R2RW

Rapid Rural Appraisal of the Rio Grande Watershed

ARD

Ridge to Reef Watershed Project

USAID Contract No. 532-C-00-00-00235-00

RAPID RURAL APPRAISAL OF THE RIO GRANDE WATERSHED

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Prepared for the:

Government of Jamaica's
National Environment and Planning Agency

And the

United States Agency for International Development

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PREFACE

The Ridge to Reef Watershed Project (R2RW) is a five year (with an optional sixth year) activity contributing to the achievement of USAID/Jamaica's SO2 – "improved quality of key natural resources in areas that are both environmentally and economically significant." R2RW comprises three Components contributing to the achievement of the results under SO2. Components1 will assist targeted organizations identify and promote sustainable environmental management practices by resource users. Component 2 focuses on identifying and supporting solutions to improve the enforcement of targeted existing environmental regulations, primarily in the Great River and Rio Grande watersheds. Component 3 provides assistance to key organizations to support, coordinate, and expand watershed management efforts in Jamaica. ARD, Inc is implementing the Ridge to Reef Watershed Project with assistance from Cargill Technical Services, Inc.

A multi-skilled, inter-disciplinary, three-person team was contracted to undertake this assignment. This Team was lead by Community Development Specialist Robert Kerr, who was contracted for eighteen (18) days. The Community Development Specialist, and Team Leader were responsible for establishing baseline information on important community development activities, identifying and setting out baseline indicators and benchmarks against which R2RW interventions can be evaluated. He was also expected to establish as best as possible the vision for community development as expressed by community leaders interviewed, and suggest objectives and paths for community development.

Sheila Carman, Natural Resources Management Specialist with Geographic information system expertise brought the biophysical input to the team. She was contracted for fifteen (15) days to review the physical and biological situations, paying special attention to features such as geology and soil, terrain, rivers, climate and others that effect environment stability and agricultural productivity. She was also asked to review the interactions between man and other natural resources as they affect resources conservation and community development.

John Cunningham, Sociologist, with several years' experience living and working in the Rio Grande Watershed, and other parts of Portland is the third member of this team. He was contracted for fifteen (15) days, with responsible for establishing baseline information on important social and economic indicators. These would be expected to serve as benchmarks against which effectiveness of R2RW interventions can be evaluated.

ACRONYMS

ARD	Associates in Rural Development, Inc
B/JCMNP	Blue and John Crow Mountain National Park
CBO	Community-based Organization
CDB	Caribbean Development Bank
CWIP	Coastal Water Quality Improvement Project
EAST	Environmental Audit for Sustainable Tourism
EIA	Environmental Information Assessment
EJASP	Eastern Jamaica Agricultural Support Project
ENACT	Environment Action Program
EU	European Union
FAO	Food and Agricultural Organization
GIS	Geographic Information System
GRW	Great River Watershed
JAS	Jamaica Agricultural Society
JCDT	Jamaica Conservation Development Trust
JSIF	Jamaica Social Investment Fund
LAC	Local Watershed Advisory Committee
LGRP	Local Government Reform Programme
LSDP	Local Sustainable Development Programme
NEPA	National Environment and Planning Agency
NIC	National Irrigation Commission
NRCA	Natural Resources Conservation Authority
NRM	Natural Resources management
NWA	National Works Agency
NWC	National Water Commission
ODPEM	Office of Disaster Preparedness and Emergency Management
PAMP	Port Antonio Marine Park
PDC	Parish Development Committee
R2RW	Ridge to Reef Watershed Project
RADA	Rural Agricultural Development Authority
RGW	Rio Grande Watershed
RRA	Rapid Rural Assessment
SDC	Social Development Commission
SO2	Strategic Objective 2
STATIN	Statistical Institute of Jamaica
TDS	Total Dissolved Solids
TPDCo	Tourism Product Development Company
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WMU	Watershed Management Unit
WRA	Water Resources Authority
WUA	Water User Association

TABLE OF CONTENTS

APPENDICES

FIGURES

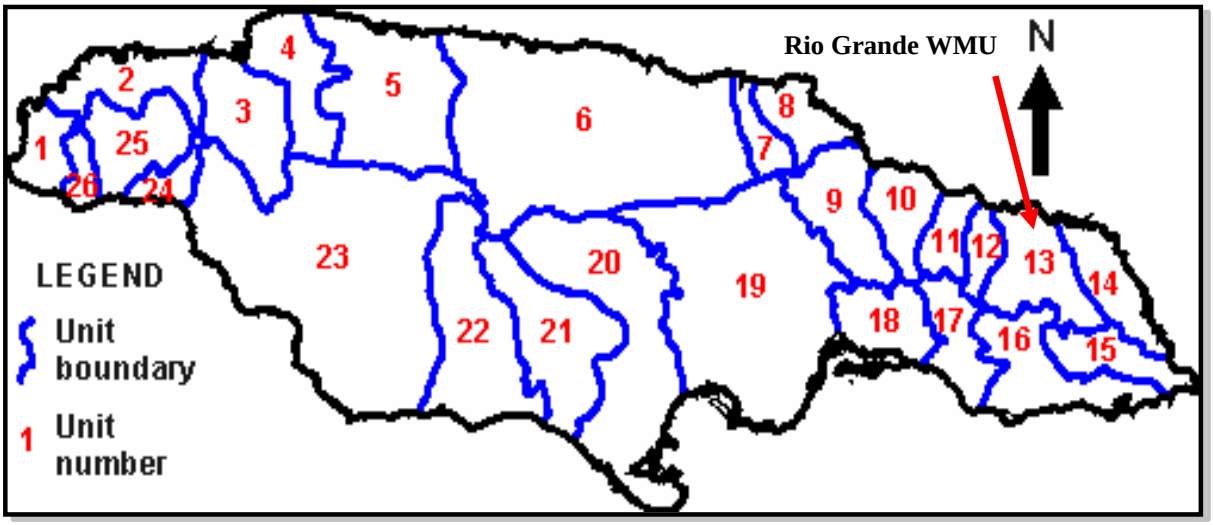
TABLES

1.0 BACKGROUND

1.1 Orientation

This report presents an integrated profile of the Rio Grande Watershed Management Unit[1] (WMU) **(Figure 1.1).** It documents natural resources as well as environmental, social and economic features. It also identifies ecological and socio-economic problems and presents critical assessments of current situations in the watershed. Human activities, as they impact upon watershed integrity, are presented in the context of sustainability and sustainable development[2].

Figure 1.1 Watershed Management Units in Jamaica (WRA, 1998) The Rio Grande Watershed is WMU # 13



This Rapid Rural Appraisal (RRA) will serve as a baseline document and will be used in measuring impact of interventions by the Ridge to Reef Watershed (R2RW) Project in the watershed. It will also be used in prioritizing issues for targeted interventions in the watershed.

This study represents one of the initial activities of the Ridge to Reef Watershed (R2RW) Project in the Rio Grande Watershed. The R2RW Project is a five-year bilateral initiative between the Government of Jamaica's National Environmental and Planning Agency (NEPA) and the United States Agency for International Development (USAID). Through three distinct but interrelated activities, this project will contribute to the achievement of USAID Strategic Objective 2 (SO 2) "improved quality of key natural resources in selected areas that are both environmentally and economically significant". The R2RW Project will be conducted in two watersheds in the island, namely the Great River and the Rio Grande watersheds. The R2RW comprises three Components:

- Through targeted organizations sustainable environment management practices identified and promoted

[1] The island of Jamaica is divided into twenty-six (26) watershed management units (WMUs) comprising all the land from the mountains to the sea and containing streams and rivers. These WMUs are essentially composites of river basins.

[2] Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Our Common Future, WCED, 1997)

- Incentives for and obstacles to enforcement of targeted environmental regulations identified and solutions supported, and

- Capacity of Jamaican agencies, international donors, and private sector and civil society organizations to implement effective watershed programmes enhanced

1.2 Terms of Reference

The objective of the RRA is the establishment of baseline data and benchmarks to be used for measuring the impacts of R2RW over the life of the Project. The baseline data is to include (but not be limited to) information on the soils, climate, slopes, erosion rates, vegetation, land use, water quality, as well as social and economic parameters. The benchmarks will include (but not be limited to) items such as important crops, state of roads, standard of living indicators, average annual income, the existence of social infrastructure and impact of floods associated with the high rainfall for which the watershed is known.

The terms of reference for the preparation of this profile are:

- Briefly review and summarize relevant publications on Portland with special emphasis on the RGW

- Interview officers of government agencies such as RADA, Forestry Department, NEPA, etc. as well as residents of the area especially farmers and leaders of Community Based Organizations (CBOs) to determine their perspectives on the watershed and the pending R2RW interventions

- Prepare maps of the major land forms indicating geological features, soils, slopes, altitudes, climatic means, rivers, vegetation, towns, villages etc

- Determine and describe relevant social organizations and activities

- Describe the community organizations that were or are operating in the community, indicating their relevance to economic and social advancement

- Determine the educational level of community residents and its relevance to social behavior

- Review the quality and quantity of social infrastructure and amenities indicating sources of support and effect on community life

- Prepare a list of activities that will contribute to improved social welfare

- Describe the social make-up of the local communities paying special attention to churches, Community Based Organizations (CBO), educational institutions, hospitals and clinics, supporting government agencies such as the Rural Agricultural Development Agency (RADA), the Forestry Department (FD), the Public Health Department (PHD), and the Police Force

- Comment on the relevance of formal governments, national and local to community development

- Describe the major financial institutions operating in the RGW, and comment on their ability to contribute to the economic development

- Describe the main farming enterprises describing practices that may be contributing to economic advancement and or environmental sustainability or degradation

- ✍ Determine the level of praedial larceny and its effects

- ✍ Review non-farming economic activities especially agro-industrial processing, tourist attractions with special reference to river rafting nature tours and hikes suggesting how these can be improved

- ✍ Prepare a list of activities that should/will contribute to economic improvement

- ✍ Review craft making and cottage industries, suggesting if and how these can be improved

- ✍ Describe the relationship between human activities such as farming, road building, house density, timber forestry, noxious plants, feral animals etc on environmental degradation

- ✍ Review and indicate the quality and quantity of the infrastructure i.e. road, water supply, electricity, telephone, postal service etc, emphasizing their relevance to community development

- ✍ Carefully examine the natural resources paying special attention to rainfall, its effect on flooding soil erosion and landslide especially in context of recent events, water availability and how it may be used to meet farming, domestic and industrial requirements

- ✍ Ascertain the names and locations of wild fauna and flora with potential for domestication and economic exploitation, and

- ✍ Comment on bamboo, paying special attention to area occupied and potential for economic exploitation

1.3 Data Sources

Data have been generated from reviews of documents and maps on selected aspects of the physical and socio-economic characteristics of the Rio Grande Watershed; from existing literature, from field reconnaissance and interviews/surveys; and from limited air photo interpretation.

The following studies were drawn on for information incorporated in this profile:

- ✍ Land use assessment of the Rio Grande Watershed

- ✍ Hydrological profile of the Rio Grande Watershed

- ✍ Climate data assessment of the Rio Grande Watershed

- ✍ Water Quality data assessment of the Rio Grande Watershed

- ✍ Socio-economic survey of selected communities in the Rio Grande Watershed

- ✍ Biophysical characteristics assessment (including geology, soils, slopes and topography) of the Rio Grande Watershed

The research also benefited from the previous work done in the parish by several projects and programs including the Dutch funded intervention in the Rio Grande Valley, and the Local Sustainable Development Project, with Portland being the demonstration parish. This is being implemented by the Government of Canada, through the Environmental Action Programme (ENACT, and the Government of Jamaica, with the National Environment and Planning Agency (NEPA) taking the lead role.

Other USAID funded interventions in the parish are also informing this profile. These include Environmental Audit for Sustainable Tourism (EAST), and the Coastal Water Quality Improvement Project (CWIP).

1.4 Structure of the Report

The first chapter presents background information including terms of reference, data sources, constraints and omissions. Chapter 2 presents a description of the Rio Grande Watershed. Chapter 3 summarizes the findings regarding the watershed conditions and data presented according to physical attributes, socio-cultural characteristics, economic situation, historical significance, infrastructure and other relevant factors. Summary, observations and recommendations are presented in Chapter 4. Figures and Tables are used throughout the Report to assist with visual aids, and a number of appendices are attached for easy references.

1.5 Constraints and Omissions

This area has been well studied due to many projects such as ENACT, EJAS and the FAO/Dutch agro-forestry projects. Information already collected for these projects provides a wealth of information on the area. Much of this information, especially the biophysical information related to soils, slopes and rainfall is still relevant and can be used as secondary sources. The socio-economic information is more dynamic and changes in the last five years should have caused significant modification. Changes such as those caused by the EU Banana restoration project and EJAS can be regarded as positive but many other such as the entry of the banana disease Black Sigatoka and deterioration of roads have been negative. For example black Sigatoka disease has increased the cost of producing banana that are sprayed to meet the quality standards of the export market, and have caused significant decline in plantain that is produced for local consumption and therefore not sprayed. Poor road conditions have caused tour operators to reduce services to the area and this has negatively affected the economies of persons who operate river rafting, mountain hikes, nature tours and other tourist attractions.

Although the Watershed Management Unit has been delineated, its specific features have not been described and collated because until now the area has been presented as a component of Portland the parish in which the watershed lies. Therefore, this Rapid Rural Appraisal is required to put together a comprehensive description of the area delineated as the Rio Grande Watershed Unit to provide the baseline as well as various benchmarks against which R2RW will operate.

2.0 DESCRIPTION OF STUDY AREA

2.1 Project Area

The Rio Grande watershed is located in the northwest section of parish of Portland and St.Thomas between 18?15' and 18?00' north latitude and 76?15' and 76?45' longitude and spans about 30,970 hectares. The Blue and John Crow Mountains form its southern, western, and eastern extremities respectively. The capital, Port Antonio, adjoining towns and coastline form the northern boundary. **Please see Figure 2.1.**

The Rio Grande Watershed Management Unit located on the northeastern coast of Jamaica is home of some of the most spectacular landscapes in the country. These landscapes result from the interplay of hills and valleys and many rivers, the largest of which is the Rio Grande after which the watershed is named. Like many other parts of the world, the Rio Grande Watershed is being affected by global climate changes such as global warming, and there are already reports of droughts and associated shortage of domestic water supplies in what is regarded as a wet area with high, well-distributed rainfall. Environmental degradation characterized by soil erosion, landslides and land occupation by noxious plants such as bamboo has reduced land available for farming.

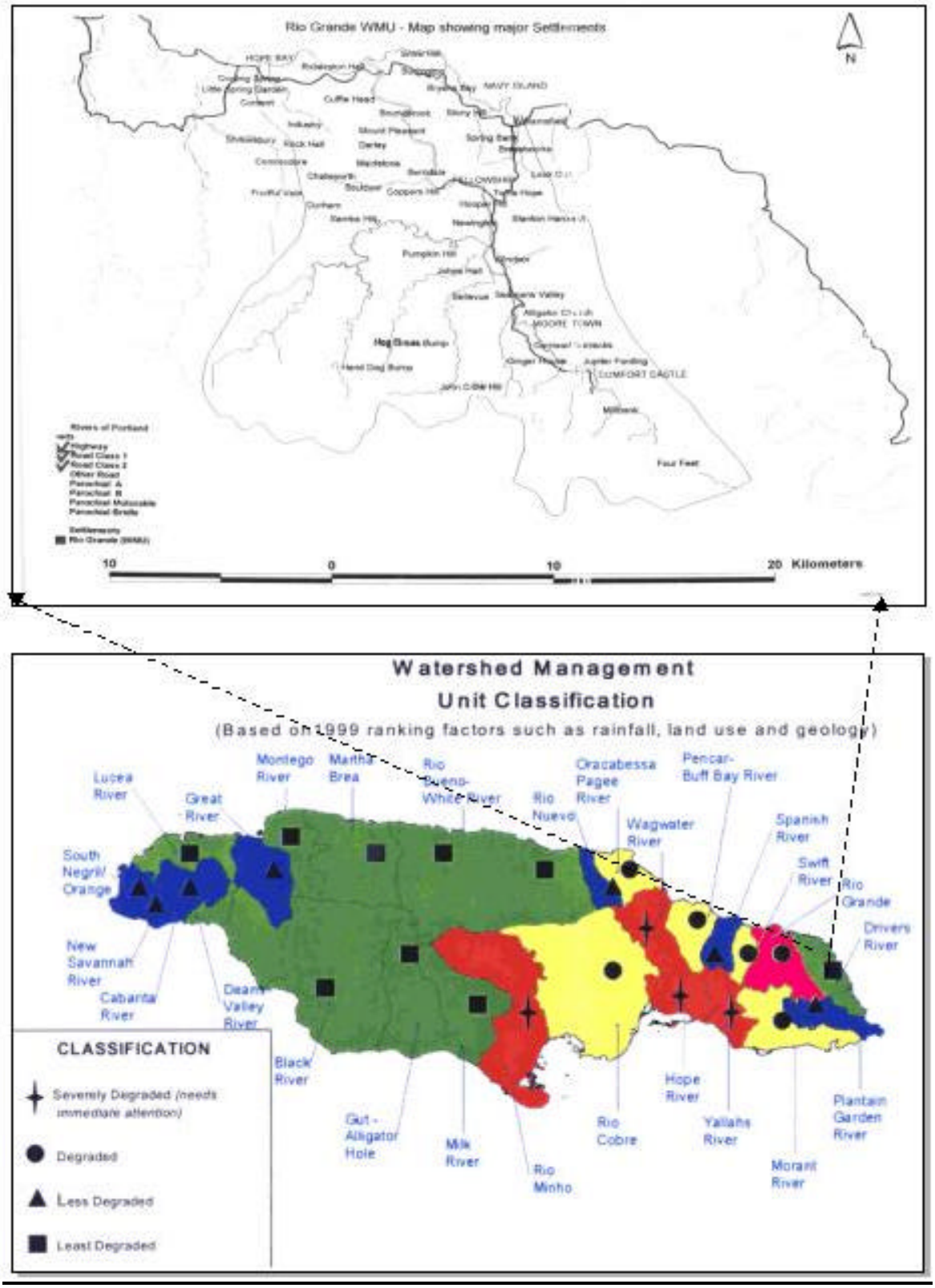
The area is rich in natural and cultural resources. Its very high rainfall and extremely mountainous topography provide spectacular scenery, salubrious climate, and rich biodiversity of global significance. Historically the area has been a focal point of pre-Columbian (Tainos), Spanish and English cultures. Together these cultures form the backdrop against which is set 300 hundred years of “occupation and continuing presence” by the Windward Maroons. These cultures and their traditions are important if not decisive factors to be taken into account in developing management strategies for the RGW.

With a population of approximately 23,000 persons, agriculture dominates the economic activities in the Project Area, followed by trading and then tourism. All the key areas of livelihood are heavily dependent on the natural and cultural resources of the areas. Rafting for example which is the main tourism activity in the watershed mainly depends on the availability and conditions of the waters of the Rio Grande; the flood plain of Rio Grande provides rich agricultural lands for Banana the main plantation crop in the watershed. Sustaining the values of these resources is decisive to the maintaining the quality of life of the communities in the area. This task is made difficult by the exceptionally high rainfall and frequent landslides and flooding, which occasions the watershed.

The unique characteristics of the RGW while offering significant development opportunities, is constrained by the fragile biophysical system which responds in catastrophic proportion even to limited modification by human impact. It is for this reason why sustainable development planning and management need to guide any future interventions in the area.

Figure 2.1 WMUs in Jamaica – Status and Location of the Rio Grande Watershed)

Watershed # 13 – Rio Grande [Portland]



2.2 Physiography

The physical features of two contiguous but strikingly different mountain ranges dominate the upper reaches of RGW: the Blue Mountains and its foothills and the **massif** of the John Crow Mountains. The Rio Grande separates the John Crow Mountains from the Blue Mountains; the ranges join at Corn Puss Gap (640m) at the boundary of the Parishes of Portland and St. Thomas. Unlike the sharp peaks of the Blue Mountains, the summit of the John Crow Mountains is a slightly easterly tilted plateau, presenting an unusual landscape of sinkholes and outcrops without any prominent features.

The Blue Mountains rise steeply within less than 5 km of the coast and are characterized by steep-sided valleys and deeply gorged rivers. The Grand Ridge forms the backbone of the range. It extends for 16 km and includes the highest land in Jamaica, much of it over 1800m. The John Crow Mountains range contrastingly rises gently from the east to a maximum height of 1,050 m, but ends abruptly along a steep escarpment to the west.

Elevations in the watershed range from zero meters at the coast to 2,246 meters in the Blue Mountains The southwest sections of the watershed have the steepest terrain. Throughout the watershed, slopes are generally steep. More than 75% of the slopes exceed 20 degrees, thus making the area prone to geomorphic change due to gravity and steep slopes. These changes are quite evident, even from a roadside vantage point, as scars from landslides are clearly visible.

2.2.1 Geology

The diverse topography of the RGW reflects the complex geological composition and history of the eastern section of the island. The dominant physical features the Blue and the John Crow Mountains though contiguous are different in origin. Blue Mountains have a complex geological history exhibiting igneous and marine influences; volcanic, sedimentary, plutonic and metamorphic rocks are all present. In contrast, the John Crow Mountains consists of white limestone overlying marine sandstone and shale.

The primary lithology of the Rio Grande Watershed is comprised of rocks laid down in the [3]cretaceous period. This lithography, which covers 53.5%, is the primary contributor of sediment to the system. It includes the Blue Mountain Formation, made up of shales, tuffs and conglomerates, and is predominant above 610 meters on the western side of the catchment and the Blue Mountain Peak. These shales give way to fertile soils. Other rocks from this period include Rio Grande limestone (Bellevue Formation) of minor significance and Ginger House Member (Bellevue Formation), shales and conglomerate (Back Rio Grande Formation), and andesitic volcanic and granodiorite. A small area of friable and permeable Granodiorite, west of Bellevue, made up of ferromagnesians which weathers deep and rapidly, and stain rock a pale brown or pale yellow-brown when it weathers.

Rocks of the Tertiary period make up the second largest coverage in the watershed (41.4%). These include limestone, limited to the lower catchment below Berrydale and along the eastern upper catchment, the John Crow Mountains, and a strip along the western bank of the Rio Grande. This limestone may also underlie the alluvium on the eastern banks of the lower Rio Grande Valley. This lithology is comprised of a thick sequence of evenly bedded chalky limestone with characteristic micro fauna. Typically, these rocks are hard micrites, which may be partially recrystallized. The watershed has a surface outcrop of Richmond Formation, a subgroup of the Wagwater Group, covering 23.6%, which is comprised of thinly bedded shales and sandstones, conglomerate and intermittent thin limestones. The Wagwater series was water lain with pyroclastics and andesitic and are basaltic in origin. This series gives way to fertile soils and is capped in some locations by gypsum and anhydrite.

[3] Last geological period of the Mesozoic era with deposits of chalk

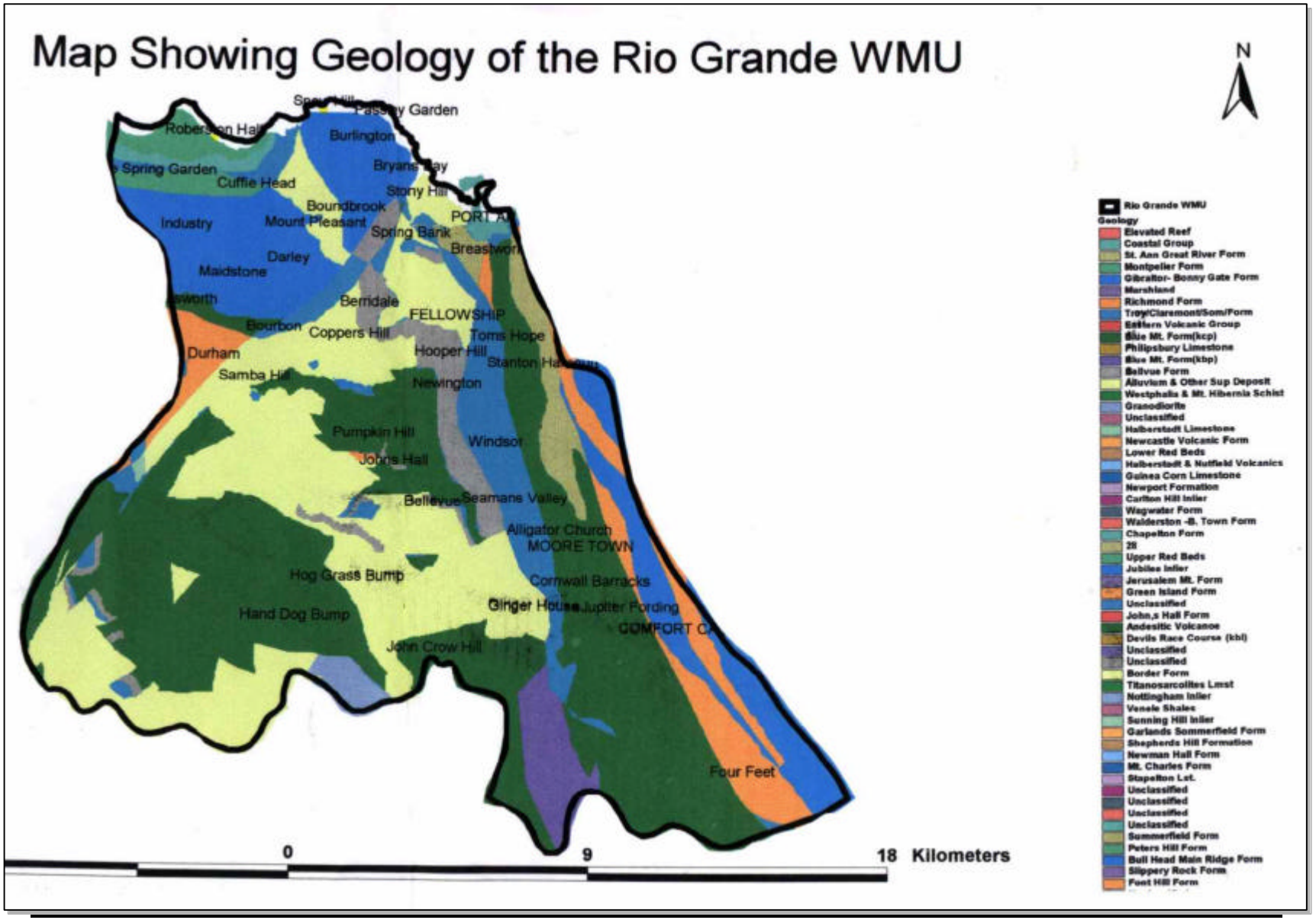
Alluvium, the youngest set of deposits laid down in the catchment, is associated with the section of the Rio Grande that comprises less than 5% of the surface outcrop in the catchment. Limited to the edges of the Rio Grande River, it comprises of a wide range of particle sizes from clay to boulders.

Coastal Group, found only along the shoreline west of St. Margaret's Bay, is a relatively unimportant lithology in the catchment.

The John Crow Mountains, an uplifted block tilted in a northeasterly direction, consists of hard, massive white limestone overlying marine sandstone and shale. However, the limestone has eroded to form a rugged landscape characterized by steep rocky knolls and deep depressions. Deposited in both shallow and deep water, these limestones abound in marine fossils.

The Blue Mountains display igneous and marine influences. They are comprised of predominantly plutonic rocks and sediments, tuffs and lava flows associated with volcanic activity with minor sedimentary and metamorphic units. Shaley metamorphic rocks, found on the north slopes of Blue Mountains, were most likely formed through contact with igneous intrusions. **Figure 2.2** shows the distribution of major geological formation in the Rio Grande Watershed.

Figure 2.2 Shows the distribution of major geological formations



2.2.2 Minerals

Historically mining has taken place in areas surrounding the core of the Blue Mountains. The Spaniards mined copper at Leckies on the Swift River in the 16th century, and copper was mined extensively in the mid-19th century, in the area of Durham, southwest of Port Antonio. No active mines currently exist within the watershed. More recent prospecting initiatives have yielded mixed results with only a few of the sites showing potential to warrant further investigation to determine commercial viability. The level of coverage by the various studies and the extent of documentation are considered to be inadequate with significant areas still remaining without proper investigation. The map and tables below provide information on sites, including prospecting history and the status of metallic and non-metallic minerals within the watershed.

2.2.3 Quarrying

Aggregate is an important material for the building and road construction sectors and forms the bulk of quarry production in Jamaica. The two principal sources of aggregate in the island are alluvial sand and gravel and crushed limestone. Deposits of the former, the traditional source of aggregate in the Jamaica, have reached a state of near depletion of many of its sites, as a result, crushed limestone currently provides over 75% of the construction aggregate. Deposits of good aggregate in the eastern part of the island are limited, with the flood plains of the Rio Grande being one of the principal sources of good quality material. Sand and Gravel are mined close to the mouth of the Rio Grande River and marl from near coastal deposits. The upper sections of the Rio Grande River (Seaman's Valley and Fellowship) are quarried primarily for sand and gravel. Sand quarrying is consequently a major economic and regularly occurring activity within the watershed.

Both Gibraltar Bonnygate Limestone and Montpellier Limestone, which are quarried at locations across the island, occur in the Rio Grande Watershed. Limestone formation and outcropping in the Port Antonio area, are *rubbly* and good quality material is limited.

Table 2.2 Occurrences of metallic and non-metallic minerals in the Rio Grande Watershed

I *- Importance* ***M (C) -*** *Metallic (Commodities)* ***ON*** *- Occurrence Number*

LOCATION	OCCURRENCE NO.	DEPOSIT STATUS: SHOWING THE PRESENCE OF METALLIC COMMODITIES & MINERALS				HISTORY OF WORK OR EXPLOITATION
		MC	I	MINERALS	I	
Rio Grande Mine	140001	Cu	P	Chalcocite Chalcopyrite Malachite	P P S	**1960** Prospecting by Consolidated Mogul Mines at which time old timbers (possibly dating from circa 1859) were reported. Numerous other small pits and trenches were noted in the immediate vicinity.

LOCATION	OCCURRENCE NO.	DEPOSIT STATUS: SHOWING THE PRESENCE OF METALLIC COMMODITIES & MINERALS				HISTORY OF WORK OR EXPLOITATION
		MC	I	MINERALS	I	
Rio Grande Mine	140002	Cu	P	Chalcocite Malachite	P P	**1869** Worked to a depth of 21m by the Rio Grande Mining Company. Some ore was shipped to England **1959** Two trenches and sampling by Consolidated mogul Mines Ltd. Old timbers were reported in the trench. **1972** Mapping and IP survey by H.S. McQueen. Some diamond drilling was carried out in the vicinity. **1976** Mapping, trenching and sampling by Noranda Exploration Company Ltd. (under option from H.S. McQueen).
Olive Mount	140003	Cu	P	Chalcocite Malachite Epidote Zeolite	P S T T	**1972** Geological investigation, sampling and IP survey by H.S. McQueen. **1973** Geological mapping, sampling and diamond drilling by H.S. McQueen. **1975** Geological mapping, soil geochemistry and sampling by Noranda Exploration Company Ltd. (under option from H.S. McQueen).
Poppy Spring	140004	Cu Ag	P S	Bornite Chalcocite Chalcopyrite Calcite Quartz	P P P T T	**1859** **Worked by the Rio Grande Mining Company. A level is reported to having been driven for "a considerable distance". A "Chesterfield No. 4" zone is also mentioned in early reports.** **1960** Prospecting by Consolidated Mogul Mines. Two adits were noted at that time. **1975** Prospecting by Noranda Exploration Company Ltd. (under option from H.S. McQueen).

LOCATION	OCCURRENCE NO.	DEPOSIT STATUS: SHOWING THE PRESENCE OF METALLIC COMMODITIES & MINERALS				HISTORY OF WORK OR EXPLOITATION
		MC	I	MINERALS	I	
Roslyn Castle	140005	Cu	P	Bornite Chalcopyrite	P P	1859 Worked by the Rio Grande Mining Company. **1960** Prospecting by Consolidated Mogul Mines.
KAG #4	140006	Cu Ag	P S	Chalcocite	P	**1975** Prospecting by Noranda Exploration Company Ltd. (under option from H.S. McQueen).
Long Spring	140007	Cu Ag Au	P S S	Chalcocite	P	1960 Prospecting by Consolidated Mogul Mines locates numerous occurrences of copper-bearing float. **1972** Prospecting by H.S. McQueen.
Rose Hall	140008	Cu	P	Chalcopyrite Malachite Pyrite Chalcocite Anorthite Barite Chlorite Goethite Hematite Quartz	P P P S T T T T T T	**1972** Prospecting by H.S. McQueen.
Bellevue	140009	Cu	P	Pyrite	P	1972 **Prospecting by H.S. McQueen. One line of IP was carried out over a portion of the alteration zone.** 1975 Prospecting and soil geochemical survey carried out by Noranda Exploration Company Ltd. (under option from H.S. McQueen).
Campbell Vein	140010	Ag Cu Ag	P P S	Quartz	T	**1975** Sampling of seven trenches or pits and road cut exposure of vein. Three diamond drill holes put down in the vicinity but not to test the vein structure (?). Work carried out by Noranda Exploration Company Ltd. (under option from H.S. McQueen).

LOCATION	OCCURRENCE NO.	DEPOSIT STATUS: SHOWING THE PRESENCE OF METALLIC COMMODITIES & MINERALS				HISTORY OF WORK OR EXPLOITATION
		MC	I	MINERALS	I	
Brighton	140011	Cu	P	Bornite Chalcopyrite Azurite Malachite Quartz	P P S S T	1869 Minor development work or prospecting.
Providence	140012	Cu	P	Cuprite Copper, native Chalcocite Malachite	P P S S	**1859** Minor development work or prospecting by an American company.
Mike Hunt	140013	Au	P	Pyrite	P	

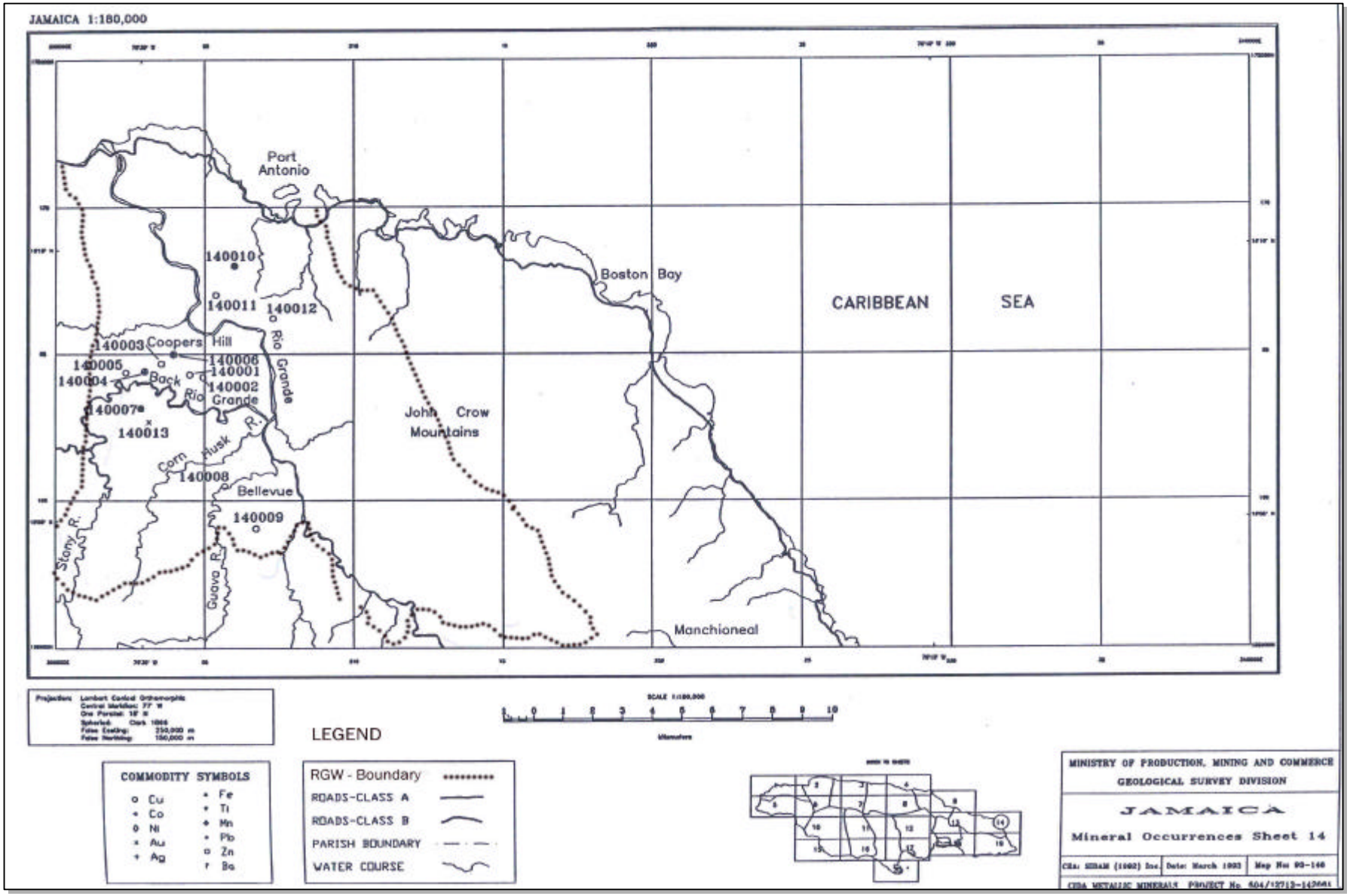
KEY:

CODE/SYMBOLS	EXPLANATION – Level of importance of mineral occurrences
P	Primary – of first order of importance or abundance
S	Secondary – of secondary order of abundance or importance
T	Tertiary – importance assigned to non-metallic indicator minerals reported from the occurrences

KEY:

Element Symbols	ELEMENTS
Cu	Copper
Ag	Silver
Au	Gold

Figure 2.2.2 Status of metallic and non-metallic minerals in the Rio Grande Watershed



2.2.4 Caves

Caves and sinkholes are abundant in the watershed. However, they are not as prevalent as in other areas of the island. Portland has 78 caves, 7.3% of caves in Jamaica. Most are located to the northeastern side of the parish, under the mountains. None of these is particularly deep. Only two exceed 100 meters. With the exception of the Foxes and Non-Such Caves, a once popular tourist attraction, they represent an unexplored source for economic development. For example, an easily assessable cave is located in Mt. Pleasant. The cave opening is wide and tall for easy access for exploration by tourists or for locals to harvest the available bat guano as fertilizer. Guano is mined from only one cave in the RGW and only one other cave (in Berrydale) is currently developed for tourism.

2.2.5 Earthquakes

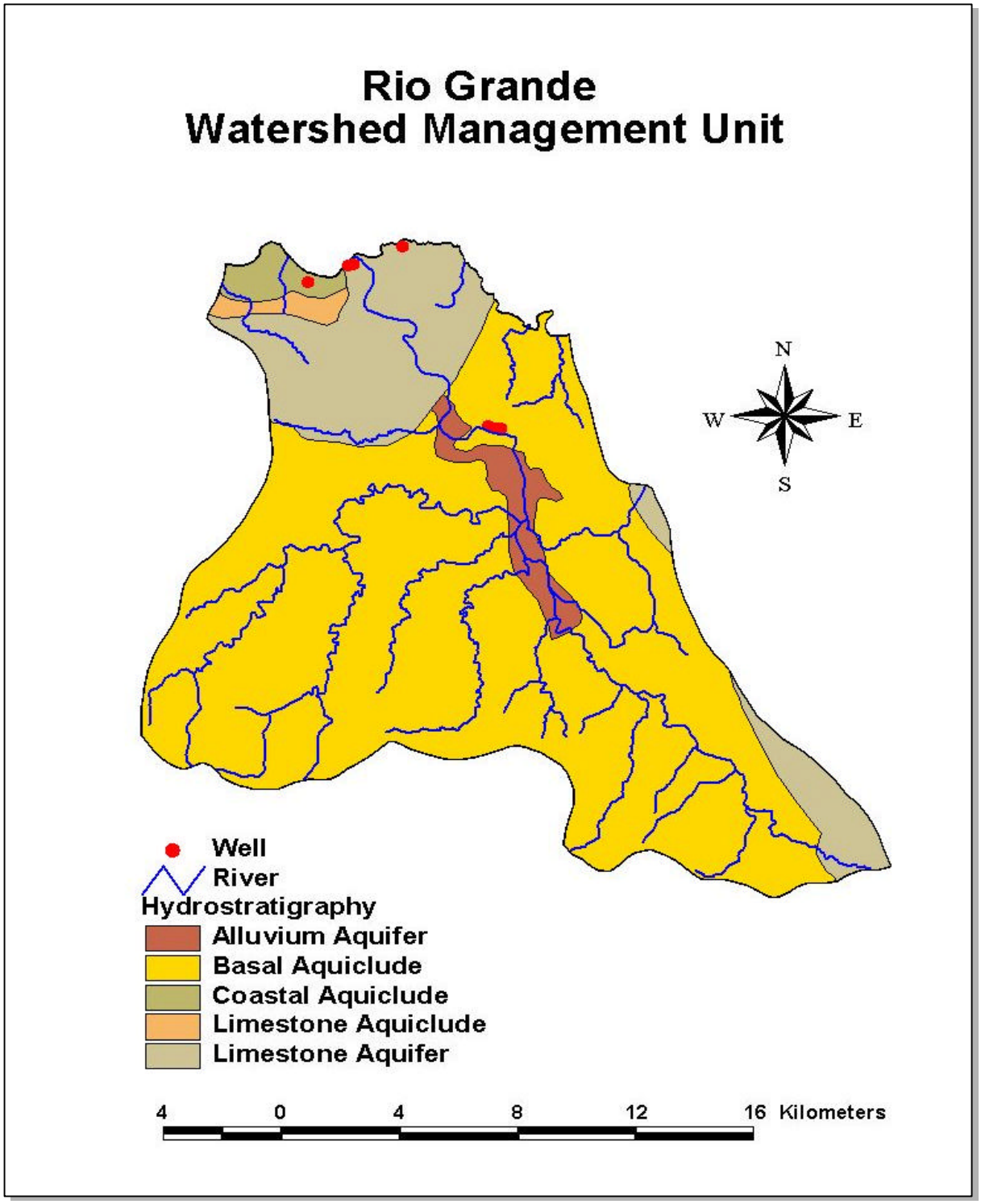
Jamaica is situated south of a transform fault where the North American Plate is sliding along the Caribbean plate. The plates are moving relative to each other at a rate of at least 37-mm per year. The movement of these plates, as well as associated fault movements on land, are the major sources of earthquakes in Jamaica. These movements produce mostly shallow earthquakes of depths less than 60 km. There have, however, been several high-intensity earthquakes recorded in Jamaica over the past 300 years. Most notable among these were the violent earthquakes of 1692 and 1907 with intensity 10 and 9 respectively on the Modified Mercalli Scale, this destroyed Port Royal and Kingston. While the Blue Mountains enjoy a fair level of seismic stability, however, some major faults are aligned approximately north south. Chief among these faults includes the Wagwater Fault, the Yallahs Fault, the Blue Mountain Fault and the Rio Grande Fault. These faults, and many smaller ones, strongly influence the patterns of drainage.

2.3 Hydro-Stratigraphy

2.3.1 Aquifers and Aquicludes

Due to the close proximity of bedrock to the surface, there is little groundwater storage (aquifers) in the Rio Grande Watershed. Rather, the watershed is made-up primarily of aquicludes, large expanses of impermeable rock. Water entering the soil encounters this layer of impermeable rock and travels laterally.

Figure 2.3 Hydro-Stratigraphy Map of the Rio Grande Watershed



There are four drilled wells located at Grants Level, near Berrydale, which tap into aquifers.

2.4 Major Geological Formation of the Rio Grande Watershed

Table 2.4 Major Geological Formation of the Rio Grande Watershed

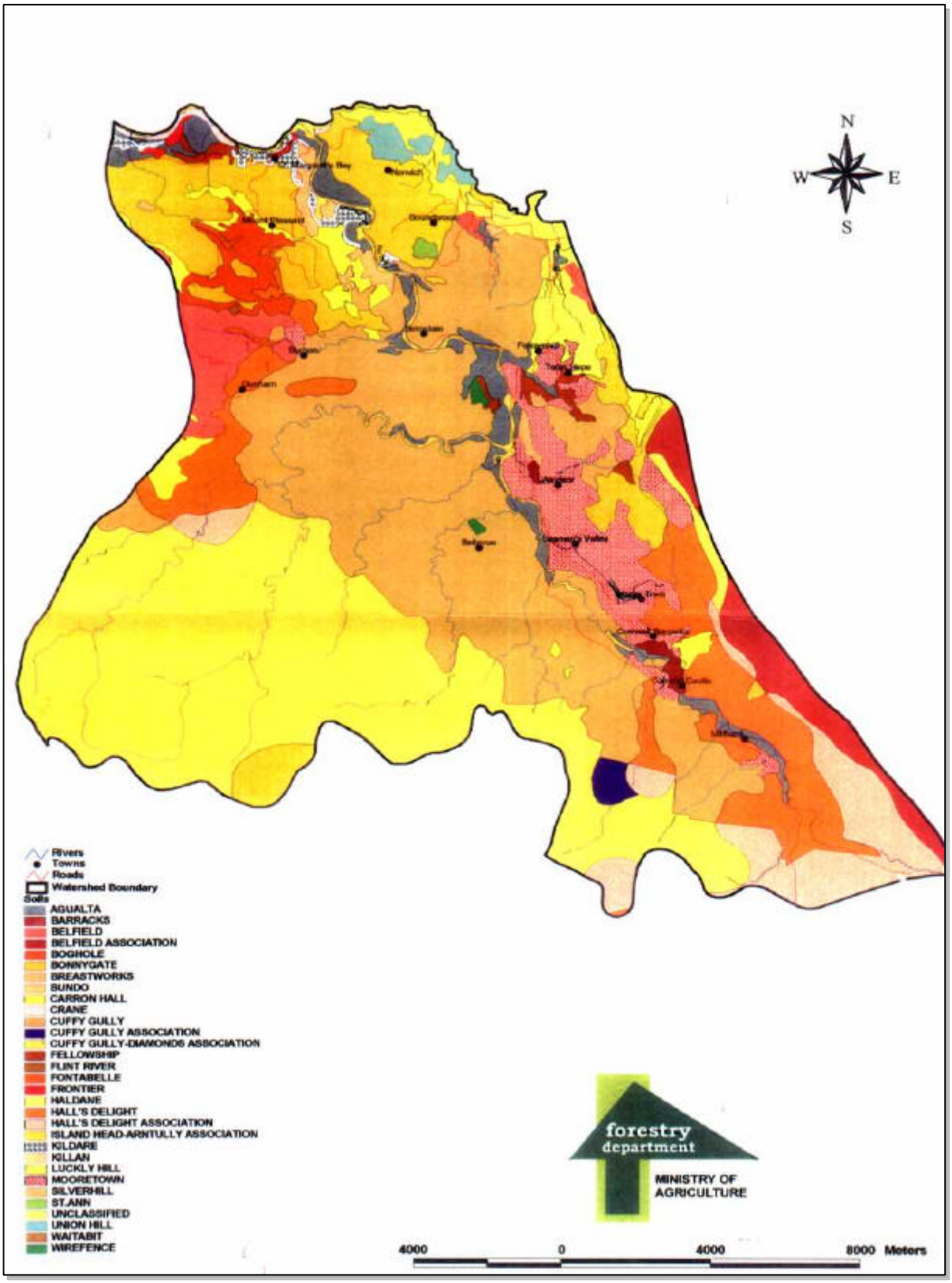
Formation	Type (Hydro-Stratigraphic Features)	Percent Of Watershed
Quaternary	Alluvium aquifer	04.5%
	Coastal aquiclude	00.6%
	Limestone aquifer	09.6%
Richmond Formation	Basement aquiclude	23.6%
	Foothill aquiclude	08.2%
Cretaceous	Inlier aquiclude	53.5%

2.5 Soils

Two soils predominate in the watershed. These are Bonnygate Stony Loam and Cuffy Gully. The Bonnygate Stony Loam, a thin brown, red or grey mantle over limestone which erodes rapidly. Due to its erosion potential, it should be left to trees and bush. It is associated with limestone outcrops, especially below Berrydale along the eastern upper catchment and a strip along the outcrops on the western bank of the Rio Grande about 1km inland from St. Margaret's Bay. The majority of this soil is found in the John Crow Mountains where most slope angle range from 25 to greater than 50 degrees, and in the districts of Boundbrook and Norwich. Cuffy Gully Gravely Sandy Loam, which covers the largest area in the watershed, are thin, well-drained soils found on weathered conglomerates, tuffs and hornfels. These soils are excessively drained and shallow, and occur, for the most part, on very steep-to-steep slopes. These soils occur west of Rio Grande from south of Millbank to beyond Berrydale and east of river from Fellowship to Boundbrook.

The dominant features affecting soil formation in the Rio Grande Watershed are parent material followed by topography. **Because rainfall is relatively uniform across the watershed, it does not affect different kinds of soil formation.**

Figure 2.5 Soils map of the Rio Grande Watershed



2.6 Natural Hazards

2.6.1 Soil Erosion Hazard

Due to the steepness of most slopes and, the associated soil types and shallow profiles, most areas of the watershed are prone to soil erosion. Metamorphic and igneous rocks are the primary source of Blue Mountain soils. These soils are highly porous loams with limited water-holding capacity subject to heavy leaching resulting in a low nutrient content and low pH. It has been recommend that these soils not be cultivated. Rather that they are left under natural vegetation due to extreme danger from erosion

This warning has also been made in reference to soils in the John Crow Mountains. These soils are thin and stony with the bedrock limestone at or just below the surface. Well to poorly drained loams and clays, under a thin layer of humus, are found in relatively deep pockets.

Soil erosion rates from Coffee cultivation are far greater than erosion rates caused by yam cultivation on hillsides. Rates of soil erosion in cultivated areas have been estimated to be greater than 150 tons per hectare annually. Rates in the undisturbed upper catchment are estimated at 50+ tons per hectare annually.

Table 2.6 Soil Chart [Characteristics and Features]

SOIL TYPE	AREA	SLOPE RANGE (DEGREES)	DRAINAGE	MOISTURE SUPPLY	EROSION HAZARD	NATURAL FERTILITY	NOTES
Bonnygate Stoney Loam	23,625 acres in parish/John Crow Mtns. & Boundbrook & Norwich running west to river.	20	Extreme rapid	Very low	Very high	Moderate	
Carron Hill Clay	22,850 in parish/ south of Fellowship, Prospect & Mt. Pleasant	10-20	Moderate to slow	High	Slight	High	Increasingl y alkaline with depth
Cuffy Gully	19,450 acres in parish/largest coverage in Watershed. West of Rio Grande from south of Millbank to beyond Berrydale. East of river from Fellowship to Boundbrook.	15-35	Fast	Fair	High to very high	Medium/aci dic	Shallow and stoney
Chaney Clay Loam/Halls Delight	15,000 acres in parish/	20	Very rapid	Fair to low	High	Medium/ne utral topsoil/ alkaline subsoil	Hard, shattered shale @12-24".

SOIL TYPE	AREA	SLOPE RANGE (DEGREES)	DRAINAGE	MOISTURE SUPPLY	EROSION HAZARD	NATURAL FERTILITY	NOTES
Fellowship Clay	1,300 acres in parish/Tom's Hope	0-2	Extremely slow	High	Almost none	Medium to high/alkaline	Water table may be at surface in rain season for two months.
Aqualta Sandy Loam	1,025 acres in parish/Millbank south to St. Margaret's Bay along river banks	0-2	Rapid	Fair to low	Very slight	High	Some packing of topsoil.
Boghole (Rock Hall) Clay	950 acres in parish/Rock Hall	0-2	Very slow	High	Very slight	Low to medium/highly acidic	Water table near or at surface after heavy rain may persist for one week. A mottled clay layer @ 6-10" impedes drainage.
Fontabelle Clay	490 acres in parish/ east of Rio Grande from headwaters to below Moore Town, north & south & in Dunham	0-2	Moderate	High	Almost none	Medium to high/ alkaline	
Barracks Silt Loam	200 acres in parish/Comfort Castle to Cornwell Barracks & along east edge of watershed.	0-20	Rapid	Fair	Slight	Medium/ alkaline	

2.6.2 Hydrology

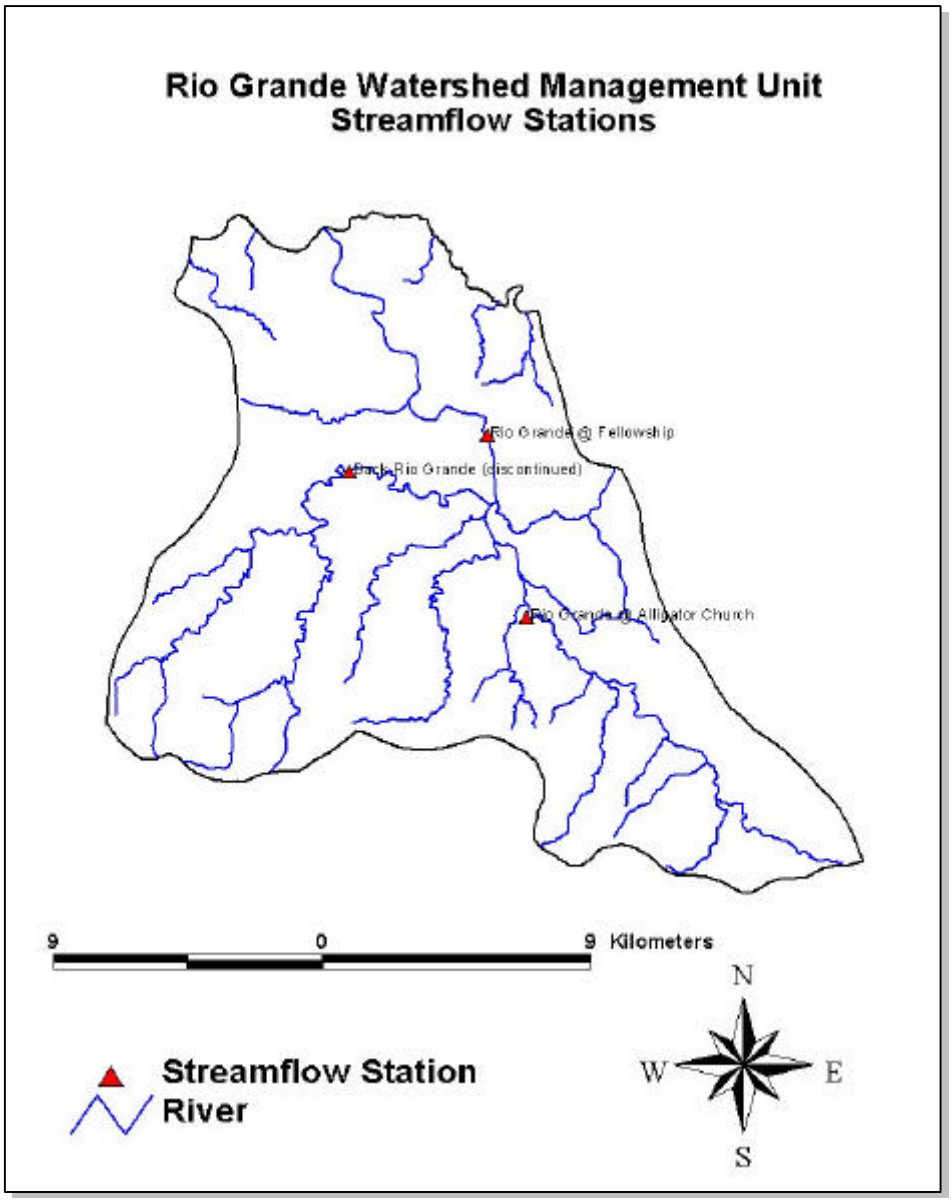
The Rio Grande River, from which the watershed takes its name, is Portland's largest and has a drainage basin which impacts on an extensive area throughout its range and in particular the lower reaches and along the coast. The high surface area of the uplands relative to the very narrow area of the coastline also makes this area prone to flooding.

2.6.3 Surface Drainage

Most of the rivers have a high flow rate and are prone to flash floods. See appendix

Figure below shows stream flow stations.

Figure 2.6 Stream Flow Monitoring Stations and Rivers



2.7 Stream Flow Analysis and Stream Flow Distribution

2.7.1 Stream Discharge

Stream discharge is measured at a station in Fellowship. The discharge peaks in May and November, as would be expected due to increased rainfall in these months. However, there is less variability in discharge levels, seasonally than what is anecdotally reported by raft's men. Average monthly flows vary between a low of 12 cubic meters per second in July to a high of 43 cubic meters per second in November. Maximum-recorded daily discharges illustrate a considerably higher variation than do the minimum discharges.

By and large, the trend in discharge rates for the Rio Grande River recorded at Fellowship for July and November indicate neither an increase nor decline in base flow. This long-term uniformity suggests that the watershed parameters that control base flow have maintained their status over time.

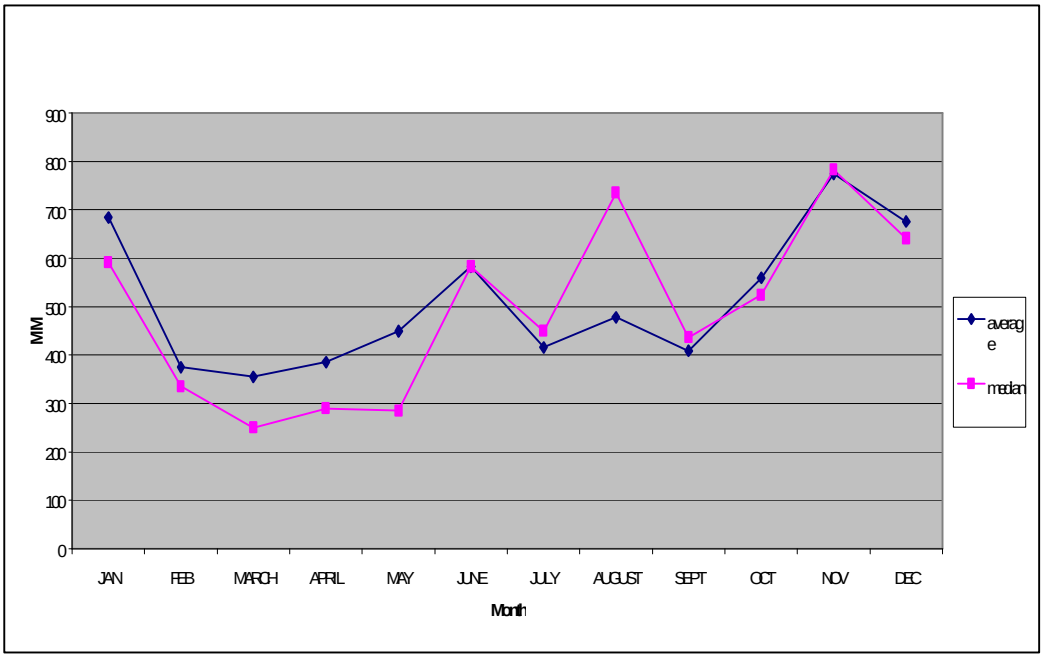
The winter rain season significantly recharges the small aquifer. Aquifer through-flow maintains base-flow during the drier spring months.

2.7.2 Waterfalls

There are four significantly impressive waterfalls within the watershed. Both Scatter Waterfalls and Nanny Falls are easily accessible and are developed. However, the area surrounding Nanny Falls shows clear signs of neglect. White River Falls and Dry River Falls are less accessible but can be reached by persons of moderate fitness. The promotion of all four falls for local tourism should be investigated.

2.8 Climate and Rainfall

Figure 2.8 Monthly Rainfall Averages at Millbank - 1957 through 1999.



The Northeast Trade winds prevail in the watershed. They blow in off the Atlantic in a southwesterly direction. As this moisture-laden air rises-up the north-facing slopes of the Blue and John Crow Mountains, it cools and condenses causing precipitation. The forest and communities at the higher levels receive the highest amounts of precipitation. Rainfall data records are incomplete. However, available records indicate annual precipitation in Millbank usually exceeds 4,000 mm. In 1960 and 1966, it received 9,431mm and 9,342mm respectively. Available records indicate that Port Antonio and Fellowship receive somewhere in the range of 3,000mm annually.

Indeed, the parish of Portland receives the highest rainfall in the country. For example, the calculated 20-year drought event for Millbank, a 5% chance that minimum annual rainfall will be 4,538mm, is significantly higher than average rainfall for most parishes in Jamaica. March and October have historically been considered months of heaviest precipitation. However, that trend

is not obvious from data collected. Data available for this document indicate that April and March receive the least amount of rainfall, while the winter months, November through January, receive the highest. It has been noted that there has been a slight decline in total annual rainfall over a 37-year period (1952 through 1987). However, there has been significant variation over time. The data collected for this document are not indicative of any decline.

The WRA and the National Meteorological Office monitor rainfall in the RGW. WRA has recently acquired state of the art solar powered continuous monitoring equipment. The figure below indicates the location of monitoring stations

Table 2.8a Rainfall and Stream Flow Monitoring Stations Locations in the RGW

Location	Type	Agency
Alligator Church Bridge	Stream Flow gauge and recorder	WRA
Fellowship	Same as above	WRA
Bellevue	Solar Powered Continuous Reading Rainfall Gauge	WRA
Millbank Ranger Station	Rainfall Gauge	B/JCMNP (Station not operational)
Tom's Hope	Rain Gauge	Private Citizen

Table 2.8b Rain Gauge Reading from Private Site [Tom's Hope]

Date Collected (October – November 2001)	Rain Gauge Readings – Community Of Tom's Hope
10/28	5.3"
10/29	7.6"
10/30	4.8
10/31	4.7
11/4	3.4

Most districts located along river courses in the upper watershed have a very limited reach of flat area that is abutted by steep slopes. During extended or intense rain events the rivers quickly rise inundating, these narrow flood plains. For example, the community of Berrydale, with shale bedrock of low porosity and hydraulic conductivity (5% and 0.041 m/day respectively), suffered from severe flooding during the October 2001 rain event.

2.9 Water Quality Monitoring Results

On-site water analysis was carried out at Grants Level and St. Margaret's Bay on 21/08/97 by Environmental science and Technology. Of the several parameters studied, Total Dissolved Solids, Chemical Oxygen Demand, Sulfate, Faecal Coli (E-Coli) and Total Coli showed a marked increase in levels between Grant's Level and the river's discharge point, St. Margaret's Bay.

However, the total Coli levels for each station, 800 MPN at Grants Level and 2,400 MPN are significantly higher than 200 MPN index/100ml (200 cells of fecal coliform/100ml water) used to indicate an acceptable water quality standard. The high levels may be indicative of pollution by the large number of pit latrines used by residents in the watershed and contamination by animal feces.

Additionally, algae blooms, observed along the river course, particularly at Grants Level and Berrydale, suggest the loading of phosphates and nitrates into the river. Phosphorous and nitrogen in stream water is largely due to contamination by fertilizers, detergents and sewage. A regular regime of water quality testing is recommended.

2.10 Flooding

✍ **How permeability affects flooding potential.**

Soils in and around Port Antonio, shallow soils containing high amounts of clay and colloids, have a below-average infiltration rate once saturated. The porosity of clay is 45% indicating it is able to hold a relatively large amount of water. The corresponding hydraulic conductivity (the rate at which water infiltrates through the material is very low, 0.041 m/day. This makes the area highly susceptible to flooding during rain events that saturate the soil to its limits. This propensity to flooding is great in the district of Prospect. During the January 1998, flooding this low-lying area was greatly affected. Buildings in the district had as much as 12 inches of water inside.

The recommendation by ENACT, in their publication *The Parish of Portland: A Sustainable Development Profile*, 2000, for the need "to conduct a comprehensive study of soil capability and landslide, erosion, flood and seismic hazards … for sustainable development planning," is reiterated here. The extent of damage from landslides and flooding, which resulted from October and November 2001 and January 1998 rain events, points to this need. This need is reinforced by the magnitude of soil loss during rains of even moderate intensity was obvious during field recent observations.

The ODPEM identified the following areas as among the "Main Flood Prone Areas in Jamaica":

- ✍ St. Margaret's Bay
- ✍ Windsor
- ✍ Millbank and Surroundings

Table 2.10 Selected peak flood discharge data for RGW

Date	Discharge Value In Cubit Meter Per Second
1960: 23/01 (Fellowship, St. Margaret's Bay and Millbank)	1687.43
1969: 09/06 (St. Margaret's Bay)	1599.66
1993: 27/01	1525.03
1988: 12/09	1112.97
1971: 12/11	1024.92
1980: 03/01	962.63
1974: 06/12	880.52

* Source River Rafting Study

Typhoid was reported in Ginger House after the 1993 Flood and Berrydale Dike was built after the 1971 flood.

2.11 Landslide Potential

Strength of materials greatly influences the magnitude and frequency of landslides. Landslide creep, earth flows, slumps and soil slips are more common on slopes made up of many of the materials that are prevalent in this watershed such as shale slopes or slopes on weak pyroclastic materials.

Water is always directly or indirectly involved with landslides. Weathering, by water, which is the primary agent in the watershed, contributes to instability of rocks by slowly reducing shear strength. This type of weathering is especially significant in limestone areas, which are very susceptible to chemical weathering. This weathering, which takes place near the surface of the earth, contributes to the instability of rocks.

2.12 Land Use and Vegetation

2.12.1 Flora

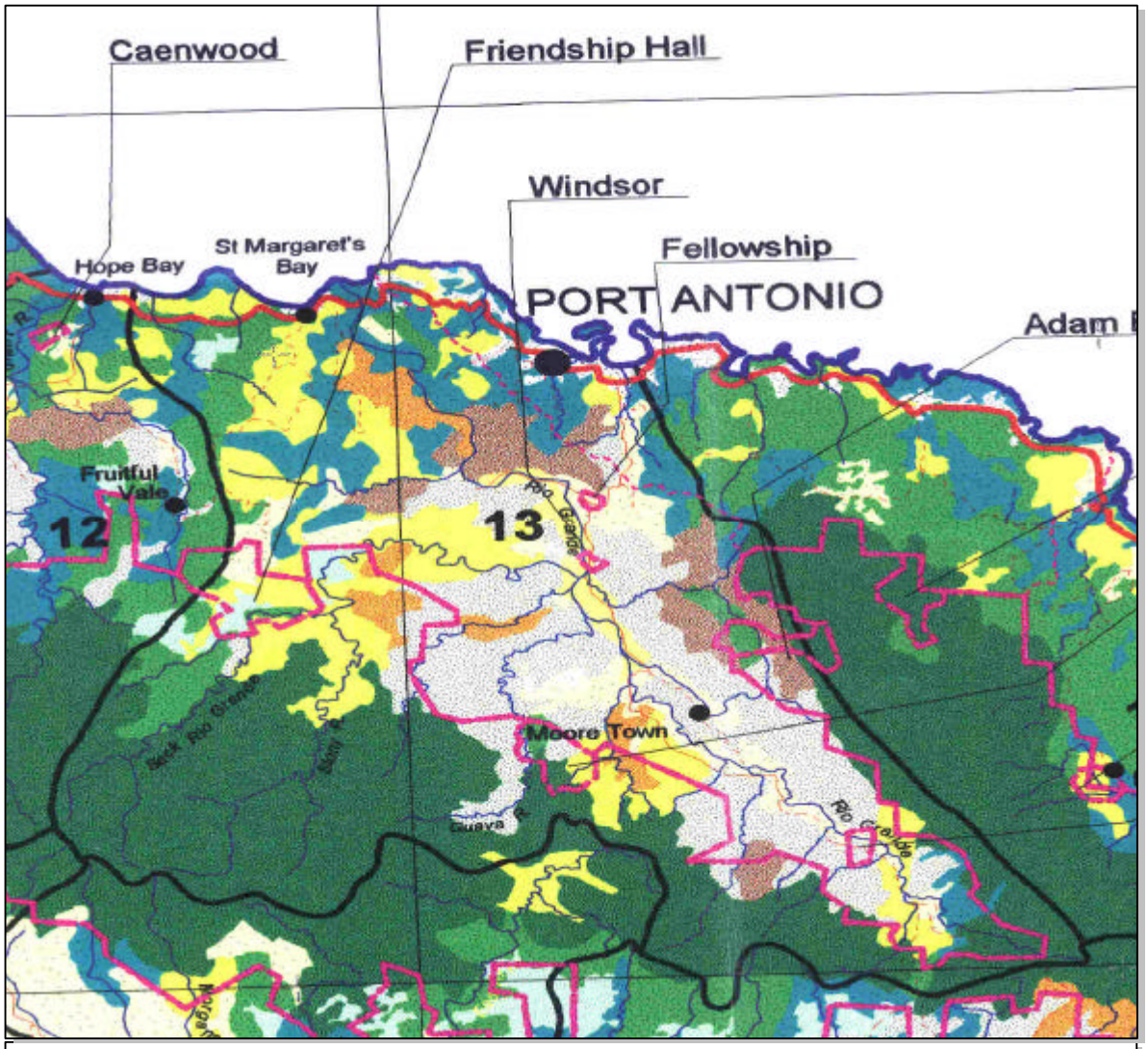
2.12.1.1 Forest

The watershed consists of a mix of natural (with varying levels of modification) and plantations forests.
The forests of the upper reach RGW experience highest rainfall in Jamaica and exhibit characteristic rain forest features tall trees (40-100m) with robust trunk and roots. Significant sections consist of ruinate forest. Wild cane is the dominant plant at rivers' edge. In the hillsides, away from the river, Bamboo, Rose Apple, Trumpet Tree and Almond are most prevalent.

The forests of the John Crow Mountains are rooted in pockets of shallow soil between outcrops of limestone. The fern and bryophyte flora of this area is particularly rich because of the high rainfall, humidity, and deep canopy shade. A large proportion of Jamaica's 579 species of ferns occurs in these mountains, and many are restricted to them (e.g. *Grammitis proctorii* and *Gruglessii*, which are endemic to the John Crow Mountains).

Many tree species contribute to the forest canopy, Santa Maria dominating in some areas, mainly due to cutting out of other more useful species. Other common trees are popnut (locally known as breadnut), mutton wood (parrot wood), galipee (woman wood), water mahoe, slugwood and soapwood. The forest structure does not show clear stratification, but common smaller trees are redwood, joiners, and long thatch palm. There are also many members of the coffee family and the melastome family. Tree ferns, in particular *Cyathea grevilleana*, are abundant in sheltered hollows. Harvesting occurring in the watershed is primarily of an illegal nature, and targets pine plantations established under FIDCO.

Figure 2.12 (a) Shows Land Use and Vegetation in the RGW



LEGEND **LAND USE/COVER MAP RIO GRANDE WATERSHED**

Forest Land use/cover (> 75%)Second Class

- Closed Broad Leaf Bananas
- Distributed broad Leaf Forest Grass/Vegetables
- Bamboo
- Tall Open Dry Forest
- Short Open Dry Forest
- Swap Forest
- Mangrove Forest

Non Forest Land Use/Cover

- Plantation: Tree Crops, Shrub Crops, Sugar Cane,
- Field: Herbaceous Crops, Fallow, Cultivated
- Herbaceous Wetland
- Water Bodies
- Bare Rock
- Buildings and other infrastructure

Mixed Land use/cover (First Class >50%, Second Class >25%)

- Fields or Distributed Broad Leaf Forest & Pine Plan
- Distributed Broadleaved Forest and Fields
- Bamboo and Distributed Broad leaved Forest
- Bamboo and Fields
- Fields and Distributed Broadleaved Forest

The native forests of the John Crow Mountains support a high proportion of flowering plant species with a limited geographical range. At one site, about 40% of the species were endemic to Jamaica, and about 10% (20 spp.) were endemic to the east of the island. Portland has the highest number of local plant endemic of all the parishes.

The best-represented flowering plant families are the orchids, the coffee family, the melastomes and the milkweed family (Euphorbiaceae). Some of the more curious elements of the flora include saprophytic and parasitic herbs, which do not have any green parts, depending on other plants for their nutrition. *Gymnosiphon* spp. are saprophytes that derive their food from dead plants. John Crow nose is a strange-looking low plant with purple club-shaped structures, which is parasitic on tree roots.

Members of the herb layer range in size from tiny pileus to the spectacular wild plantain. Ferns are abundant, making up 40% of the ground cover in certain areas. Climbers, both flowering plants and ferns are very abundant. The largest of these is **cacoon**, a vine with a woody coiling stem as thick as an arm. The fruit from the cacoon contains toxins and is used by locals to purify water stored in drums and containers. Climbing aroids are frequent, represented by five finger and philodendron spp the dried roots and stems of which are used in the wicker furniture industry. Strangling figs are also plentiful, and may develop to huge trees.

2.12.1.2 Aquatic Flora

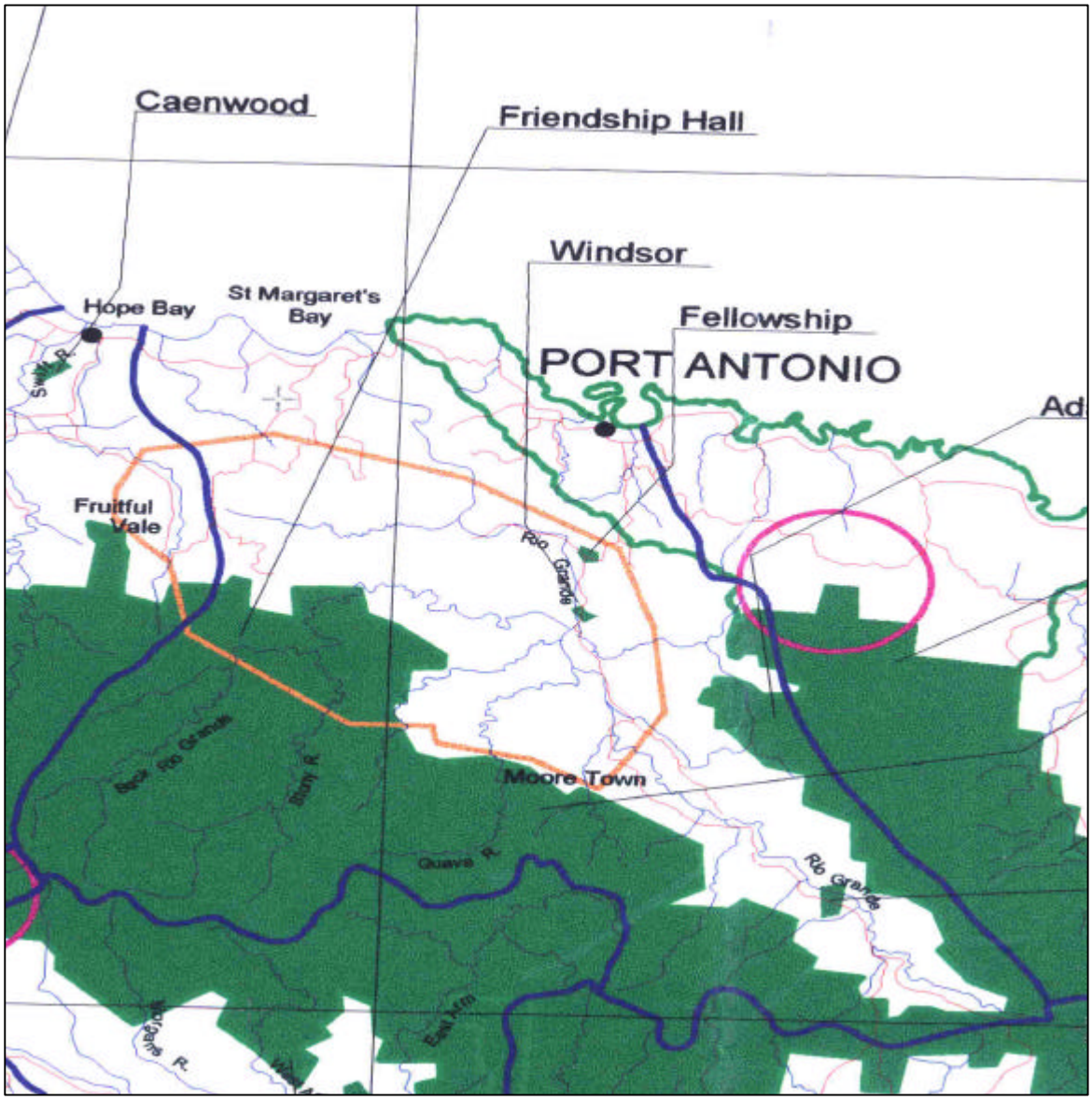
The predominant aquatic flora evident in the watershed is algae. Algae are indicative of a eutrophic environment. Sources for the excess nutrients causing these conditions are pit latrines located in close proximity to the river, pesticide and fertilizer run-off in the upper catchment, and human activity such as clothes and vehicle washing.

✍ **Economic Benefits that can be derived from Specific Flora**

The Oil nut tree, used to make castor oil is abundant in the region. However, it is no long being harvested. The economic potential for castor oil production could be researched.

Additionally, consideration could be given to the agro-processing of marmalade from Bitter orange, which is now processed for home use.

Figure 2.12 (b) Map of Critical Areas



LEGEND (Forestry Management Plan) – Identified Critical Emphasis Areas

Management Status

- Protected Area
- Forest Reserve
- National Water Commission Land

Identified Areas

- Forest Departments Critical Areas
- NRCA/NEPA Critical Areas

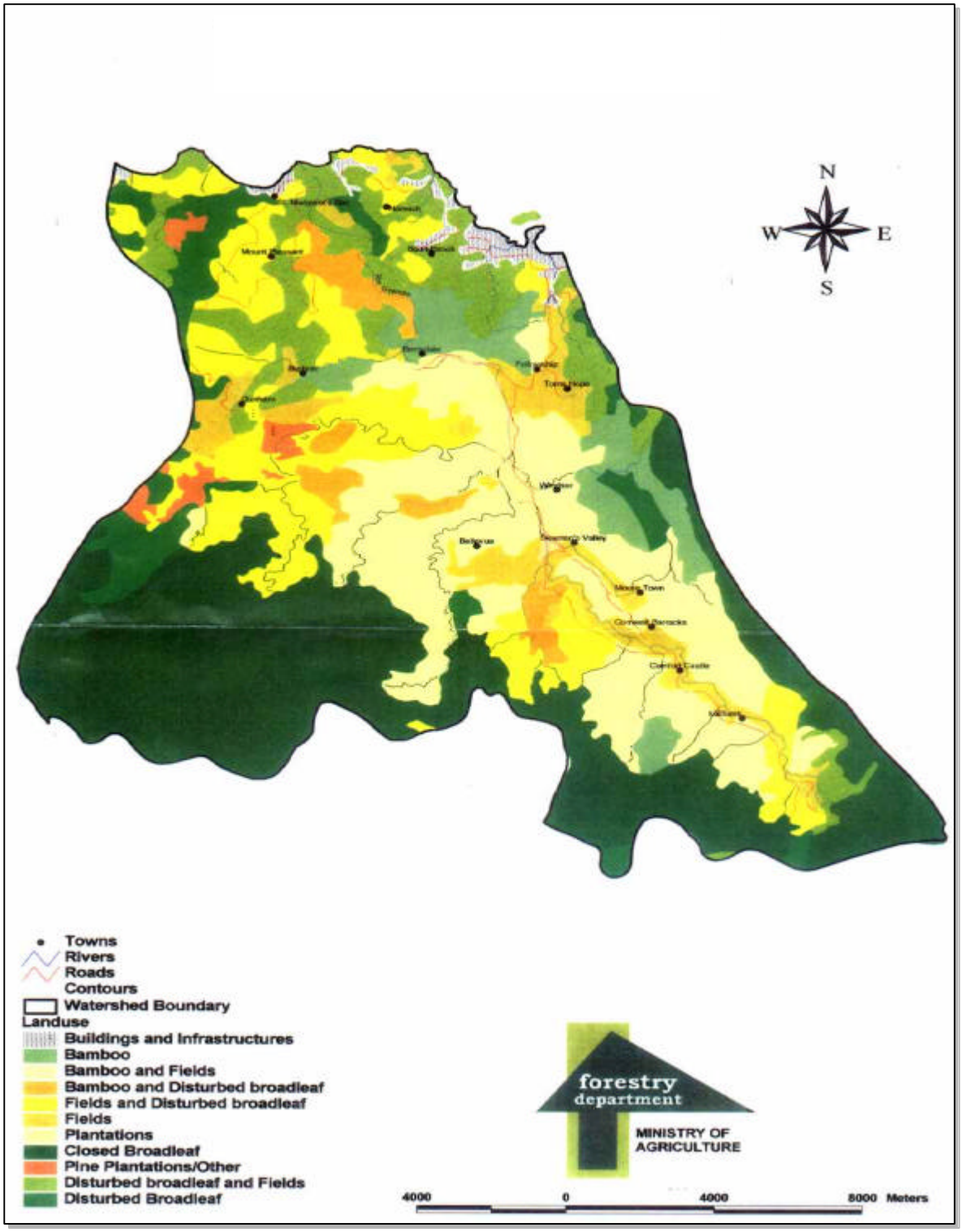
Basic Features

- Watershed Boundaries
- Rivers and Streams
- Roads
- ? Cities & Towns

Figure 2.9.0.1 Critical Emphasis Areas

Figure 2.12 (c) Map of Potential Reforestation Areas in the Rio Grande Watershed

Figure 2.12 (d) Land use Map of the Rio Grande Watershed



2.12.1.3 Noxious Plants - Bamboo

Bamboo is an introduced species from Asia that has naturalized. The plant blooms once in 120 to 160 years after which it dies. The average height is 15m and average diameter is 45cm. As it grows in clumps, loose canopies are formed allowing more light penetration than in secondary forests. These clumps may serve as forest regeneration by providing for seedling growth below. The bamboo also creates a microclimate for shade tolerant plants such as bromeliads and mosses. Leaf litter may aid in the introduction of nutrients to the soil. Locals have traditionally used bamboo in a variety of ways including the making of handcraft and for fencing. It is also in high demand for raft construction.

2.12.1.4 Pines and Other Plants

Plantations of Caribbean pine (Honduras) and other pines are scattered throughout the watershed. Some of these date from the expansion of timber planting to rehabilitate deforested hillsides during the 1950s, and others from more recent expansion of timber production during the 1970s and 1980s under FIDCO. In drier areas, these monocultures usually have a bare understorey, although some native shrubs do occur beneath these stands. Usually, there are dense tangles of ferns or thickets of combustible grasses as the sole herbaceous cover. Some imported pines are adapted to fire, and can tolerate low levels without being killed (in contrast to most native species).

Studies of bird communities in mature Caribbean Pine plantations revealed a much lower number and diversity of birds than in adjacent native forest (less than half the number of species). More importantly, many endemic species, such as Jamaican blackbird and crested quail dove, were not found in these plantations at all.

Other species grown in plantation in the watershed include hardwoods such as Blue Mahoe, Honduran mahogany, Teak, *Eucalyptus* species, Cedar and Broadleaf.

2.12.2 Fauna

2.12.2.1 Mammals

Few mammals occur naturally in the watershed, among the few that exist is the Jamaican hutia (or Indian coney). About the size of a rabbit has within the last few decades become increasingly restricted in range. Significant decline in population is reported in some areas and extinction in others. Although it is not presently considered endangered, it is protected under the Wild Life Protection Act. The reasons for its decline are deforestation and hunting, coupled with predation from introduced mammals, especially dogs, rats and mongooses.

Occasional sightings of hutias in the Blue Mountain range, specifically in northeastern areas and in the area of Cuna Cuna Pass. The hutias utilize holes formed by roots, hollow trees and crevices in rock-fall areas.

✍ **Bats**

Twenty-one species of bats are known from Jamaica. Three species, (*Phyllonycteris aphylla, Artibeus flavescens* and *Eptesicus lynni*), are endemic but their status and habitat are unknown The distribution of bats in Jamaica is poorly known. Most sampling has been of known cave roosts. Very little is known about the feeding habits of bats within the forests.

✍ Other Mammals (Introduced species)

Several introduced species of mammals are found within the watershed. Some are now a significant part of the fauna, such as, the Indian mongoose, which was introduced to Jamaica in 1872 to control rats and snakes. The most recent addition to the list of introduced fauna is the white tail deer which was reported to have escaped into the mountains from a tourists attraction during hurricane Gilbert in 1988.

✍ Feral Animals

Feral pigs are present in the RGW introduced by the Spanish in the 1600s have today continued to be an important source of protein, especially for the Maroons who perfected the technique of jerking pork (spiced treatment of the raw meat to preserve it for several days). The tradition of boar hunting continues in the RGW. The meat when jerked is considered a delicacy. Pigs are present in fair density throughout the John Crow Mountains and the lower reaches of the northern slopes of the Blue Mountains. Feral pigs are predators of ground insects and molluscs, and selectively feed on the fruits of some forest trees. They cause localised heavy damage to understorey areas of forest and destroy ground flora.

2.12.2.2 Birds

The lower montane forests of the John Crow Mountains support some of the greatest diversity of land birds to be found in Jamaica. More than 30 species of birds live in the watershed. Eleven of these are endemic to Jamaica. Smooth Billed Ani is most commonly seen because it inhabits areas along the roadside, in pastures and gardens. This member of the cuckoo family is not endemic.

The most commonly seen water bird is the Green Backed Heron, *Butorides virescens*. These birds nest along the riverbanks and are not endemic to Jamaica.

The John Crow Mountains support major populations of larger, more mobile frugivores and omnivores. Some of these are endemic to Jamaica. These include the yellow-billed parrot (which only occasionally ranges to the higher parts of the Blue Mountains), the rarer black-billed parrot and Jamaican Crow. The endemic Jamaican owl and endemic sub-species of common patoo are found here as well.

The John Crow Mountains represent the centre of the range and main habitat of the black-billed streamertail. This bird has generally been regarded as distinct from the more common red-billed streamertail at the subspecific level. The black-billed streamertail is common in the John Crow Mountains, while the red-billed streamertail is absent. The two streamertails overlap in range in the vicinity of Corn Puss Gap, which separates the two ranges, but they do not appear to hybridise.

✍ Migrant Birds

Most forest birds, which migrate to Jamaica, do so from North America during the winter months, and return to North America during summer months to breed. A few species migrate from northern South America during summer to breed in Jamaica, and return to South America during winter.

Of the roughly 40 forest bird species, which are winter migrants, some spend the winter in Jamaica; others use Jamaica as a stop en route to wintering grounds in South America. Few if any of these species appear to depend principally on large tracts of primary forest; most migrants appear not to be very habitat-specific in their wintering grounds. However, they do form a significant part of the forest bird community during the months that they are present.

2.12.2.3 Snakes

Jamaica has six species of snake of which five are endemic. One of these, the black racer, is probably extinct. Of the remainder, three are found within the RGW.

The endemic Jamaican boa, or yellow snake, is found in a wide range of habitats across Jamaica however, their distribution suggests that they depend on low altitude forest (below 900 m). Thus, the higher sections of the watershed may not be favourable habitat for boas. Most records of sightings are from the eastern part of the Blue Mountains, that is near the lower altitude reaches of the northeastern slopes of the Back Rio Grande catchment, Pig hunters from the Bellevue area have captured several specimens. While seldom hunted, the morbid fear of snakes felt by many locals often means that those that are seen are killed. Thus as populations are exposed by encroachment into forested areas, boas are at risk of being killed. In some instances locals hunt snakes to obtain the oil for medicinal purposes.

2.12.2.4 Lizard and Frogs

Many of Jamaica's 24 lizard species are found within the watershed. The genus *Anolis* has six (6) endemic species in Jamaica and one introduced species.

Frogs are the only amphibians native to Jamaica. All 22 native frogs of Jamaica are endemic, and most (17 species) belong to the genus *Eleuthrodactylus*. Recent studies suggest that the 17 native species in this genus are derived from a single ancestor.

There are two major centres in the distribution of these endemic frogs. One is in the Cockpit Country; the other is the Blue Mountains and the John Crow Mountains. Ten of Jamaica's 22 species of endemic frogs occur in the B/JCMNP and sections of the watershed. Of these, 9 are in the genus *Eleuthrodactylus.* Of these, five (*E. andrewsi, E. orcutti, E. pentasyringos, E. alticola* and *E. nubicola*) are endemic to these mountains, and the last two are restricted to the Blue Mountains. Furthermore, all these endemic frogs depend on undisturbed primary forest for their survival. Most are ground dwellers or live in low shrubs and ferns.

The ground-dwellers rely on deep undisturbed piles of leaf litter. Two species (*Eleuthrodactylus jamaicensis* and *Osteopilus brunneus*) live in tree canopies, the former in epiphytic bromeliads. Removal of forest cover would lead to the elimination of these two species.

2.12.2.5 Invertebrates

✍ **Insects**

Giant Swallowtail Butterfly

Best known among the butterflies is *Papilio homerus*. This is largest of New World butterflies, with wing spans a spectacular 15cm (6 ins) from one wing tip to another. The Giant Swallowtail is now one of the rarest animals in the world (listed by the IUCN on its `Top 12 Endangered Species List' in 1988).

The Giant Swallowtail Butterfly, Papilo homerus, is endemic to Jamaica. This species is an endangered butterfly and rarely seen in the watershed. Most sightings have been in the upper reaches of the Rio Grande Valley in the vicinity of the Cuna Cuna Pass and the lower sections of the White River. The butterfly is threatened in its small remaining populations both by commercial collecting and destruction of its habitat. The Convention on International Trade in Endangered Species (CITES Appendix 4) lists the *Papilio Homerus* and has banned trade in the butterfly.

The management plan for the B/JCM Park (1993-96) motes *"In Jamaica, deforestation is particularly significant to Papilio Homerus' survival because the butterfly has tied its existence to that of the Water Mahoe (Hernandia catalpifolia). It is on the leaves of this tree alone that the adult female lays her eggs, so that while adults may feed on different tree sources, without the Mahoe, the young cannot survive".*

The remaining population is threatened by the following alterations in habitat:

(a) Deforestation
(b) Agricultural conversion and intensification
(c) Alteration of Pastures
(d) Urbanization and industrialization

Members of the Pierdiae species, Cabbage Butterfly, are abundant in the region. This species is typical of ecologically degraded forests

The forests in the RGW support a great variety of insects in a wide range of families; among the more familiar are Elatedae (peenywallies, click beetles) Lampyridae (Blinkies, fireflies) and in places Culicidae (mosquitoes). Euglossine bees are among the major pollinators of flowering plants in the Blue Mountains. For nearly all families of insects, however, their distribution in the watershed is very poorly known. This is also the case for the many groups, such as moths.

Butterflies, probably because of their conspicuousness, are one of the few groups of insects for which taxonomy and distribution are clearly understood.

✍ Other Invertebrates

There exists very limited knowledge of the distribution, taxonomy and ecology of many of the other invertebrates of the watershed, besides insects,. No significant research has been done in regards to include spiders and harvestmen, isopods, crabs, scorpions, molluscs and the primitive Onychophora. (The Jamaican species of this order belong to the genus *Peripatus* and are considered vulnerable). Two endemic terrestrial crab species are known from the John Crow Mountains and two others are known from the Blue Mountains. Numerous species of land snails are known to be endemic to the forests of the John Crow Mountains.

Table 2.12.3 Summary of the main biophysical feature of the RGW

Biophysical Feature	Description	Opportunities	Constraints
Topography	Extremely Mountainous	Attractive landscape Salubrious Climate	Area not suited for traditional agriculture
	Throughout the watershed, slopes are generally steep. More than 75% of the slopes exceed 20 degrees. Thus making the area prone to geomorphic change due to gravity and steep slopes	Explore the viability of non-traditional agriculture e.g. tree crops using suitable tree species Alternative income generating activities e.g. eco-tourism Diversify the economic resource base	

Biophysical Feature	Description	Opportunities	Constraints
Geology John Crow Mountains	Characterized by steep rocky knolls and deep depressions. Deposited in both shallow and deep water		
Earthquakes	Major faults aligned approximately north south. Are the Blue Mountain Fault and the Rio Grande Fault.		Special attention to the location of structures such as large buildings, roads and bridges
Caves	Caves represent an unexplored source for economic development. From tourism or harvesting bat guano as fertilizer	Eco-tourism and mining of guano for fertilizer Research on cave dwelling organism	
Hydrology	High water table due to the close proximity of bedrock to the surface, Limited groundwater storage (aquifers) in the Rio Grande Watershed		Tendency for rapid flooding to occur
Rainfall	Very high and seasonal Levels	Rainfall catchment for domestic and agricultural use	Flooding from extreme rainfall occurrences in the mid and lower section of the RGW
Soils	Conglomerates on the western side of the RGW Give way to fertile soils Highly erodible soils - The Bonnygate Stony, erodes rapidly.. s, and	Carefully managed agriculture is possible	Risk of flooding and loss of top soil and nutrients Due to its erosion potential, it should be left to trees and bush Locations Majority of this soil is found in the John Crow Mountains where most slope angles range from 25 to greater than 50 degrees and in the districts of Boundbrook and Norwich
Soils and Land Capability	Most of the Land in the watershed are in the land use category Primarily VE (See Table 2.6) Land to be left in its natural state		These lands are describes as *Non arable lad; steeply sloping with extreme danger of erosion*

Biophysical Feature	Description	Opportunities	Constraints
Clay Soils around Pt. Antonio	Soils in and around Port Antonio, below-average infiltration rate once saturated	Develop a Drainage Plan for the Town	Makes the area highly susceptible to flooding during rain events
Topography & Soil Profiles	Steepness of the most slopes and, The associated soil types and shallow profiles,		Most areas of the watershed are prone to soil erosion
Conductivity of soils	Most of the soils are highly porous loams with limited water-holding capacity subject to heavy leaching resulting in a low nutrient content and low pH.		It has been recommend that these soils not be cultivated (Both Mountain Ranges)
Surface Drainage	Most of the rivers have a high flow rate and are prone to flash floods		Very limited permanent use can be made of the river banks and flood plains
Natural Features	Waterfalls - There are four significantly impressive waterfalls within the watershed.	Scatter Water White River Falls and Nanny Falls; Are easily accessible caves	Poor Road conditions and lack of an organised product (marketing and management of impact)
Rainfall	Portland and the RGW receives the highest rainfall in the country	Rain water catchment and tanks as a source of domestic and agricultural water supply	Prolonged periods of heavy rainfall affects social activities, limits available days for tourism and causes flooding and loss of investments
Water Quality	The total Coli levels for each station, 800 MPN at Grants Level and 2,400 MPN are significantly higher than 200 MPN index/100ml (200 cells of fecal coliform/100ml water) High Phosphorous and nitrogen in stream water is largely due to contamination by fertilizers, detergents and sewage	Develop a programme for proper waste disposal and sewage waste management A regular regime of water quality testing is recommended	Limited use of this water for recreation and Increased cost purification's requirement and cost.

Biophysical Feature	Description	Opportunities	Constraints
Bio-diversity	High Rate of Endemism among plant and animal species (Portland has the highest number of local plant endemic of all the parishes)	Research Scientific Tourism Enhance protected area activities (B/JVMNP) Commercial Horticulture Mushroom Production Wicker Production Castor Oil Production Agro-processing	Sensitive ecosystem requiring the scientific monitoring of impact and zoning
Introduced animals	Wild Boar and white tail deer	Continued Source of Meet for the “jerk trade” Adventure Tours (deer Watching)	Limited knowledge of the status of populations
Hunting of Snakes and Conies	Snake are hunted for snake oil and conies are captured and killed for their meat	Conservation programme	
Giant Swallowtail Butterfly	Endemic species and the largest butterfly in the Americas	Potential for patenting and brand name for product from the Watershed Scientific and eco-tours Butterfly Farming	Endangered species
Other Invertebrates	Limited Knowledge of their taxonomy and importance	Opportunity for research	
Noxious Plants (Bamboo)	Bamboo Plants invasive plant impacting negatively on the bio-diversity of the watershed.. Support some shade tolerant species	Has many traditional uses Such as Handcraft Provides materials for fence post and the construction of Rafts for the tourism industry	Negative impact on the Biodiversity of the area

3.0 OVERVIEW - HUMAN SETTLEMENT

The Rio Grande Watershed currently has over 45 fragmented small settlements scattered in ribbon style development along the edges of the main thoroughfares. Human settlement and the development of infrastructure in the Valley has been largely unplanned and dictated by the interests of individual settlers and landowners. The pattern of settlement and land use in the Rio Grande was established in the context of over 300 hundred years Maroon occupation and the political interests of the early colonial administration. Slavery and the plantation system promoted establishment of communities in the upper areas of the watershed by escaped slaves in the 17th century onwards and later ex-slaves in the 18th and 19th centuries (post-slavery period) fleeing the hardships of the plantation life.

In addition to the above, the two most important limiting factors, which framed the siting of the early communities in the watershed, were access to:

- Suitable agricultural lands, and
- Trade routes

The dominant physical and characterizing features of the RGW are: -

- Extremely mountainous terrain and high rainfall,
- A narrow coastline,
- Numerous and very swift rivers, and
- Highly erodible and fragile soils.

These characteristics have made suitable locations for the establishment of communities very scarce and a source of longstanding problems for residents in the RGW. Scarcity of land and economic hardships combined with inadequate planning regulations has contributed to settlements being established on flood plains.

3.1 Regulatory Framework

Over the centuries, there has been very little attempt at regulating where people built homes or established farms. The Town and Country Planning Act (1957) which is used to guide and regulate land use and development, only pertains to the coast and one (1) mile inland. For this reason, it cannot be applied to harmful and inappropriate land use activities. The NRCA Act and permit system for site modifications does not practically regulate housing construction. Several other laws exist for protection of the watershed resources, such as the Watershed Protection Act (1963), the Wild Life Protection Act (1945) and the New Forest Act (1996).

Many of these laws lack regulations and the responsible agencies are often without adequate resources for their consistent enforcement, where they do exist. The causes of flooding along the coast often have their genesis in illegal malpractices such as deforestation in the upper areas of the watershed and the disposal of garbage in gullies by residents living in communities along the coast. A reorganized and revitalized Forestry Department has sought to address some of the past deficiencies with the passage of the New Forest Act (1996), which replaced the Forest Law of 1937. Regulations for the new act have been passed and a National Forest Management and Conservation Plan (January 2000) as requirement of the new regulations, has also been prepared. The critical issue of financing forestry management has also been addressed through the establishment of a Forestry Development Fund to fill the funding gap. Other creative strategies outlined in the Management Plan include, co-management and an incentive framework for the involvement of the private sector, NGOs and local communities.

Local Forestry Management Committees involving stakeholders are proposed which focus on watershed management. Under the new regulations and plan, private individuals will have the opportunity to lease public lands for timber production and agro-forestry.

3.2 Impact of Floods and Landslides on Settlements

Fragile geological features subjected to the stress of high and intense rainfall phenomenon, are the principal natural features of the RGW impacting on the livelihoods of the communities in the area, and determining the management agenda for the R2R Project.

Fragile immature soils and a relatively impermeable layer result in frequent floods and landslides. These features form the backdrop against which 'subjective' human activity plays an aggravating role and the creation disasters. Typically, there is loss of livestock, produce, and sometimes-human life as well as extensive damage to agricultural lands and infrastructure because of flooding and landslides. Despite the very predictable November to January rainy seasons and the likely recurrence of floods, preventative measures usually not consistently implemented to mitigate future impact.

3.3 Governance

Several Agencies of government and NGOs are active within the Rio Grande Watershed. Local government is the main responsibility of the elected Parish Council that acts as a liaison between central government and the citizens. There are currently four Parish Council Divisions within the watershed. Through the Parish Council Act its has the responsibility for physical planning, infrastructure development and maintenance, infirmaries, welfare and poor relief and commercial services, and regulates the development.

The Local Building Act, which requires the Parish Council as the Local Planning Authority to inspect and approve all building plans, does offer some measure of control over illegal construction. Approval by this agency however is usually focused on structural integrity. In the past, building plans with soak-away pits for housing were routinely approved throughout the valley. The presence of a high water table, sewage contamination of waterways and rivers from the washing out of these pits by frequent floods were problems not then factored into the approval criteria. Only in recent years have the approval standards been broadened to include environmental concerns. The very dispersed nature of the settlements along the entire length and breadth of the watershed has created very high delivery cost per capita for services and naturally promotes a greater degree of insularity.

✍ Co-management (State/Civil Partnerships)

Agreements and partnerships have developed between the state and NGOs in implementing tasks with were traditionally reserved for the government. The management of protected areas has been one of such areas where this partnership has acquired a more formal status, with several NGOs being delegated management on behalf of the state of large areas of public lands for management. The JCDT in March 2002 signed a delegation agreement with two (2) agencies of government, the Forestry Department and the NRCA for the management of the B/JCMNP. Several other similar relationships at different level of formality between state and NGOs/CBOs have developed to support government policies.

The Government however has in the past not articulated a clear and consistent policy in the way it related to the emerging quasi-state role and services played by NGOs and the relationships have developed in a somewhat ad hoc fashion in response to practical issues. The opportunity for extended and effective partnership with NGOs and CBOs in addressing development issues in the RGW and similar areas has neither been fully explored nor effectively exploited. NGOs such as PEPA, which is involved in establishing the PAMP, the JCDT that manages B/JCMNP and to a

lesser extent the emerging CDCs have played and can, continue to play a critical role in resource management in the RGW. Many of these NGOs have over extended their capacity in trying to fill the vacuum of assistance to communities tackling the development challenges in the watershed. These groups are now faced with decline and in some instances closer. Government's supporting partnership is vital for their survival and effectiveness.

The current government initiatives LSDP and the LGRP recognize this opportunity and seek to address problem through a programme of structured involvement of local communities and interests in the management of the Parish and the watershed. The process requires the organization of the stakeholders in the parish into an advisory structure (PDC) parallel to and working in conjunction with to the Parish Council. It entails representation of communities' members from the level of the district. Unfortunately there are no clear commitment and plans for the long term financing of the process.

The efforts at establishing the PDCs and their objectives is not supported by a clear popular National Strategy for Sustainable Development within which:

- Local Sustainable Development Planning and the RGW management can be framed. Given the country's limited natural, financial and human resources a strategic plan is necessary which prioritizes and integrates their use sustainably, in such a manner as to give Jamaica its most competitive edge in the global market.

- The post-colonial longstanding and conflicting issues of power and accountability are comprehensively addressed

3.4 Maroon Community (Windward Moore Town Maroon Community)

Cantered around the community of Moore Town the Maroons function as a "self-governing" and autonomous district occupying lands obtained in 1740 under the treaty with the British Government. This treaty gave them rights to the lands they now occupy and the authority to manage their own affairs. A council headed by elected colonel runs the affairs of the Maroon community. Their preservation of the West African languages and customs of their fore parents makes this community an invaluable reservoir of cultural heritage; of immense local and international value and significance. This resource and its potential is however in practical terms not given the support required to realise its potential as a centre of folk research, or heritage tourism. Moore Town as is the case with the entire valley lacks proper infrastructure and services. The roads are in very poor conditions and telephone service is not available

3.5 Sustainable Development and Democracy

The issue of power and control over the use of national resources and state taxes in a planned process involving the citizens in communities throughout the island is a very sensitive political issue. While there is public and state support for transparency and greater democracy, no real and significant shift of power from the state to citizen or from central to local government has occurred. The Parish Councils as the expressions of the framework or intent of local government are still not entranced in the constitution but can be with a change of Government or policy.

3.6 Representation

The complaint from the residents within the watershed of not being able to *see or hear* from their Member of Parliament is widespread. This lack of representation and accountability is symptomatic of deep political and social issues relating to the empowerment of citizens. While these problems are outside the direct scope of the R2R project, its strategic objectives need to support their resolution in order not to contribute to the further scattering of resources and effort without any lasting and incremental impact.

Finding solutions to these fundamental issues, which to a large measure have their basis in the lack of education, awareness and capacity are essential parts of the sustainable development process. The R2R programme will facilitate the sustainable development of the RGW, to the extent that it is able to contribute to the communities' capacity to critically examine and determine their relationship with the state and their role in development.

3.7 Local Government Reform

The Local Government Reform process has had positive though limited impact, although there are expectations it could lead to greater revenue and autonomy for the Parish Council. The newly added regional component to the LGRP on the other hand has visibly created efficiency problems. For example it has been reported that the location of the regional office of the NWA with responsibility for Portland, in the parish of St. Mary, along with reduced staffing, has meant significantly more travelling for senior officers and tardiness in executing contracts in Portland

Land taxes and other fees payable to the council have not kept pace with the real value of the dollar and are now way below the real cost of the services provided by the Parish Council. These fees though currently collected by the tax department are supposed to be available to the Parish Council to meet its many public obligations, however the process of obtaining these funds is slow and indirect.

Arrangements allowing the Council to collect and retain fees are being put in place. The arrears on land taxes and various fees for licenses run into millions of uncollected income from both public and private sectors. This has resulted in the indebtedness of the Parish Council to various service providers such as the JPSCo

3.8 Social Capacity

3.8.1 Community Organizations Role and Relevance

Not since the 1960s and 1970s and the introduction of programmes such as the Jamaica Movement for the Advancement of Literacy (JAMAL), the National Youth Service (NYS), and the Youth Development Councils, has there been a national programme to develop the organizational and institutional capacity among civil society. The decline of these programmes in the RGW is evident in the low levels of literacy, social cohesion and organizational capacity.

Figure 3.8.1 Chart of Meeting Venues used by Youth Groups and Citizens' Associations In RGW

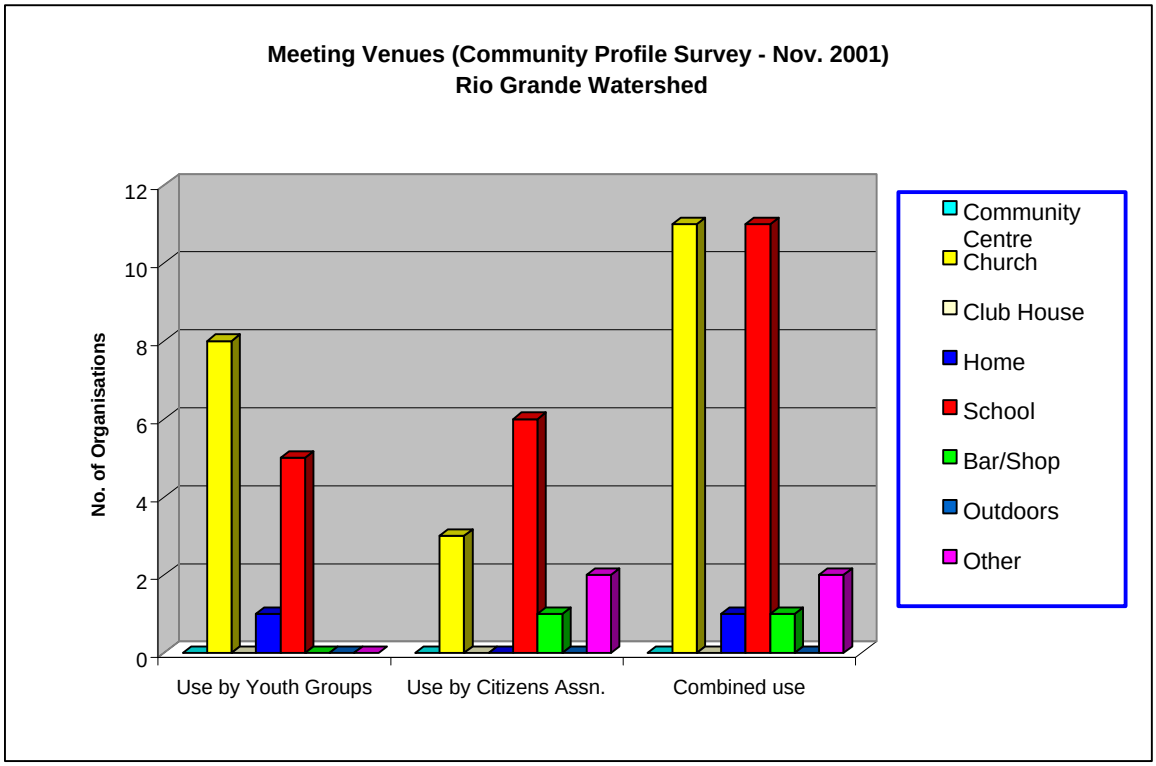
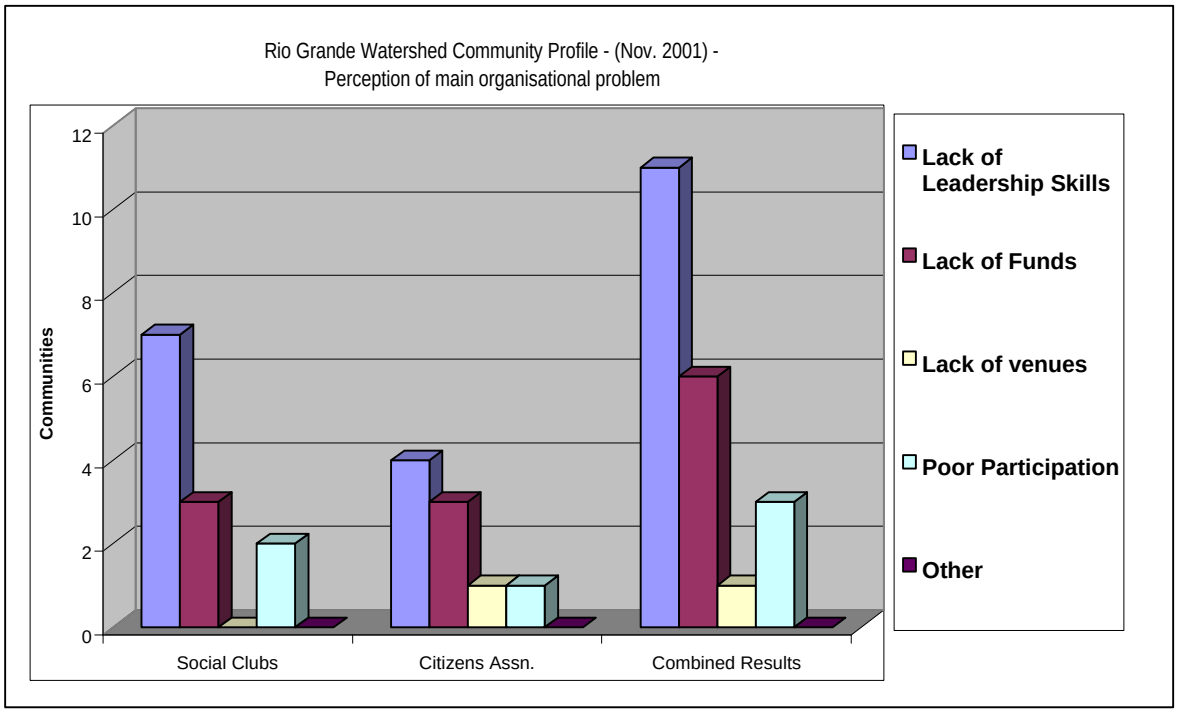


Figure 3.8.2 Community Profile Survey – Chart of the main organizational problems



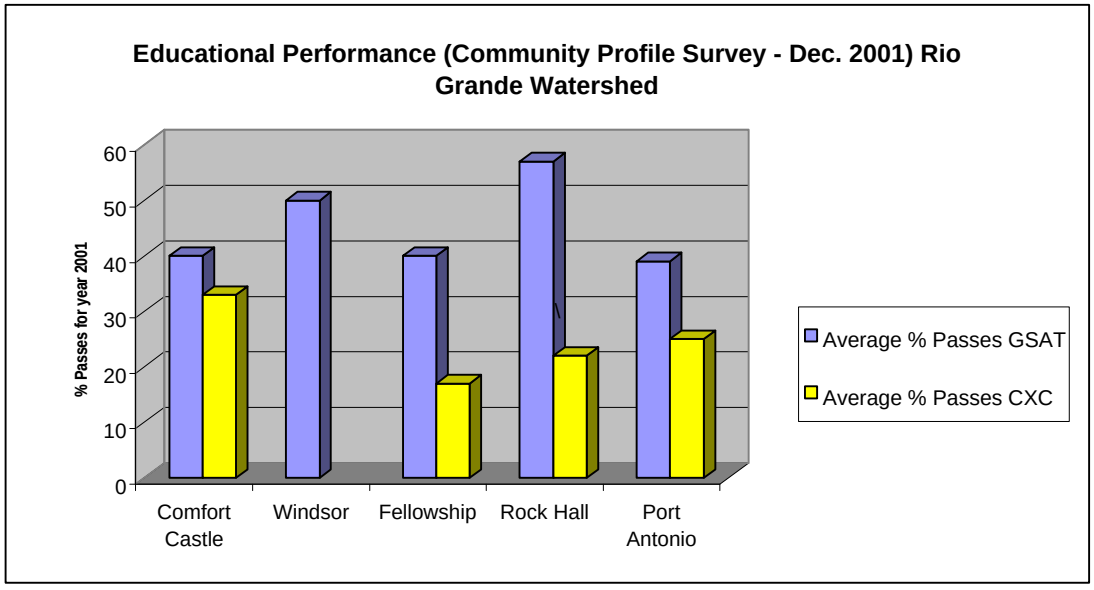
The appraisal identified a number of problems affecting the organizational capacity of the communities in the watershed chief of which is the absence or shortage of experienced leaders **(Figure 3.8.1).** The chart **(Figure 3.8.2)** also indicates that the lack of suitable meeting place is also a common problem facing civic organizations. The lack of suitable meeting places does not appear to be a major difficulty as churches and business places within the communities are available for use as alternative venues. This however does not negate the fact that there is a widespread need for community centres. Community centres effectively utilized can become an important asset in building local capacity and community cohesion.

The presence of trained and aware leaders within communities can have a catalytic and positive effect on the development of a community. The success of some of the most outstanding environmental and development initiatives in the watershed have resulted from effective local leadership. For example, the stop-order action brought against a large and influential coffee farmer in Cooper's Hill by the NRCA had its genesis in strong and aware leadership of two or three persons. The order prevented the farmer from engaging in any further destructive forest clearing and other harmful environmental practices. Another example the effectiveness of strong community leadership is the successful JSIF/Berrydale Citizen's Association joint road repair and maintenance project (Fellowship to Berrydale Rafting Station). This project was a jointly financed initiative that resulted in the satisfactory repair of the road from Fellowship to Berrydale and the organization an on-going programme of road maintenance through voluntary community effort.

3.9 Education and Training

The appraisal has identified that there is a below average level of educational performance in the RGW. Although most of the communities in the watershed are within easy access of primary, secondary and even tertiary level training institutions, the number of persons qualifying at secondary and tertiary levels is very low.

Figure 3.9 Chart – Percentage Average Passes in GSAT and CXC Examinations



3.9.1 School Absenteeism

Absenteeism from schools is a traditional problem within the RGW. Many schools suffer a significant drop in attendance on Fridays. Rafting has reportedly had a negative influence on the community's educational performance. The relatively high income from rafting operations

provides an incentive for premature departure from school. Absenteeism is also due in part due to the perceived need for children to assist parents/adults on market days. Schools in Coopers Hill are reported as having outstandingly high-levels student absenteeism

3.9.2 Rose Programme

This programme established by the Ministry of Education to revitalise secondary school education has had some positive results, - but mainly for those children who are able to attend classes regularly. The programme operates “shelters” for the rehabilitation of students whose literacy levels are behind set targets. Those that are successfully rehabilitated are allowed to re-join the main stream of students. These Shelters are essentially remedial class within the school.

Low literacy and education levels that exist throughout the watershed are undermining factors contributing to the failures of many development initiatives. It is likely that the cause of failure of several community projects because of “poor planning and lack of proper management” has a strong correlation with the low literacy levels in the watershed.

This element of social capacity or lack of capacity has clear implications for the level of effort and the duration of support required for the implementation of future development initiatives in the RGW

3.10 Development Initiatives in the RGW

RGW has benefited from the program of several agencies, many of which are often not integrated or programmatic in their approach. Given the diverse needs and issues affecting the area, it is not likely that any one agency will have all the resources or the technical capacity to tackle the needs of the development. Watershed Management, a component of development in the Valley should therefore be addressed along with other problems of low organisational capacity high levels of illiteracy and poor infrastructure. Often where flooding has led to disasters, co-operation, awareness and capacity within the community to do simple river maintenance tasks could have had preventative or significant mitigating effects. **Table 3.10** summarises some of the experiences of different initiatives within the watershed

Table 3.10 Projects and Financial Institutions Support Development in the RGW

Project/Develop-ment Initiatives	Objectives	Status	Achievements	Issues
Berrydale Citizen’s Association Road Project	Ongoing maintenance of the road in this area.	Ongoing	Community based road maintenance. Completed 4.4 Km of road resurfacing in 1999.	
Micro-Financial Services	Loan program to assist small business throughout Portland.	Large amount of outstanding loans in the area, mostly shopkeepers. Total debt in the Rio Grande Valley is over one million dollars.	Assisted with working capital, purchasing of goods and equipment. Business expansion.	No accountability, or initiative to repay loan. Lack of training.

Project/Develop-ment Initiatives	Objectives	Status	Achievements	Issues
Portland Integrated PC Bank Limited	Offers loans for agricultural enterprises and non-agricultural enterprises in Port Antonio.	High loan delinquency and exclusion from further borrowing of the PMO. Members of the All Island Banana Growers Association are unable to pay off their original debt. The AIBGA is currently no longer active in Portland.	Secured loan to coffee farmers based on Crop-Lean.	Lack of commitment to repay loans. No long-term vision. Lack of infrastructure in the communities. No recognition or adherence to scheduled payments. Lack of respect for the PC Bank.
Accredited Community Development Fund	Retails loans to persons in Portland involved in micro businesses. Grants loans to farmers who have short-term cultivation, or catch crops.	Experience within the Rio Grande Valley before 1999 have not been good. Borrowers in Windsor, Fellowship, Moore Town, and Cooper's Hill have been repaying their debts.	Accessing four million dollars to micro businesses.	Training is needed in business financing. Sensitizing more about what responsibilities are involved when taking out loans.
Blue and John Crow Mountain National Park	Sustainable Management of the natural resources within the Park.	Ongoing and managed by the JCDT (ENGO). Ranger Station in the water shed (Mill Bank) closed. No permanent presence of Park staff. Funding and staff reduced by 50%. LAC inactive.	Increased community environment awareness. Successful community based projects, eg. Suspension bridge at Millbank. Formation of Local Advisory Committees (Park support group)	Inadequate national framework for sustainable management and support for protected areas Inadequate use by the Park of local support.
Private Investment for fruit canning industry	Fruit canning factory for local and export markets.	Development plans suspended indefinitely		Reliable access of produce to the market. Reliable utilities services.

Project/Develop-ment Initiatives	Objectives	Status	Achievements	Issues
Installation of Double Compartment Ventilated Pit Latrines	Install 13 toilets in the district of Berrydale.	Ongoing	Completed 1/3 of the installation	Inadequate funding to address the needs of other communities in the watershed, the majority of which have soak away pits.
Rio Grande Co-Operative. USAID funded project started in the 90's	Co-operative export marketing of non-traditional crops eg. Dasheen, pepper	No longer operational	Successful export of produce for the first year.	Lack of adequate market research and financial planning.
Comfort Castle Sewing Project launched in 2000	To manufacture and marketing home-made quilts for local and export markets.	Dormant	Trained personnel for production. Market secured through Reggae to Wear Garment Company in Trelawny. Raw Material obtained from abroad. Production of promotional samples. Three sewing machines obtained through donations.	Adequacy of trained and experienced leadership within the communities. The suitability of co-operatives as a tool of economic development in communities in the watershed.
Port Antonio Marine Park	To protect Port Antonio's coastal waters. Protection of terrestrial areas to protect both land and sea.	NRCA rejected the proposal from PEPA. Currently networking with NEPA to modify the proposed management plan for the Port Antonio Marine Park.		Five year plan in Port Antonio, which involves the development of the Port Antonio Marine Park. Lack of resources to properly manage and supervise the project.
Government of Netherlands Project in 1987	To enhance the socio-economic aspect of the communities throughout the Rio Grande Valley.	The project was in operation for nine years, until 1996. No longer operational.	Skills Training Increased economic development Community strengthening	Lack of Interest by community members. Lack of Management skills. Inadequate markets

Project/Develop-ment Initiatives	Objectives	Status	Achievements	Issues
Mushroom Project Mount Pleasant	To grow and market mushroom to the local tourist trade	Dormant	Develop methodology and techniques of growing Identified and supplied markets	Inadequate water supply (mushroom culture requires a high water demand)

3.11 Natural Disasters –Flooding/Landslides

The appraisal identified a number of activities by residents, which contributed to flooding in the valley and the coastal section of the watershed. During the November 2001 floods, residents pointed to the Back Rio Grande (tributary to the Rio Grande) as the major source of floodwaters that damaged the communities of Berrydale, Fellowship and sections of Port Antonio. It was noted that the waters of this tributary remained turbid several weeks after the heavy rains had ceased. Reportedly, a major cause of the flooding at Berrydale was in fact due vandalism and theft of the retaining wire around a nearby groin. This resulted in its disintegration under pressure from floodwaters and loss of its protective functions. Blocked drains (in the coastal sections of the watershed) were also contributing factors to the. extent of flooding in and around Port Antonio. Large trees falling into the was a contributing factor to the extensive nature of the flooding

3.12 Rehabilitation and Pre-Disaster Preparation

The lack of funding to carry out post-disaster rehabilitation work and pre-disaster activities has been a reoccurring feature of Rio Grande watershed management. Each successive flooding events takes on even more disastrous proportions as despite estimates being prepared and support promised, the funding provided is never adequate and the various recommendations are often only partially implemented.

3.13 Agriculture and Development

Agriculture in the watershed consists of a mixture of traditional small farms and plantations. Banana and more recently coffee are the major plantation crops. Small farmers grow yams, dasheen, and various tubers on privately owned land account for most of the agricultural production in the valley. Both plantation crops and small-scale produce are sold on the export and local markets. Many farmers' practice mixed agriculture and intercropping For example in Windsor farmers grow tree crops, and vegetable along with banana trees

Very little in the way of organic farming is done and planters rely heavily on inorganic fertilizer because of the low nutrient levels of the soils in the area. Pesticides are also extensively used to combat fungal growth promoted by the high humidity levels in the watershed.
Dasheen is reportedly doing very well as an export crop, fetching prices of about JA$19-20.00/lb. Private exporters are the main buyers from the local farmers. The Rio Grande was one the centre of dasheen production.

The local demand for banana has been favourable due to additional requirements of the chips making industry. There are two factories currently operating in the Rio Grande Valley, one at Bellevue and the other at Seaman’s Valley. The community of Kent (near to Alligator Church Bridge) is regarded as the “bread basket” of the valley because of the very high productivity of the farms in that district. Mixed cropping is the dominant form of agriculture practiced in that area.

The development of agriculture in the watershed has seen the state playing a very active role through various forms of subsidies for farmers. Planting material and cash have been given to farmers as incentive to reforest, and practice terracing and other soil conservation measures. Financial and/or in-kind flood relief assistance to individual farmers affected by disasters is the norm. There is no agricultural insurance scheme and the farmers have come to depend and expect state support for farm rehabilitation after natural disasters. This assistance has traditionally been given even if the farms are sited in known flood prone locations. State agencies such as RADA in adopting this approach to agricultural development in the watershed have promoted among the local population dependency rather than the capacity to offer effective self-interested leadership.

The EU/GOJ funded EJAS Project though representing a subsidy of sorts has had some positive effect using a more enlightened approach. Under this project, farmers are required to form themselves into registered groups of not less than fifteen (15) persons in order to receive technical assistance in production and marketing. The farmers are given in kind, assistance and not cash as with the latter, there is often little guarantee or likelihood that it will be applied as intended.

The EJAS project has spirited the revitalization of several dormant JAS branches in the RGW. These farmers have found as an easy way to establish an organization to access the assistance of the project.

3.13.1 Coffee

The extension of the Blue Mountains Brand classification areas to include coffee grown in the Rio Grande Valley has promoted the expansion of coffee plantations in the area. The expansion has however been at the expense of the watershed as land clearing and road constructions have been carried out without proper soil conservation measures.

3.13.2 Nurseries

There are no commercial nurseries currently operating in the valley, and most seedlings and seeds for tree crops are obtained from outside the area. Fruit trees such as ackee and mangoes as agro-forestry inputs are popular, however many farmers are unable to afford the high cost and opt for timber trees.

3.13.3 Recent Development in Banana Production

Currently Small farmers account for only 10% of the overall banana production as disease and the high input cost have driven many small plot farmers out of operation. Currently Portland supplies only about 5% of the export market for bananas from Jamaica. Several exporters of banana have turned to supplying the very viable local banana chips market resulting in banana production for the local market being now far in excess of that which is exported. The Rio Grande Valley grows 85-90 % of Portland's Bananas and is highly significant livelihood to residents in the Valley

3.13.4 Jamaica Agricultural Society

The JAS branches although they exist in several of the communities within the RGW, they have very little independent institutional capacity and have had a history of frequent dormancy. The branches have no full time staff and rely on voluntary inputs from its local leaders and the organizing support of one full time parish organizer. This organizer who is assigned from the national body the responsibility for the entire parish with very limited time to devote to each branch.

3.13.5 Rural Agricultural Development Authority

The efforts of RADA in assisting in the management of agriculture in the RGW are negatively impacted by budgetary constraints. On occasions the extensions services are affected by their inability to pay travelling cost for technical officer to work in the field.

The approach to agricultural development has been directed by a narrow focus on the production of the crop, and not on the entire process and the need for integrated inputs. Sustainable agriculture development in the RGW must begin in the schools. Teaching the science of agriculture in schools is basic to ensuring a high level of literate and educated farmers with the potential to organize their corporate activity to respond competitively in a globalised market place. Organizing for the independence (Capacity building) of the farmers as partners with the state in promoting research and facilitating trade agreements should be the vision of farming development in the RGW.

Table 3.13 Main Agriculture Issues identified by the appraisal (Source - Community Profile Surveys and Interviews)

Category	Issues	Opportunities
Infrastructure and services	ROADS AND TRANSPORTATION The poor road conditions were listed as the number one problem facing farmers in the watershed. The main problem related to the high cost of transportation	✍ State/Community Road repair and maintenance partnership ✍ Organization of farmers association for joint marketing and transport arrangements
Natural disasters and damage to farms	LOSS OF EARNINGS AND DAMAGE TO FARMS	✍ Introduction of an Agricultural Insurance Scheme ✍ Development of an Agricultural & Land Use Plan
Marketing of produce	DIFFICULTY OF INDIVIDUAL FARMERS FINDING AND SUSTAINING LUCRATIVE MARKETS Decline in the viability of the EU market for Bananas	✍ Organization of farmers into associations ✍ Development of education and training programmes for farmers as the basis of participation and receiving support
Agricultural Financial Assistance (loans and grants)	✍ Low earnings and saving from farming and ✍ Need for Training: - lack of financial management skills and - illiteracy ✍ Outstanding Loans by many farmers in the watershed Several farmers have bad credit ratings from outstanding loans and have no secure to use as collateral on new loans	✍ Development of education and training programmes for farmers as the basis of participation and receiving support ✍ Development of alternative crops (non-traditional export crops) ✍ Development of Agro-processing enterprises e.g. Banana Chips factory ✍ Programme of Land Titling

Category	Issues	Opportunities
Environmental	✍ Pest management – Fungi (Black Sigatoka affecting Banana Plantations**)** ✍ Parasitic nematodes ✍ Poor disposal of protective plastic sleeves by banana farmers The bags are discarded along the banks of rivers and into small streams	✍ Agricultural Research and partnership and involvement of the JSA and Universities ✍ Crop Diversification ✍ Recycling programme for plastic sleeves
Land tenure and scarcity of suitable farm lands	✍ Framers having no proper titles to their land ✍ Limited availability of suitable farm lands Much of the small scale farming in the watershed is done on privately owned land without proper titles or on informally accessed crown lands	✍ Programme of Land Titling ✍ Alternative income sources e.g. eco-tourism, craft making, condiments and dried fruits, and agro-processing

3.14 Financial Institutions

Several financial institutions have over the years assisted in the development in the watershed through agricultural and non-agricultural loans. These include the Banana Exporters Corporation (BECO). This is a private grower's corporation functioning as a purchaser and sole export entity for local bananas.

Their services include:

✍ Export of bananas organized through the ports of Port Antonio and Kingston wharves.

✍ Technical Assistance to farmers in the planting, growing and care of the produce including:

i. Quality Assurance of bananas supplied to the local and export market by farmers,

ii. Technology transfer including business management training and environmental science,

iii. Assistance in combating the (1999-2001) outbreak of Black Sigatoka leaf fungal disease which severely affected the banana industry in the Valley,

iv. Drainage and water management assistance – e.g. the construction of check dams for irrigation and flood Control, and

v. Provision of planting materials (banana suckers).

Much of the assistance has been provided under the European Union Banana Support Programme, implemented by BECO. The company offers an environmentally friendly programme of support e.g. Policy of assistance excludes farms which carry out practices harmful to the environment or which are:

✍ Poorly located, and

✍ Farms using noxious chemicals are required to operate and use a charcoal pit for disposal.

TESTCO a European Supermarket Chain paying premium prices for Jamaican export banana, have established stringent "farm gate" environmental standards as a pre-requisite for accepting the produce. The company's management cited some of the main problems it encountered in dealing with farmers in the watershed were:

- Unwilling to take technical advice,
- Low levels of awareness
- Low levels of literacy

3.14.1 Development Options Limited

Another financial institution support through which assistance is available to farmers and residents in the RGW is: Development Options, a Kingston based institution offering loans for small business development under a Micro-Financial Services program which is managed through an agent based in Port Antonio.

Funding for this program was initially supplied by the Governments of Netherlands and Jamaica, and managed by Development Options. One of the main criteria for loan approval is that the candidate applying must have run their business for at least one year. The program assists persons in working capital, purchasing of goods, fixed assets, equipment, machinery, and tools. The loans given out my "*Micro Fin"* are designed to help small shopkeepers and other business operations expand their operations and support local economic development. Many loans were given to shopkeepers in the Rio Grande Valley, are still outstanding and in arrears. Clients in the Rio Grande Valley owe over 1 million dollars in outstanding loans. The company's management cites a the following as the main tendencies among these delinquents:

- Poor financial management, and
- Unwillingness to repay loans.

3.14.2 Portland Peoples Integrated Co-operative Bank

The Portland Integrated People's Co-operative Bank is another source of assistance to farmers and residents in the valley. The bank offers agricultural and non-agricultural loans. Loans are available to farmers and their families, for support enterprises e.g. small cook shops, and hairdressing parlors. Other services offered include bill payment through Paymaster; typing, faxing, over- the counter savings accounts, and fixed investment (starting at $10,000).

Only projects that are legal and which the bank considered viable are eligible for financing. Currently the bank has due to the high level of delinquent loans and the impact of the banana disease suspended new loans to banana farmers.

The loans from the bank can be accessed at an Interest rate of 13%. Farm loans have the option of a moratorium on interest rates the duration of which is dependent on the turn around time for the crop. Medium term crops such as bananas and plantains, which are reaped after approximately 1 year, have a 1-year grace period, and a 3-5 years period for repayment. Short term crops – coco/dasheen/vegetables, carries a 3-month grace period and 3 months for repayment, while chicken rearing has an 8-week grace period and 2-3 months for repayment.

Long-term crops such as coffee/citrus/coconuts have 3-4 years' grace period and a 6 years for repayment period. The repayment period is set close to reaping and collection of income. There is a maximum of 10 years to repay loans. Performances on loans are mixed, banana farmers have the highest delinquencies and loans have been discontinued; whereas loans to coffees farmer have had a good repayment rate. Of the 13M dollar in loan package for banana farmers, 85% went to the RGW; loans to coffee farmers totaled approximately 4M dollars. Loans to vegetable growers were negligible amounts of money.

Delinquency and late payments are the main problems facing the bank in respect of its loans to farmers in the watershed. This is considered due in part to their failure to keep proper financial records and low literacy levels.

3.15 Sand Mining

Sand mining occurs at several sites within the Watershed. Sand mining requires a permit from the NEPA and the Ministry responsible for mining. Mining occurs at Grant's Level (a district en route to Berrydale from Fellowship) where there is active sand/soil extraction. Sand mining also takes place at St. Margaret's Bay where larger boulders are extracted from the river using a combination of heavy duty equipment, such as truck, backhoe, and stone crushing machines. This results in oil pollution of the surrounding waters. The sand mining is a controversial issue and its impact needs to be properly assessed. While there are obvious negative impacts, such as increased difficulty of maneuvering rafts along the river because of the increased depth of the river, increased turbidity, bank erosion and pollution, sand mining allows for the periodical removal of built up sediment from the river bed minimizing the risk of flooding.

3.16 Watershed Protection

3.16.1 Bio-diversity - Blue and John Crow Mountains National Park

Due to a lack of funding and support the JCDT managed park has not been able to maintain the operations of the Ranger Station at Millbank nor an active presence of the Rangers in the watershed. This has led to a visible decline in the organized conservation and development activity within the communities of the upper reaches of the valley. The defunct state of a once very vibrant LAC, reoccurrence of incidences of dead animals being disposed of in the river, illegal forest clearing and fishing methods were cited as examples of this decline.

Despite the fact that the majority of citizens were more conservation minded however without the organized framework that the LAC working with Park Rangers provided to respond to these environmental problems, very little action is taken. There was the feeling by the community that there was an urgent need to revitalize the Ranger Station and the role of the Park as a supporting and facilitating agency in the Valley

3.17 Infrastructure and Services - Roads and Transportation

Table 3.17 Profile of the conditions of the main access roads

Description	Length (Km)	Condition	Notes
1. Fellowship - Berrydale		Good	
2. Breastworks – Windsor	8.98	Poor – Sections with asphalt – pot holes and undermined edges	On Contract for Rehabilitation
3. Windsor – Moore Town	4.78	Poor	NWA now responsible
4. Moore Town – Seaman's Valley	3.06	Poor – broken asphalt with Pot holes	As above

Description	Length (Km)	Condition	Notes
5. Alligator Church - Bellevue	5.56	Poor – no asphalt (pot holed and stony	Schedule for Rehabilitation (Repairs delayed due to Alligator Church Bridge being unsafe for heavy equipment) The Bridge has not been handed over by the Public Works
6. Seaman's Valley - Millbank	11.28	Very Poor – pot hole with exposed sub-surface	Rehabilitation delayed for the above reasons
7. Millbank – Bowden Pen	4.72	Very Poor – not asphalted	Same as above
8. Golden Vale - Cooper's Hill	3.2 (approx.)	Fair (repaired 2000 by JSIF)	Only 2.0 km repaired the remainder in very poor condition, impassable when wet
9. St. Margaret's Bay – Mount Pleasant	N/A	Fair-poor Asphalt with Broken surface –	Block Drains and poor maintenance are the main problems
10. Mount Pleasant - Bourbon	N/A	Extremely Poor Broken Sections and asphalt in patches	
11. Maidstone - Bourbon	N/A	Extremely Poor – broken surface with gullies	1997- Dutch/JSIF Project – no maintenance (water erosion main source of damage)

The very poor road conditions continue to be the major obstacle in the view of the community undermining development in the Valley. For example in the mid-90s, a private investor abandoned plans for a fruit-canning factory because of the frequent landslides and roadblock caused by "Friday" [Jupiter Fording area – here the road narrows at a point where the bank is high and unstable]. Massive landslides at "Friday" have in the past cut off the communities in the upper regions [Comfort Castle and Millbank] for several days.

The formation of the National Works Agency as an executive agency (State Corporation) is intended to add new levels of efficiency compared to that of its predecessor, the Public Works Department. The NWA has assumed responsibility for the infrastructure (roads) formerly serviced by the PWD. The exception to this being the rehabilitation of roads damaged during the November 2001 floods, for which the NWA has been given contracts for repairs including those managed by the Parish Council.

Road repairs in the watershed has been very costly for the parish and there appears to be both a lack of resources and willingness to build properly engineered road to handle the very high rainfall characteristic of the area and frequent and land slides

3.18 Cultural Heritage

3.18.1 Great Houses

Great Houses - Commodious, solidly built and impressively elegant dwellings of the landed proprietorship. Built primarily in the 'middle' period of Jamaican architecture - (about 1760-1820) displayed local interpretations of the Victorian and Georgian building styles. Typically these dwellings were sited on hills overlooking "rolling pasture" or
sugar cane lands of the estate and served not only as a family home, but also as the centre of administration for the district, the focus of social life and an exquisite hotel for friends and distinguished travellers to spend time, at no cost. The De Montevin Lodge in Port Antonio is a fine example of brick victorian architecture of a more recent period (1862).

Four Great Houses are said to exist in the area the locations of three site of were identified. Two are located near the district of Darley and one (1) close to Rock Hall. There appears to be little public knowledge and documentation of heritage sites in the upper reaches of the watershed.

3.18.2 Rafting

Rio Grande rafting has been the most popular tourism attractions in Portland for the past 5 decades and remains one of the important sources of livelihood in the mid and lower sections of the watershed. Rafting is conducted mainly from the station at Berrydale. TPDCo currently manages the operations of the station as no suitable management entity was identified.

A Survey done in 1999 indicated there were 198 Raft Captains (not including assistants) involved in the service making 4,998 legal raft trips (those carried on by licensed rafts men). Illegal tours accounted for additional estimated 25% of tours. Total pay to Rafters was JA$128.00 million dollars for the year at a rate of US$4.5.00/trip (then ROE JA$40.00 to 1.00 US$). Each Raft Captain was paid JA$1,000.00/trip out of which JA$200.00 was paid to an assistant for the return of the raft up stream. The raft stop concessionaire was paid $800.00/trip (tax included). Some raft captains were able to make 2 trips per day during the peak season
Some of the main problems affecting the enterprise are:

- Tardiness in settling credit on the part of tour operators which resulted in the accumulation of huge debts to the rafting industry, and

- The raft captains were not trained in money management, which resulted very little of their income being saved or invested wisely. Income was spent on women, liquor and “obeah”

An EIA conducted in 1998 by a local firm concluded that the frequency of rafting tours risked exceeding the carry capacity of the river and degrading the quality of the experience.

3.18.3 Heritage and Eco-tourism

The rich cultural resources of the valley offer considerable potential for tourism. The B/JCMNP potentially provides the framework for eco-tourism development within the park and sections of the watershed. Two companies currently offer hiking and sight-seeing tours into the watershed; the Grande Valley Tours and the Valley Hikes. The clientele is primarily European (mostly Germans) followed by Americans The peak season occurs during the months of February to March of each year The combined volume of tourist to these areas is less than 2000 persons per annum (excluding rafting) and the product is not effectively developed or marketed. The attractions are scattered and in, most instances lack stand-alone appeal.

Old Time Sinting” has emerged as a popular an annual heritage celebration and community event with good support from residents in and outside the valley. However cultural initiatives occurring

the Valley appear to be largely are uncoordinated and outside of a common tourism development strategy

The Spectacular White River Falls (Holland Mountains) continues to be a source of attraction to tourists venturing into the upper reaches of the Valley

3.18.4 Craft Making

Craft making activity within the Watershed is at a very low level. One of the most popular souvenirs in the Valley is that of the mini rafts which can be had at rafting stops during the rafting tour. Out side of these rafting stops only few scattered artisans carry on most of the trade with very little organized marketing activity. An exception is a craft shop in Berrydale operated by Mr. Winston McKenzie. The Grande Valley Tour Company assists the shop with the marketing of its craft items. The shop is included as a stop on the tour's itinerary. Grande Valley Tours is in the process of developing a colored catalogue of the shop's craft to be using to promote and market the enterprise. The clientele include the major hotels in Pt. Antonio and a few as far away as Ocho Rios and Montego Bay.

A considerable amount of traditional craft making talent exists in the watershed with a variety of items being made different materials. Handcraft remains however a part time livelihood and minor income source one for most persons, despite the potential of the industry. Given the absence of any organized programme of craft development and marketing, individuals are not encouraged to make significant investment of time and capital into craft making.

Artisans in the Valley utilize a wide range of raw materials in craft making these include:

Bamboo
Wild Cane
"Marth Grass"
Dried coconut husk and shells and
Broken stained glass for bottles

Berrydale is one of the more active districts

4.0 SUMMARY OF ISSUES

The RGW while exhibiting some level of degradation, is fairly intact in its upper reaches, where human impact is relatively limited, however in the lower sections where the population pressures are more concentrated, tangible environmental and social problems are evident. The following is a summary of the main finding of the Appraisal of the RGW:

Table 4.1 Summary of Biophysical Features of the RGW

Biophysical Feature	Description	Opportunities	Constraints
Topography	Extremely Mountainous	Attractive landscape Salubrious Climate	Area not suited for traditional agriculture
	Throughout the watershed, slopes are generally steep. More than 75% of the slopes exceed 20 degrees. Thus making the area prone to geomorphic change due to gravity and steep slopes	Explore the viability of non-traditional agriculture e.g. tree crops using suitable tree species Alternative income generating activities e.g. eco-tourism Diversify the economic resource base	
Geology John Crow Mountains	Characterized by steep rocky knolls and deep depressions. Deposited in both shallow and deep water		
Earthquakes	Major faults aligned approximately north south. Are the Blue Mountain Fault and the Rio Grande Fault		Special attention to the location of structures such as large buildings, roads and bridges
Caves	Caves represent an unexplored source for economic development. From tourism or harvesting bat guano as fertilizer	Eco-tourism and mining of guano for fertilizer Research on cave dwelling organism	
Hydrology	High water table due to the close proximity of bedrock to the surface, Limited groundwater storage (aquifers) in the Rio Grande Watershed		Tendency for rapid flooding to occur
Rainfall	Very high and seasonal Levels	Rainfall catchment for domestic and agricultural use	Flooding from extreme rainfall occurrences in the mid and lower section of the RGW

Biophysical Feature	Description	Opportunities	Constraints
Soils	Conglomerates on the western side of the RGW Give way to fertile soils Highly erodible soils - The Bonnygate Stony, erodes rapidly.. s, and	Carefully managed agriculture is possible	Risk of flooding and loss of top soil and nutrients Due to its erosion potential, it should be left to trees and bush Locations Majority of this soil is found in the John Crow Mountains where most slope angles range from 25 to greater than 50 degrees and in the districts of Boundbrook and Norwich
Soils and Land Capability	Most of the Land in the watershed are in the land use category Primarily VE (See Table 2.6) Land to be left in its natural state		These lands are describes as *Non arable lad; steeply sloping with extreme danger of erosion*
Clay Soils around Pt. Antonio	Soils in and around Port Antonio, below-average infiltration rate once saturated	Develop a Drainage Plan for the Town	Makes the area highly susceptible to flooding during rain events
Topography & Soil Profiles	Steepness of the most slopes and, The associated soil types and shallow profiles,		Most areas of the watershed are prone to soil erosion
Conductivity of soils	Most of the soils are highly porous loams with limited water-holding capacity subject to heavy leaching resulting in a low nutrient content and low pH.		It has been recommend that these soils not be cultivated (Both Mountain Ranges)
Surface Drainage	Most of the rivers have a high flow rate and are prone to flash floods		Very limited permanent use can be made of the river banks and flood plains
Natural Features	Waterfalls - There are four significantly impressive waterfalls within the watershed.	Scatter Water White River Falls and Nanny Falls; are easily accessible caves	Poor Road conditions and lack of an organised product (marketing and management of impact)

Biophysical Feature	Description	Opportunities	Constraints
Rainfall	Portland and the RGW receives the highest rainfall in the country	Rain water catchment and tanks as a source of domestic and agricultural water supply	Prolonged periods of heavy rainfall affects social activities, limits available days for tourism and causes flooding and loss of investments
Water Quality	The total Coli levels for each station, 800 MPN at Grants Level and 2,400 MPN are significantly higher than 200 MPN index/100ml (200 cells of fecal coliform/100ml water) High Phosphorous and nitrogen in stream water is largely due to contamination by fertilizers, detergents and sewage	Develop a programme for proper waste disposal and sewage waste management A regular regime of water quality testing is recommended	Limited use of this water for recreation and Increased cost purification's requirement and cost.
Bio-diversity	High Rate of Endemism among plant and animal species (Portland has the highest number of local plant endemic of all the parishes)	Research Scientific Tourism Enhance protected area activities (B/JVMNP) Commercial Horticulture Mushroom Production Wicker Production Castor Oil Production Agro-processing	Sensitive ecosystem requiring the scientific monitoring of impact and zoning
Introduced animals	Wild Boar and white tail deer	Continued Source of Meet for the “jerk trade” Adventure Tours (deer Watching)	Limited knowledge of the status of populations
Hunting of Snakes and Conies	Snake are hunted for snake oil and conies are captured and killed for their meat	Conservation programme	
Giant Swallowtail Butterfly	Endemic species and the largest butterfly in the Americas	Potential for patenting and brand name for product from the Watershed Scientific and eco-tours Butterfly Farming	Endangered species

Biophysical Feature	Description	Opportunities	Constraints
Other Invertebrates	Limited Knowledge of their taxonomy and importance	Opportunity for research	
Noxious Plants (Bamboo)	Bamboo Plants invasive plant impacting negatively on the bio-diversity of the watershed.. Support some shade tolerant species	Has many traditional uses Such as Handcraft Provides materials for fence post and the construction of Rafts for the tourism industry	Negative impact on the Biodiversity of the area

Table 4.2 Summary of Main Socio-economic Features of the RGW

Socio-Economic Feature	Description	Opportunities	Constraints
Non availability of suitable land for housing and agriculture	Persons are unwilling to relocate to housing sites any significant distance away from their farm and livelihood		The topography of the area limits the available land for settlement and farming
Sewage disposal	Numerous soak away pits in the watershed resulting sewage contamination of waterways and rivers	Promotion of Sealed Pits latrines connected to a MAIN	The high water table and cost of constructing a sewage system in the RGQ
Flooding in Port Antonio	Blocked drains in the lower section of the coast are contributing factors to the extent of flooding in Port Antonio	Community-based solid waste management programme	Limited state funds
Sand Mining in the Rio Grande River	The sand mining is a controversial issue and its impact needs to be properly assessed	Proper Research and study of the impact of sand mining	
Absence of the support from the B/JCMNP	Closer of the Ranger Station at Millbank and no an active presence of the Rangers Dormancy of the LAC in the watershed.	Organising stakeholders to provide support for the continued operations of the Ranger Station	Lack of an effective framework for financing the operations of the Park and financing the activity of the Rangers
Heavy use of Pesticides and Fertiliser	The very poor nutrient retention capacity of many soils in the RGW require sustained use of fertilisers High humidity factor promotes fungal growth and the heavy use of pesticides	Promotion of environmentally safe fertilisers (Organic) Integrated pest management and the Environmentally safe pesticides	

Socio-Economic Feature	Description	Opportunities	Constraints
Education & Training	Less than 40% average CXC passes in RGW	Establishment of computerized learning centres	Low literacy and education levels that exist throughout the watershed are undermining factors contributing to the failures of many development initiatives
High Levels of dependency on Banana production	The Rio Grande Valley grows 85-90 % of Portland's Bananas and is highly significant livelihood to residents in the Valley	Opportunity to collectives Marketing to local sources Support increase efficiency local agro-processors	Current problems with banana cultivation (poor roads, heavy use of chemicals, likely loos of EU preferential tariff)
Agricultural Insurance and rehabilitation of farms following natural disasters	There is no agricultural insurance scheme and The farmers have come to depend and expect state support for farm rehabilitation after natural disasters	Development of an Agricultural Insurance programme	Expectations of State support Low income from traditional Need for widespread support for insurance scheme to operate Farmers have a poor track Record of making regular payments
Weak Farmers Organization (JAS)	The JAS branches lack organizational capacity (no full time staff and rely on voluntary inputs from its local leaders and the organizing support of one full time parish organizer)	Institutional Support and capacity building	Low levels of literacy and training of farmers
Roads & Infrastructure	The very poor road conditions continue to be the major factor undermining development in the Valley	Development of proper standards for road repairs in the RGW	Road construction represents a high investment cost for the with low returns
Rio Grande Rafting Operations	Carrying capacity may be exceeded	On going monitoring of the quality of the inputs and the level of client satisfaction	
Numerous attractions and good tourism development potential	Despite the rich potential for tourism development the product remains largely unorganized and underdeveloped	Development of a tourism strategy for the valley	Weak community-base partners In experience in marketing and product development

Socio-Economic Feature	Description	Opportunities	Constraints
Craft making Potential	Handcraft remains however a part time livelihood and minor income source one for most persons, despite the potential of the industry	Handcraft Development Programme	

Table 4.3 Matrix of Survey Findings Showing Household Views

	(100) Comfort Castle	(101) Millbank	(200) Windsor	(300) Fellowship	(301 & 302) Berrydale East & West	(304) Tom's Hope	(400) St. Margaret's Bay	(401) Mt. Pleasant	(402) Rock Hall	(502) Boundbrook
Q69: What are the positive things about living in this community	fresh air, peace & love, children can run around	fresh air, peace & love, children can run around, green space	fresh air, peace & love, no crime	no answer	fresh air, no crime, peace & love, children can run, green space	fresh air, children can run, peace & love	no crime, peace & love, fresh air	fresh air, no cime	fresh air, children can run, peace & love	no crime, children can run around
Q70: What are the negative things about living in this community	poor roads, lack of employ-ment	poor roads, lack of employ-ment	poor roads, landslides and flood damage, lack of employment, praedial larceny	poor roads, landslides & flood damage, lack of employment praedial larceny	poor roads, landslides & flood damage, lack of employ-ment	poor roads, lack of employ-ment	lack of employ-ment	poor roads, lack of employ-ment, praedial larceny	poor roads, landslides, lack of employ-ment	poor roads,lack of employ-ment
Q71: 5 Years ago, were things better than now	much better	worse much worse	no change	little better	little to much better	little better	much better	little better	little better	no change

Table 4.4 Matrix Profiles of Selected Communities and Districts in the RGW

M – Male F – Female

	(100) Comfort Castle	(101) Millbank	(102) Moore Town	(200) Windsor	(202) John's Hall	(300) Fellowship	(301 & 302) Berrydale East & West	(303) Durham	(304) Tom's Hope	(400) St. Margaret's Bay	(401) Mt. Pleasant	(402) Rock Hall	(500)Port Antonio	(502) Boundbrook
Population	296 M 262 F	145 M 104 F	138M 148 F	396 M 295 F	43 M 24 F	296 M 262 F	124 M 105 F	120 M 115 F	123 M 113 F	288 M 328 F	140 M 145 F	146 M 134 F	3988 M 4877 F	153 M 190 F
Land Capability	Non arable, steep extreme danger of erosion	Not areable with extrame danger of erosion	Not areable with extrame danger of erosion	Not areable land	Sandy loam with unstable rocks	non arable, steep extreme danger of erosion	Limestone & sand on the flat, shelly loam on steep; prone to land erosion	Not areable with extrame danger of erosion	marginal cultivation due to danger or erosion			Non arable, stoniness & severe erosion hazards	Soils with low conductivity area prone to flooding	
Road Conditions	Very poor	Very poor, not asphalted	Poor, not asphalted	Poor	Poor	Poor	Good	Very poor	Fair - asphalt in most areas	Fair-poor Asphalt with broken surface	Fair-poor Asphalt with broken surface		Fair- Asphalted with poor drainage and road maintenance	Poor condition partially asphalted with pot holes
Employed male & female	50% M 12% F	85% M 21F	63% M 15% F	65% M 18% F	81% M 33% F	54% M 26% F	43% M 12% F	69% M 2% F	62% M 26% F	42% M 19% F	58% M 11% F	64% M 20% F	45% M 31% F	51% M 28% F
Home Duties	18% M 70% F	0 M 54% F	6% M 55% F	2%M 53% F	13% M 45% F	7% M 44% F	1% M 63% F	0 M 83% F	0 M 41% F	4% M 53% F	0 M 68% F	0 M 53% F	5% M 35% F	0 M 30% F
Unemployment male & female	9% M 3% F	.6% M 5% F	13% M 4% F	10% M 5%F	1% M 0% F	15% M 8% F	17% M 2%F	5 % M 0 F	6% M 7% F	16% M 6% F	4% M 4% F	5% M 2% F	20% M 10% F	27% M 13% F
Cooking Fuel	Cooking gas	Cooking gas	Cooking gas	Cooking gas	Cooking gas	Cooking gas	Cooking gas	Cooking gas	Cooking gas	Cooking gas	Cooking gas	Cooking gas	Cooking gas	Cooking gas

	(100) Comfort Castle	(101) Millbank	(102) Moore Town	(200) Windsor	(202) John's Hall	(300) Fellowship	(301 & 302) Berrydale East & West	(303) Durham	(304) Tom's Hope	(400) St. Margaret's Bay	(401) Mt. Pleasant	(402) Rock Hall	(500)Port Antonio	(502) Boundbrook
Lighting Fuel	Public power supply	Public power supply	Public power supply	Public power supply	Public power supply	Public power supply	Public power supply + kerosene	Public power supply + kerosene	Public power supply	Public power supply	Public power supply	Public power supply	Public power supply	Public power supply
Electricity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes					
Telephone	No	No	Cell service	Cell service	No	Land + cell	Land + cell	Cell service	Land + cell	Land + cell	No	No	Yes	Yes
Domestic Water Supply	Block during rain	Block during rain	Excellent - self supply, tanks & spring with pump	Inadequate & irregular source		Standby intake	System serves only 150 persons		Inadequate source					
Water Quality	Good except during rains	Good except during rains	Good	Good-calcium problem		Good	Good		Good	Visible water contamin-ation	Turbid at high river flows	Turbid at high river flows		
HUMAN WASTE DISPOSAL														
a) Toilets - WC + Sewer	**N/A**		**3%**	**0.78%**	**0.76%**	**3%**	**12%**	**2%**	**0**	**0**		**0.9%**	**6%**	N/A
b) WC-Sewer	**N/A**	**0**	**0**	**0**		**5%**	**0**	**0**	**17%**	**31%**	**9%**	**8%**	**38%**	**23%**
c) Pit	**N/A**	**93%**	**88%**	**86%**	**96%**	**76%**	**92%**	**94%**	**71%**	**57%**	**85%**	**88%**	**47%**	**69%**
d) None	**N/A**			**0**	**0**	**0**	**0**	0%	**2%**	**0**	**0%**	**2%**	**1%**	

	(100) Comfort Castle	(101) Millbank	(102) Moore Town	(200) Windsor	(202) John's Hall	(300) Fellowship	(301 & 302) Berrydale East & West	(303) Durham	(304) Tom's Hope	(400) St. Margaret's Bay	(401) Mt. Pleasant	(402) Rock Hall	(500)Port Antonio	(502) Boundbrook
e) Solid waste disposal	Back yard pit	Back yard pit	Back yard pit	Back yard pit		Back yard pit	Back yard pit		Back yard pit	Transport-ed to Buff Bay dump	Back yard pit	Back yard pit	Transport-ed to Buff Bay dump	Transport-ed to Buff Bay dump
Key Toilets - WC + Sewer = Flush toilet connected to sewer main WC - Sewer = Flush toilet not connected to sewer														
Main Source of income	Farming, domestic, construc-tion, selling in bar	Farming, higglering, craft	Agriculture	Selling/ higglering		Plumbing, teaching, farming	farming		Farming	Pharmacist, security, cooking	Selling, taxi	Taxi, tour guiding, teaching, farming, security	Tourism, Trading, and Fishing	Farming, construc-tion, domestic
Environmental Problems	Deforest-ation; use of poison for fishing	Dead animals in river, illegal fishing & forest clearing methods	wild cains, thin soils, steep slopes	Meteoro-logical station, slaughter house on riverbank.		Flooding	Flooding, sand mining and its effects rafting and river pollution; car washing; illegal dumping		Flooding, Parasitic Nematodes	Sand mining; soil erosion; improper solid waste disposal	High potential for landslide	High potential for landslide	Improper solid waste disposal	Flooding, block drainage, detergents and leakage of fluids from cars, meteoro-logical station
Social Issues	Pre-mature school leavers	Illiteracy		Unemploy-ment			Rafting, premature departure from school			Unemploy-ment; drug use	Illiteracy and praedial Larceny	Unemploy-ment	Maintenanc e of buildings	
Educational performance	40% GSAT 33% CXC		40% GSAT 50% GCE	50%GSAT		40% GSAT 17% CXC	20% GSAT 10% CXC		50% GSAT 30% CXC/GCE	40% GSAT 30% CXC		57% GSAT 22% CXC	39% GSAT 25% CXC	Non

	(100) Comfort Castle	(101) Millbank	(102) Moore Town	(200) Windsor	(202) John's Hall	(300) Fellowship	(301 & 302) Berrydale East & West	(303) Durham	(304) Tom's Hope	(400) St. Margaret's Bay	(401) Mt. Pleasant	(402) Rock Hall	(500)Port Antonio	(502) Boundbrook
Profiles	Craft & small scale agriculture	Craft & small scale agriculture	Craft & small scale farming	Coffee, Banana and reforesta-tion	Traditional export crops	Plantation (Non traditional crops)	Plantation (Non traditional crops) ; craft	Praedial larceny	Farming banana, dasheen & yams raising chickens, ducks, rabbits & pigs	Block-making factory	Small crops (pumpkin, squash, sweet potato, okra)	Small crops (chicken)	Higglering	Mixed agriculture & fishing
Assets	N/A	Hiking trail	Nanny falls & Nanny monument		Hiking trail; mineral spring	Tourism	Caves, water falls; hiking trail; rafting					Hiking trails & natural mineral spring	Historic Bldgs and Harbour/Navy Island	Tourism
Farmers organizations	Active JAS	Ginger Franers Assn.	Active JAS	Active JAS			Active JAS		Active JAS	Active JAS		Active JAS	JAS	Non
Citz. Assc./Y. Clubs	Citizen assc.& youth club	Citizen's assc.		Church group		Citizen's assc., youth club	Citizen's assc. & youth club		Citizen's assc.	Church group	Church group	Citizen's assc.	Church / Citizens/Youth	Citizen's Assn and Y/ Club
Clinic	0	0	1	0	0	1	0	0	0	0	0	0	1	0
Police Station	1	0	0	0	0	0	0	0	0	0	0	0	1	0

1999 Streamflow Data RGW

e – estimated

WATER RESOURCES AUTHORITY													TIME-SERIES TYPE : FLOW (CUBIC FEET PER SECOND)					
Full Report of Data: Daily Flow					Station Number: 10120103								Station Name : RIO GRANDE @ ALLIGATOR CHURCH (10120103)					
	JAN		FEB		MAR	APR	MAY		JUN		JUL		AUG		SEPT	OCT	NCV	DEC
1	438	e	357		132	279	33	e	35	e	130	e	36	e	103	235	339	287
2	275	e	357		120	225	33	e	33	e	96	e	35	e	84	164	284	254
3	191	e	304		119	193	32	e	32	e	86	e	35	e	75	511	241	195
4	160	e	284		105	158	30		30	e	82		34	e	67	271	195	164
5	137	e	249		98	132	31		30	e	72		34	e	61	188	195	146
6	130	e	238		93	119	31		30	e	66		32	e	54	152	306	134
7	125	e	249		88	94	30		28	e	70		31	e	50	126	290	188
8	375	e	228		87	88	30		27	e	58		31	e	45	110	382	182
9	351		840		171	80	30		26	e	58		35	e	43	108	728	173
10	312		511		142	72	40		26	e	158		31	e	42	152	2032	146
11	275	e	1042		115	66	37		25	e	180		30	e	40	372	955	134
12	612	e	860		91	62	31		26	e	105		30	e	40	796	658	220
13	836	e	570		85	58	30		26	e	173		29	e	43	1112	500	152
14	1373	e	433		84	56	503		757		166		29	e	58	430	745	130
15	485		1019		82	52	206		735		252		28	e	42	327	1059	124
16	379		1040	e	81	49	146		262		204		28	e	88	220	870	119
17	1295		702	e	1832	47	81		331		146		56		132	211	470	114

WATER RESOURCES AUTHORITY			TIME-SERIES TYPE : FLOW (CUBIC FEET PER SECOND)
Full Report of Data: Daily Flow	Station Number: 10120103		Station Name : RIO GRANDE @ ALLIGATOR CHURCH (10120103)

	JAN		FEB		MAR	APR	MAY		JUN		JUL		AUG		SEPT	OCT	NCV	DEC
18	1264		470	e	1518	45	54		502		108		40		82	426	336	110
19	623		370	e	595	43	46		298		87		152		58	191	412	110
20	455		354	e	354	41	38		204		73		330		46	146	542	120
21	385		283	e	882	40	73		188		67		186		42	265	333	114
22	379		250	e	392	39	85		158		64		122		39	285	252	110
23	351		307	e	271	37	289		130		54		91		37	465	206	122
24	336		203	e	220	36	393		520	e	51		70		534	309	175	122
25	344	e	340	e	180	36	202		195	e	47		60		230	3189	154	114
26	703		206		158	35	120		112	e	44		54		379	769	138	110
27	888		177		140	35	82		94	e	42		52		312	379	132	107
28	577		150		124	34	60		410	e	40		51		223	564	173	105
28	528				119	34	51		450	e	40		48		164	693	519	103
30	423				173	34	45		185	e	39		97		154	886	262	103
31	369				629		38				37		177			452		197

2000 Streamflow Data RGW

e- estimated

DAILY FLOW																							
Water Resources Authority																							
JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
150		146		63		34		21		4064		38		41		117		310		1133		1177	
105		132		62	e	32		20		856	e	38		92		87		280		1012		1115	
112		122		61	e	31		104		387	e	37		53		85		228		645		2261	
98		120		60	e	29		49		286	e	37		42		410	e	201		421		1778	
90		114		60	e	26		32		477	e	274		100		123	e	274		304		1531	
88		110		58	e	25		1354		220	e	566		245		96	e	191		245		740	
169		184		56	e	24		215		163	e	245		103		86	e	152		208		488	
169		191		54	e	23		123		133	e	124		82		78	e	138		187		405	
122		138		53	e	22		87		113	e	90		183		165	e	130		165		298	
97		119		53	e	21		70		103	e	73		109		96	e	124		154		238	
85		173		53	e	32		61		92	e	61		77		78	e	203		139		203	
81		156		64	e	26		51		80	e	57		69		110	e	150		130		189	
206		182		59	e	24		264		75	e	49		58		312	e	291		124		171	
173		142		54	e	37		108		70	e	45		52		151	e	159		121		161	
321		114		52	e	114		75		67	e	64		71		131	e	173		114		149	
504		112		50	e	96		62		64	e	51		51		112	e	115		108		177	
312		107		48	e	51		56		61	e	44		48		106	e	112		102		135	
315		105		45	e	35		53		58	e	44		43		100	e	294		121		124	
244		114		42	e	31		46		57	e	41		41		185	e	136		97		664	

DAILY FLOW								TIME-SERIES TYPE: FLOW (CUBIC FEET PER SECOND)							
Water Resources Authority								Station Name: Rio Grande @ Alligator Church (10120103)							
184	114	41	e	28	46	55	e	40	41	176	e	660	94	1359	
154	105	40	e	32	77	51	e	39	39	140	e	267	94	1486	
136	103	40	e	48	87	48	e	39	38	130	e	163	108	6933	
252	97	39	e	65	61	67	e	38	85	124	e	383	1540 e	2790	e
193	100	38	e	36	49	51	e	37	767	119	e	530	672 e	1488	e
142	108	38	e	30	41	48	e	37	718	116	e	275	454 e	896	e
122	85	37	e	28	37	46	e	36	345	112	e	179	232 e	580	e
119	73	36	e	25	34	44	e	36	250	156	e	139	131 e	490	e
412	69	36	e	23	34	42	e	36	203	342		2210	130 e	690	e
284	63	35	e	22	31	40	e	35	163	262		2180	678 e	437	
213		34	e	21	32	38		85	132	415		3136	2092	321	
169		34	e		749			63	108			2525		3340	

APPENDIX B

PICTURES

East Town River (River Pollution) - Dec. 2001

Unnamed Streamed – Cornwall Barracks

Panoramic view of the Rio Grande Watershed (Boundbrook Hills)

View of Port Antonio Harbour from Rio Grande Watershed


JAMAICA
2001
TRAILS

Nanny's Bump Grave (Moore Town)

Nanny Falls (Moore Town)

Rafting on the Rio Grande

Harvested Bamboo – Bowden Pen

APPENDIX C

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R2Rw

Ridge to Reef Watershed Project