	92	58	87	152	76	196	366	233	152	16
2000	55	20	14	82	183	59	82	92	235	179	95	124
Normal (1951-80)	**53**	**49**	**56**	**103**	**180**	**123**	**50**	**168**	**215**	**287**	**187**	**112**
Jamaica Normal (1951-80)	**108**	**85**	**83**	**137**	**225**	**184**	**134**	**181**	**205**	**271**	**185**	**148**

Source: National Meteorological Service

Table 5.3: Monthly Rainfall Data for St. Catherine 1996-2000 (mm)

YEAR	MONTH											
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
1996	44	46	51	85	134	74	75	169	129	237	163	21
1997	60	27	33	31	31	197	50	57	124	133	197	65
1998	58	43	120	73	67	64	104	127	216	280	175	129
1999	45	76	137	27	54	83	93	87	303	214	135	20
2000	23	23	15	46	106	64	55	75	223	115	80	142
Normal (1951-80)	**53**	**50**	**57**	**91**	**171**	**139**	**108**	**138**	**174**	**238**	**121**	**88**
Jamaica Normal (1951-80)	**108**	**85**	**83**	**137**	**225**	**184**	**134**	**181**	**205**	**271**	**185**	**148**

Source: National Meteorological Service

Table 5.4: Estimated Maximum 24-Hour Rainfall (mm)

STATION	Maximum 24-Hour Rainfall @ Return Period (Yrs)			
	10 Yr	25 Yr	50 Yr	100 Yr
Amity Hall	151	181	204	226
Innswood	168	208	237	266
Bernard Lodge	234	298	345	392
Bodles	170	208	236	264

Source: National Meteorological Service

Rainfall intensity-duration-frequency (IDF) curves are available for the Norman Manley and Sangster International Airports. Intensity-duration-frequency (IDF) data and design storm are useful design parameters for the highway, but these curves are not available for the rainfall stations along the Kingston to Bushy Park segment of the highway. Based on maximum 24-hour rainfall and applying the Thiessen Method, the design precipitation volumes for the Rio Cobre and the gullies crossing the highway were estimated and are presented in Table 5.5.

Table 5.5: Design Volumes of Precipitation for the Kingston -Bushy Park Alignment

River	Watershed Area (km^2)	Design Volumes of Precipitation (24 hrs) (mm)			
		1/10 Yrs	1/25 Yrs	1/50 Yrs	1/100 Yrs
Rio Cobre	540.0	204	264	298	338
Town Gully	8.3	230	255	330	378
Salt Island Creek	6.1	230	255	330	370
Cut Throat Gully	7.1	213	260	318	360
Black River East	54.5	213	260	318	360

Source: Dessau-Soprin International Inc 2000

The closest meteorological station to the alignment with evaporation data is the Bodles Station. The evaporation data for this station is presented in Table 5.6. Evaporation data available for Bodles Station reflects average annual evaporation twice the average annual rainfall.

The Norman Manley International Airport is the nearest meteorological station with wind, temperature and relative humidity data. Daytime temperatures average 31^{o}C with higher values from June to September and lower temperatures between December and January. The relative humidity varies from 72 to 79 percent.

The average wind speed at the Norman Manley International Airport Station is 15 km/hr and the wind direction is predominantly east- southeast. The Norman Manley Airport Station is more exposed to south-easterly winds and it is therefore anticipated that wind speeds on the St. Catherine Plains are lower than at the airport.

Table 5.6: Climatic Data

STATION	**Months**											
	J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Ev (mm)	127	148	180	192	198	192	220	183	159	146	129	133
Max. T ^{o}C	30.2	30.3	30.2	30.7	30.9	31.6	32.4	32.4	32.1	31.4	30.8	30.4
Min. T ^{o}C	16.9	16.9	17.3	18.4	19.8	20.6	20.4	20.4	21.2	20.5	19.6	17.9
Humidity	78	76	75	74	76	75	72	76	79	79	78	76
W. S. (knots)	6.7	8.1	8.3	7.7	9.4	11.5	10.8	8.7	7.6	6.1	5.5	6.1

Source: National Meteorological Office. Ev - Evaporation, Max - Maximum. Min - Minimum, T - Temperature, W.S. - Wind Speed.

The maximum 24 hour rainfall associated with the recent flood event (May 22-31, 2002) for the Bernard Lodge, Innswood and Bodles Rainfall Stations were 170.4 mm, 123.5 mm and 213.4 mm, respectively. The rainfall intensity for the Bernard Lodge and Bodles Stations correspond to a return period of approximately 25 years, and less than 5 for the Innswood Station.

5.1.2 Geology and Soils

The entire Kingston - Bushy Park segment of the highway is underlain by Plio-Plistocene alluvium deposit. The alluvium consists of coarse gravel, sand, silt and clays. In general the alluvium changes from a predominantly sandy sequence to predominantly clayey sequence, moving from east to west.

The thickness of the alluvium along the proposed alignment is an average 60 m. Formations belonging to the White Limestone Group underly the alluvium.

The soils along the route are derived from the alluvium and consist of silty-clay and clayey-loam. In general the soils have moderate to low water retention capacity and consequently are fairly well drained. In areas dominated by clay, such as Bushy Park, the drainage is poor.

Underlying the soil horizon, especially in the Bernard Lodge area are significant deposits of high-grade sand. The sand is often mined illegally for use in the construction industry.

5.1.3 Surface Water Hydrology and Drainage

The alignment is located in the southern sub-basin of the Rio Cobre Hydrologic Basin (Figure 5.1). The Rio Cobre is the only major stream along the proposed alignment, but there are a number of gullies and the Black River. There are no tributaries to the Rio Cobre south of the Bog Walk Gorge.

The highway crosses the Rio Cobre in the vicinity of Caymanas Estate (0+900). The drainage area of the Rio Cobre above the crossing with the highway is 554 km^2. There is no recording streamflow station in the vicinity of the crossing of the highway and the Rio Cobre and therefore no continuous record of streamflow is available from this location.

Figure 5.1: Hydrostratigraphy

The Water Resources Authority (WRA) does instantaneous streamflow measurements at this location. However, in excess of ninety percent of the records are for low flow and therefore no record of measured peak flow is available. Water is diverted from the Rio Cobre at Headworks/Angels via the Rio Cobre Dam and Irrigation Canal for irrigation to the St. Catherine Plains and for domestic water to Spanish Town and environs. As a consequence, during the dry season the river becomes ephemeral downstream of Central Village as the low flow is lost to the alluvium aquifer.

The WRA monitors the flow in the Rio Cobre at Headworks after diversion to the Rio Cobre Canal. The average daily flow at this station is 5.5 m^3/sec and the maximum measured peak flow was 183 m^3/sec. The estimated 50 and 100 Year return period peak flow using the Compound Poisson/Exponential Distribution Function Method at this station is 1926 and 2400 m^3/sec respectively (Dessau-Soprin International Inc. 2000). The maximum instantaneous peak flow estimate using the regional frequency analysis for this station is 1316 m^3/sec (Thomas, 1987).

The first 1.3 km of the Kingston to Bushy Park is within the flood plain of the Rio Cobre. This area was inundated by floodwaters during the flood in June, 1969 (Appendix II - Plate 16). Beyond 1.3 km the proposed highway is protected from flooding by the Rio Cobre Dyke which extends from Lakes Pen to Hunts Bay along the west bank of the river.

A number of minor gullies cross the proposed highway. These are from east to west, Town Gully (10+000 km), Salt Island Creek 1 (11+350 km), Salt Island Creek 2 (13+180 km), Cut Throat Gully (18+160 km) and Black River East (18+480 km). The drainage area and the estimated peak flow at these crossings are presented in Table 5.7.

Table 5.7: Peak Flow at Return Periods - Minor Gullies

NAME	WATERSHED AREA (km2)	PEAK FLOW @ CROSSING (m3/sec)			
		10 Year	25 Year	50 Year	100 Year
Town Gully	8.3	30.6	37.3	59.3	74.9
Salt Island Creek 1	2.8	14.2	17.3	27.5	33.5
Salt Island Creek 2	3.3	16.4	20.0	31.9	38.7
Cut Throat Gully	7.1	23.0	33.7	48.4	60.0
Black River East	54.5	138.6	205.6	298.6	371.3

Source: Dessau-Soprin International Inc. 2000

Flow in the minor gullies is sustained largely by seasonal surface runoff, irrigation return flow and stormwater from drains in built-up areas north of the highway. Without flow contribution from irrigation return flow to these gullies, they could be considered seasonal gullies.

The Rio Cobre Irrigation Canal/System, operated by the National Irrigation Commission, crosses the highway at six locations. The irrigation canal transfers water from the Rio Cobre River at the Headworks Dam to the south St. Catherine plains. There will be no significant modification to the existing canal network as a consequence of the highway construction.

The last 13 km (7+000 to 22+000) of the highway alignment traverse cane fields. Irrigation of the sugarcane is done by flooding of the furrows. The excess irrigation water is returned to either of the five seasonal gullies described above.

5.1.4 Groundwater Hydrology

The alignment of the highway between Kingston and Bushy Park is underlain by the Rio Cobre alluvium aquifer as described in Section 5.1.2. The alluvium aquifer is an important source of irrigation water to the St. Catherine Plains and domestic water to Portmore and Spanish Town, and environs. The aquifer is composed of sand and gravel and the average depth to groundwater in the vicinity of the highway is 6.0 m.

The alluvium aquifer is highly vulnerable to contamination from improper waste disposal at the surface, given the relatively shallow groundwater table and the high permeability of the aquifer material. The alluvium aquifer is also vulnerable to saline intrusion. Water quality data from a number of domestic water supply wells tapping this aquifer in the Portmore area have shown elevated levels of sodium and chloride, both indicators for saline intrusion. Over abstraction from these wells may be the cause of saline intrusion.

Underlying the alluvium aquifer is the limestone aquifer. The limestone aquifer is however naturally saline in this general area and therefore cannot be used in its present state for either irrigation or domestic purposes.

5.1.5 Hazard Vulnerability

Flooding as a consequence of extreme rainfall events and hurricanes is the major natural hazard in the study area. The area has a history of flood damage and therefore particular attention must be paid to design for flood-waters. Events of the 1980's and 1990's, as well as the recent events of May 2002, remind us of the need for integrated drainage and hazard impact assessment.

Earthquakes are the other natural element, which the highway design must take into account. The alignment lies outside the most seismically active area of Kingston.

Safety constitutes the third area of concern, as with all construction projects. Technological hazards must be planned for. The alignment lies within a setting of heavy

traffic movement and therefore a traffic safety plan must form a part of construction planning.

Rainfall over the period May 22-31, 2002, caused extensive flooding in St. Catherine and other southern parishes. Flooding was reported in the vicinity of the recently completed Old Harbour Bypass that will connect to this section of the highway. The flooding was attributed to design/construction flaws in relation to hydraulic structures such as bridges and culverts. It is important therefore that lessons learned from this recent experience be incorporated in the design and construction of the highway from Kingston to Bushy Park.

5.1.6 Air Quality

Air quality data collected in 2000 as part of the baseline data collection for the Strategic Environmental Assessment (Government of Jamaica, 2000) showed levels of particulates at Bushy Park to be 1150 ug/m^3 which exceeded the NRCA/USEPA 25 hour standard of 150 ug/m^3. Analysis in the area of Lime Tree revealed much lower levels of levels of 91 ug/m^3. Samples of air quality taken on February 18, 2002 are given in Table 5.8.

Table 5.8: Air Quality Data (February 18, 2002)

LOCATION	**PARTICULATE CONCENTRATION mg/m^3** Actual duration 6 - 8 hrs Results extrapolated to 8 hrs.	**AVERAGE mg/m^3**	**USEPA/NEPA mg/m^3**
4- Way intersection for Greater Portmore, Hellshire, & Spanish Town	0.139875989	0.139876	0.3
Bernard Lodge Compound	0.138821464	0.138821	
Old Harbour Bypass (Ackee Factory)	0.083997795	0.083998	

Key: mg/m^3 - milligrams per cubic meter air

Air quality levels measured at the three sites are presently within the national guidelines and USEPA PM10 standard for ambient air of 0.15 mg/m^3

5.1.7 Noise

Levels of noise determined at Lime Tree and Bushy Park for the Strategic Environmental Assessment (Government of Jamaica, 2000) revealed levels of noise below the NIOSH eight (8) hour standard. Levels of noise detected at three stations along the Kingston to Bushy Park alignment are also within the required limits. The data is given in Table5.9.

Table 5.9: Noise levels detected (February 18, 2000)

LOCATION	NOISE (db)	NIOSH Standard dB(A)	NRCA/World Bank Guidelines dB(A)
4- Way intersection for Greater Portmore, Hellshire, and Spanish Town	65.1	85	70
Bernard Lodge Compound	54.4	85	70
Old Harbour Bypass (Ackee Factory)	64.2	85	70

An illustrative guide for the World Bank Guidelines for levels of acceptable noise is shown in Figure 5.2. This figure shows noise levels in five different categories. The recommended noise levels differ depending on where the road is sited and frequency of use. Busy roads or highways generally have noise limits typical of those for industrial zones, because they carry both domestic and heavy-duty equipment. The baseline noise measurements (Table 5.5) indicate that the area is on average in the noise category for 'busy roads'.

In the Jamaican context the Highway 2000 road corridor will traverse both quiet country-side areas as well as busy towns. The choice of material for the road surface as well as the planting of vegetation along the road verges will help to reduce the impact of traffic noise on those living close to the road network. This is dealt with in more detail in the section under impacts and mitigation.

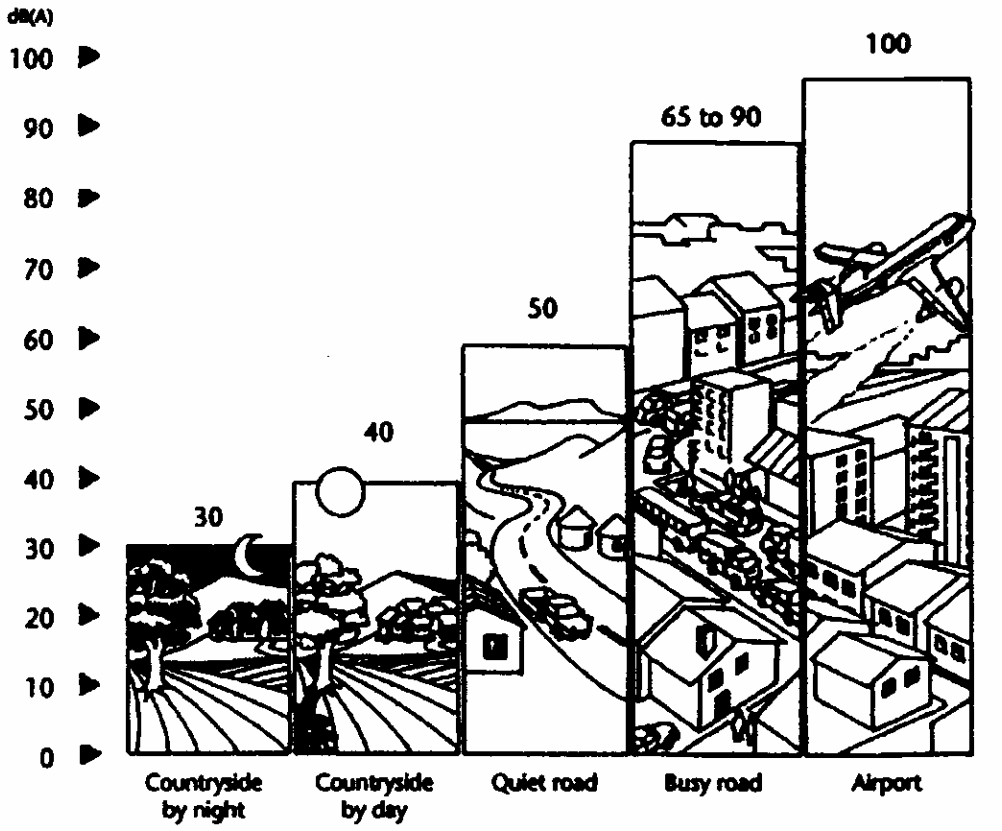

Figure 5.2: World Bank Guidelines Illustration

Adapted from Roads and the Environment: A handbook. World Bank Technical Paper No. 376. 1997.

5.1.8 Water Quality

Water quality determined at three points along the Highway alignment, are given in Table 5.10.

Table 5.10: Water Quality Data for the Rio Cobre, Black River and Coleburn Gully

Parameter	Rio Cobre 0+800	Black River 18+400	Coleburn Gully 21+220	NEPA Standard
pH	7.4	7.3	6.9	7.0 - 8.4
BOD (mg/L)	1	2	1	0.8 - 1.7
DO (mg/L)	5.4	6.7	3.8	-
Temperature ^{O}C	30.1	27.6	29.8	32
TSS (mg/L)	0.5	0.5	1.97	-
Conductivity (mS/cm)	0.522	0.622	0.952	0.15 - 0.60
Chloride (mg/L)	22.4	41.6	70.4	5 - 20
Turbidity (NTU)	13	8	23	-
Nitrate (mg/L)	9.7	7.9	10.6	0.1 - 7.5
Phosphate (mg/L)	0.77	0.61	11.9	0.01 - 0.8
Sulphate (mg/L)	19	34	42	3.0 -10.0
Oil & Grease (mg/L)	3.06	2.66	2.7	-
Total Coliform (MPN/100ml)	∃2,400	460	∃2,400	(90% of sample) < 100
Faecal Coliform (MPN/100ml)	460	11	1100	(90% of sample) < 10
Iron (mg/L)	14	151	240	-
Lead (mg/L)	<20	<20	<20	-

Manganese (mg/L)	<5	13	65	-
Zinc (mg/L)	<5	<5	13	-

Samples of water taken at Coleburn Gully show that at present the system is very stressed from poor water quality. High coliforms, chloride, and phosphate levels were measured at this site, with low levels of dissolved oxygen.

The Rio Cobre station also showed effects of contamination from human or animal excreta evidenced in the elevated fecal coliform levels.

Nitrate and sulphate levels were elevated at all three sites sampled.

Upstream of Spanish Town, effluent from industrial complexes in the Upper Rio Cobre Sub-Basin have caused contamination of the river. In general, with treatment the water quality satisfies potable standards. Below Spanish Town the river is contaminated by municipal waste transported into the river by stormwater drains and sewage treatment plants.

During the wet season the river displays very high turbidity due to high erosion rates in the watershed. The river water quality in both the wet and dry season is generally very poor in the vicinity of the proposed highway.

The proposed highway is expected to impact both directly and indirectly on the Rio Cobre. It is important that adverse impacts be minimized to prevent further degradation in water quality. The Rio Cobre is also a significant source of recharge to the alluvium aquifer and therefore any further degradation in water quality will impact negatively on groundwater resources in the alluvium aquifer. As noted above (Section 5.1.4) the aquifer is highly vulnerable to contamination.

5.1.9 Landscape Attributes and Scenic Vistas

The proposed alignment traverses several acres of sugar plantations and open spaces in St. Catherine, all of which have the potential for scenic views. The Bushy Park Aqueduct, a registered monument under the Jamaica National Heritage Trust Act will be visible to commuters in the vicinity of Bushy Park where the Highway connects and merges with the existing Old Harbour Bypass. Additionally, scenic vistas through sugar cane lands for most of the alignment will be of aesthetic appeal.

5.2 BIOLOGICAL ENVIRONMENT

5.2.1 Vegetation

The vegetation is characterized primarily by modified and secondary communities, and there are no areas of primary vegetation or natural forest which will be impacted by Highway 2000. The modified communities are largely sugar cane plantations (large herbaceous cultures) as well as areas of Mixed Culture and Mixed Subsistence and pasture. Other areas not currently cultivated can be classified as secondary communities, which have formed as a result of invasive species and wasteland which have become vegetated over time.

Between 0+000 and 3+000 the existing road is lined with overgrown vegetation characterised by mature trees with a partially closed canopy and thick underbrush. At 1+000 an interchange is proposed which is south-west of the existing 4 way signalised intersection between the Dyke Road and Greater Portmore Road. The northern side of the intersection is characterised by a large depression which is sparsely vegetated. The southern side is overgrown scrubland.

At 4+750 to 5+000 the proposed Highway crosses the railway and an existing unclassified road. This area is also dominated by overgrown scrubland with open areas along the railway.

Between 7+500 and 11+000 sugar cane plantations of Bernard Lodge Sugar Estate dominate the area. Between 11+000 and 12+000 in the vicinity of Windsor Park land is also owned by Bernard Lodge but is not currently under cultivation. This area is wasteland dominated by the thorny *Acacia sp.* plants. Sugar Cane plantations occur again between 12+000 and 18+000. Between 18+000 and 20+000 thorny scrubland dominated by *Acacia sp*. is interspersed with overgrown scrubland.

The dominant tree species identified using Adams (1971) are given in Table 5.11.

Table 5.11: Dominant Tree Species Identified

Common Name	Scientific Name	Status	Range
Guango	*Samanea saman*	Introduced in many tropical areas and often naturalized	Common in inhabited areas and old pastures, secondary communities
Wild Tamarind	*Pithecellobium arboreum*	Mexico to Costa Rica, Greater Antilles	Widely distributed, mostly in woodlands on limestone
Coolie Plum	*Ziziphus mauritiana*	Native of warm parts of the Old World, now in Florida and the drier parts of the West Indies and tropics	Established and fairly common is some waste places, occasionally forming thickets
Ackee	*Blighia sapida*	Native of West Africa	Commonly cultivated
Banana	*Musa sp.*	Indigenous in the Old World Tropics, now distributed throughout the tropics worldwide	Commonly cultivated
Poincianna	*Delonix regia (Poinciana regia)*	Native of Madagascar, now widely introduced in the tropics	Commonly cultivated and occasionally naturalized
Acacia	*Acacia tortuosa*	Hispaniola, Puerto Rico, Virgin Islands and the drier islands of the Lesser Antilles	Common locally in secondary thickets on arid limeston
Mango	*Mangifera indica*	Native of SE Asia now widely distributed	Cultivated and naturalized, many varieties differing in shape, size, colour, texture and flavour of fruit occur in Jamaica, all have been introduced
Whis/Withe	*Tournefortia hirsutissima*	Florida, continental tropical America, West Indies	Very common as a weed on banks and waster ground and secondary in thickets and woodland margins
Sugar Cane	*Saccharum officinarum*	Widespread in the subtropics and tropics	Abundantly cultivated, mostly at low elevations on level ground in deep soils
Coconut	*Cocos nucifera*	Cultivated and naturalized	Native of the old world tropics
Weeping Willow	*Casuarina equisetifolia*	Native of tropical Asia and Australasia, naturalized in the West Indies and elsewhere	Common, mostly in sandy coastal areas and often planted
Lime	*Citrus aurantifolia*	Native of tropical Asia	Commonly cultivated and naturalized in Jamaica

5.2.2 Fauna

The entire alignment for Highway 2000 between Kingston and Bushy Park is through areas that can be described as cultivated (sugar cane plantations) or disturbed (thorny scrubland, secondary vegetative communities or overgrown shrubland) and some pastureland. These areas can be good for bird watchers and may include commonly occurring birds such as grassquits, kingbirds and doves. Terrestrial birds as well as coastal species were observed. The alignment also runs parallel to the existing railway line which has been in existence for over two hundred years and so there are no areas of primary vegetation.

A list of bird species observed along the Highway alignment, including ecological information, is given in Table 5.12. Of the species observed none are considered endangered or threatened although endemic species were observed.

A review of the distribution of reptiles and amphibians (Schwartz and Henderson, 1991) shows several species having been recorded from the general vicinity of the alignment. None of these species are considered rare or threatened. Table 5.13 gives details on the distribution of the species and their habitats.

Table 5.12: List of birds observed along the Highway 2000 alignment

Common Name	Scientific Name	Status	Range	Habitat
Smooth Billed Ani	*Crotophaga ani*	Common resident	Most Caribbean islands except Barbados, North, Central and south America	Cultivated land, pastures and wet meadows
Northern Mockingbird	*Mimus polyglottos*	Very common resident	Bahamas, Greater Antilles and N America	In gardens, pastures, secondary growth and cultivated areas
Black Necked Stilt	*Himantopus mexicanus*	Common resident	N and S America and West Indies	Salt marshes and shallow coastal bays, fresh and saline ponds
American Kestrel	*Falco sparverius*	Very common resident	*F.s. dominicensis* in Jamaica, Hispaniola and adjancent islands. Also Cuba, other WI islands, N, C, and S America.	All habitats.
Killdeer	*Charadrius vociferous*	Common resident	*C.v. ternominatus* in the Greater Antilles and Bahamas	Sandy areas and short grass
Lesser Yellowlegs	*Tringa flavipes*	Fairly common winter visitor	North America, winter south to South America	Mudfalts
Great Egret	*Egretta alba*	Common resident	*C.a. egretta* in the Bahamas and Greater Antilles, also worldwide	Wetlands
Glossy Ibis	*Plegadis falcinellus*	Rare resident	Worldwide	In flooded fields (of

		and common winter visitor		Mandela Highway near Ferry) and open marshes (near Caymanas)
Cattle Egret	*Bubulcus ibis*	Very common resident	Worldwide	Pastures and open areas
Great Blue Heron	*Ardea herodias*	N, C and S America, West Indies	Common winter visitor	Wetlands
Greater Antillean Grackle	*Quiscalus niger*	Other subspecies in Cuba, Cayman, Hispaniola	Jamaica – endemic subspecies *Q.n. crassinostris*	Cow pastures, cultivated land and around human habitations.
Turkey Vulture (John Crow)	*Cathartes aura*	Common resident	Greater Antilles, N,C and S America	All habitats, found around dead and decaying matter
European Starling	*Sturnus vulgaris*	Introduced and now in large numbers	Many countries worldwide	Lowlands, parks, gardens and pastures.
Yellow-faced Grassquit	*Tiaris olivacea*	Locally common resident	*T.o. olivacea* in Cuba, Hispaniola, Jamaica and Cayman. Other subspecies in Puerto Rico, Mexico C. and S. America	Gardens, grasslands, edges of forests and woods and cleared areas.

Table 5.13: Reptiles and Amphibians Previously Reported from the vicinity of the Proposed Highway alignment

Scientific name	Distribution	Usual Habitat
Eleutherodactylus gossei	Endemic	Sea level to 1000 ft
Eleutherodactylus planirostris	Introduced on Jamaica found in Cuba, Bahamas and other areas of introduction	Semi-aquatic near streams on rocks, shrubbery and ground
Anolis garmani	Jamaica and introduced in Florida and Cayman	Sea level to 4000 ft.
Anolis grahami	Jamaica, introduced on Bermuda	Grazed pastures, well-watered shady gardens, xeric forest, common on trees
Anolis lineatopus	Jamaica	Ranging from open dry areas to dark forest, in shady gardens, second growth, grazed pastures
Anolis valencienni	Jamaica	Sea level to 4000 ft. Second growth forest, xeric woods, open and heavily shaded situations, bushes, fence posts
Aristelliger praesignis	Jamaica, Cayman	Rotten trees, rock piles, old buildings, under large rocks
Mabuya mabouya	South America, Panama, Greater Antilles, Virgin Islands, Turks and Caicos	Primarily xerophilic but also found in mesic situations, under rocks and brush
Sphaerodactylus argus	Jamaica, Cuba, Bahamas, Florida Keys, Nicaragua	Open and heavily shaded situations, bushes, fence posts
Sphaerodactylus goniorhynchus	Jamaica	Sea level to 4000 ft. Heavy forests, xeric scrub, coastal scrub, rotten logs, under rocks
Sphajerodactylus parkeri	Jamaica	Sea level to 750 ft. Xeric wooded hillsides, leaf litter, under rocks
Arrhyton callilaemum	Jamaica	Sea level to 3000 ft. Dry limestone plains to forests, under logs and trash.
Tropidophis haetianus	Cuba, Hispaniola, Jamaica	Open and shaded situations

5.2.3 Parks and Protected Areas

The Portland Bight Protected Area (PBPA) had been earmarked for special protection under the NRCA Act and was declared as a Protected Area under Section 5 of the Natural Resources Conservation Act (1991) on Earth Day, April 22, 1999. The proposed alignment for Highway 2000 will be just within the northern boundary of the PBPA, which is marked by the railway line. The Highway will enter the PBPA in the area south of McCooks Pen/Bridge Pen and will follow the existing railway line until it connects to the recently completed Old Harbour Bypass. These areas are disturbed and degraded and are not considered to be of high ecological significance. Figure 5.4 shows the PBPA Portland Bight Protected Area. The highway is not expected to impact directly on the dry limestone habitat of the endemic and endangered Jamaican Iguana in the Hellshire Hills, the Braziletto Mountains nor the caves at the southern end of Portland Ridge, which provide a habitat for endemic fauna.

Figure 5.4: Portland Bight Protected Area Boundary

5.3 SOCIAL ENVIRONMENT

5.3.1 Land Use and Zoning

The alignment passes largely through lands which have been zoned for agricultural use. Sugar cane cultivation - current and abandoned - with the attendant sugar estate infrastructure is the dominant use.

The highway begins on the Caymanas Estate, which currently provides sugar cane for processing at Bernard Lodge, and uses the existing road network that will be crossed by the Highway alignment.

At the initial stage of the route (chainage 0+000 – 2+000) where H2K intersects the Mandela Highway and the Dyke Road out of Portmore there are major transportation and traffic functions associated with the existing Mandela Highway and Portmore Drive. Mandela Highway is the major artery westward of the Kingston Metropolitan Area, and Portmore Drive connects Greater Portmore, a major residential area, with the Mandela Highway.

The lower reaches of the Rio Cobre traverse this area and H2K will incorporate the existing bridge as it passes to intersect with the Dyke road where there will be a major interchange (Appendix II – Plate 1). Several small informal itinerant vendors are located in this area on the existing Portmore Drive and they will have to be moved. An equipment lot/dump on the northern side of the existing intersection (proposed interchange) with Dyke road leading toward Grange Lane will also have to be relocated. The settlement, Christian Pen, lies between the railroad and Dyke road and the road leading from Christian Pen will intersect at the interchange.

In the vicinity of the interchange construction planning must also take cognizance of a major electrical utility transmission corridor which lies to the west and south of the

interchange and passes farther south through the Dunbeholding to March Pen area.

Considerable illegal dumping is evident along the road to Grange Lane. A closed major waste disposal facility was located at Lakes Pen in close proximity, and trucks seem to continue to bring refuse to the general area. Management of construction debris must ensure that dumping is not exacerbated along this route.

Between chainage 2+000 and 3+000 are significant horticultural enterprises, which occupy land previously part of the Agro 21 farm holdings (Appendix II – Plate 8). Intensive cultivation of foliage was evident under large shade houses, and a smaller operation growing coffee seedlings is also present. The alignment will pass through or immediately adjacent to these plots.

Sand mining believed to be illegal was also evident, and close monitoring of the source of materials for H2K construction is essential as sand mining from this area increases the flood risk on the Rio Cobre floodplain.

Between chainage 3+000 and 4+000 the alignment crosses degraded cane fields some of which are covered with guinea grass that is reaped for livestock, and small farming plots of scotch bonnet pepper and callaloo.

South of the train line in the vicinity of Grange Lane are approximately ten dwellings . The alignment crosses the railroad and an irrigation canal. The Lakes Pen dump in this area has been abandoned and covered by the solid waste management authorities.

At approximately chainage 6+000 the alignment passes close to the entrance of the Bernard Lodge Factory operations (Appendix II – Plate 10), and intersects the main road from Lakes Pen to Naggo Head and to Bernard Lodge residential areas. This major intersection is heavily travelled by estate trucks, tractors and other vehicles.

A domestic well operated by the National Water Commission is in the area of Lime Tree settlement. Maintaining access with minimum disruption is a major issue for this area. The alignment passes through the cane lands of the Sugar Co. of Jamaica in the Bernard Lodge Estate area. Cane carts and trucks are regular aspects of traffic. The alignment crosses the Dunbeholding road (7+000) which carries commuter traffic between Braeton and Spanish Town. The Tamarind Farm Prison and farm are located in this area as well. Estate operations including irrigation lines are major considerations and field connectors are required.

On the Windsor Park lands (10+000 – 13+000) the alignment splits the Estate and therefore connectors to facilitate operations will be required. Some fifteen dilapidated units were located close to the alignment at about 12+000, and these will probably have to be moved.

The alignment travels just south of the railroad in the vicinity of Hartlands. North of the railroad is the White Water Housing estate and expansion of the estate is proposed for the area. The alignment crosses the road connecting Chedwin Park (on the main east west corridor) with the Hartlands property to the south.

The alignment travels adjacent to the railroad and the transmission corridor 14+000 to 18+000 through active cane plantations. Field connectors will be provided to facilitate continuing operations of the estate and the service road maintained for utility company operations.

At 18+000 the alignment crosses the Black River (Appendix II – Plates 13 and 14) just before entering the Cherry Gardens Estate which has pasture and dairy operations. Land acquisition will be required in this area. The alignment connects with the Old Harbour Bypass at Bushy Park to the west of Cherry Gardens Estate.

The Spanish Town Interchange will be sited to the west of Salt Island Road in an area currently under sugar cane cultivation. A six-lane Toll Plaza will be sited on the north-south link, which will connect the interchange to the existing round-about at Spanish Town.

The major issues relate to crossings for economic and social rights-of-way. Where the alignment intersects working units on sugar estates, movement of equipment and crop must be facilitated. Irrigation channels must be maintained to service the water needs of the farms.

In summary, the greater part of the alignment will utilize lands that are currently under sugar cane cultivation. These are in the areas at 7+500 to 11+000, 12+000 to 18+000 – Caymanas, Bernard Lodge, Windsor Park, Hartlands, Innswood, McCook's Pen and Bushy Park. Other areas, between 11+000 and 12+000 are sugar cane lands currently out of production and now thorny scrubland dominated by *Acacia sp*. Between 18+000 and 20+000 thorny scrubland also dominates.

5.3.2 Land Acquisition

The Highway corridor was selected using the least constraining methodology. This method sought to minimize the number of parcels of land being crossed and to maximize on crossings of large parcels, particularly those that are state owned. Land Acquisition is currently the responsibility of the National Roads Operating and Constructing Company Ltd. (NROCC), a government agency. Within the segment Kingston to Bushy Park, 117 parcels of land will be crossed. Approximately 90% of these are state owned properties with the major owners being the Urban Development Corporation and the Commissioner of Lands. Acquisition of land is currently in progress, and is being conducted in accordance with the laws of Jamaica.

5.3.3 Population

The alignment will travel from the periphery of the Kingston Metropolitan Area (parishes of Kingston and St Andrew) through the parish of St Catherine. Together the KMA and the Parish of St Catherine accommodate the largest agglomerations of population, representing over 60% of the island's population. KMA, Portmore, Spanish Town and environs are the largest settlements. The first phase of the Highway will therefore be available to serve the single largest concentration of the Jamaican population in the adjacent areas of the Kingston Metropolitan Area and St. Catherine.

The last census of population was completed in 1991 and population estimates are available for subsequent periods through the Statistical Institute of Jamaica (STATIN) and the Social Development Commissionwhich has utilized STATIN projections to develop Parish Profiles. The population characteristics for the H2K alignment under study will be presented by parish.

5.3.3.1 Kingston and St. Andrew

General Population Characteristics

The parish of Kingston and St. Andrew account for an estimated 43.0% of the total population of Jamaica (Profile of St. Andrew, SDC, 1997). Kingston is designated fully urban, but St. Andrew has an urban and rural population mix, with the urban segment accounting for 86.0% of the parish's population. The rural rate of increase is however higher then the urban rate, 35% and 22% respectively (Parish of St. Andrew, Population Census, 1991). This higher rate of increase may be attributed to rapid urbanization and a shift in the population of Kingston and St. Andrew outwards from the city centre to peri-urban areas. Inter-parish movement also contributed significantly to the increased population growth rate of St. Andrew (Profile of St. Andrew, SDC, 1997).

During the period 1970-1991, the population of St. Andrew grew by approximately 19%. In 1970, 361,800 persons lived in urban St. Andrew, compared to 420,000 and 440,000 in

1982 and 1991, respectively (Parish of St. Andrew, Population Census, 1991). The population density in 1991 was 1,185 persons per square kilometre (Profile of St. Andrew, SDC, 1997).

Table 5.14 Population Size and Growth, St. Andrew (1970 - 2000)

Census Year	Population			Rate of Growth % per annum	Sex Ratio
	Total	Male	Female		
1970	413,300	192, 500	220,800	3.39	87.18
1982	482,900	225,200	257,700	1.31	87.39
1991	510,400	238,000	272,400	0.62	87.37
2000	603,642 (est)	-	-	1.25	-

Source: Population Census, St. Andrew 1991

Age Structure

The population profile for this parish reflects a young age structure, with the highest proportion of the population under the age of 30 years. This may be attributed to a high fertility rate for the period 1971 to 1982. However, in recent years, the population has been ageing with a corresponding decline in fertility rates. In 1995, St. Andrew had the lowest average fertility rate of 2.0. (SDC Parish Profile, 1998).

Migration

Rural urban migration accounts for a significant proportion of the population growth in St. Andrew. Between 1982 and 1991, internal migration into the parish stood at 49,679 of which 30,754 were females (SDC Parish Profile 1997). In-migration from the rural hinterland is expected to continue as persons seek expanded economic, social and educational opportunities.

5.3.3.2 St. Catherine

General Population Characteristics

The population of St. Catherine increased by 36,600 in the intercensal period 1982-1991. While the parish experienced modest growth rates prior to the 1970's, the period between 1970 and 1982 was one of rapid growth due mainly to the development of dormitory communities in Portmore and new residential areas in Spanish Town. This trend continued into the 1990's, with the construction of new housing units and the potential for more persons to acquire houses. The rapid population growth rate is also attributed to a steady drift of persons from Kingston into these new residential areas.

Table 5.15 Population Size and Growth, St. Catherine (1970- 2000)

Census Year	Population			Rate of Growth % per annum	Sex Ratio
	Total	Male	Female		
1970	180,400	88,800	91,600	1.63	97.0
1982	332,600	163,000	169,600	5.23	96.1
1991	369,200	180,000	189,200	1.17	95.1
2000	438,640	-	-	1.55	-

Source: Population Census, St. Catherine 1991

Although the largest parish in Jamaica, St. Catherine is densely populated. The parish accommodates almost 20% of Jamaica's population, and has a density of 337 persons per square kilometer (Profile on the Parish of St. Catherine, SDC, 1997).

Seventy percent of St. Catherine's population lives in areas designated urban. The expansion of the urban population is concomitant with a decline in population of the rural areas characterised by slow growth and development. Apart from Spanish Town and Portmore, other areas have experienced increased population growth rates. These include Old Harbour, Linstead, Bog Walk, Ewarton, Above Rocks, Point Hill and Lluidas Vale.

Old Harbour's population moved from 5,097 in 1970 to 17, 778 in 1991. The town continued to grow at a rapid rate throughout the 1990-2000 decade, and the estimated population in 2000 was over 27,000. Old Harbour has exceeded its absorptive capacity, and signs of urban decay are evident. Rapid increase in traffic led to significant congestion into and out of the town centre, thus emphasizing the need for a traffic artery to circumvent the town centre.

Age Structure

The youngest age groups (0-29) in St. Catherine account for the highest proportions of the population, a factor which is attributed to the high fertility rates of the past decades. In 1970, the under 15 age group comprised a significant proportion of the population, almost evenly distributed between males and females (Table 6.6). However, as the population ages, the ratio between male and female widens by about 5%.

Migration

The rapid expansion of the housing stock in St. Catherine is the main pull factor accounting for several waves of in-migration over the last three decades. From 1982-1991 the parish absorbed over 40,000 persons, of which 22,704 were females (SDC Parish Profile, 1997). During this period, St. Catherine became the host parish for migrants from all parishes, but the greater influx came from Kingston and Clarendon. The net gain of immigrants from Kingston was 40%. Out-migration which occurred simultaneously with in-migration stood at over 17,000, with the most persons moving to the adjoining parishes of St. Andrew and Clarendon.

5.3.4 Traffic, Transportation and Access Roads

5.3.4.1 Access to Highway 2000

Highway 2000 will be operated as a closed system toll highway. Access to the Highway between Kingston and Bushy Park will be limited to the following points:

- From Mandela Highway Interchange at 0+000
- From Portmore Causeway Interchange and Bridge at 0+ 1+500 (in 2004)
- From Spanish Town Interchange at 7+450 or further west at 11+000
- From Bushy Park Interchange at 22+000

The Bushy Park to Sandy Bay segment of Highway 2000 involves the recently completed Old Harbour Bypass, which will connect at the Bushy Park interchange.

5.3.4.2 Railway

The cessation of the railway service from Spanish Town to Kingston in 1993 dealt a blow to the public transport system, and caused hardship for transport of agricultural goods to markets. Proposals to restore rail service have been reviewed and discussed. Highway 2000 will not sterilise the railway, and highway design has taken account of the potential need for crossings. Within the Kingston to Bushy Park section a rail crossing will be in the vicinity of Grange Lane at 5+000. The alignment runs parallel to the railway from approximately 13+175 to beyond the connection with the Old Harbour Bypass at 22+000. Rail bridge crossings, which facilitate drainage and stormwater run-off, must be aligned with drainage structures for the Highway 2000 alignment, so as to optimise drainage capability in the respective areas.

5.3.4.3 Traffic and Crossings

During the construction phase it is expected that traffic flow will be disrupted in areas where the Highway crosses, merges or connects with existing roadways. These will be at the following points (see Figure 1.1):

- Mandela Highway at 0+000
- Dyke Road west of existing four way intersection in Christian Pen area 1+500
- Dyke Road in the areas of Lakes Pen/Grange Lane at 4+950
- B Class Roads through Bernard Lodge Estate at 6+250, 8+100 and 10+650
- Unclassified roads through sugar cane plantations at 8+100, 8+500, 9+000, 12+350 and 13+000
- B Class Road in Hartlands at14+000
- Unclassified roads at 17+100, 18+800, 19+250
- Unclassified roads in Cherry Garden at 21+000

The highway will cross the major east west corridor from the KMA to the western parishes of the island, and an interchange will be provided to facilitate access. This area of the H2K is densely travelled by commuter and commercial traffic.

The alignment will cross a number of local routes, and crossings as described above, have been provided so as to minimize dislocation. Reference is made above in Section 5.3.1 (Land Use and Zoning) to the traffic and transport communication requirements of the sugar cane /factory operations, and the several road crossings associated with small settlements in the area. Existing roads crossing the Highway, railway crossings, pedestrian and farm crossings, including field connectors will be designed and constructed as grade separated crossings.

Crossings will be provided at the following areas:

- Interchange ramp on Mandela Highway at 0+300 and 1+800
- Field Connector at 2+650 (estate)
- Local Road at 4+800 (Lakes Pen Road)
- Railway at 4+800 (Grange Lane Area)
- Local Road at 6+250 (Naggo Head Road)
- Interchange Ramp at 7+400 (Salt Pond Road to Braeton in the south)
- Field connector at 8+100
- Local Road at 10+800 (Salt Island Road to Hill Run in the south)
- Field Connector at 12+350 (estate)
- Local Road at 14+000 (Hartlands Road)
- Field Connector at 17+100
- Local Road at 21+000 (Bushy Park Intersection)

5.3.4.4 Bridges

Bridges over streams and gullies have been provided at the following points:

- Town Gully at 9+900
- Salt Island Creek 1 at 11+350
- Salt Island Creek 2 at 13+200
- Cut Throat Gully at 18+150
- Black River at 18+420
- Coleburn Gully at 21+200 (already constructed and to be modified to connect to the Old Harbour Bypass)

5.3.5 Infrastructure

5.3.5.1 Irrigation canals

In St Catherine, large farms, mainly in sugar cane, use approximately 80% of all irrigation water (Appendix II – Plate 15). Seven projects have been identified in St. Catherine and these developments should see increases in sugar cane, fish and vegetable production. The demand for irrigation will increase and future requirements are projected at 330Mm^3/yr.

The Highway crosses several irrigation canals at the following points:

- 3+800
- 5+000 (parallel to railway line)
- 7+400 (parallel to B Class road)
- 8+150 (parallel to Unclassified Road)
- 2+500
- 13+750
- 20+400

The irrigation system is critical to agricultural activity on the St. Catherine plains – crops, livestock and fish farms. Water is diverted from the Rio Cobre at Headworks Dam to the National Water Commission Treatment Plant at Spanish Town and via the Rio Cobre Irrigation Canal for irrigation on the plains. The National Irrigation Commission operates the dam and irrigation system known as the St. Dorothy irrigation system.

5.3.5.2 Utilities

Utilities, including telephone and electricity networks, occur along the length of the proposed alignment. Where the highway crosses these networks structures will have to be relocated. All negotiations with the utility companies are being carried out by the National Roads Operating and Constructing Company (NROCC).

5.3.6 Business Enterprise

The major business entities have been identified as agriculture based and there is one manufacturing entity. The agricultural entities include:

- Sugar Company of Jamaica which includes several properties
- Ashman Food Processing (at the junction with the Old Harbour bypass) which processes ackee for export, and is the largest and first factory to be certified for export to the lucrative United States market.
- Horticultural Enterprises west of Christian Pen
- Small farms with pepper, callaloo, guinea grass etc.
- Cherry Gardens Dairy/cattle farm

The manufacturing entity is Agricultural Chemicals Ltd.

The only itinerant vendors evident were located close to the Dyke road interchange.

5.3.7 Solid Waste Management

The Riverton Landfill is the official solid waste disposal site for the KMA and parishes of St. Catherine and Clarendon. The former Lakes Pen dump has been officially closed and covered. Spoil and waste generated by works on the project need to be appropriately disposed of. Solid waste is illegally dumped along sections of the alignment, particularly between 0+100 and 4+000. This material will have to be cleared.

5.3.8 Proposed Developments

The Kingston to Bushy Park section of Highway 2000 will connect to the recently constructed Old Harbour Bypass to create a toll Highway linking Kingston to Sandy Bay. Upgrading of the Portmore Causeway and construction of a new bridge will connect to the Mandela Highway/Portmore interchange. A subsequent phase of highway development will involve the extension of the alignment from Sandy Bay to Williamsfield. The Williamsfield to Montego Bay, and Bushy Park to Ocho Rios segments will complete the cross-island toll road. Several projects and developments are envisaged, access to which will be facilitated by Highway 2000.

Development of tourism on the south coast of Jamaica is expected to benefit from the improved intra-island transport link provided by the toll road. Shipment of agricultural produce, particularly sugar cane, is also expected to benefit from time-savings in transportation.

5.3.8.1 Millennium Projects

Highway 2000 is expected to serve as a catalyst for several Millennium Projects. Proposed development includes housing, industrial development, tourism development and new transportation facilities. The following are the millennium projects:

- ***New Town, Clarendon:*** This town will be built on 9,000 acres of land in Clarendon, eight miles east of May Pen and two miles west of Old Harbour. This project is designed to include all infrastructure necessary for ideal living, including different types of residences, farm land, industry, commerce and recreation. International competition was held for the design of the New Town and the design company selected in February 2002.
- An ***Outlet Mall*** featuring a large retail, dining and entertainment facility is to be built near to the New Town

- ***Multi-Purpose Stadium:*** This stadium, also to be located close to the New Town, will be able to host a number of sporting events, and accommodating 65,000 seats. A 250-room hotel will also be included.
- ***Vernam Field Airport:*** An international passenger and cargo airport, with warehousing is to be situated on 800 acres close to the New Town.
- ***Four Industrial Parks***: Each park will provide 800,000 sq ft of factory space. One of these parks will be located at the New Town.
- ***Milk River Spa and Resort:*** Expansion of existing facility into spa, health institute and 300 room hotel, with private and public bathing pools.

5.3.8.2 Other Developments

Other projects listed but not detailed include:

- Infomatics Park
- Beaches Whitehouse Hotel (currently under construction)
- Port Royal Re-development,
- Gunboat Beach Development,
- Rugby Lime and Minerals, and
- Expansion projects in the bauxite/alumina sector.

Housing

Several housing developments by the National Housing Trust (NHT) are planned or underway in this corridor. They include:

- Hansen Home, St Catherine
- Bernard Lodge, St Catherine
- Twickenham Park, St Catherine
- Longville H/D, Clarendon
- Mineral Heights, Clarendon
- Monymusk, Clarendon
- New Yarmouth, Clarendon

Toby Heights, Clarendon, is another development planned. 186 ha at Toby Abbots Pen is being developed into 414 lots, and will include such amenities as a trade school, police station, post office, banks, retail and commercial activity and a central sewage system.

Industrial Developments and Industrial Parks

Several industrial parks and centres are being planned which will fall close to the corridor of Highway 2000. Most of these are within the Kingston to Spanish Town industrial axis and include:

- Special Economic Zone, Hellshire.
- Free zone on 100 acres of land allocated by the UDC.
- Special Economic Zone, Ariguanabo lands, Spanish Town. Space reserved for 36 factory buildings of 30,000 sq ft each.
- Shenzhen Economic Zone of Jamaica, Spanish Town. Export Free zone with facilities for the warehousing, consolidation and transhipment of manufactured goods, mainly from Asian countries. Will include a Retail Franchise outside of the Freezone.
- Caymanas Industrial Estate, Cow Park, Portmore.
- An industrial complex with 400,000 sq. ft. of factory space.
- Portmore Infomatics Park, St Catherine. A new Free Zone offering state-of-the-art communications technology and services to investors.
- Ferry Industrial Centre, Mandela Highway, Kingston. Over 1.5 million sq ft of factory space and related infrastructure for light manufacturing and assembly industries.
- International Marine Dock and Transport Facilities. A major marine dock and servicing facility on the south coast offering repair services, transhipment etc.

5.3.8.3 Transportation

In addition to the Millennium Projects, three major transportation projects are planned.

(1) Mandeville Airport - In addition to the proposed rehabilitation of Vernam Field, the Mandeville Chamber of Commerce has proposed to construct a new airport complex on a 195-hectare site at Albion, south east of Mandeville. Albion is the location of the Alpart bauxite storage facilities. Nearby mined-out bauxite lands have been identified for the project. The runway will be capable of accommodating 50-passenger turbo-prop aircraft and medium-sized business jets. The initial length will be 1,676 m (5,000 ft.), with provision to extend it to 2,134 m (7,000 ft.). The complex will also include an industrial park for light manufacturing and other commercial activities; a JDF camp to replace the Foster Barracks at Mandeville; and, a municipal cemetery to serve Mandeville and the surrounding region.

(2) Interchange Ramp at 19+500 to 19+900 to connect to another phase of Highway 2000 linking to Ocho Rios

(3) Upgrading of the Portmore to Kingston Causeway and Bridge and Interchange Ramp at 1+500

5.3.8.3 Other Infrastructural Developments

A marine dock and servicing centre for commercial activities such as ship repair and trans-shipment, as well as complementary services for the existing Port Bustamante facilities and Vernam Field. Development of the dock will induce other development such as a power generating station and cruise ship facilities. Highway 2000 is expected to facilitate and enhance these development initiatives.

5.3.9 Archaeological and Cultural Heritage

Jamaica has rich architectural and archaeological resources that reflect the colonial and modern history of the country. There are valued aboriginal, natural, cultural and industrial sites. St. Catherine is considered Jamaica's most historic parish as it was here that the Spanish colonists first settled in the 1500's. The Jamaica National Heritage Trust (JNHT) has provided a compendium of 'Listed Sites' to be found along the Highway alignment (Table 5.16). The Grid References are incomplete, as the precise location of some of the sites is not yet known. However, this data will become available if a detailed archaeological survey is commissioned by the JNHT.

Table 5.16: Listed Sites along the Highway 2000 Alignment, Kingston to Bushy Park

Location	Grid Reference	Nature of Site	Description
Windsor Park	N/A	Archaeological resources possible	N/A
Bridge Pen	N/A	Archaeological resources possible	Spanish bridge reported from area.
Bernard Lodge Lime Kiln	156200 E 142800 N	Sugar Estate/Lime Kiln	1918 sugarcane estate sited on former Dirty Pit Pen. Old sugar works & possible burial sites. Anglo-Jamaican influence. Lime Kiln.
Cherry Gardens	N/A	Sugar estate	Sugar, banana, cattle production in 18th Century. Vernacular Estate Houses.
Bushy Park Aqueduct	242800 E 142800 N	Aqueduct	Sugar, bananas, cattle production in 18th Century. Vernacular Estate Houses. Aqueduct is a Declared Monument.

Source: Jamaica National Heritage Trust, 2002

5.3.10 Sourcing and Storage of Earth Materials

The earthworks quantities required for the highway construction is approximately 65 m^3 per km. The material will be obtained from registered and/or certified sources. The backfill materials will mainly be obtained from licensed limestone quarries in close proximity to the site. Storage will be on sites on which the top-soil (first 20 cm) has been removed. This top-soil will be replaced after removal of the stored material. Heights and slope gradients will be within standard limits. Fugitive dust will be minimised by regular sprinkling and addition of chalky material. Berms will be established to prevent wash down of material in the event of heavy rainfall.

5.3.11 Construction Camp Site

The exact location of the construction campsite has not yet been determined. A site will be selected, that will be in close proximity to the proposed alignment. The camp site will be organised with specific zones for container offices, maintenance, power and water supply, solid waste collection, traffic (vehicular and pedestrian), car park, and stockpiling of earth materials. Solid waste will be sorted and removed by licensed contractors. Waste-water will be piped into a septic tank which will be emptied on a regular schedule. Fugitive dust will be minimised by regular sprinkling of stockpiled earth materials. Machinery and equipment will be certified and regularly maintained to ensure minimal release of toxic emissions and particulate material.

6.0 DETERMINATION OF POTENTIAL IMPACTS AND RECOMMENDATION OF MITIGATION MEASURES

This section identifies the potential impacts and suggested mitigation measures as related to the Kingston to Bushy Park segment of Highway 2000. Findings of the assessment are presented according to site preparation, construction and operation phases. The impacts will be determined as significant positive or negative, direct or indirect, long term or short term. As indicated in the Terms of Reference (Section 1.5) special emphasis has been placed on the following:

- Flora and Fauna
- Plant and animal communities immediately outside the project corridor
- Noise and Air Quality
- Waste Disposal (construction spoil)
- Sourcing and Storage of Earth Materials
- Hazards and Risks (flooding, health and safety, accidents)
- Relocation/Resettlement
- Potential Loss of Economic Activity/Local businesses
- Loss of agricultural lands
- Community disruption
- Crossings and access
- Traffic Flow
- Interchanges and Toll Plazas
- Public Sentiment
- Existing Enterprises
- Proposed Developments
- Archaeological and cultural heritage
- Aesthetics and amenity

It is important to note that during the process of the Strategic Environmental Assessment described in Section 1.2, various alternatives to the proposed route were considered in order to optimize the alignment along the entire length of the highway, and to minimise negative environmental impacts. In the Kingston to Bushy Park section, three alternatives were considered between chainage 0-20 km, and these are shown in Box 6.1 below, along with the selection of the preferred alignment.

Box 6.1: Consideration of Alternatives

(Source: National Development Bank of Jamaica Ltd. SEA Vol. III, 2000)

Mandela Highway to Bushy Park Junction (0-20 km)

(Functional Planning Drawing P001)

Alternative A: From Six Miles, north of Gregory Park, south of Spanish Town, through the areas of Dunbeholding and March Pen, Hartlands and Amity Hall going north toward Cherry Garden. Significant geotechnical and environmental challenges through the Rio Cobre floodplain as well as minimal ability of the highway to attract local traffic.

Alternative B: Generally following the existing railway corridor, skirting to the south of Spanish Town just north of Bernard Lodge. Significant property constraints through Gregory Park, geotechnical challenges through the Rio Cobre floodplain and challenges in connecting to Spanish Town Road.

Alternative C: From the area of Ferry, through Christian Pen, Bernard Lodge and south of Spanish Town, south of McCook's Pen, crossing Cut Throat Gully, Black River and Coleburns Gully.

Preferred alignment: Alternative C. Minimal geotechnical, physical, and property issues.

Additionally, the alignment as presented in the Outline Design has been further improved by a shifting of the alignment for the Spanish Town Bypass (between chainage 4+000 km to 14+000 km) northward (Figure 1.2). Issues as related to the physical terrain, ownership and land use remain the same. The number of structures also remains the same. This proposed alignment is an improvement over that presented in the Outline Design in that it reduces the potential disruption to sugar cane cultivation by eliminating the creation of small non-viable portions of land north of the highway, as the alignment runs much closer to Spanish Town.

The Spanish Town Interchange will be sited to the west of Salt Island Road in an area currently under sugar cane cultivation. A six-lane Toll Plaza will be sited on the north-south link, which will connect the interchange to the existing round-about at Spanish Town. A more easterly location had been previously considered but was not feasible as commuters traveling from Kingston to Ocho Rios would begin on the highway and then connect to the existing Spanish Town Bypass, resulting in no gain in travel efficiency. A more westerly siting of the interchange allows commuters traveling from the east and the west, and wanting to go north, to connect to the existing round-about at Spanish Town. This will also help to alleviate the current problems of congestion now occurring on the Spanish Town Bypass.

Potential negative impacts of the entire Highway 2000 Project, and recommended mitigation measures, were determined in the Strategic Environmental Assessment and are presented in Appendix III for reference.

6.1 ALIGNMENT

The alignment for Highway 2000 was determined using several criteria and utilising the least constraining methodology. Optimisation of the alignment was carried out through the consideration of alternatives during the Functional Planning stage (Government of Jamaica, 2000 – Volume III).

- **Over existing springs**

The Highway crosses several gullies and streams and one major river as identified in Section 5.1.4.1. Drainage structures have been designed to ensure continuous flow thus preventing ponding and flooding. A 100-year return period has been used for major structures and the overall drainage system has been designed to accommodate flash floods and catastrophic events which characterize the area.

- **Through sugar cane plantations**

The main plantation to be affected by the Highway is the Bernard Lodge Estate. The Highway will cross land currently under cultivation as well as areas not currently in crop, and which have become overgrown. These lands offer minimal engineering challenges because of the topography.

- **Through existing vegetative stands**

Vegetative stands are all modified vegetation including scrubland and wasteland. There are no stands of primary vegetation are along the current alignment.

- **Where infrastructure exists**

The extensive St. Dorothy irrigation network exists in this agricultural area. Culverts to be constructed under the roadway will maintain the service of irrigation canals.

- **Where land has to be acquired**

Land acquisition for the required acreage is the responsibility of the National Roads Operating and Constructing Company (NROCC). Negotiations have been underway with land owners regarding acquisition.

- **Railway crossings**

The Highway will cross the existing railway line. The railway will not be sterilized but a grade separated crossing will be provided in the form of a bridge to allow for passage of trains, in the event of rehabilitation of the railway service.

- **Agricultural roads and existing local roads**

Points have been identified where the Highway will cross or intersect with agricultural or local roads (Section 5.3.4.3). Two of these are the Mandela Highway and the Dyke Road at which Interchange Ramps will be constructed. Four field connectors will be provided to facilitate passage of agricultural and other vehicles through the sugar cane plantations (Section 5.3.4.3) and five crossings will be constructed to maintain access with existing local roads.

- **Archaeological and cultural resources**

Five areas have been identified by the Jamaica National Heritage Trust as having potential archaeological and/or cultural resources. The Bushy Park Aqueduct is at Grid Reference 242800 E/142800 N and is close to the area where the Kingston to Bushy Park segment will connect to the existing Old Harbour Bypass. The Aqueduct is a Declared Monument The Bernard Lodge Lime Kiln on the Bernard Lodge Sugar Estate is a Listed Monument. The areas of Cherry Gardens, Windsor Park and Bridge Pen are noted for their possible archaeological and cultural information, which has yet to be verified.

6.2 SITE PREPARATION, CONSTRUCTION AND OPERATION PHASES

6.2.1 Natural Environment

6.2.1.1 Hydrology and Drainage

Hydrology and drainage are the most significant considerations for the Kingston to Bushy Park segment of the highway. As noted in Chapter 5, storm run-off and irrigation systems require careful engineering. The natural drainage is north to south and the highway alignment is east to west. Inadequately designed hydraulic structures could result in impact to the highway, existing infrastructure and properties adjacent to the highway. The other potential impacts of the proposed highway are:

- Direct Impacts
  - Ponding
  - Soil Erosion
  - Pollution
  - Water Supply
- Indirect Impacts
  - Pollution
  - Water Demand and Supply

Impacts relate to the high volume events (major drainage) as well as to drainage requirements for run-off from more frequent events (minor drainage).

Site Preparation and Construction

Impact

The potential impacts on drainage relate to changes in runoff pattern and volumes due to changes in topography and/or modification to stream channel morphology. The proposed highway crosses the Rio Cobre River, the Town, Salt Island Creek (two crossings), Cut Throat Gully and Black River East. The paved surfaces will result in the reduction of

percolation of water through the soil at the level that currently occurs in agricultural lands. This will result in an increase in terrestrial run-off into gullies and streams and a reduction in aquifer recharge. Flooding from the Rio Cobre could impact the first 1.3 km of the highway. It is expected that run-off will increase from both the more frequent minor events as well as the major events.

Mitigation

Surface drainage design considers both the major and minor systems. The major system is the route followed when the minor system is exceeded. The engineering design has used the 100-yr. event as design criterion for major drainage, including bridge openings, to accommodate flash floods and catastrophic events, which typify the area. Storm water runoff (more frequent events) will be handled by curbs, channels, catch basin inlets, storm sewer\s, minor swales and roadside ditches. These have been designed to prevent ponding and flooding of the highway and adjacent properties.

The guiding principles for the design of the highway in relation to drainage are:

- Stream channel modification will be avoided as much as possible except where such modification will reduce potential impacts
- All bridges and culverts over 5.0 m in total opening width are designed to pass the 100 year storm with a minimum freeboard of 1.0 m between lowest point on bridge and high water level.
- Culverts under 5.0 m opening width are designed to pass 25-yr storm with minimum 600 mm freeboard between the edge of the road and high water level during 100-yr storm event.
- Scour protection will be provided where necessary.
- Highway profiles must be consistent with major drainage to enable free flow.
- In-stream erosion control measures will be applies where necessary.
- Railway bridge opening must be aligned with the highway drainage system.

The springs and streams that currently run under the road must be allowed to maintain their channels, and design must ensure that there is no blockage.

If these principles are adhered to, the potential for flooding, as a consequence of the highway construction, should be negligible.

Using flood waters for artificial recharge of aquifers must be carefully considered as clay layers occurring close to the surface will retard downward percolation and concentrate water close the surface. Construction of a spreading area to facilitate artificial recharge would also be costly in terms of diversion and land availability.

Operation Phase

During the operation phase the mitigation measures incorporated in the engineering design should prevent problems of ponding and improper drainage on the Highway. Scheduled inspections and maintenance of these drainage channels is critical.

6.2.1.2 Hazard Vulnerability

Site Preparation and Construction Phase

Impact

Flooding is the major natural hazard to be encountered by construction of the highway, and the major impact is derived from the effect of extreme runoff on the site. The area through which the alignment passes is prone to extreme events, which generate high water levels in gullies and rivers. The major river is the Rio Cobre which is crossed by a bridge in the vicinity of the Dyke road, which itself runs along the dyke protecting the surrounding floodplain from high water levels. Ponding of the flat sugar cane lands is common as sugar cane lands are dissected by irrigation furrows which distribute water throughout the fields. High rainfall contributes to ponding and waterlogged conditions which can hamper site preparation and construction activities.

With respect to man-made/technological hazards, accidents can occur as a result of construction activities directly on-site and as a result of activities off-site, such as transportation of equipment and materials.

Mitigation

Design of bridges, culverts and drainage channels have taken account of the 100-year event and the channels are therefore expected to handle the flood flows. Section 6.2.1.1 describes the drainage systems expected to mitigate flooding potential.

Site preparation and construction schedules should take account of the traditional rainy season in May and September-October, making note, however, of the hurricane season June to November, which sometimes brings heavy rains. Extraordinary tropical systems have also caused problems of supersaturation, so that schedules should factor the eventuality.

Crossings of major irrigation canals should also be planned to take account of the rainy season.

A safety management plan including traffic handling and equipment management procedures should be developed as part of the construction scheduling.

Operation Phase

During the operation phase the mitigation measures incorporated in the engineering design should prevent problems associated with hazards. Safety is a major consideration and it is strongly recommended that a targeted driver education campaign be mounted to improve driving practices, and to meet the requirements of the toll road.

6.2.1.3 Soil Erosion

Site Preparation and Construction Phase

Impact

Changes in stream morphology could result in higher velocities thus increasing the potential for soil erosion in the stream channels of the Rio Cobre, Black River and gullies. Such erosion may undermine the foundation of structures such as bridges and river training works. There is also the potential for soil erosion on embankments and in roadside ditches (scour).

Mitigation

Soil erosion can be minimised by the following measures:

- Protection measures to prevent scour
- Planting of vegetation on embankments
- Paving of roadside ditches

Operation Phase

If the measures recommended in the Site Preparation and Construction Phases are implemented, then soil erosion should be minimal in the Operation Phase. Maintenance of slope protection (structural and non-structural) is also critical.

6.2.1.4 Air Quality

Impact

Road construction activities will result in the removal of extensive acres of vegetation in sugar cane plantations, in secondary communities and scrubland areas, as well as stripping of existing road surfaces. This will create areas of exposed top-soil which can become airborne by daily winds. This would result in an increase in levels of fugitive dust. The transport of aggregate for road and drainage culvert construction will also contribute to the fugitive dust levels. Construction vehicles will emit air-mass contaminants such as nitrogen and sulphur oxides as well as particulates. Removal of vegetation also reduces the air-shed purification functions offered by plants.

Mitigation

Periodic wetting of loose dirt, un-vegetated areas and stripped road surfaces should be carried out to reduce the levels of fugitive dust generated during site preparation and construction activities. Stock piling of earth materials for construction should be carried out within temporarily constructed enclosures to limit fugitive dust.

Vehicles transporting earth materials should be covered *en route.* Mixing equipment should be sealed properly and vibrating equipment should be equipped with dust removing devices. Masks should be provided to vehicle operators and construction workers in order to protect them from dust impacts, which can result in respiratory distress.

Landscaping should be carried out and should include the replanting of vegetation where appropriate. This should include medians, verges and buffers which will serve to replace

vegetative mass, add to airshed purification functions, increase aesthetic appeal and provide both visual and noise buffers.

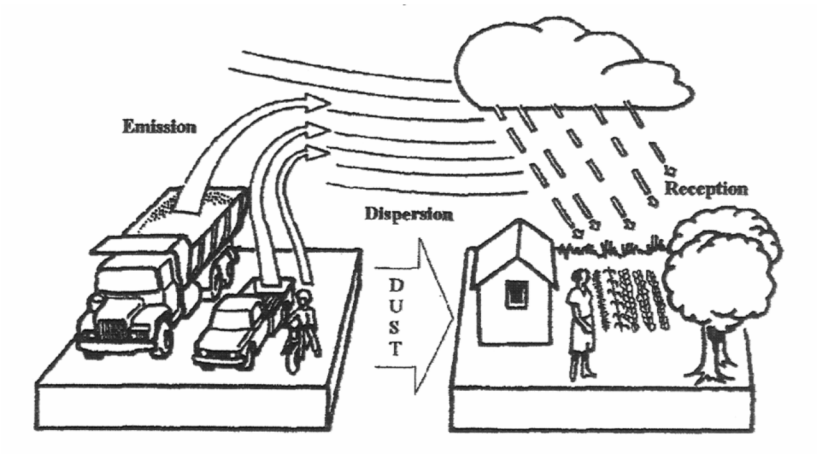

Figure 6.1: Illustration of Dispersion of Dust and Emissions

Operation Phase

Impacts of motor vehicle air pollution (emissions) during the operational phase can be mitigated by routing traffic away from populated areas (already mitigated in the selection of the optimal alignment) and reducing traffic congestion by providing sufficient capacity (already mitigated in the engineering design for Highway capacity and optimal speed). Entries and Exits should not be sited near residences, hospitals and schools. Planting tall leafy and dense vegetation between roads and human settlements can serve as a physical barrier and assist in filtering pollutants.

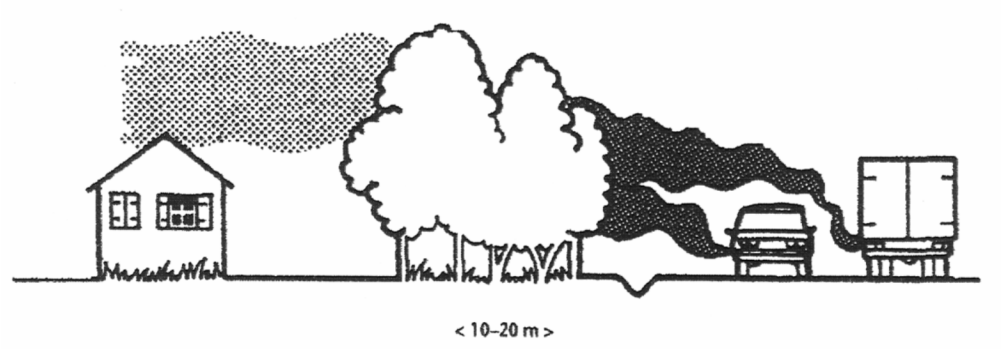

Figure 6.2: Illustration of the Effect of Vegetative Barriers on Vehicle Emissions

6.2.1.5 Noise

***Site Preparation and** Construction Phase*

Impact

Levels of noise are expected to increase during construction activities with the use of heavy machinery and earth moving equipment.

Mitigation

Noise from construction activities has the potential to create significant negative impact. However, noise impacting the public from construction activities can be minimized by phasing relevant construction activities and restricting the use of certain equipment to standard working hours, and by limiting noisy construction activities to the hours between 9 am and 5 pm in close proximity to residential areas. Businesses that operate during standard working hours will have to be informed of the construction activities, so that management and staff can be aware of and therefore be prepared for, periods of high noise levels. Construction machinery and vehicles should be serviced at regular intervals, in order to keep their operational noise to a minimum.

Operation Phase

During the operation of the Highway noise levels are expected to be higher at the Toll Plaza than along other sections of the right-of-way due to halting vehicles concentrated in one area.

Mitigation

To mitigate against increased levels of noise along the alignment, it is recommended that vegetative buffers be planted on berms along the length of the right-of-way. The alignment passes mainly through rural landscape and therefore concrete barriers would reduce aesthetic appeal and block potential scenic vistas. Noise levels are expected to be higher at the Toll Plaza than along the other areas of the alignment. However, the Toll Plaza will be sited approximately 500 m south of the nearest settlements, and vegetative buffers planted on berms should provide adequate protection against noise in this peri-urban area.

6.2.1.6 Water Quality

Site Preparation and Construction

Impact

There is the potential for both surface and groundwater pollution directly and indirectly by the construction of the highway. Contamination of surface water sources is likely, especially during the construction phase. Groundwater contamination can occur from improper waste disposal associated with new development along the highway or increased groundwater production to meet increased water demand. Clearing vegetation, stripping of road surfaces, stockpiling of earth materials, bridge and culvert construction are all activities that can result in the release of unwanted earth materials into gullies and streams.

Mitigation

Measures to control or limit sedimentation of streams and gullies during the construction phase will include storage of earth materials within containing berms, and the deployment of silt screens as required at gullies and streams during the construction of bridges and culverts. The engineering design has incorporated measures for slope stabilization and reinforcement at the approach to bridges. This serves to prevent slope failures which not only undermine the bridge approach but also result in the wash down of soil into streams and gullies.

Construction spoil and stripped top-soil should be disposed of properly so as not to block drains and culverts and to prevent wash-down into gullies, rivers and streams. Top-soil should be stock-piled for future use in landscaping. Construction spoil should be removed by certified contractors to a legal disposal site.

Construction camps should be provided with adequate portable toilets (chemical toilets) and solid waste receptacles. These should be removed by certified contractors.

The following points are emphasized for mitigation of negative impacts:

- Enforcement of waste disposal laws and regulations
- Solid waste and spoil from road cutting should not be disposed into gullies or waterways
- Controlled development of groundwater to meet increased water demand.

Operation Phase

Impact

The presence of paved surfaces created by the Highway will result in a reduction of percolation of rainwater and an increase in surface water run-off. Engineering design has mitigated against flooding, by appropriate drainage design. All major structures (greater than 0.5 m in span) have been designed to convey a one hundred year storm. Wash-down of top-soil can be minimised by landscaping and planting of soil stabilising vegetation.

Mitigation

Landscaping should include planting of stabilizing vegetation on slopes and river banks where appropriate. Engineering designs have included slope stabilization methods. During the operation phase, landscaping, including the replacement of vegetation on slopes will assist in binding soil and thereby minimising the loss of top-soil, and also potential sedimentation in streams and gullies. During the operation phase treatment of landscaped medians and verges should be carried with organic fertilizers and pesticides to reduce terrestrial run-off of toxic chemicals. Vegetation for landscaping should be selected for appropriateness to site, and to provide some representation of tree and flowering species not commonly used.

6.2.1.7 Water Demand and Supply

Site Preparation and Construction Phase

Adequate clearance will be made at irrigation canal crossings and therefore the highway is not expected to impact on the irrigation water distribution system. Water mains

traverse construction areas and adequate attention should be paid to the distribution network so as to avoid breaking mains, which would result in disruption of supply to residents and businesses.

Operation Phase

Development along the highway will be an indirect impact of the highway and will result in increased water demand in an area that is presently experiencing inadequate water supply. There are no expected direct impacts to water supply during the operation phase.

Mitigation

The following mitigation measures should alleviate the potential demand problems:

- Development of new supply sources and conjunctive use schemes where possible
- Planning for new developments associated with the highway should include consideration of water supply
- Improved water management measures (e.g. conservation, reuse, recycling, water demand and water loss management)
- Development of unconventional supply sources (e.g. desalination)

6.2.1.8 Vegetation

Site Preparation and Construction Phase

Impact

The vegetation identified along the Highway alignment comprises agricultural stands of sugar cane, secondary scrubland, overgrown pasture, and thorny scrubland dominated by *Acacia sp*. No significant rare, threatened, endangered or endemic species are expected to occur in these areas. These areas provide green space, which assists in the purification of the air shed by removal of carbon dioxide and release of oxygen. Additionally, the areas provide host plants for species of insects, reptiles, amphibians, butterflies and birds. Site preparation and construction activities will remove several acres of these vegetative stands removing the airshed purification function and some habitat. Removal of the

vegetation will also expose top-soil which can be washed into streams and gullies during rainfall events.

Mitigation

Vegetation will have to be cleared to provide land for the proposed road works. Clearing of the vegetative stands should be carried out on a phased basis to reduce the amount of exposed top soil that can be washed down in rainfall events. To continue to provide airshed functions of purification it is recommended that verges and medians be replanted with trees and shrubs. Additionally, tree planting can be carried out to form shelter belts, windbreaks, noise buffers, slope stabilization bands, erosion control and for aesthetic appeal. Selection of plants for landscaping should consider the following: habitat suitability, trees of national interest, flowering trees and shrubs.

Operation Phase

Vegetation planted for landscaping buffers and aesthetic appeal should be maintained, and a maintenance programme should be established and implemented.

6.2.1.9 Fauna

Site Preparation and Construction

Impact

Birds located in the modified vegetative communities will relocate when their habitat is removed. Species along the proposed alignment such as reptiles are also highly mobile and should also relocate to adjacent similar habitats. Insects, snails and other groups with low mobility may suffer from loss of specimens, as a result of heavy machinery and the use of earth moving equipment.

Mitigation

Landscaping and vegetation buffers will result in the replacement of some habitat for selected species.

Operation Phase

Impact

Once the highway is completed there is always the risk of increased access to rural areas resulting in poaching of wildlife.

Mitigation

It is not expected that poachers will be a threat, as targeted species such as Jamaica's endemic parrots do not occur in this area. However, encroachment by squatters could result in degradation of areas. As a Toll Road, the highway will be limited access and will be enclosed by fencing thereby reducing the possibility of encroachment from the road way. Plant and animal communities immediately outside the project corridor should not be at risk.

6.2.2 Socio-cultural Environment

6.2.2.1 Land-use and Zoning

Impact

The alignment will disrupt the current modus operandi of the cane lands and sugar estate by crossing internal roads and by taking out lines of cane cultivation to facilitate passage of the road and space for construction support activities. It is expected that the alignment will require a right of way of approximately 2,200 square kilometres (22 km **x** 100 m right-of-way) passing through approximately 9.5 km of active sugar cane cultivation. The estimated acreage of sugar cane to be lost is therefore 950 square kilometres.

Small farming plots will also be taken out and compensation will need to be provided for loss of crops.

A portion of the land occupied by the large horticultural enterprises in the vicinity of Christian Pen will be affected, and the required economic unit will need to be determined with the owner of the enterprise.

Mitigation

Current land use and ownership necessitates acquisition and purchase of land. Discussions must be held with the Sugar Company of Jamaica to ensure preservation of economic units for estate and factory operations. Field connectors must be provided and full consultation on the requirements for operations must be held, to ensure appropriate provisions for the needs of the operations. Sterilisation of economic units must be avoided.

Valuation of crops should also be undertaken to facilitate discussion with the respective farmers, and to avoid unnecessary/disruptive conflict.

It is expected that the National Roads Operating and Constructing Company Ltd. (NROCC) will conclude negotiations for land acquisition prior to construction and start-up to avoid construction delays

Operation Phase

During the operation phase the Highway is not expected to have any significant negative impacts on aspects of land use and zoning. The impacts identified in the construction phase will obtain for the operation of the highway. It is expected that land acquisition will minimise disruption to the working units of farm operations.

6.2.2.2 Traffic, Transportation and Access Roads

Impact

Site preparation and construction activities will impinge on traffic flow in the areas where the Highway connects or crosses existing roads including agricultural feeder roads. However, through-way will have to be maintained and obstruction to traffic minimised. Where interior roads will be truncated, the alternate routes should be clearly communicated.

Mitigation

Scheduling of construction work should seek to minimise disruption by using non-peak traffic times for movement of material and heavy equipment. Arrangements for parking and storage of material should be made as far off-site as is feasible for efficient operations. Discussions should be held early with relevant stakeholders to determine their needs and requirements and to advise them of the construction schedule. Public notices by the print and electronic media should also be posted in order to make the general public aware of the construction schedule and to provide construction updates. Properly trained flag men and road side signs should also alleviate discomfort to commuters.

6.2.2.3 Business Enterprises

Site Preparation and Construction Phase

Impact

Some business will be affected by the Highway construction. These include:

1. Bernard Lodge Sugar Estate. Impacts will include loss of agricultural land, disruption to reaping and production activities, disruption to transportation of goods, and obstruction of feeder roads.
2. Ashman's Food Processing Ltd.

   Ashman's Food Products Ltd. is located on the southern side of the Old Harbour Bypass by the Bushy Park access and the connection to the Kingston to Bushy Park section. The factory processes ackee for export as well as callaloo. During construction of the Old Harbour Bypass production was reportedly affected by high levels of fugitive dust, and it is expected that the connection in the vicinity of the bridge could cause some elevated dust levels at the factory.

3. Horticultural Enterprises

   The horticultural farms described above will be required to give up some land to the alignment.

Mitigation

- Discussions should be held with businesses that are likely to be impacted by the Highway construction.
- Discussions must be entered into with the managers of Ashman's Food Products Ltd. making them aware of the proposed construction activities. A physical barrier in the form of agricultural shade cloth should be considered after discussion with the factory management to reduce levels of dust affecting the factory workers and the product which is placed in the open air to dry.

Operation Phase

Impact

Impacts during the operation phase will include increased levels of traffic noise and atmospheric pollutants.

Mitigation

Vegetation buffers and physical barriers should be constructed as appropriate in the vicinity of business enterprises to reduce the levels of noise and noxious fumes that may affect management and staff. A tree-lined buffer in the agricultural estate should assist in the absorption of particulates and other pollutants.

6.2.2.4 Employment

Site Preparation and Construction Phase

Impact

Employment opportunities will be created during the site preparation and construction phases. This will mostly be unskilled labour for the duration of the construction activities. Additionally, economic opportunities will involve the sourcing of construction material and linkages created with local and regional suppliers and industries.

Mitigation

Casual labour will find employment and this is expected to be a positive impact for surrounding communities. However, workers should be briefed on traffic management, solid and liquid waste disposal, dust management, parking, idling of equipment and oil spill control.

6.2.2.5 Solid Waste Management

Site Preparation and Construction Phase

Impact

Solid waste generated from the site preparation and construction activities will include construction debris, vegetation, solid waste from beaches and solid waste generated from the construction camp.

Mitigation

Construction sites generate considerable waste and provision must be made for suitable collection by certified contractors and disposal at legal sites. Worker briefing should include instructions on how to dispose of food and drink containers emphasizing the need to protect the harbour and the gateway to Kingston. Construction camps should be adequately equipped with portable chemical toilets.

6.2.2.6 Proposed Developments

Proposed developments that are likely to benefit from the Highway are given in Section 9.3.8. There are no proposed developments that are likely to be impacted negatively by the construction of the Highway.

6.2.2.7 Public Health and Safety

Site Preparation and Construction Phase

Impact

There are no sensitive land use issues such as homes, schools, health centres, hospitals or churches in the vicinity of the proposed Highway. However, staff of the business enterprises and persons living in adjacent areas utilize the bus stops, existing roads and agricultural feeder roads. This poses a potential public health and safety risk to persons crossing the road in light of increased traffic generated from construction and movement of construction equipment. Increased levels of fugitive dust and construction noise are

also public health issues as the air quality is already deteriorated in this region and noise and activity levels are high.

Mitigation

To minimise risk to the public the construction activities which will directly affect the movement of traffic and pedestrians, should be carried out outside peak hours and standard construction techniques for sign–posting and flagging should be adhered to. Dust control by wetting is essential to prevent aggravation of the already poor air quality. Unnecessary idling of construction related vehicles should be discouraged. Construction of acceleration and deceleration lanes for business and recreational entrances is essential to reduce the accident risk, as well as proper sign posting of speed limits and entrances and exits.

Operation Phase

Impact

Improper use of Highway ramps, exits and interchanges can result in traffic accidents.

Mitigation

An extensive Highway Public Education Programme should be designed and implemented to make commuters aware of proper procedures on the Highway. This should include aspects related to tolling, lane changing, use of ramps, and access and exits. Enforcement of Highway legislation and procedures will be required.

6.2.2.8 Archaeological and Cultural Heritage

Site preparation and Construction Phase

If site preparation and construction activities begin without proper archaeological studies and the opportunity for rescue archaeology the following negative impacts could occur:

- Increased access to existing sites & new sites.
- Increased risk of damage to artefacts.
- Increased risk of modifying the integrity of the site.

- Destruction of known sites.
- Damage to components of the site.
- Loss of the context, when moving components of heritage site.
- Reduction of value of the heritage components.
- Destruction of heritage site and components.
- Loss of unknown archaeological sites.
- Loss of clues to the understanding of past cultures and historical events.
- Loss of unique cultural insight for Jamaica's past.

Mitigation

The Jamaica National Heritage Trust should be involved in discussions about the occurrence of possible sensitive areas along the Highway alignment. The JNHT should be given an opportunity to conduct a Watching Brief during the construction phase and to perform Rescue Archaeology if any artifacts are discovered.

Operation Phase

Impact

Damage to artifacts and heritage sites can occur if open access is maintained.

Mitigation

Any sites discovered should be properly secured to reduce public access and interference.

6.3 POSITIVE IMPACTS

6.3.1 Physical Environment

The highway is expected to improve drainage systems through engineering design of major structures to accommodate a one hundred year storm event, and integration of minor drainage ways into an overall stormwater management system. Erosion potential should also be minimised along embankments. The opening of scenic vistas along the alignment will provide new aesthetic elements. Vegetative buffers and landscaping will facilitate continued air-shed purification functions.

6.3.2 Biological Environment

Although scrubland, secondary growth and sugar cane cultivations will be lost in the process of vegetation clearance during site preparation and construction, landscaping along the highway will restore vegetative matter and provide habitats for some species, during the operation phase.

6.3.3 Social Environment

Site Preparation and Construction Phase

During site preparation and construction employment will be generated for several categories of workers including casual labourers, skilled and unskilled workers, as well as suppliers of goods and services.

Operation Phase

During the operation of the road it is anticipated that there will be many positive impacts. These will relate to the movement of goods and services in a shorter time, reduction of wear and tear on vehicles, as well as reduction in levels of stress and frustration experienced during traffic congestion. Health and safety are always an issue when a new

road is opened with more lanes and with a higher design speed than the existing road. Safety on the roads is expected to improve in the long term, with a more efficient road network and the associated driver education programme to be implemented.

Other possible positive impacts related to cultural heritage, include the discovery of new archaeological sites, opportunities for interpretive sign posting of sites, and increased access for heritage tours.

6.4 STAKEHOLDER CONSULTATION

Public consultations for the project have involved three types of consultations:

- Information Sharing with the General Public/Targeted Groups
- Consultations with Stakeholders
- Community Meetings

6.4.1 Information Sharing with the General Public/Targeted Groups

Organised by the Development Bank of Jamaica Ltd. over the last two years several presentations on Highway 2000 have been held. These have included the following sessions at:

- Montego Bay
- Mandeville
- University of Technology
- Jamaica Institute of Environmental Professionals, Kingston
- Chambers of Commerce and Parish Councils

These sessions have involved presentations by the Highway 2000 Project Office on the Highway and other Millennium Projects, the engineering aspects of the Highway, the environmental issues and other issues related to traffic, tolling, and financing.

6.4.2 Consultations with Stakeholders

Consultation and interviews have been held with relevant stakeholders including property owners, business enterprises and potential commuters. During the SEA process consultations were also held with various groups including environmental scientists with specific expertise, and other relevant professionals, as well as with Environmental Non-Governmental Organizations/Community Based Organizations and Government Agencies. In addition, a Sensitivity analysis was conducted with stakeholders and specialists in related disciplines.

6.4.3 Community Meetings

One community meeting is scheduled for July 2002 in St. Catherine, to present the findings of the Environmental Impact Assessment. The results of this community meeting will be submitted as a separate report, to the National Environment and Planning Agency (NEPA), but will still form a part of the EIA process.

6.4.4 Future Meetings

If a permit for the proposed highway construction is obtained from the National Environment and Planning Agency (NEPA), meetings should be held with the relevant stakeholders (including residents, community groups and business enterprises) to present a construction schedule and to seek cooperation of management and staff. It is essential that commuters be apprised of the construction plans so as to gain their cooperation and to enable them to plan for possible additional "travel to work" time during the construction period. Meetings with residents will also assist possible community relations, which are essential to the smooth functioning of this project. Environmental Management of the construction phase should also be discussed with relevant stakeholders.

TABLE 6.1 IMPACT MATRIX

IMPACT MATRIX PAGE 2

7.0 MONITORING PROGRAMME

If a permit is granted for the proposed project, and before site preparation and construction activities begin, TransJamaican Highway Ltd. should submit a Monitoring Programme to NEPA. The aim of the Monitoring Programme is to ensure compliance with relevant legislation, implementation of the mitigation measures and long-term minimization of negative environmental impacts. The Monitoring Programme should include a Construction Plan and Schedule with a description of any proposed phasing of activities, recommended Mitigation Measures and proposed methods of compliance. The Monitoring Programme should also include an Inspection Protocol; planned Supervision of Site Preparation and Construction Activities and implementation of Post Construction Monitoring. During construction fortnightly reports should be submitted to NEPA as well as a final summary report of the effectiveness of the mitigation measures.

8.0 SUMMARY AND CONCLUSIONS

The Highway 2000 Project is one of the Government of Jamaica's landmark Millennium Projects. Phase 1A of the project includes construction of a highway from Kingston to Sandy Bay incorporating the recently constructed Old Harbour Bypass, construction of the Portmore Causeway and Bridge and upgrading of the Dyke Road. The section from Kingston to Bushy Park requires construction of a four-lane toll highway with an interchange at Mandela Highway and at Spanish Town.

The highway alignment passes mainly through scrubland and sugar cane lands across the southern St. Catherine plans, crossing the Rio Cobre and several smaller streams and gullies. There are no areas of primary vegetation and the highway will not dissect any settlements.

Although some potential negative impacts have been identified for the project, the majority are short-term direct impacts related to the site preparation and construction phases. Most of the negative impacts identified can be successfully mitigated. Potential negative impacts that have been identified include the risk of flooding. Engineering designs for major structures have been specified for a 100 year event and this should mitigate against potential flooding in minor and major events. The highway passes through mainly crown lands although there are some parcels of privately owned land. Land acquisition and utilities negotiations are being managed by the National Roads Operating and Constructing Company (NROCC). Land acquisition is approximately 90% complete.

There are several positive impacts associated with the project. These include improved efficiency in travel time and travel costs, greater movement of goods and services, improved access to remote areas, support of new developments and employment opportunities. Implementation and enforcement of the mitigation measures recommended and on-going public communication are however, required to ensure successful project execution with minimum negative impacts on the environment.

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