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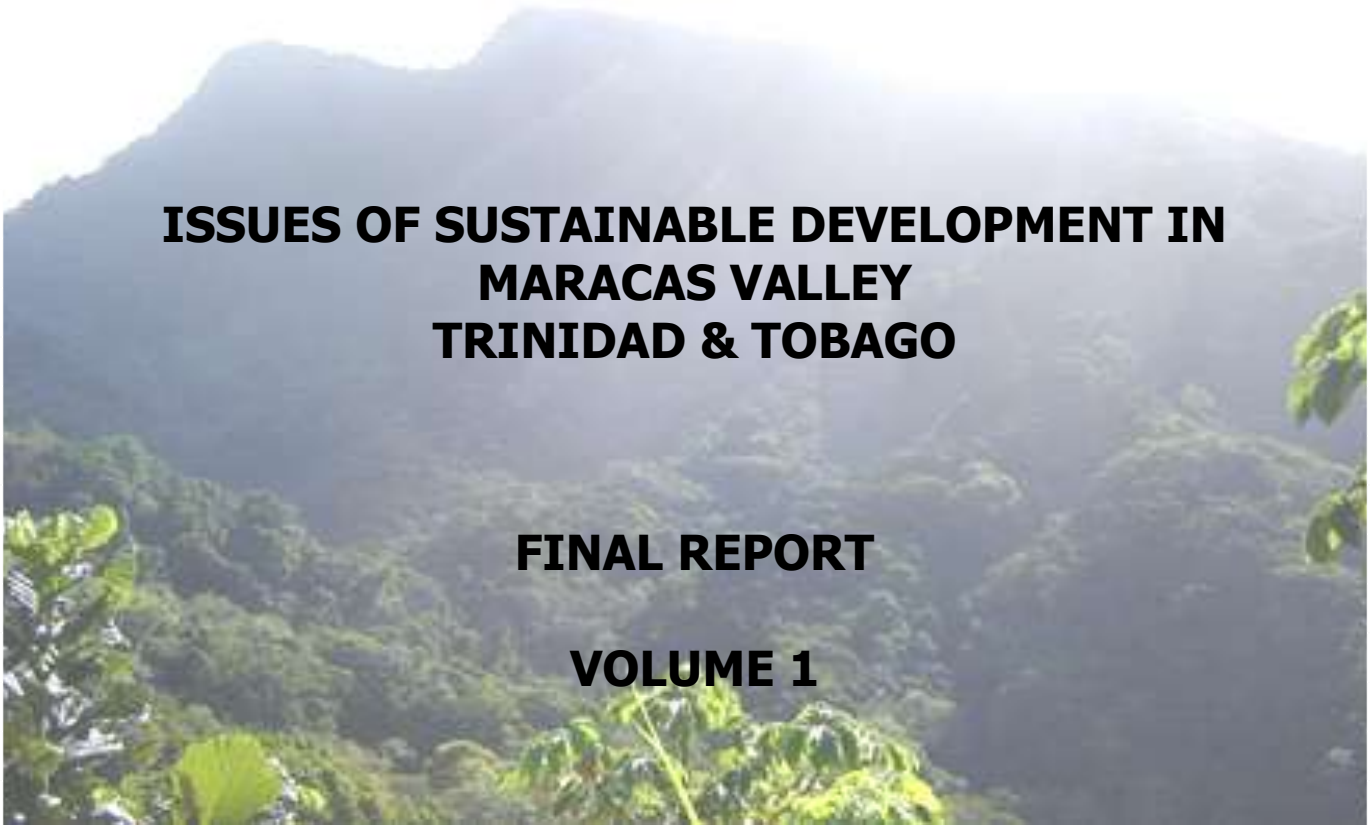

ISSUES OF SUSTAINABLE DEVELOPMENT IN MARACAS VALLEY TRINIDAD & TOBAGO

FINAL REPORT

VOLUME 1

MARACAS VALLEY ACTION COMMITTEE

July 2010

MARACAS VALLEY ACTION COMMITTEE

MISSION STATEMENT

The Association is a non profit, non political organisation committed to:

a) Emphasising community responsibility for the Maracas Valley community

b) Promoting maintenance, restoration and enhancement of the natural and man-made environment of Maracas Valley

c) Insisting on transparency and the value of public participation in the decision making process of the relevant authorities or bodies concerned with the development of the Maracas Valley community,

and all activities incidental thereto.

PREFACE

Maracas Valley Action Committee (MVAC) submitted an application in July 2005 to the United Nations Development Programme – Social Development/Global Environment Facility Small Grants Programmes by way of a Project Concept Form. This was a request for the planning grant of TT$12,000 to assist with the preparation of a project proposal entitled "*An Environmental Problem Definition Of The Maracas St. Joseph Sub-Region With Proposal For Alleviation Measures Towards Sustainable Development Of The Maracas St Joseph Valley*"

This specific application did not find favour.

However, in March 2008, MVAC was invited to resubmit the Project Concept form to the United Nations Development Programme (UNDP) Global Environment Facility (GEF) Small Grants Programme (SGP). Subsequently, in April 2008, MVAC was invited to submit a full proposal to obtain funding to carry out a project in Maracas Valley entitled "*Issues Of Sustainable Development For Maracas Valley, Trinidad And Tobago*.

This proposal was approved by the UNDP GEF SGP National Steering Committee (NSC) in June 2008 and a contract entered into with the UNDP GEF SGP to carry out the study as stated over a 14 month period, starting at the end of September 2008

In order to achieve the objectives of the study, four individual components were identified for information gathering as follows:

1. A series of Stakeholders/Community consultations/meetings to be held throughout the Valley; these meetings to be participatory and inclusive in order to give every member of the community an opportunity to participate in the consultations and follow-up actions
2. A socio-economic study which would give indications of population densities and movements during the study period

3. A land use study which would monitor the changes in land use and land capability trends during the study period.
4. An environmental study to evaluate the effect of changes in land use patterns.

It is envisaged that:

- involving members of the community as active participants in this study would assist in empowering the communities to analyse their situation and become involved in the development of effective and sustainable development proposals and
- Monitoring trends in changes in land use over a period of time using both historical and more recently collated data will highlight the positive and negative effects of developments which have taken place within Maracas Valley since 1970 to the present time.

It is anticipated that the results of this study will be widely disseminated and will be used as a basis for seeking partnerships with regional and national planning and policy making agencies, such as the Regional Corporation; Ministries of Planning, Economic, Social Restructuring and Gender Affairs, Housing and the Environment with special reference to Town and Country Planning Division and the Environmental Management Authority; the Ministry of Works and Transport and other relevant authorities.

ACKNOWLEDGMENTS

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Thanks also go to the UNDP Global Environment Facility Small Grants Programme for the financial support which made this report possible and to Anna Cadiz, National Coordinator, Small Grants Programme GEF-SGP.

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1.1. Executive Summary

9 Introduction

10 Maracas Valley is situated along the East West corridor in the foothills of the Northern Range, about 16 km east of Port of Spain, and runs due north from the town of St. Joseph which was the first Spanish settlement and capital of Trinidad. It is one of several Valleys which form the watershed area of the Northern Range and provide approximately 80% of the water supply of the country

The study area includes the area from the junction of the Maracas Royal Road and Riverside Road to the north of El Luengo Village and also includes the Acono area. It is a long, narrow valley with only one entry/exit, surrounded by steep hills and comprising many villages and, more recently, many mainly dormitory residential communities. There are footpaths which link Maracas Valley to Las Cuevas and Maracas Beach to the north, to Caura Valley to the east and Santa Cruz Valley to the west. There are still strong traditional links between residents in the northern part of the valley and residents in Las Cuevas.

Prior to 1970, residents of Maracas Valley were mainly engaged in agricultural pursuits, living close to and working on estates which varied in size from 15 acres to over 300 acres. Trees were planted and maintained as cash crops and fruits and vegetables were grown round the houses and on low fertile land. Recreational pursuits mainly centred on the land and rivers – hunting, fishing, swimming etc.

Commencing in the mid 1960s these estates were cut up and subdivided into progressively smaller plots of land, forming mainly dormitory residential communities. More recently planning permission has been granted for a number of multi-family residences or townhouses. The result of this has been a 134% increase in population, 250% increase in the number of buildings constructed, 117% increase in built up areas, 226% increase in the road network. The one continuously operating quarry in Acono has also increased in size by 283%. The loss in forest cover was 17.5% between 1970 and 2005.

This rapid increase in construction and quarrying activities has had a considerable negative effect on the land, roads and rivers systems in the Valley. Heavy trucks, increased run off from construction sites, increased traffic, have caused landslides and the river beds have been raised considerably by silt and debris. Pools where children learnt to swim have been filled with silt. Large rocks which slowed the river flow are no longer visible. Feeding beds which provided a source of food for fish have also been destroyed, resulting in the death of much of the aquatic life in the river. This has been compounded by non functioning sewage treatment plants associated with some of the large developments and other sources of pollution which have effectively turned parts of the Maracas River into an open sewer in the dry season – totally unsuitable for bathing. Natural habitats for wild life have been destroyed and a disturbing loss of biodiversity recorded. Quarrying operations have also had a negative effect of the amount of potable water obtained from the WASA substation at Acono and concern has been expressed that if permission was granted for another quarry at Ortinola, this would further deplete the supply of water from the Acono plant.

From its inception in 2002, Maracas Valley Action Committee (MVAC) commenced a monitoring and data gathering role, contacting the various decision making Ministries and other Organisations to voice concerns about the apparent lack of a holistic approach to development planning within the Valley.

In 2008, MVAC obtained funding from the UNDP GEF SGP to assist with the carrying out of a project entitled 'Issues of Sustainable Development in Maracas Valley, Trinidad and Tobago'. Additional resources for this project to be successful were required from voluntary technical contributions provided on a pro bono basis by professionals living in the Valley. Individual reports associated with the project were well and professionally executed. This was so with both the paid and pro bono work carried out. However, it was noted that pro bono work sometimes took longer to produce results than work paid for at the market price. Difficulties were also experienced in generating interest in the project among the professionals living in the Valley, even though they were also stakeholders. .

Challenges to the Project

- Data collection - Difficulties were experienced with respect to obtaining consistent updated data from the CSO. The lack of available historical data for water quality testing in the Maracas rivers was disturbing. Also in the GIS mapping project, although datasets were available for the years within the period of study, inconsistencies were noted between spatial and attribute data. This created considerable problems when attempting to map trends in land use etc. This lack of planning information, difficulties with accessing reliable planning data and projections created difficulties in carrying out the project.
- Sourcing and locating background information
- Obtaining information about applications for CECs from EMA was comparatively easy. It was noted, however, that decisions seemed to be inconsistent, particularly with respect to the requirement for an EIA to be carried out. Accessing information from Town and County Planning Division about the status of applications for outline and final approvals for new buildings or sub-division of land was more difficult until this year when MVAC was allowed access to the records at the Tunapuna Office. This was very useful in compiling information indicating further development planned for the Valley.
- Lack of communication between EMA and TCPD raised a question about planning permission seemingly being granted for a housing development in Riverine Road, Acono, when there was no apparent record of a CEC being granted.
- The decision making process in the case of the La Baja/La Seiva housing development has been, and still is, of particular concern to residents of the Valley. Questions have been raised about why no EIA was required for clearing 13.5 ha of hillside land, some of which has a gradient of steeper than 1:3 with an unstable soil structure.

Socio-Economic Study

In relation to the Socio-economic study , two of the findings will be noted here. One is the low level of literacy in the area in relation to the national average. The other is the

fact that few in the community are aware and, if aware, few are concerned about the levels of deforestation occurring in the Valley. The need to sensitize the inhabitants to the effects of deforestation is therefore crucial.

11 Land use Report

The following data should be noted:

The change analysis indicated the following for the period 1970s to 2009:

1. an increase of 134% in population
2. an overall increase of 250% in the number of buildings constructed
3. an increase of 117% in the built-up areas
4. an increase of 226% in the road network (117% increase in areas within 91m elevation, 207% increase in areas between 91-152m, 500% increase between 152-213m, and 108% increase above 213m.
5. an increase in size of 283% in Coosal's quarry.

The effect of these increases is as follows:

- Loss of land available for agricultural purposes
- Loss of forest cover on fragile hillsides
- Blocked roads, drains and river courses
- Loss of habitat and food sources leading to a loss of biodiversity, both land based and aquatic
- Reduction in water supply
- Rise in level of river beds, with subsequent loss of pools for recreation purposes and the covering of large rocks which assisted in checking the flow of flood waters
- Higher peak river flows in rainy season and lower base flows in dry season
- Flooding in the St. Joseph, Valsayn and Caroni Plain areas

These negative effects of the development in construction and industry are exacerbated by traditional slash and burn methods of agriculture and recent instances of squatting on the steep slopes of hillsides.

Because of the rapid increase in population:

- There is a much greater pressure on the one access road which is nearing its maximum capacity
- There is an urgent necessity improve infrastructure to keep pace with the demand, particularly in relation to sewerage systems.. At the moment these are faulty or non-existent and are presently polluting the river.

Concern has also been expressed about:

- Building on steep slopes and above the 100m contour
- New road construction, especially above the 100m contour and on steep slopes
- Seemingly inconsistent and ad hoc approach to approvals for construction
- Damage to existing properties and land in the vicinity of new developments
- Security of tenure for long-term squatter communities
- Influx of new squatting activities particularly on steep slopes:

Data Collection has over the years been inadequate. In order to accurately plan for the future, regular and highly technical data collection needs to be carried out.

12 Rivers and Roads

Maracas River is a source of potable water

It is important that we preserve the Maracas River because it is an important source of water to the valley through WASA's water works in Acono and Lluengo). There is no feasible alternative. This will mean a ban on further quarrying in Acono and Maracas Valley. It is also highly recommended that land previously used for quarrying be rehabilitated, that sensitive watershed areas be given forest cover and that agricultural and hunting practices which encourage forest fires in the dry season be banned.

The river in its lower reaches near the Silver Bridge is highly polluted with faecal matter, making clear the need to have one properly run sewerage system for the entire valley.

The rivers have also traditionally been a source of food and recreation. Pressure on the river through the recent developments has greatly reduced this resource. It is important that what remains is protected.

Maracas Royal Road

Maracas Royal Road is the only access road to the inhabitants of the valley. Traffic counts have been taken as part of this study. It has been found that the traffic on this road has almost reached its maximum carrying capacity and when the new houses that have already planning permission are built it is likely to go beyond what is sustainable.

The nature of the road, its narrowness and winding nature, make it also unsuitable for heavy truck traffic.

It is important that the traffic on this road be monitored in relation to an expected continual increase and also in the light of disaster-preparedness

13 The Environment and Biodiversity

The indigenous wild life of the Valley, whether mammal, reptile, bird or butterfly, is being threatened by ongoing trends and developments, in part through destruction of habitat. These are:

- Large-scale housing construction,
- Silting of rivers through construction and quarrying
- Slash and burn agriculture
- Indiscriminate hunting
- Sewage in the river
- General negligence in relation to bush fires.

The at least partial success of the reforestation programmes in El Chorro and Wharf Trace and the educational projects in El Luengo funded by the UNDP/GEF/SGP are

heartening but ongoing community education is required to instill in future generations the value of the earth's biodiversity for the health and well being of future inhabitants.

14 Stakeholder Meetings

The stakeholder consultation provides the major issues which the residents of Maracas Valley determine as the priority challenges facing the valley both from and environmental/land use and socio-economic perspective. The major environmental/land use issues are; quarrying, deforestation, illegal/unplanned development, land tenure and garbage in river and the major socio-economic issues are; road access/maintenance, drugs/crime, water supply, recreational and community centre facilities and fire services/hydrants. These findings can inform the development of targeted projects. Further it can inform policy formulation for the sustainable development of the Valley in a way that meets the needs of the people. Seven stakeholders meetings were held initially One major issue which arose in some communities was that of uncertainty of land tenure.

Many of the villagers are in legal terms squatters, even though they have lived on a particular site for over 20 years. New squatter establishments are still being erected, despite protests from existing legal residents. A policy has to be clearly identified and implemented to address these issues.

The meetings did not attract large numbers, however, despite different approaches to advertising and the attraction of refreshments and in some cases, also entertainment.

Two further meetings were held: one, a meeting of long-term residents where their reminiscences video-taped for future reference and the other a final stakeholders meeting at the USC in January 2010 to give feedback to the residents on the progress of the project up to that point.

It has to be concluded when taken with results of the socio-economic survey that one of the problems in the community and for projects such as this is lack of knowledge about environmental issues and general apathy and feeling of powerlessness to be able to improve a situation.

15 Qualitative Economic Valuation

The value of the natural environment is just beginning to be considered seriously in economic terms. It is evident from the qualitative economic valuation that that there is a large economic cost resulting from unplanned development, particularly on the slopes. Quarrying, population growth, poor sewage disposal and deforestation, causing river degradation have an economic cost. The economic cost is in the loss of agriculture, loss of recreational facilities, poor water quality, and loss of healthy lifestyle. Recovery also has a significant cost and in some cases may not be possible.

It is recommended that a proper quantitative economic assessment be done which will involve substantial data collection. This will enable a monetary figure to be put on the cost of environmental degradation.

16 Challenges to Sustainable Development

Some of the Challenges to sustainable development in the Valley have to do with the fact that rules about construction standards and regulations and legislation to protect the environment have not been enforced. In some cases the laws are adequate but there is no mechanism in place to enforce the laws. A slow justice system and a laissez-faire culture aggravate the problem .In some cases the laws need to be upgraded to be more environmentally friendly. Ministers should no longer have the discretion to alter or bypass laws that seek to protect the environment.

What compounds the issue is the multiplicity of institutions that have responsibilities in the Valley but not one has a supervisory authority to see that development of the Valley proceeds in a holistic way.

Party politics seems to be a hindrance in local government and community issues than a help as it serves to divide communities.

RECOMMENDATIONS

Watershed Protection

- Protection of water catchments
- Effective monitoring of Maracas River
- Enforcement of construction regulations
- No additional quarries
- Protection of water catchments
- Reforestation of denuded hillsides
- Establishment of centralised sewerage system in Maracas Valley
- Establishment of an autonomous authority to manage water resources in an integrated manner
- That all institutions, owners of defective waste water treatment plants etc which pollute the rivers should be made to pay towards the rehabilitation of the rivers.
- That quarries and construction companies should be charged for all silt and debris which lands in waterways and also be forced into suitable rehabilitation programmes

Over-all Policy

- That a land use policy for Trinidad and Tobago be put into operation
- That the Minister's discretion particularly in matters concerning the protection of the environment be exercised only in the public interest and a report must be laid in Parliament for its approval showing justification for the exercise of that discretion.
- That a mechanism be created for the enforcement of existing laws
- That existing laws be updated to be more environmentally friendly.
- That there should be a moratorium on major construction and further quarrying activities in Maracas Valley until a holistic land use policy is put into operation

17 Community as stakeholder

- That there be more transparency and public participation with respect to applications for Planning Permission

- That public consultations and site visits to be mandatory with respect to applications for Planning Permission for proposed changes in land use.
- That measures be put in place to effect regularization of tenure for existing communities.
- That there should be ongoing education for the community in relation to the value of the natural environment
- That there should be a plan for Disaster preparedness and emergencies in the Valley considering the one access road.

The Way Forward

Based on the goodwill and exposure generated by the project, it is now essential to generate a mechanism by which the results of this study reach, and are taken seriously, by the various decision-making organisations. To this end it will be necessary to set up outreach activities associated with the various educational institutions, and to strengthen ties with the communities in the Valley. The need for a sustained and meaningful education programme about the necessity of protecting the environment which shows tangible benefits to the population is now becoming critical. The responsibility lies with this present generation to protect future generations.

1. INTRODUCTION

1.1 BACKGROUND TO THE MARACAS VALLEY ACTION COMMITTEE

Maracas Valley Action Committee (MVAC) came into being in 2002 when a small group of residents of Alta Gracia Gardens in Maracas Valley became concerned about the increase in quarrying (El Chorro), and the degradation of the hillsides due to slash-and-burn farming and construction (both approved and otherwise). They contacted other residents throughout the Valley. All expressed similar concerns and came to a common conclusion – the increased activities put an intolerable burden on the existing infrastructure.

The first meeting of concerned residents from throughout the Valley took place at the then Caribbean Union College (CUC) on June 23rd 2002 and MVAC was born from that meeting. In the initial stages MVAC was run by an interim steering committee.

The first Annual General Meeting was held on March 6th 2005 when a full Executive (President, Vice-President, Secretary, Treasurer and three standing members) was appointed for the first time as well as three subcommittees – PRO, Fund Raising and Projects committees. The setting up of the web page, maracasvalley.org, was one of their first initiatives.

From that time on, MVAC took on the role of raising the concerns of the residents throughout the Valley with the various ministries and organizations involved in the decision making process with respect to the Valley (Environmental Management Authority, Town & Country Planning Division, Ministries of Planning and Development, Works and Transport, Tunapuna/Piarco Regional Corporation, and so on). Valuable interaction has also been developed between MVAC and village councils and other community groups throughout the Valley.

At the same time, MVAC commenced a monitoring role – keeping a record of all the activities taking place within the Valley as a whole and how they were affecting the equilibrium and lifestyle of the residents. MVAC has also evolved into a recognized not-for-profit, non-governmental organization, formally registered (November 17th 2004) and with a constitution (July 14th 2005) and mission statement (October 12th 2003). Regular general meetings have been held and various activities organized (Awareness Walk, Environmental Fair, Family and Fun Day).

Two PowerPoint presentations have been prepared:

1. To sensitize the residents of Maracas Valley to the rapid rate of expansion of construction, quarrying and population throughout the Valley and the effect of these on living conditions within the Valley
2. To air these concerns to a wider audience via the media, namely Gayelle in September 2005 and CNC3 in 2008.

Of major concern to MVAC over the years has been that the decision-making authorities do not seem to take into consideration the overall effect of the increasing demands on the infrastructure of the Valley, but seemed to view each application for development in isolation.

Various studies carried out over the last 30 years have indicated a growing concern about the destruction of the watersheds and the potential reduction in the water supply for the country. Maracas Valley is a watershed area under siege.

1.2 MARACAS VALLEY AND ITS HISTORICAL BACKGROUND

Trinidad is the larger of the two islands which make up the archipelagic state of Trinidad and Tobago. It is the most southerly island of the West Indies chain of islands and lies just about six kilometres off the northeast coast of Venezuela in South America. Historical data indicate that both Trinidad and Tobago were once connected to the South American mainland and this has impacted upon the island's biological diversity and

topography, which have more similarities to that of South America than do the other West Indian Islands.

Trinidad is the oldest settled island in the West Indies having been settled by Amerindians of South American origin. "Discovered" by Christopher Columbus in 1498, it became a Spanish colony but was only formally established as such with the foundation of San José de Oruña (St. Joseph) in 1592 and remained as such until it was ceded to Britain in 1802. The country became independent in 1962 and in 1976 severed its links with Britain, and became the Republic of Trinidad and Tobago, although remaining within the Commonwealth.

Maracas Valley is situated along the East West Corridor in the foothills of the Northern Range, about 16 km east of Port of Spain, and runs due north from the town of St. Joseph which, as indicated above, was the first Spanish settlement and capital of Trinidad. It is thus of historical importance to Trinidad. Additional information on Maracas Valley of historical interest was obtained from Michael Anthony's "Towns and Villages of Trinidad and Tobago" as follows:

- Maracas Valley used to be called "Valle de San José" (St. Joseph Valley). The path over the mountain to Maracas Bay was very important in the early years, one reason being security. The name was eventually changed to Maracas Valley
- A survey in 1797 showed that it was principally under sugar – three sugar mills worked by mules, a rum distillery and four coffee mills; total numbers of labourers being 248 of whom 128 were enslaved and 120 were free blacks.
- By 1811 the predominant crop was cocoa. The total population was 496 people; made up of 74 white, 190 free blacks, 223 enslaved; 350 acres under cocoa, 35 under sugar cane, 80 under coffee
- Some of the names of estates in 1838 were Santa Barbara, Santa Rosa, Montserrat, la Merced, la Florida. La Victoria
- In 1852, one of the first schools was in Maracas village in the district of Guarataro
- In 1869, the 70 children enrolled in the school spoke either Spanish or French but no English

- Not until the 1920's did Maracas Valley begin to change with the paving of the main road
- In 1946 the population was 2,960

The study area (4,142 ha) includes the area from the junction of the Maracas Royal Road and Riverside Road to the north of El Luengo Village and also includes the Acono area. It is a long, narrow valley with only one entry/exit, surrounded by steep hills and comprises many villages and, more recently, many mainly dormitory residential communities. There are footpaths which link Maracas Valley to Las Cuevas and Maracas Beach to the north, to Caura Valley to the east and Santa Cruz Valley to the west. There are still strong traditional links between residents in the northern part of the valley to residents in Las Cuevas.

In 1927, the Seventh Day Adventist Church established a presence in Trinidad and purchased La Realista Estate, just south of the junction of Maracas Royal Road and Acono Road. This has become an important educational establishment within Maracas Valley and offers primary, secondary and tertiary educational facilities. In recent years, the tertiary educational facility has been upgraded to university status and is known as the University of the Southern Caribbean (USC). This campus has undergone considerable expansion in recent years with many new buildings for teaching and administrative purposes. Associated with the teaching programme there are farm, workshops, cafeterias as well as dormitory facilities for the students and housing accommodation for staff. The USC student numbers have increased in recent years from 760 in the academic year 2001/2002 to 4,100 in the academic year 2008/2009. Student numbers in the primary and secondary schools have been given as 290 with 15 teaching staff in the primary school and 519 students with 27 teaching staff in the secondary school in 2009. An establishment of this size will probably require approximately 1,000 support staff. A proposal has also been submitted to the Environmental Management Authority (EMA) to establish a residential community comprising 100 single family residences, 100 clustered family residences and 15 homestead plots.

Historical data has been collated showing the changes in land and river use from the start of the study period in the late 1960's until present.

1.3 CHANGES IN LAND USE

Prior to 1970, residents of Maracas Valley were mainly engaged in agricultural pursuits. There were several large estates with areas in excess of 300 acres, as well as many smaller estates varying between about 15 and 100 acres. Tree crops were cultivated on the hillsides, with potential cash crops of tonka bean, cocoa, coffee and citrus. Immortelle was used as shade trees especially for cocoa. Other trees planted for timber were poui, cedar, mahogany, match stick and incense, to name a few. Vegetables and fruit trees were also planted around the houses and on low-lying fertile land with slash and burn farming being practiced on some hillsides. At that time residents lived mainly in villages, most often in the region of the large estates which were often their source of employment. Most of the homes were constructed out of wood or wattle/mud with grass or thatching palm roofs.

The major communities established at that time were in La Mango, La Baja, Wharf Trace, La Seiva, Upper and Lower Acono, Maracas Settlement and El Luengo.

Starting in the mid 1960's some of the large estates were subdivided and new settlements were introduced as follows:

- Valley View in the 1960s – this started with just a few houses close to the Maracas Royal Road and has expanded considerably over the years.
- Mountain View in the 1970s. Of interest here is that in 1973 there was a proposal to site a supermarket within this community. There was also a recreational area associated with this development, but that has been converted to residential and the residents use the original recreational area which had been established for the wider community in the area.
- Acono Ridge Phase I in the mid 1970s. Phase 2 has recently been approved.
- Alta Gracia in 1980 – was originally 31 residences total – converted to 70 by subdivisions in 1990 and 2002.

- Poolside Phases I and II in the late 1970's for Poolside Phase 1 and Poolside Phase II in the mid 1980s. In Poolside Phase I development is virtually completed, but development in Poolside Phase II is ongoing with the expansion into Spring Hill, which started in 2005
- Avondale Gardens in 1977
- Maracas Gardens, mid to late 1980s. A shopping complex was proposed for this area and a sod-turning ceremony was performed by the then Prime Minister, George Chambers in 1986. That proposal never came to fruition and in its place are 35 townhouses and several residences.
- La Baja was an existing settlement in the 1960s, but expanded rapidly in the 1980s. There is also a recent proposal to establish a large gated community of 188 single family residences, starting high up in La Baja with entry to Maracas Royal Road.
- Balata Trace had only a few houses in the 1980s but is still expanding.
- Chaconia Drive between Balata Trace and La Baja in 2005
- Acono Park in 2004
- Riverine Road also in 2004/2005
- Mira Flores, a single residence with gatehouse in the 1960s, introduced townhouses during the early 1990's as well as additional single family residences and apartments.
- After Mira Flores, townhouse developments were established in Maracas Gardens (2002), between Balata Trace and La Baja (2004), Mountain View (2007), Poolside Phase II (2008) (also two apartment buildings), between El Chorro and La Rue Pomme (2009), an HDC development very close to the El Naranjo Water Works (started in November 2006, buildings completed by mid 2009 but still awaiting sewerage treatment plant), and opposite Mountain View (2009). Additional townhouse developments have been proposed for USC, opposite USC, Valley View and Riverine Road.

These new developments, which have added a total of approximately 2000 residences, have had a considerable impact on the Maracas Royal Road and Maracas River. Unfortunately, the example set by Edric Anderson in the establishment of the Valley View community, where the roads were carefully laid out following contour lines; natural

drainage channels were not disturbed and minimum clearing of vegetation encouraged, has not been followed by other developers. This has resulted in the siltation and pollution of the Maracas River and its tributaries as well as blocking the Maracas Royal Road on occasions.

Coosal's quarry was established approximately 75 years ago. Originally the operation did not have the sophisticated extraction equipment which it has today, and so did not have a significant impact on the environment of the surrounding areas. There have been two construction booms during the time span of this study. The first one was associated with high oil prices in the mid to late 1970s and the other from the mid to late 1990s until 2008/9. Large trucks were introduced in about 2004/2005 at which time the output from the quarry increased dramatically. The residents in the Acono area started to complain about increase in asthma cases in young children and the elderly as a result of the dust and diesel fumes from the trucks, the increased silting up of the river bed, and damage to the road surface. Concerns mainly about the increase in noise, reduction in air quality, damage to the road surface and traffic jams caused by the increase in construction and quarry vehicles were also expressed by residents throughout the Valley.

1.4 EFFECT OF DEVELOPMENT AND QUARRYING ON RIVERS

In the days when St. Joseph was the capital of Trinidad, river travel by boat was probably the quickest and the most convenient. Boats used to sail up the Maracas River in order to reach the plantations established to the north. A later record (Collens 1888) describes a trip to the Maracas Waterfall during which "We shall have over and over again to ford what will be in some cases mere tranquil rippling streams, but in others rushing torrents, which drive along, furiously going for the huge boulders disputing the way as if the issue were one of life and death". Even in the lifetime of one resident, John Jaggernath, the Hosay was floated down the river from the bridge at Acono junction by the residents of Pepper Village. Vivid descriptions of people jumping off large boulders into pools 10-15 ft deep have been recorded. The river was a source of food and recreation for residents

and visitors to Maracas Valley. Youngsters learnt to swim in the river; fish were always available for the pot and under the rocks could be found crayfish.

The situation now is that there are few large boulders obvious in the rivers and very few pools suitable for bathing. The main reason for this could be because of the amount of debris and silt deposited in the river beds when land is cleared for quarrying and/or construction. One known and recorded colony of crayfish was recently destroyed when the land was cleared for the La Baja development and the developer used a backhoe to clear the waterway and a recent fish kill was recorded in Caurita when a retaining wall was being constructed. In this case it was thought that hardeners used in the cement mix could have been the cause. Although EMA were notified, they did not have the personnel available to respond at that time.

1.5 RESEARCH ON AQUATIC LIFE IN THE RIVERS OF MARACAS VALLEY.

Copies of four theses for either undergraduate or postgraduate students at UWI have been located as follows:

- A 1966 undergraduate study of an undisclosed stretch of the Maracas River identified the more common macrofaunal species. These included aquatic larval forms of insects such as (damsel flies, caddis flies, dragonflies, mayflies, and others), some snails, freshwater prawn and fish (including guppy, teta, catfish, guabine, sardine). (Thornhill et al. 1967)
- A 1994 ecological study identifies the aquatic insects from a stretch of the Maracas River. Organisms from 15 orders and adults from eight orders of aquatic insects were recorded. Since the purpose of the investigation was to examine seasonal fluctuations in composition and abundance, not all organisms were identified to genus or species level. (Maharaj, 1994)
- A 1985 study compared the macrofauna in two branches of the Acono River, one downstream of Coosal's quarry and the other a pristine control. The former was

almost devoid of aquatic life, and this was attributable to the physical conditions caused by the quarry. (Caesar, 1985)

- A 1986 study found that velocity, oxygen concentration and size of substrate decreased as the river descended, while temperature increased. The number of animals was greater in the higher reaches of the river, where oxygen concentrations are higher. Also, there were significantly more animals in the dry season than in the wet. (Ottley, 1986)

It should be noted that the recommended indicators for assessing the anthropogenic impacts in the rivers of Trinidad and Tobago now seem to be the use of the identification of benthic macroinvertebrates present in the river environment. (UWI, 2007)

1.6 **STRUCTURE AND PRESENTATION OF REPORT**

In order to fulfill the objectives of the Project, detailed studies were carried out by specialist consultants as specified in the Preface as follows:

- A socio-economic study
- A land use study using GIS
- A river quality study
- A water supply study
- A road use study
- Qualitative economic valuation

Each consultant submitted a detailed report. Summaries of these studies are given in the following sections of this report. The detailed reports are presented separately in Volume 2.

In order to ensure the fullest possible involvement of the communities in the Valley, a series of Stakeholders' meetings were held throughout the Valley, covering all areas of the Valley.

Relevant conclusions and recommendations are presented at the end of this report.

2. SUMMARY OF A SOCIO-ECONOMIC PROFILE OF MARACAS VALLEY

2.1 INTRODUCTION AND OBJECTIVES

The report presents the findings of a household survey carried out between June and July 2009 in the Maracas Valley, St. Joseph, the objective of which was to:

a. Provide a socio-economic profile of the Valley
b. Identify its particular population characteristics
c. Identify socio-economic and environmental problems and needs

2.2 METHODOLOGY

The methodology used involved the administering of a questionnaire to a random sample of 450 households selected through established CSO procedures. The Maracas Valley can be subdivided into 17 communities. For the purpose of controlling the study variables in a more manageable manner, the communities were further condensed into eight communities based on geographical proximity and a number of households selected as follows; Maracas St. Joseph (139), La Baja (79), Acono (59), Alta Gracia(43), La Seiva (43), Riverview Gardens (37), La Mango (30) and El Tucuche (20).

2.3 RESPONSE RATE

There was 100% response rate to the questionnaire with a completion rate of 97.1%, partially completed 2.7% and 0.1% or one refusal.

2.4 MAJOR FINDINGS

2.4.1 Demographics

From a gender perspective**,** women comprised 49.6% of the population of the Valley while men comprised 49.2%, thus reflecting an almost even spread.

In terms of age distribution, the Valley has a relatively youthful population as 48.2% are 29 years and under, 41.2% between 30-64years and only 9.1% 65 years and over.

The ethnic mix was found to be; persons of mixed origin 38.3%, of African descent 32.7%; Indians 12.2%, Spanish/Panyol 8.9%, Chinese 0.7% and Caucasian 0.4%.

The most practiced religion in the Maracas Valley was found to be Roman Catholicism (59.1%). Other Christians comprise 26.4%, Spiritual Baptists 5.6%, Hindus 2.7% and Muslims 1.1%.

The survey revealed that the communities comprised residents who have spent a long time in the Valley with 75% over 21 years, of which 45% have lived here for over 41 years and 12.5% have lived in the valley 10 years and under.

2.4.2 Household Composition

With respect to household composition, the survey results indicate that head of households in 41.4% of the households were fathers, 30.1% mothers; 4% equally shared 24% siblings or other adult.

The main income earner was discovered to be the head in 65.5% of the households, 17.6% mother and father together; 9.8% other members of household and in 2.6% someone not from the household.

The size of the household varied from 1 (13.6%) to 13 (0.4%), with the average household size being 3.74

With respect to children**,** 76.9% of households have no children under 5 years while 23% have 1 to 5 children under this age

2.4.3 Home Ownership

Of the population sampled, 81.7% of the respondents owned their own homes versus the national figure of 77.7%. This meant that the Valley experiences a higher than average position as property owners. It was also found that most homes had adequate supplies of utilities and basic amenities; reliable electricity supply, good water supply, adequate household appliances, indoor toilets and average garbage collection services

2.4.4 Employment

In terms of main sources of employment, it was found that most of the working population of the Valley is employed in three main sectors: services (59.6%),

construction (21.1%) and manufacturing (11%). Very small proportions work in petroleum/gas (0.7%) and agriculture (3.4%).

Professionals represent a minority of 24.8%, while 74.5% are in clerical, sales & service, craft, plant & machinery.

Of the total working population, 72.3% work in the private sector of which 20.4% are self-employed and 23.2% work in the Government or public sector.

2.4.5 Fear of Crime

The survey revealed that fear of crime plagued 70.7% of the people in the Valley. This compares to the national pattern of 77.9%. In effect the people of the Valley live with a greater sense of security that the average person overall.

The table below shows the factors most feared in order from highest to lowest fear.

- Murder (81.2%)
- Robbery (74%)
- Assault and battery (61.3%)
- Rape (60.1%)
- Burglary (59.2%)
- Kidnapping (58.3%)
- Larceny/theft (50.3%)
- Abduction (47%)
- Arson (35.2%)
- Praedial larceny (28.6%)
- Domestic violence (13%)

It is worthy of note that the actual victims of crime in the Valley averages 0.2% to 5.9%. by category and victim percentage the following are the actual criminal activities that predominate in the Valley; robbery 5.9% , assault and battery 3.2% and burglary 3.2%

2.4.6 Village Council

The survey sought to examine the general knowledge and feelings of residents towards village/community councils in the Valley. From a knowledge perspective, 68.7% of respondents knew that a council existed, 11.2% said none existed and 20.1% were not sure.

With respect to services provided**,** 53.6% indicated that the Village Council provided no services to their community. In terms of satisfaction, 54.7% were dissatisfied with the council and 24.2% were satisfied.

Of the persons surveyed, 15% belonged to a community group, 80.4% did not and 4.4% had dropped out.

And finally questions on funding of village councils revealed that 90.3% were self funded, 19.4% funded by private grants and 11.3% through government grants.

2.4.7 Recreational Activities

When asked about the preferred forms of recreation enjoyed by persons, the answers showed:

- Beach/river sport (69.4%)
- Sports (40.3%)
- Cinema (30.9%)
- Hiking (18.6%)
- 'Liming" (hanging) on the block' (11.9%).

2.4.8 Socio Economic Needs

Respondents identified the following as the most critical socio-economic issues affecting the Valley:

- access roads/drainage/pavement/street lights (31.1%). This came up as number one in the stakeholder consultation.
- community center/sport facilities (26.2%). This ranked number four in the stakeholder consultations.
- security (22.5%). This came in as number two in the stakeholder consultations

- youth programmes (14%)
- public utilities (10.8%). Water specifically ranked number three in the stakeholder consultations.

2.4.9 Health

This was particularly revealing, as 71% of respondents suffered none of the health problems identified on the questionnaire. The following are the major health issues found

- 15.5% had asthma
- 4.8% skin infections
- 3.4% bronchitis
- 2.5% cancer
- 6.2% 'Other' (e.g., lung infection, headache, wheezing, chest problems)

2.4.10 Environmental Problems

Ranked from highest to lowest order, the following are the most pressing environmental challenges facing the Valley, in the view of respondents:

- Flooding (36.3%)
- Landslides (27.7%)
- Destruction of forest (27.6%). This ranked number two in the stakeholder consultations
- Water pollution (24.4%)
- Quarrying (21.3%). This ranked number one in the stakeholder consultations
- Air pollution (21.4%)
- Uncontrolled housing construction (17%). This ranked number three in the stakeholder consultations
- Fire hazards (13.1%)

- 'Other'- e.g., drainage/soil erosion/dumping- (12.9%), squatting (6.6%), sewerage (5%). This ranked number five in the stakeholder consultations.

2.5 CONCLUSIONS

Based on the data generated by the social survey, the developmental conditions and challenges faced by residents of the Valley are at best mixed. While commonalities exist there is also much variation within the area of study in relation to the various social, educational, economic and environmental issues examined in what can be considered a pioneering, baseline survey of the region. Notwithstanding their relatively small size, the communities seem to be characterized more by difference and dissensus rather than commonality and consensus. In such a situation, making generalizations or trying to capture major trends, patterns or tendencies is always problematic. The following observations therefore are made and have to be read within the above empirical parameters.

On the positive front, the area of study can boast of high levels of home ownership, relatively good housing conditions e.g., electricity, gas, water supply, basic household conveniences (except for La Seiva), although pit latrines remain a concern, no overcrowding of households, good garbage disposal, little or no major health and environmental problems, greater community financial self reliance, no dependence on government employment or work programmes (such as URP, CEPEP etc.), a large cadre of white collar professionals, little or no crime and a relatively high level of social trust. In addition, there has been no major or significant influx of new persons into the Valley and contrary to a popular perception or concern, there has been actually a decline in housing construction in the area as a whole, although there were increases in Alta Gracia, La Baja and Maracas/St. Joseph.

On the negative side however, educational performance is generally dismal and combined with the issues of functional illiteracy, low numbers pursuing further studies, a definite digital divide (low computer ownership and internet access) are a cause for concern. In

relation to employment, dependence on the volatile construction sector is prominent which is generally consistent with the predominance of low status occupations among residents. The functioning of the system of local government however, which has been going through much talked about reform over the last 5-10 years, at least received rather mixed reviews. This is so for while on the one hand there was general satisfaction with garbage collection in the area of study, significant dissatisfaction was expressed towards the functioning of the local Village Council which does not seem to be meeting the full expectations of residents many of whom do not even know that one exists in the first place. The Valley also suffers from low police action on reported crime and, equally important, a low level of civic engagement measured in terms of low group membership, community participation and interaction, and a limited tendency to do favours which translate into little social solidarity and neighbourliness. In addition, there is no consensus on what can be considered important community needs or positive developments (apart from roads, pavements and the like) within the area of study over the past decade (2000-2009). Surprisingly, issues like deforestation, uncontrolled housing did not receive widespread numerical support. In this regard, it is worth noting that in the three communities which experienced increases in housing construction (Alta Gracia, La Baja and Maracas/St. Joseph), neither 'uncontrolled housing construction' nor 'deforestation' was identified as major environmental concerns (see Table 102). And, of these three communities, it was only in Alta Gracia that any environmental issue, namely 'flooding' and 'land slides,' stood out as major concerns. Related to this, there was little use or knowledge of special glass disposal/recycling bins to help deal with garbage disposal. What all this suggests is that much more needs to be done to educate and sensitise the residents about the importance of the environment and the environmental perils that face the Valley. Interestingly, the survey found that some of the major problems that confront the Valley relate not to health, crime or the environment but to the lack of social solidarity and neighbourliness or in short, social capital, although the level of social trust appears relatively high.

3. LAND USE STUDY

3.1 OBJECTIVES

Many issues have been identified as being of importance with respect to land use within the watershed area of Maracas Valley as defined in the attached map. These are addressed in the work plan and defined as follows:

- Carry out an inventory of current land use
- Classify lands based on ground slope
- Classify lands under forest cover
- Classify lands under cultivation/ tree crops/horticultural/food crops
- Classify lands used for residential purposes
- Classify lands used for institutional/educational (primary, secondary, tertiary) purposes
- Classify lands used for mining/quarrying purposes
- Classify lands used for commercial purposes
- Classify lands used for recreational/private/public purposes
- Define road network main roads, secondary roads, paved
- Define right of way, bridle paths, unpaved roads
- Analyse data and compare with maximum capacity usage
- Use information gathered to assist with the preparation of short, medium and long term development plans for Maracas Valley

3.2 METHODOLOGY

The methodology employed in ascertaining the effect of changes in land use patterns was as follows:

In the first instance, historical data was sourced, and then, starting with the earliest available sources, data was gathered on the various aspects of land use from that point to the present, which would also give an accurate portrayal of the current land use. A trend analysis of the effects of changes in land use was then carried out with the objective of providing current data and to recommend measures which could be of use to the various decision-making authorities in identifying sustainable future usage, and thus feeding into potential development plans for Maracas Valley.

The following approach was adopted to achieve this objective:

- A digital copy of the 1970 ordinance survey map of Maracas Valley was used as baseline data
- 1994 aerial photography was used as interim point of comparison
- 2005/7 Ikonos imagery was used as final data collation for all aspects except buildings and roads.
- A geography student from UWI was employed to map new buildings and roads data and to update the above to June 2009 using GPS equipment by ground truthing.
- Employ a GIS consultant to carry out the trend analysis of relevant factors from 1970 to June 2009, including all aspects of land use and changes in population etc., and to prepare the relevant maps required for the report.
- Liaise with TCPD and EMA to access information on the status of approvals granted for outline and final planning permissions from TCPD and the status of CEC applications from EMA.

3.3 SOME IMPORTANT ASPECTS OF LAND USE CONSIDERED

3.3.1 **Land Under Forest/Tree Cover**

From the information gathered for this report, at this time 70% of the land in Maracas Valley is under tree cover, of which 7% is Forest Reserve. Most of this land is steeper than 1:3 (1v:3h) or 20% slope. This situation has almost certainly changed, however, because of the areas denuded by forest fires in this recent (2010) dry season.

Goswami (1986) stated the following regarding the vegetation cover at that time – "The existing forest types range from Lower Montane rain forests to secondary growth and young bush. These are usually found on slopes on the sides of the streams. Three-tier forests with crappo (*Carapa guianensis*) and guatacare (*Eschweilera subglandulosa*) as dominant trees, still cover some of the high altitude areas and the slopes of the peak El Tucuche. (The slopes of El Tucuche are constituted into a Forest Reserve) Despite progressive destruction of forests in the northern part of the Maracas watershed since the sixteenth century, owing to inaccessibility, this reserve at the head of the watershed remains well covered with good natural forests.

"The forests in the southern foothills of the watershed and in the Northern Range are often classified as the naked Indian-incense-poui ecotone. Repeated forest fires, shifting

cultivation and over-felling have converted much of the forests of the lower slopes into scrubs with coarse grass and scattered large trees.

"The important tree species present over the area are angelin (*Andira inermis*), bois flot (*Ochroma puramidale*) cypre (*Cordia allidora* - a dominant species), guatacare (*Eshweilera subglandulosa*), hog plum (*Spondias mombin*), immortelle (*Erythrina micropteryx*), juniper (*Genipa americana*), mahoe (*Sterculia caribaea*), olivier (*Terminalia sp*.), poui (*Tabebuia serratifolia*) and serrette (*Byrsonima coriacea*). Bamboos are seen on drier locations. The two exotics, pink poui (*Tabebuia rosea*), and teak (*Tectona grandis*) are seen on some opened up areas, indicating that some tree planting was done on land which is now abandoned".

The above is very much in line with present findings.

Lists of trees, shrubs, ferns and grasses of common occurrence are given in Appendix I

3.3.2 The Importance of Trees:

- They form the natural habitat of the wild life of Trinidad and are essential for the survival of agouti, deer, iguana, armadillo, opossum, birds, and many other animal species named in the Fauna section of this report.
- The flowering trees are an important source of nectar and a number of apiaries produce honey which has a distinctive flavour due to the flora of the area.
- Forests are also important in absorbing carbon dioxide (the source of organic matter) and producing oxygen (an important element for a healthy atmosphere).
- The value of the forest may be justified if carbon trading is used to set a value to its worth other than the tangible ones (forest products – timber, honey production, wild meat).

3.3.3 Maintaining the Tree Cover/Forest is also Important Because:

- The forested areas behave like a sponge absorbing the rainfall until it becomes fully saturated (which can only occur after prolonged periods of intense rainfall).

- The moisture then gradually seeps out under gravity into the water courses while the vegetation take out what is needed for plant growth.
- Runoff from forested areas is typically 5 to 25% of the rainfall.
- The soils under forest cover will be protected by the vegetative cover of the trees which will allow the topsoil and tree roots to absorb the moisture from rainfall and promote luxuriant growth.

3.3.4 Maintaining the Stability of the Land.

During the dry season of 2010 the forested areas were plagued with forest fires. Steep areas without forest cover (mature trees) were burned bare exposing the fragile topsoil to direct rainfall. With the removal of this forest cover rainfall will run off immediately into the water courses. The effect of this will be:

- In steep terrain the velocity of the runoff will be very high and will cause erosion and trigger landslides.
- The result of erosion is removal of the toe of slopes and an increase in the steepness of the land surface. The soil will become unstable and there will be some downward movement of soil mass which will cause cracks at the upper end of the slope. These cracks will allow moisture to penetrate the soil mass which weakens the soil structure and lubricates potential slip planes. Over time land slides will be inevitable, causing
- Blocked roads, drains and river courses
- Flooding during periods of heavy rainfall
- The structure of some buildings may be vulnerable to erosion

Run off from residential and built up areas is typically 50 to 90% of the rainfall. The capacity of the existing drainage system would thus have to be increased if the forest cover is further depleted.

3.3.5 Roads on Steep Hillsides

Roads built on steep hillsides, especially on gradients of, or greater than, 20 degrees or 1:3 (1 vertical: 3 horizontal) will be subject to the following constraints:

- Heavy vehicles will not be able to climb such roads with their maximum allowable gross weight.
- Vehicles going down such steep slopes will have severe braking problems when the road is dry and may skid when wet, especially if the road surface is polished or smooth.
- The garbage collection vehicles will not be able to access areas with steeply inclined roads.
- In the event of fire, fire-tenders will be severely challenged to reach fires in a timely manner
- In the event of a medical emergency, ambulances will also be severely challenged

3.3.6 **Conclusion**

The forest is essential for

- Preserving the natural habitat for wild life.
- Protection of the environment from the harmful effects of heavy rainfall.
- The catchment and production of potable water
- Carbon trading can be used to set an economic value for maintaining forest cover.

From the above it can be stated that it is highly desirable to protect the forest cover from depletion and to reforest areas that have been cleared.

3.4 LAND CAPABILITY REPORT WITH COMMENTS ON SOILS FROM AN ENGINEERING PERSPECTIVE

The lands in question comprise eight main soil types of varying slope categories.

The 81/181 – Maracas/Matelot sandy clay loam is the dominant soil series (fig 4?), particularly on the steep slopes. The underlying soil-rock is schist, phyllites with some quartz. Most of these soils are under forest cover and generally low in nutrients except close to the surface where leaf litter improves the nutrient value. The recommendation for this soil series is that it be planted with forest or tree crops such as cocoa, citrus. Vegetables and root crops may be successfully grown in the sheltered valleys. Slopes, once cleared erode easily and become unproductive. They are not suitable for more intensive agriculture or fruit crops. It is strongly recommended that these areas remain under forest cover to protect the catchment and promote the sustainability of fresh water production. Farming of these soils where the slopes are steep (greater than 1v:3h) should be carried out by terracing (an agricultural practice that is not practiced by the slash-and-

burn type farmer) which should be introduced but requires great investment in labour or machinery to form terraces. Construction has taken place on these soil types in La Mango, La Baja, Poolside I and II, from Wharf Trace north to Mountain View, Maracas Gardens, Lower Acono, La Grine Road, Quarry area of El Chorro Road and El Luengo.

The flatter areas which are mostly along the sides of the major water courses i.e the Maracas River and Acono River comprise soils classified as La Pastora sandy clay, River estate series, Santa Cruz series, Anglais series and St. Joseph fine sandy clay. These soils are the deposits of the weathering and erosion of the steep higher slopes and comprise fine gravels, sands and silty clay. They are generally free to moderate draining and can sustain good crop production. These are however the areas with the highest density of buildings (residential, institutional and commercial). The built areas are mainly along existing roadways and the more remote areas (back yards) are still under some form of vegetative cover, fruit orchards or food crop cultivation. It is recommended that buildings only be allowed in the empty plots between existing built upon plots. These mainly fine grained soils will have low bearing capacity and single or two storey structures can be founded on relatively shallow foundations. Multi-storey buildings with more intensive loads will require either raft type or deep foundations - (pilings). These soils are easily eroded by heavy runoff if there is little or no vegetative cover. There may be some justification where the owner of the property with road frontage can be allowed to erect a second structure with access through the property adjacent to the road.

Most of these areas do not have wastewater collection systems and sewer treatment plants. The sullage water (kitchen and bathroom effluent) is generally discharged into the existing drainage system while the toilet effluent is piped into on-site systems (septic tanks and soak-a-ways). Increasing the population in these areas will further reduce the water quality of the river water.

.
In light of the recent intensive development of the lower elevations below 91m contour and moderate slope it is recommended that:

- Further buildings be permitted only on unoccupied lots

- An integrated wastewater collection system be installed with attendant treatment plants
- The existing forested areas be conserved and a programme of re-forestation be implemented.

The following table represents the land capability classification for each soil series with their slope categories. It should be noted that classes V, VI and VII are not suitable for cultivation. The subscripts e, w, s represents restrictions to productivity.

Soil Type	**Land Capability Classification**					
	$0^o - 20^o$	$2^o - 5^o$	$5^o - 10^o$	$10^o - 20^o$	$20^o - 30^o$	30^o+
81 Sandy clay loam				IVe	VIe	VIIe
181 Sandy clay loam				IVe	Vie	VIIe
43 Acono fine sandy		IVs	IVs	Ve		
243 Santa Cruz fine sandy loam			IIIw	IVe		
223 River Estate loam	Iw	IIIw				
323 St. Joseph fine sandy loam	IIIw	IVs	IVs			
123 Guanapo sandy clay loam		IIIw				
53 Anglais clay		IIIw			Ve	
182/L La Pastora sandy clay				IVe	Ve	

3.5 TOWN AND COUNTRY PLANNING DIVISION APPROVAL AND THE CERTIFICATE OF ENVIRONMENTAL CLEARANCE

3.5.1 The Town And Country Planning Act

The Town and Country Planning Act Chapter 35:01 came into effect on August 1st 1969. The objective of this Act is stated as being "An Act to make provision for the orderly and progressive development of land in both urban and rural areas and to preserve and improve the amenities thereof; for the grant of permission to develop land and for other powers of control over the use of land; to confer additional powers in respect of the acquisition and development of land for planning; and for purposes connected with the matters aforesaid".

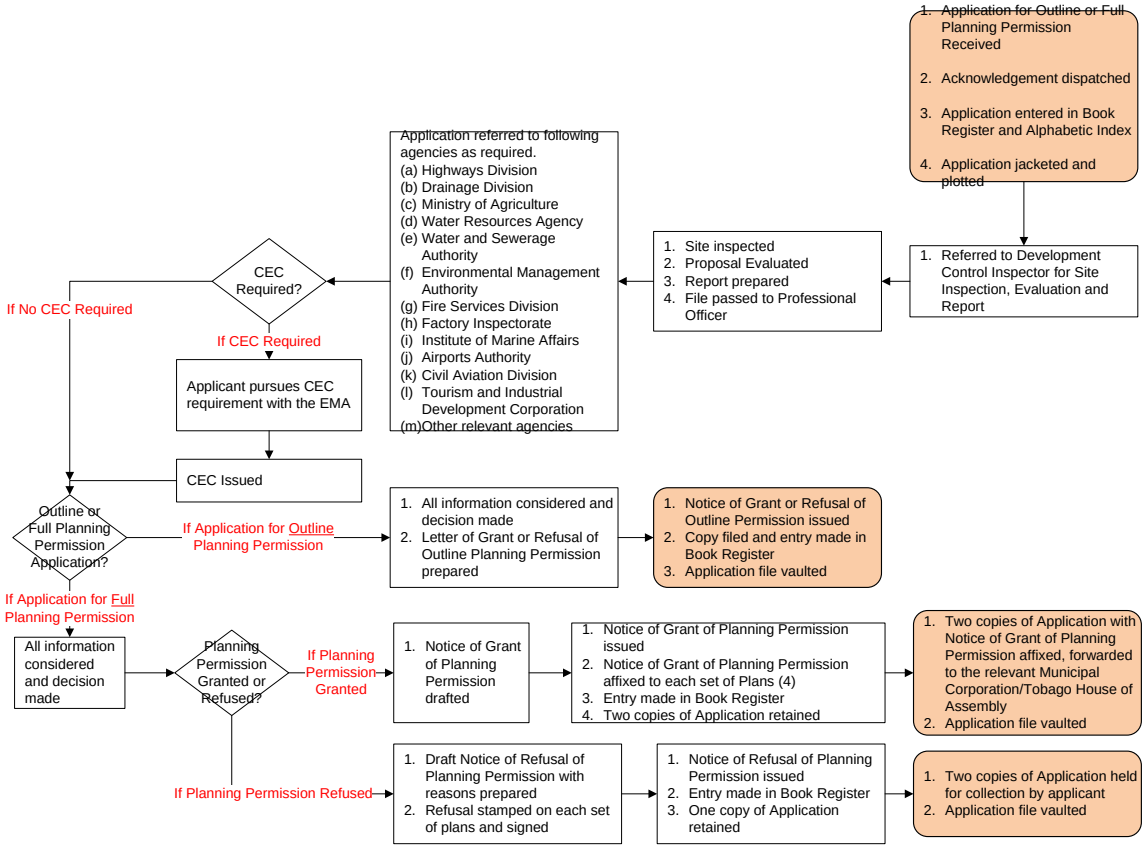
3.5.2 Development Of Land

Part III of the Act refers specifically to the Control and Development of Land. Under Section 8 of the Act permission is required for any development of land which is carried out after the commencement of this Act.

The expression Development means the carrying out of building, engineering, mining or other operations in, on, over, or under any land, the making of any material change in the use of any buildings or other land, or the subdivision of any land.

The flow chart below indicates the procedures and permissions required before any construction work can commence.

Trinidad & Tobago's Town and Country Planning Act Chapter 35:01 Effective 1st August, 1969
Processing of Applications for Planning Permission (Source 18th July, 2004 Newsday, Section A, Page 16)



As can be seen above there are two possible stages involved in any application – a developer can apply for either Full or Outline Planning Permission as follows

3.5.3 **Outline Planning Permission**

A developer normally applies for Outline Planning Permission in the first instance because this does not involve the expense of preparing plans and technical drawings for the development, just a location sketch which would enable the site to be clearly identified. A copy of the deed of ownership and a survey plan are usually also required.

It should be noted that the granting of Outline Planning Permission simply informs the applicant whether or not the type of development is consistent with existing land use policy, and also provides overall development standards applicable to the particular site. There are usually reserved matters which have to be approved and these have to be submitted for approval within a specified time (usually one year). It should also be noted that Outline Planning Permission does not authorize the commencement of development.

This may not commence until after approval of the reserved matters has been obtained. Outline Planning Permission lapses if an application for approval of the reserved matters is not received within the specified time period. This indicates that any developer who offers land for sale on the granting of Outline Approval from Town and Country Planning Division is at best misleading potential purchasers because there is no certainty that the specific parcel of land being sold will be granted Full Planning Permission. It is, however, the obligation of the potential purchaser to ensure that all documentation with respect to the development is in place before entering into any agreement. Too often, potential purchasers are too trusting or gullible and finish up purchasing a piece of land or property for which Final Planning Permission has not been granted and are thus unable to obtain a loan or mortgage.

3.5.4 **Final Planning Permission**

Full Planning Permission is only granted after completion of any reserved matters, such as the granting of a Certificate of Environmental Clearance (CEC) from the Environmental Management Authority (EMA), and approvals from all the agencies identified above. Once Outline Planning Permission has been granted the developer may apply for Full Planning Permission. This requires a much more detailed submission in respect of the development. Full Planning Permission does not have any time limits and construction activities may be carried out at any time in the future. The developer must, however, proceed in strict accordance with the terms of such permission. Failure to do so may result in enforcement action.

3.5.5 **The Certificate Of Environmental Clearance Application Process**

Under Designated Activity Number 8 of the EMA Act, if an application for planning permission is submitted to carry out any of the following actions over a two year period, an application must be made to the EMA for a CEC: This part of the Act states:

Activity is – Clearing, excavation, grading and land filling
Definition is –

(a) The clearing, excavation, grading or land filling of an area of more than two hectares during a two year period.

(b) The clearing of more than one half a hectare of a forested area during a two year period
(c) The clearing, excavation, grading or land filling of any area with a gradient of 1:4 or more.

Amendments were made to this activity in July 2007 (Legal Notice #143) and December 2008 (Legal Notice 186) by the Minister under Section 35 of the EMA Act which excluded land designated for quarrying activities from requiring a CEC from the EMA.

A summary of applications to the EMA for CEC's in Maracas Valley since 2002 is shown below:

Maracas Valley Action Committee – Summary of Data on Land Clearing - Developments of Interest – 2002-2008

CEC#	Date Recd	EIA Reqd?	Developer	Site details	CEC Approval
0103/2003?	17.01.2002	Yes	Learie Bruce etc	Extraction of dirt at El Chorro Road	Yes
0139/2002 See 1836/2007	05.03.2002	Yes	Specialised Rentals Ltd. Oliver Holder/Lystra Williams	Preparation of land for housing development – location – opposite CUC	Pending
0226/2002	09.07.2002	Yes	Development Planning Associates(2000) Ltd – Ewoud Heesterman	Development of land for residences, guesthouses, restaurant and guest facilities at Caurita Estate	Pending
0340/2002	03.12.2002	Yes	CUC – Ivan Laughlin	Infrastructure, roads, pipeline distribution system for sewage disposal, waste water treatment La Realista – housing, schools, agro-forestry	Pending
0341/2002	03.12.2002	Yes	CUC – Ivan Laughlin	As above – clearing of land	Pending
0393/2003	17.02.2003	No	F.W.Hickson & co Ltd	To conduct land development activities to facilitate a housing development at Maracas, St. Joseph	Yes
0568/2003	29.09.2003	Pending further info	Jerry Lutchman	Clear and grade land for sub-division (Riverdale, Acono Road) – 8.4ha	Pending?
0653/2004	20.02.2004	Subject to further info -> No	Alicia's House Ltd – Samuel Thom	Infrastructural activities. Construction of a housing development at Maracas Royal Road	Yes
*0688/2004	31.03.2004	??	A de B. Consultants – D. Bartholomew	To clear and excavate the area for 27 residential units at Acono Road – Felix Nelson at Acono Ridge	7.03.07
*0697/2004	07.04.2004	No	M Valley Ltd – Lennox Phillips	Infrastructural activities. The establishment of residential development at Maracas St. Joseph – Maracas Gardens	Yes 16.06.2004
0792/2004	04.08.2004	Subject to further info -> No	Aar Ell Project Managers – Buddie Miller	Construction of townhouses	Pending -> Yes
0874/2004	19.11.2004	No	Woodguill Development Co. Ltd – Timothy Mooleedhar	Development of 2.4285 ha to provide 20? (At least 25 going in) serviced lots Acono Park. Cut off traditional right to way.	Yes
**0942/2005	18.01.2005	No	Alicia's House Ltd – Samuel Thom	Cutting of a rock face at the base of the hillside land to facilitate the removal of approx 10,000m^3 for the construction of an 88m access road to an approved 5 lot housing development – Poolside Phase II	Yes

*0950/2005	21.01.2005	Subject to further info ->No	M Valley Ltd – Lennox Phillips	The establishment of infrastructure for a housing development at Maracas St. Joseph – Maracas Gardens	Pending -> Yes
1023/2005	19.04.2005	Subject to further info	Michael Valere	To develop an ecotourism destination in conjunction with agricultural and animal husbandry projects along Maracas Royal Road, San Pedro, Maracas Valley	Pending
1737/2006 -> 2175/2008	20.12,2006 - >06.02.2008	->No ->No	Jeffrey Guillen/ Mrs. Frances Hanson-Lewis assoc Env. Consults Ltd.	Only initial application. No details – to be monitored -> Woodguill (with Anthony Rahael)	->N/A? ->Yes App 28.05.2008
1836/2007 see 0139/2002	12.03.2007	Subject to further info	Universal Resources Co. Ltd – Louis John-Williams	To conduct land development activities for the establishment of a housing development on 16.873ha at LP#90 Maracas Royal Road	Pending ->App 26.09.2008
1853/2007	28.03.2007	->No	Learie Bruce Electrical Services Ltd., De Matas etc.	To conduct land development activities for the establishment of single family residences and residential homesteads at La Rue Pomme	->App02.07.2007
***1931/2007? 0568/2003?	22.06.2007	Subject to further info	Possibly also Jerry Lutchman	To conduct land development activities for the subdivision of an area located at LP No2, Riverine Road, off Acono Road.	Pending? Houses being built?
2175/2008	06.02.2008	No	Woodguill (Jeffrey Guillen /Anthony Rahael)	The establishment of infrastructure for a Res. Dev. within a site comprising 13.5ha of land at La Baja, Maracas Royal Road	Yes 28.05 2008

* There were objections on record for these developments

.

** This land was cleared but then one partner sold out and the remaining one sold the land; 18 townhouses were built on the cleared access road. The developer has now applied to clear more steep hillside land to gain access to the approved five housing lots.

*** This deserves further investigation. It appears that planning approval for at least one of these applications was approved by TCPD in January 2010, but according to EMA, no CEC was approved. Building commenced on this land in 2004.

Land clearance etc on some of the above has already commenced.

A summary has also been prepared indicating the status of present and potential future construction activities with the assistance of the EMA and Town and Country Planning Division. This listing does not include individual applications for single family residences.

Summary of construction activities in Maracas Valley
Information collected from July 2008 to March 2010

Area	Comment	Number of Units still to be occupied
Between Balata Trace and La Baja	a gated community –12 town houses and 24 single family residences	15
La Baja Road	188 single family residences + undisclosed number of multi-family residences – just received a CEC	188 +?
Poolside Phase II	18 Townhouse + ongoing construction from previous approvals in Spring Hill + a request from the developer to clear a hillside for further previously approved development.	18 3 5
Wharf Trace	ongoing planned and unplanned single family residences, most not regularized	
La Seiva Village	Ongoing development, not all regularized, but ongoing process	
Maracas Gardens	At least 200 single family residences, of which just over 50 have been completed. + 20 Units on 20 acres (entry through gated community).	142 20
Mountain View	18 townhouses constructed within Mountain View + another 12 constructed opposite the entrance to Mountain View. Mainly unoccupied	20
Valley View, Quartz Road Laura Drive	Approvals granted for 8 Townhouses. No construction started Approvals in place to subdivide land (Laura Drive) into 10 plots (4 residences built)	8 6
University of the Southern Caribbean	100 single family residences, 100 cluster residences, 15 homestead plots. Still awaiting CEC to be granted. More work requested by EMA on EIA.	215

Opposite University of the Southern Caribbean	A combination of single family residences on varying sized lots + cluster housing. CEC granted, but no record of Planning permission application	54
Acono Park	A gated community which cuts off a traditional right of way	26
Riverine Road, Acono Road	Phase I was granted final planning approval for sub-division of land in Jan 2010. Construction started in 2004, 5 or 6 are completed. Phase II is now being cleared for single family residences + possible townhouses No record of a CEC having been granted.	37 15 +?
Acono Ridge	Estate being subdivided into 26 homestead plots	26
Caurita Estate – Caurita Road	Application to EMA for establishment of an eco-lodge with outbuildings, restaurant etc	No further information
Sumbadora Road – Dr. Prempeh	Subdivision of land into 8? smaller parcels' Approvals granted?	8?
Santa Barbara Estate	Subdivision of large estate. 5 built houses	16
El Chorro Road	ex quarry (Leary Bruce)	40
El Chorro Road	Christine Seedarne. Approvals granted 1999. No construction started	10
El Chorro Road, El Chorro Gardens	Jerry Lutchman. Approvals granted 1999. No construction started	25
Alta Gracia Gardens	Permission granted to subdivide homestead plots into single family smaller plots – an increase from 31 to 70	38
Between Alta Gracia and El Luengo/Naranjo Water Treatment Plant	HDC housing development to the north of Alta Gracia Gardens – multi-family units	41
	Total	976

3.5.6 Comments

1. There is an apparent lack of communication between the two organisations and this was especially noted in an application to subdivide and develop an area in Riverine Road, off Acono Road. Enquiries were made about this development in 2005. Officers from EMA visited the site along with a representative from MVAC. Roads and houses were being constructed, but according to the EMA records, a CEC had not been granted. On contacting the T&CPD the officer was informed that approval had been granted so the matter was dropped. It was subsequently noted that final approval was not granted for this subdivision until January 2010 (for Phase 1) by which time many more roads and houses had been constructed. The EMA records at that time still indicated that no CEC had been granted.
2. Decisions on the granting of CECs by EMA seem to be disturbingly inconsistent. Initially Environmental Impact Assessments (EIAs) were always requested for the clearing of land over two hectares, but apart from the application from the University of the Southern Caribbean (USC), subsequent approvals for applications for land clearance were first of all moved to a pending situation followed by the granting of a CEC without the EIA requirement. This is particularly disturbing because seven or eight years after the initial application, a CEC has not been granted for the sub-division of the USC land, but CEC approvals have been granted in other similar cases, such as La Baja, Maracas Gardens, the land opposite USC, Acono Park, Felix Nelson in Acono Ridge etc.
3. Considerable concern has been raised by residents of the Maracas Valley community since 2008 with respect to a development taking place in the La Baja/La Seiva area. Outline planning permission was granted for the subdivision of the 13.5 ha of hillside land in 2007. An application was made for a CEC from EMA in February 2008 and this was granted in May 2008 without any requirement for an EIA to be carried out. This decision was questioned by MVAC. The developer then immediately started clearing the La Baja hill area without adhering to conditions identified by the EMA in the TOR. However, serious action was not taken against the developer until he started to construct a road to cross the Maracas River in order to gain access from the development to the Maracas Royal Road in March 2009. Permission had neither been

sought nor granted for this activity. A Notice of Violation was then issued to the developer in April 2009 by the EMA and later Tunapuna/Piarco Regional Corporation also went to court to legally instruct the developer to stop construction. However, it is understood that final planning permission was granted by T&CPD for at least one phase of this development in May 2010. To date, land owners in this vicinity have lost approximately five metres of river reserve and are becoming concerned about the stability of the foundations of their homes.

Also included in the above development is a proposal to construct houses on the hill to the west of the river in La Seiva. That hill was previously denuded of forest by slash-and-burn farmers and more recently cleared by the developer and fire. It is very steep with gradients steeper than 1:3 in places and the surface is very unstable. International guidelines recommend that land of that gradient is liable to landslides and thus unsuitable for housing. Even if modern technology enables the construction of houses, the construction of stable roads will be a severe challenge.

3.5.7 **Recommendations**

1. There should be an improvement in communications between EMA and TCPD
2. No building should be allowed on slopes steeper than 1:3 or 20^0. This should be reserved for reforestation and the biodiversity balance restored by planting a combination of forest and fruit bearing trees and shrubs suitable for both preserving the integrity of the soil and slope and to provide food for wild animals and birds.

3.6 **LAND TENURE IN MARACAS VALLEY**

The issue of security of land tenure was one which was raised at many of the stakeholders meetings.

Settlement in Maracas Valley was originally based close to or on the large estates where residents generally worked. These were often owned by absentee landlords who left the

running of the estates to their managers. Many of these estates were eventually abandoned, but the workers continued to live there, often paying land rent to the owners/managers or their representatives. Of particular note here are the lands in La Mango, Wharf Trace, La Seiva, across the river from El Tucuche, Gurratta, El Luengo, and large parts of Acono such as Green Hill, Tractor Hill and Caurita Road, to name a few.

Many of the large estates and large parcels of land were sold, either freehold or leasehold, starting in the 1960s with Valley View. This means that most of the newcomers to the Valley who have purchased land hold proper title to their land, but most of the families who have lived and worked in the Valley all their lives have not regularized their title to the lands on which they live. They are thus termed as squatters. It is possible that since they have occupied private land for over 16 years they can claim rights to that land under 'Adverse Possession', but they have to go through the legal process. Some residents of La Mango, La Seiva, Calcutta Village have done so, but there is still a large number who have not. This is one area of concern which should be addressed.

In the meantime, there has also been an influx of more people from outside the valley who have become squatters, clearing large tracts of hillside land and causing potential future problems associated with the indiscriminate clearing of fragile hillside. This should be discouraged, but there seems to be some reluctance on the part of the authorities to deal with this problem.

Land tenure in Maracas Valley can thus be classified as follows:

- Long-term squatters who can prove that they have occupied the land for over 16 years and .can thus claim ownership under "Adverse Possession". This requires a legal process which must be followed.
- More recent residential squatters who can claim no rights to the land on which they are squatting;
- Agricultural squatters
- Squatters on State land. It is understood that squatters on State lands cannot lay any permanent claim to those lands.

- State lands leased for agricultural purposes. Fixed-term leases may be applied for and granted for State land to be used for agricultural purposes.
- Leasehold – some landowners have sold the land as leasehold land - leases seem to vary in time frames from 99 years to 999 years (e.g. Leotaud Lands) and on completion of the purchase are formally registered in the Red House and hence on the Cadastral Sheets.
- Freehold – this applies to residents who have purchase the title deeds to their land and are formally registered in the Red House and hence on the Cadastral Sheets
- Certificate of Title – this is an alternative document in place of a Deed. This is also formally registered as proof of ownership in the Red House and hence on the Cadastral Sheet.

3.7 SUMMARY OF THE REPORT OF CHANGE ANALYSIS USING GRAPHIC INFORMATION SYSTEMS (GIS)

In order to obtain a clear assessment of the changes in land use over the study period (1970 to present), and to present and analyse the data collected indicating the correlation between people and the environment, it was agreed that the use of a mapping format was the most feasible approach.

The oldest land use maps available for analysis were created using topographic maps from the 1970s. In 1994, Lands and Surveys Division updated land use maps for Trinidad, available in digital format. The most recent land use map of the study area used for analysis was created by feature extraction from 2005 – 2007 IKONOS imagery at 1m resolution. The land use change analysis was therefore restricted to these periods.

A review of the available datasets indicating the status of the land cover, slope classes, growth of built-up areas in relation to elevation, addition of new road network etc., was then undertaken. Datasets were available for time spans of 1970, 1990, 1994, 2000, 2002, 2005, 2008, and 2009 but inconsistencies between spatial and attribute data for the years listed were noted. The datasets were updated by field work in 2009 using GPS to identify new roads and housing.

Change analysis results have been given with respect to population, land cover, the built environment, road network, elevation, slopes and soils in the study area. It should be noted that population growth statistics were based on estimates for the years between the censuses and the results will be reviewed as soon as the 2010 census data becomes available. Of particular interest was the identification of recent and anticipated construction in areas which have been identified as posing a high risk to construction.

3.8 CONCLUSIONS

The change analysis indicated the following for the period 1970s to 2009:

6. A 134% increase in population
7. An overall increase of 250% in the number of buildings constructed
8. A 117% increase in the built-up areas
9. A 226$ increase in the road network (117% increase in areas within 91m elevation, 207% increase in areas between 91-152m, 500% increase between 152-213m, and 108% increase above 213m.
10. A 283% increase in size of Coosal's quarry
11. A 17.5% loss of forest cover from 1970 to 2005

It was also noted that 20 per cent of the area under 213m and having slopes greater than 1:4 posed a high risk to construction. Thirty one percent of the area between 91-152m and 63.9 percent between 152-213m had slopes greater than 1:4. This is significant given the fact that the sandy clay loam, prone to erosion, is the dominant soil type in the study area.

3.9 RECOMMENDATIONS

There is no single agency in the country that has the responsibility for producing data that permits consistency in data collection and distribution. The establishment of such an agency is urgently needed for further estimation of change in the study area and for other threatened areas in the country. Until this is achieved, greater inter-agency collaboration needs to take place to rationalise boundaries for units of analysis, to improve the accuracy of the road network, road classification and street names, to verify land use classification,

to bring all data to one common projection and coordinate system, and to ground truth all data derived from aerial photographs and satellite imageries.

To arrive at a more accurate assessment of change in built-up areas, aerial photos of time periods at shorter intervals need to be examined.

To achieve a more realistic picture of the status of the Maracas Valley study area, the analysis needs to include updated cadastral maps, proposed quarries, areas experiencing loss of heritage and degradation of aesthetic quality. Flood and landslide events need to be mapped to improve the at-risk-to-construction map. A soil classification for engineering purposes and an accompanying map need to be developed for the country.

The analysis needs to be expanded to show the capability of the study area to manage disasters, particularly as there is only one main access road into the Valley.

To prevent further damage to other watersheds in the country, it is recommended that relevant agencies and organisations perform change analysis of this nature in those areas.

4. RIVERS AND ROADS

4.1 INTRODUCTION

Some historical background to the rivers has been given in Section 1. In recent years, construction, quarrying, slash-and-burn farming have caused high peak flows and flooding during periods of heavy rainfall. River beds have been raised by siltation and sedimentation and waterways blocked by debris – logs, branches etc.

For many years, gabion baskets have been used to shore up and protect the river banks. Gabions are wire mesh boxes, containers or baskets filled with rock to prevent soil erosion and to retain/contain soil particles. This has created problems in a few cases because after a few years, the wire which provides the frame for the baskets rots and the stones then fall into the river. Pictorial records have shown the baskets in the river by La Baja and rotting baskets in the El Tucuche Gardens area.

More recently in Alta Gracia Gardens and Caurita Road, the Ministry of Works and Transport, Drainage Division has constructed reinforced concrete retaining walls. Some concern has been expressed about this because in order to lay proper foundations it was necessary to go some distance into the river bed. This means that the river channel is narrowed quite significantly so the river in flood will be restricted. In cases where the level of the river bed has already been raised considerably as a result of previous flooding and subsequent sedimentation and the same volume of water flows during periods of heavy rainfall this could aggravate the flooding problems.

In Alta Gracia Gardens in particular, the bridges were built using concrete cylinders as support and there is concern that the subsequent narrowing of the river course will cause more flooding and further damage to the road structure and existing retaining walls.

4.2 SUMMARY OF AN ANALYSIS OF RIVER FLOWS AND WATER QUALITY MARCH 2010

A flow gauging and water quality sampling exercise was carried out on 15th March 2010 in the Maracas and Acono rivers for the purpose of determining dry season river base flows and river water quality as well as the determination of the level of pollution loads discharged to the Maracas and Acono Rivers.

At the request of MVAC, flow gauging was undertaken by AQUATECH Engineering Ltd. and water sampling and analyses by CARIRI. CARIRI's Service Project Report detailing the results of river water analyses was completed on 29th March 2010.

Flow measurements were recorded and samples were extracted for analysis using grab sampling at three locations:

1. Upper Maracas River (upstream of the junction with the Acono River)
2. Acono River (upstream of the junction with the Maracas River)
3. Lower Maracas River (upstream of the Silver Bridge

It was noted that:

1. The dry season flows (river base flows) are comparable with average base flows measured over the past decades in the Maracas River (WRA data)

2. Between the junction of Maracas and Acono rivers and Silver Bridge, the Maracas River receives an additional flow from aquifer discharge into the Maracas River as well as the discharge from five dysfunctional package wastewater treatment plants (WWTP) – The University of the Southern Caribbean, Mountain View, Mira Flores, Maracas Gardens and Poolside Phase II.

3. As regards classification of river water quality:

    - Upper Maracas River: Overall river water quality classification according to LBWA (Loire-Brittany Water Agency) is between Classes 1B and 2;
    - Acono River: Overall river water quality classification according to LBWA is between Classes 2 and HC;

- Lower Maracas River: Overall river water quality classification according to LBWA is between Classes 3 and HC;

(see table below for an explanation of the above classification)

*Table **Error! No text of specified style in document.**-1 Ambient Water Quality - Loire Britanny Water Agency – France*

Water Quality Classes		
1A		Excellent
1B		Good
2		Average
3		Poor
HC		Very Poor

4. None of the samples met the Faecal Coliform requirement for river bathing (Max count 100ml: 100) and thus, in the dry season, **the Lower Maracas River is not suitable for bathing**. Some upstream sections of the Acono and Upper Maracas rivers are probably suitable for bathing and this could be verified via sampling and analyses;

5. One method of visualising the impact of pollutant discharge would be to state as follows:
   - In the upper Maracas Valley section of the river, the Ammonia and BOD5 measurements were equivalent to close to 200 equivalent habitants discharging effluents directly or indirectly into the Upper Maracas River (before the junction with Acono River);
   - Close to 380 equivalent habitants (almost twice as much as in Upper Maracas River) discharge effluents directly or indirectly into the Acono River (before junction with Maracas River);
   - Close to 3,150 equivalent habitants discharge effluents directly or indirectly into the Maracas River between the junction of the Upper Maracas/Acono Rivers and Silver Bridge;

6. The Water Pollution Rules - 2001 (EMA) define permissible levels (maximum values) of water pollutants for effluent discharges into the environment. For BOD5, the permissible levels are 30 mg/l for discharge into inland surface waters (this should apply to Maracas River);

7 On 15-3-2010, the calculated average level of BOD5 effluent discharge into the section of the Maracas River between the junction of Acono and Maracas rivers and the Silver Bridge was 65 mg/l, thus more than twice the permissible level and violates the stipulations of the Water Pollution Rules - 2001;

8 Direct sampling of these three points (USC discharges to river) as well as sampling from the four dysfunctional WWTPs (listed above) should be undertaken as a matter of urgency to ascertain the precise contribution of these major pollutant sources (considering the low dilution capability of the river in the dry season). This would be the first step towards the identification/development of mitigation measures to lower the negative impact of these discharges to the Maracas River and the riverine environment.

RECOMMENDATIONS

As regards actions towards the restoration of the water quality of the Maracas and Acono rivers, the following could be undertaken:

1. Determination of the status of the suspected polluters (four package plants + USC + College Health Foods) with regards to the Water Pollution Rules. Have they registered with the EMA and have they obtained a Registration Certificate or a Permit?

2. If not (as is most probable), invite the suspected polluters to register with the EMA and pressure the latter to initiate the permitting process;

3. As shown above, the current effluent discharges to the lower Maracas River violate permissible levels set by the Water Pollution Rules and dry season measurements have shown that the river is not suitable for bathing;

4. To give impetus to the permitting process, measurements (initiated by EMA or directly by the polluter or, by default, by MVAC) should be carried out at the discharge point to ascertain the precise pollutant loads discharged to the environment;

5. This should then inform the permitting process and assist with the development of mitigation plans to reduce pollutant discharges to the environment (minimization of liquid waste and construction of functional package sewerage treatment plants);

6. WASA could be approached to ascertain the refurbishment schedule for the Mountain View WWTP. Pressure could be applied for the Authority to adopt the other three WWTPs (Maracas Gardens, Mira Flores, Poolside) as only WASA has the capacity to effectively run and maintain these plants;

7. Ultimately, as package plants rarely perform well and are a burden to the operations of a utility, the laying of a sewer line (with pump stations) along the Maracas Royal Road should be undertaken. Comprehensive plans and designs for the sewerage of the East West Corridor (Mount Hope to Sangre Grande including Maracas Valley) have been developed by consultants in 2004-2005 for WASA. As of today, implementation has not yet begun!

8. These actions are long overdue and it is time that we reclaim our rivers!

13.3 SUMMARY OF ANALYSIS OF WATER SUPPLY IN MARACAS VALLEY – MAY 2010

4.3.1 Objectives

The objectives of this study are:

1. To determine the status of water supply in Maracas Valley in 2007 and 2010;
2. To evaluate the effect of the current 2010 dry season on water supply in Maracas Valley;
3. To evaluate the effect of the proposed Ortinola Quarry on Maracas Valley water supply:
    a. In 2010;
    b. In 2015.

This report presents successively:

1. The 2007 water balance (water supply versus water demand);
2. The 2010 water balance (water supply versus water demand):
    a. In the rainy season;
    b. In the dry season;
3. The effect of the proposed Ortinola Quarry on the:
    a. 2010 water balance;
    b. 2015 water balance.
4. Conclusions & Recommendations

4.3.2 Water Supply Versus Water Demand

A summary of water balance calculations at the various horizons considered is given in the following table:

No	Designation	Without Ortinola Quarry			With Ortinola Quarry		
		2007	2010		2010		2015
			Dry Season	Rainy Season	Dry Season	Rainy Season	
1	Water Supply (m3/day)	5,800	3,700	5,800	3,700	4,700	4,700
2	Water Demand (m3/day)	6,100	6,500	6,500	6,500	6,500	6,400
3	Water Balance (1 - 2) (m3/day)	- 300	- 2,800	- 700	- 2,800	- 1,800	- 1,700
4	Water Balance Deficit / Surplus in % (= 3 / 1)	- 5%	- 76%	- 12%	- 76%	- 38%	- 36%
5	Comments	Near Equilibrium	Very Large Deficit	Slight Deficit	Very Large Deficit	Important Deficit	Important Deficit

WITHOUT THE PROPOSED ORTINOLA QUARRY

2007 Water Balance

Maracas Valley is fed by two water supply systems namely:

1. Acono Water Works;
2. Lluengo Water Works.

In June 2007, (transition period in terms of rainfall), Water Supply was measured as 5,800 m3/day (51% from Lluengo water works and 49% from Acono water works).

In 2007, Water Demand was calculated assuming a population of 11,300 inhabitants as 6,100 m3/day.

Thus, in 2007, Water Supply (5,800 m3/day) and Water Demand (6,100 m3/day) were almost at an equilibrium.

2010 Water Balance

In 2010, assuming a population of 11,800, water demand is calculated as 6,500 m3/day.

In 2010, water supply is measured as 5,800 m3/day in the rainy season and 3,700 m3/day in the dry season.

The 2010 rainy season water balance thus shows a 12% deficit (of water supply) as water demand (6,500 m^3/day) exceeds water supply (5,800 m^3/day).

The 2010 dry season water balance shows an important 76% deficit as water demand (6,500 m3/day) exceeds water supply (3,700 m3/day).

It should also be noted that if water transfers from Maracas Valley to the St Joseph Hill[1] are taken into account, the 2010 dry and rainy season deficit would be even higher.

IMPACT OF THE PROPOSED ORTINOLA QUARRY ON THE WATER SUPPLY OF MARACAS VALLEY

2010 Water Balance

Rainy season Water Supply: 4,700 m3/day

This represents a 19% (rounded to 20%) reduction in the water supply capacity of Maracas Valley (currently 5,800 m3/day).

Dry season Water Supply: 3,700 m3/day

With the Ortinola Quarry, the 2010 rainy season water balance shows a 38% deficit as water demand (6,500 m3/day) exceeds water supply (4,700 m3/day).

With the Ortinola Quarry, the 2010 dry season water balance shows an important 76% deficit as water demand (6,500 m3/day) exceeds water supply (3,700 m3/day).

2015 Water Balance

In 2015, assuming a population of 15,000 and a more responsible use of water by inhabitants, water demand is calculated as 6,400 m3/day.

In 2015, water supply is calculated as 4,700 m3/day (Acono River intake decommissioned due to Ortinola quarry activities)

In 2015, the impact of the Ortinola Quarry would negatively affect the water balance of Maracas Valley as the water deficit is calculated as 1,700 m3/day or 36% of 2015 water supply.

It is again confirmed that in 2015, the Ortinola Quarry would continue to have severe repercussions on the water supply of Maracas Valley notwithstanding the fact that leakage levels and per capita water use are expected to fall.

4.3.3 Conclusions

The WASA operated Acono and Lluengo water works currently provide water supply to Maracas Valley and sections of the St Joseph Hill. Despite intermittent water shortages in some areas and chronic water supply problems in other areas (Upper Wharf Trace for example), Maracas Valley currently enjoys a reasonably good water supply.

In 2007, the water balance (water supply versus water demand) was at a near equilibrium. As a result of population increase and with no meaningful action on water wastage and leakage, the water deficit increased to 12% in 2010 (rainy season).

The exceptional 2010 dry season has however further increased the water supply deficit which has been estimated at 76% of water production. This is however not a systemic problem but a seasonal one and the situation should improve with the onset of the rainy season.

The proposed Ortinola quarry would have serious repercussions on the water supply of Maracas Valley as it would lead to the closure of the river intake at the Acono Water Works thus reducing WASA's water supply capacity in Maracas Valley by 19% (if no new water sources within the Valley are tapped or no water transfers from outside the Valley are mobilised).

With the Ortinola quarry, the 2010 water deficit has been calculated at 38% of water supply in the rainy season and 76% of water supply in the dry season !! This last figure is deemed to be conservative and the deficit in the dry season would probably be higher as a result of reduced yields at the Acono well, a consequence of reduced infiltration rates due to quarry operations at Ortinola.

In 2015, notwithstanding the anticipated drop in leakage levels and per capita water use, the Ortinola quarry would continue to have severe repercussions on the water supply of Maracas Valley as the 2015 deficit has been calculated in the vicinity of 36%.

It is illusory to believe that a more substantial reduction of leakage levels could be achieved by WASA in Maracas Valley by 2015 thus augmenting volumes for consumption. Achieving water balance equilibrium in 2015 would indeed require reducing leakage levels from the present 40% to 6% !!!!! (National average 50% - 60%). In other words, mission impossible for WASA which is already overstretched with 40,000 leak repairs per year and ineffective leakage control policies and practise (especially as regards invisible leaks).

Also, there is limited scope to tap new surface water resources within the valley as this would lead to the virtual drying up of the Maracas River during periods of drought. Indeed, measurements carried out in March 2010 at the confluence of Upper Maracas and Acono rivers gave 45 l/s in the Upper Maracas River and 25 l/s in the Acono River (and this includes non-negligible elements of wastewater).

Finally, reclaiming (for water supply purposes) the Acono River which passes through Coosal's quarry calls for major undertakings which realistically, will only be achieved once quarrying operations have been scaled down and site remediation measures have been implemented (landscaping with backfilling and grading, improving site drainage and sediment traps, revegetation and reforestation etc…).

The above does not preclude (quite the contrary), the quarry operator (Coosal) from taking effective steps to reduce the amount of river water abstracted for his daily operations, to improve site drainage/sediment traps thus reducing current levels of sediments discharged to the Acono River.

To conclude, current quarry operations have reduced WASA's water supply capacity within Maracas Valley (at Acono Water Works) and thus contribute to the current water deficit.

The opening of a new quarry at Ortinola would definitely condemn WASA's intake on the Ortinola River, further reduce WASA's water supply capabilities at Acono and aggravate the water supply deficit in the valley. From an exporter of water to neighbouring areas (St Joseph Hill), Maracas Valley would become a net importer of potable water to limit the severe water supply deficit. Where this water would come from is presently unknown as other areas of the East West Corridor are already on scheduled water supply and are experiencing water deficits.

4.3.4 Recommendations

The following recommendations are given:

1. Preserving WASA's water supply capacity within Maracas Valley (Acono and Lluengo water works) is of prime importance as importing water into the Valley from neighbouring catchments is both expensive and currently not feasible due to the severe water deficit experienced in most areas of the East West Corridor;

2. This objective is in line with Maracas Valley's role as an important water catchment within the Northern Range. This role is currently being severely challenged as a result of unchecked development within the Valley (including hillsides with slopes greater 1 in 4), abusive land use practises (slash–and-burn agriculture, deforestation etc…);

3. The observed increase in river peak flows and the degradation of river water quality over the last decades are a testimony of the degradation of the Maracas Valley water catchment with less infiltration, more runoff and erosion;

4. Maintaining the present capacity of WASA's Acono and Luengo water works requires the abandonment of the proposed Ortinola quarry which would invariably spell the death sentence of WASA's catchment on the Ortinola River due to increased runoff and turbidity in the rainy season and diminished river base flows in the dry season. The sorry state of the Acono River which runs through Coosal's quarry bears testimony to this prediction;

5. Take energetic steps to reclaim the Acono River which passes close to Coosal's quarry by reducing water abstraction for quarrying operations, improving drainage and effectiveness of sediment traps, remedial landscaping (including backfilling and grading), reduction of run-off etc. These measures are compulsory for quarry operators in many countries;

6. More aggressive leakage control (especially as regards invisible leaks) and the introduction of universal metering should be actively pursued by WASA as it would result in effective water demand management (reduction in leakage levels on WASA's mains and water wastage at customer premises);

7. Universal metering should be rolled out by WASA in 2010 starting with areas with 24/7 water supply. Maracas Valley areas which qualify should thus be included in this important exercise;

8. The above should somewhat improve the water balance though it is acknowledged that some water mains are beyond repair and should be replaced (it does not always make economic sense to systematically repair the same main on a regular basis). When annual cost of leakage repairs (combined with the production cost of lost water) exceeds the annual depreciation cost of a new pipeline, it is cost effective to change the pipeline;

9. Some areas of Maracas Valley suffer from chronic water shortages (upper Wharf Trace for example). The installation of a booster and a water tank midway up the hill would alleviate this problem. WASA should address this issue as a matter of urgency;

10. Generally speaking, a reliable source of water is a basic human requirement which impacts on health, comfort levels and living standards. The fact that Maracas Valley, one of the prime water catchments of the Northern Range, cannot sustain its own potable water requirements speaks lengths on the relentless pace of unchecked urbanization and the continued degradation of the water catchment. This should be reversed as a matter of urgency with special emphasis on water catchment protection, greater control and regulation of housing developments, implementation of check dams to stem runoff and increase infiltration, reforestation, or terracing of cultivated hillsides etc.

4.4 ROAD

4.4.1 Summary of Traffic Counts – 2007 to 2010

In response to concerns raised by Residents of Maracas Valley about the increase in traffic resulting from the rapid increase in both construction activities and quarrying on the single one way in one way out 'horse and buggy' road, professional traffic counts were carried out on behalf of MVAC in November 2007, in November/December 2008 and in February 2010. Two sites were selected. One was between Balata Trace and La Baja Road which gave an indication of the traffic associated with the Valley itself, but excluding vehicles coming to and from Balata Trace and La Mango and the other one just before the junction of Riverside Road and Maracas Royal Road. The actual results of these counts are indicated in the attached 'Traffic Count Report'.

The objective of the exercise was to

- Determine the daily traffic count volumes on the Maracas Royal Road
- Determine the peak traffic volumes on the Maracas Royal Road
- Determine the percentage of trucks and other heavy vehicles utilizing the road
- Determine the percentage of trucks and heavy traffic traversing Bridge 1/1 (Silver Bridge)
- Compare the data from 2008 with the baseline data obtained in 2007.

It should be noted that the system used was able to differentiate between motor vehicles, trucks and other heavy vehicles.

Conclusions were as follows:

1. Based on the characteristics of the road, the estimated capacity of the Maracas Royal Road is between 800 to 1000 vehicles per hour.

2. There are two daily peaks on the Maracas Royal Road consistent with the morning and afternoon commute periods.

3. The morning peak is spread out over a two hour period, whereas the afternoon peak is spread out over a three hour period.

4. At the morning peak, the Maracas Royal Road has approximately 750 vehicles in the southbound lane. The road is therefore operating close to the peak capacity.

5. There was a significant increase in truck traffic on the Maracas Royal Road between 2007 and 2008, but an equally significant decrease between 2008 and 2010.

6. Future traffic monitoring is strongly recommended.

4.4.2 Suggestions to Representatives of the Traffic Branch, Ministry of Works and Transport in March 2010.

In March 2010, members of the Maracas Community were invited to discuss potential ideas for improving the flow of traffic in the Valley at peak periods.

Suggestions made were as follows:

- A traffic light or roundabout should be installed at the junction of Riverside Road and Maracas Royal Road
- The road going from King Street to Curepe should be made one way – E to West a.m., West to East p.m.
- A box should be installed at the traffic lights at the junction of Abercromby Street and EMR and traffic police should be present from 7.00 a.m. to 8.30 a.m. to ensure that vehicles do not enter the box unless there is a clear space on the other side.
- A traffic light and box should be installed at the intersection of King Street and EMR and again monitored by traffic police. Alternatively, a large roundabout at this intersection could be an option
- A box should be installed at the Traffic lights at Champs Fleurs and again monitored by traffic police, especially in the early morning period and traffic traveling from East to West at peak hours in the morning should be prevented from joining the Champs Fleur traffic onto EMR.
- There is some ambiguity with the traffic light at the junction of Abercromby Street and EMR. When traveling from the East and turning right into Abercromby Street there is a preferential green light for a short while. An improvement here could be to indicate the preferential green light with a green arrow to indicate right of way, which could then change to a flashing orange arrow to indicate that drivers do not have the right of way, but can filter into Abercromby Street if the way is clear.
- On street parking should by prohibited on Abercromby Street and the narrow sections of Maracas Royal Road (La Seiva, Gurratta, and Maracas St. Joseph)

Other matters discussed were:

- Education and enforcement (with respect to boxes at traffic lights especially)
- Traffic wardens – these will be used to assist police in monitoring intersections, no parking areas etc
- No entry to side streets – e.g. vehicles go down Charlotte street and when King Street is blocked and create a further blockage on EMR.

Subsequently,

- MVAC was informed that the Ministry is considering the suggestion to install a roundabout at the junction of King Street and Eastern Main Road.
- A box has been installed at the junction of Abercromby Street and Eastern Main Road.

5. ENVIRONMENT

- **5.1 BIODIVERSITY**

- **5.1.1 The Fauna of Maracas Valley**

The Environmental Management Authority has recognized the importance of our mountains and forests in protecting the biodiversity of Trinidad and Tobago and ultimately the wellbeing of its inhabitants. Animals, birds and insects inhabit the mountains of the Northern Range. El Tucuche (the second highest mountain in the country) in Maracas, is the home to the golden tree frog, found nowhere else in the world but in the highest reaches of the Northern Range.

Animals indigenous to Maracas Valley include the mammals: manicou, agouti, lappe, anteater, porcupine, armadillo (tattoo), deer, quenk (a wild hog), red howler monkey, squirrel, ocelot, and also many species of reptile including the snakes such as macajuel, iguana, matte and other lizards. Amphibians, apart from the common toad, are more elusive.

In the Northern Range there are well over 200 species of birds. As an illustration of the wealth of bird life in Maracas Valley, 45 different species of birds were spotted in the residential part of Maracas Valley in 2009- 2010. (See the Appendix II for a complete listing).

In December 2009 a bird count was taken in the Ortinola, El Tucuche and El Luengo area - along a trail of 12 miles and in a time frame of 11 hours. 51 different species of bird were noted. (See Appendix for a complete listing)

The wealth of wildlife in Maracas Valley is evident. However we cannot afford to be complacent about this diversity of species or the apparent abundance.

Although there have been no formal studies done on the numbers of mammals still living in Maracas Valley, anecdotal information from long-time residents seems to suggest that the anteater, armadillo (tattoo), quenk, monkeys, deer and even the iguana, matte and tarantula are more rarely seen in 2009/10 than they were 20 to 30 years ago. Hunting, forest fires and clearing of land seem to be factors in this reduction. (See Appendix II)

Some residents, in an informal study in the Acono area over the period 1970 to 2010, have noted that some of the birds normally seen in the past, like the turquoise tanager, the

yellow-bellied elaenia, the tropical screech owl and the ferruginous pygmy-owl, are now rarely seen. This situation also applies to some mammals like the quenk and snakes and other reptiles like the matte, iguana, and the macajuel. (See Appendix II for a complete listing).

- **5.1.2 Effects Of Development**

The conversion of forests to agricultural land (mainly by slash-and-burn), middle-class housing development and increased mining have all impacted negatively on the flora and fauna of Maracas Valley by removing habitat and sources of food. An additional threat may also be the dogs which are kept in the gardens of the middle-class homes. A further threat may be from the Ministry of Health spraying to control mosquitoes. This must have an effect on insect life, and casual observation indicates a great reduction in butterflies. This in turn will negatively affect insectivorous birds and mammals (especially bats).

5.1.3 Over-Hunting

Hunting season opens on October 1 and ends on the last day of February. But hunting occurs throughout the year by the non bona-fide hunter on a casual basis. Short-term benefits for the individual are, in the case of hunting of wild animals threatened with extinction, obviously at the expense of the long-term, even for the hunter himself.

- **5.1.4 Slash-And-Burn Agricultural Fires**

Fires are started for a number of reasons: “to plant crops by the slash-and-burn method; to smoke out wild animals;” to make a cook” on a river “lime”; to burn garden waste. They are often not monitored or put out when their purpose is complete and therefore frequently cause bush fires which then deforest the mountainside. Fires started by the river or the lower reaches of the hills can eventually snake up the mountainside and threaten even the generally protected upper reaches of El Tucuche (as has happened this year, April 2010) Primary forest once burned cannot return to its original state. There will be secondary growth instead. The eco-system will be damaged, habitat and food sources destroyed. Some animals are burned as they flee; some are suffocated in their holes. Fires are often deliberately encouraged to catch the animals for the highly-priced wild meat

market. And some fires are started accidentally and negligently with a discarded cigarette.

- **5.1.5 Need for Education**

.Education about the need to protect the environment before it is too late is critical now. It must be performed in a sustained manner and must show tangible benefits to the population. It must target both adult and child using all avenues: the media in all its forms and the schools.

- **5.1.6 Lack of Law Enforcement**

The fire season in Trinidad and Tobago is the period 1st December to 30th June. The law states that:

"On any parcel of burnt area contrary to the terms and conditions of a permit, no person is allowed to plant any annual crop within a period of one year after which the fire is set.

Any person who is guilty of an offence under this Act is liable to a fine of TT $1,500.00 and to imprisonment for six months".

The apparent inability of the relevant agencies to enforce the laws is a major challenge to preserving the bio-diversity and protecting the environment.

- **5.1.7 Recommendations**
  - A moratorium on hunting.
  - Enforcement of existing laws
  - Training of community groups to help put out forest fires.
  - Education through the media and schools on environmental issues and the urgency of addressing them.
  - That alternative forms of income generating activities be found to replace hunting, such as eco-tourism projects
  - Training in more sustainable agricultural methods.
  - More data-gathering

5.2 PROJECTS BEING UNDERTAKEN BY OTHER GROUPS IN THE VALLEY

5.2.1 National Reforestation and Watershed Rehabilitation Programme 2004-2014

- **Background To The Programme**

In 2000 The Government of Trinidad and Tobago realised the necessity of bringing Trinidad and Tobago nearer to the standards of the developed world in relation to

environmental concerns. The developed world had long recognized the need to protect natural environments for the long-term sustainability of the earth.

In the particular case of Trinidad and Tobago, therefore, the Government recognized the need

- to protect and manage existing forests
- to protect watersheds by replenishing ground cover
- to plant suitable trees in deforested areas partly because of recurring bush fires during a series of dry seasons
- to encourage community participation in order to foster a responsible attitude to our natural environment
- to enforce existing legislation against destruction of the natural environment
- to encourage the use of the natural environment in sustainable ways through lumber production and eco-tourism

Maracas Valley is one of the areas to benefit from The National Reforestation and Watershed Rehabilitation Programme. In Maracas Valley the programme deals with two areas and two community groups. They are the La Chorro Village Settlement, assisted in its operation by the Maracas Village Community Council and Wharf Trace, assisted in its operation by Wharf Trace Village Council.

The Maracas Valley is a watershed area. A series of dry seasons with recurring bush fires has caused a reduction in forest cover, leading to soil erosion, increased siltation and flooding and a reduced aquifer recharge

- **The Scope of Works**

The scope of works in this project was expected to include:

- Planting of trees
- Protection of young trees for 5 years by workers in the project
- Protection of the area from fire and illegal occupancy
- Creation and maintenance of fire traces
- Construction and maintenance of check dams
- Beautification of existing trails and waterways
- Encouragement of existing forest regeneration
- Improvement of existing watershed management practices.

In the original plan, the species of trees to be planted in the case of El Chorro were: mahogany, apamate, cedar, crappo, pomerac, primrose (plumrose), pommecythere, nutmeg, brazil nut and chennet. In the case of Wharf Trace area, cedar, mahogany,

mahoe, apamate, hogplum, jamoon and cypre. The practice of planting mixed species of trees has been followed to help prevent devastating effects of fire.

There has been, however, considerable flexibility in relation to the kinds of trees planted. More fruit trees have been planted, for example, than was originally envisaged- e.g. mango, pomerac, wild caimite. One criterion has been the encouragement of wild life,

It was planned in the original project that state lands would be used in the first instance but that private owners would be encouraged to buy into the project. In the El Chorro area over 40 acres have been planted and in the Wharf Trace area 30 acres.. In each area there is a gang of 35 workers. It has been reported that the workers on the project have shown responsibility in the tending and protection of the young plants. Even with the devastating bush fires of the 2010 dry season the workers in the El Chorro area have been able to prevent the fires from encroaching on to the new plantation. One of the devices has been the creation of wider than normal fire traces. They have also expressed gratitude to the coordinator for the educational courses offered to them during the programme. Hope has been expressed that the programme will continue and be expanded,

The seedlings of these trees and others are grown in a nursery in Maloney organised by the over-all project coordinator for the area. The focus of the reforestation aspect in Maracas Valley is to provide forest cover rather than the provision of trees for lumber in order to protect habitats, to prevent erosion and resulting downstream flooding.

- **Community Involvement**

From the outset the government saw the importance of community involvement. The community councils were engaged to manage the gangs of workers who would live in the area of reforestation. Every effort was to be made to make use of community resources in the project. In this way it was though that, as stakeholders, they would feel the programme belonged to them and there would be a vested interest in protecting what had been planted. In addition there were opportunities to educate the labour force in the best practices in agriculture as opposed to the traditional practice of “slash-and-burn”. Opportunities would also be explored to promote eco-tourism to replace forms of

employment which have been more destructive of the natural environment. There is evidence to suggest that focus on community involvement was the correct initiative for this project

Expected Benefits of the Programme

- Additional forest cover can help to support indigenous wild life and mitigate the effects of climate change
- Reforestation can occur in exchange for carbon emissions on the world market
- Reforestation can increase the potential for eco-tourism
- There is an expectation that people in the communities will develop a more responsible attitude towards the natural environment through the Programme.

- **Programme Challenges**

- Fire remains a problem despite the cutting of fire traces. One particular problem is the negligence of the hunters who set fires to catch animals and do not extinguish these fires and farmers who burn to clear land.
- Known culprits are difficult to prosecute because of the slow judicial process in Trinidad and Tobago
- Continued educational programmes and more effective policing are required to help avoid the fires that can destroy the work of the programme
- In Wharf Trace, there is presently a land tenure problem. Lands that were considered to be crown lands have been claimed by a private owner. This situation needs to be properly investigated. It is recommended that both private and state lands are seen as part of the project to avoid erosion in the future.

5.2.2 Project Title: Mapping of Bio-Diversity and the Development of a Plan for Conservation and Management for the El Luengo Village

(Submitted by Mary Nicole Reyes on behalf of the El Luengo Village Council)

The community of El Luengo is situated at the north western extremity in the Maracas Valley. El Luengo hosts a resident population of about two thousand (2000) persons. It consists primarily of agricultural crops and lush forests that form the upper watershed in the valley. The importance of the watershed is reflected in the topographical maps that show it is the origin of more than eighteen (18) tributaries that flow into the Morang River and eventually into the St. Joseph River, also referred to as the Maracas River, and originate in this area.

In the past, quarrying operations were carried out in the valley and within recent times the attitudes of quarrying operators suggest that consideration is being given to reactivate these quarrying operations. When one considers the degree of unemployment, particularly among the youths, it is not too farfetched to conclude, that despite the detrimental consequences of such operation to the community, such activities may muster significant support.

The main goal of the project is to conduct an Inventory of the Biological Diversity of the area and develop a Plan for Conservation and Management for the El Luengo Village. The exercise will encompass the participation of the entire community in the inventory of the biological diversity and forest typing, water testing, soil classification and education and training. Ultimately the community will take collective responsibility for the conservation and management of its natural resources.

The main goal of the project is mapping of the Bio-Diversity and the Development of a Plan for Conservation and Management for the El Luengo Village. In addition the anticipated outcome will assist WASA, Forestry Division, EMA, TDC, UWI, etc. with research and referral documentations on the ecological and systematic inventory of biodiversity within the northern range.

The main activities will encompass:

(i) Identification of the Natural Boundaries
(ii) Systematic Inventory of Bio-Diversity
(iii) Water Quality and Management
(iv) Soil Classification
(v) Forest Classification (Seasonal Evergreen, Montane Forest, Elfin Woodlands)
(vi) Identification of the Area Unique Elfin Woodlands
(vii) Education and Training

6. STAKEHOLDERS CONSULTATIONS

6.1 INTRODUCTION

Stakeholder consultations - a project objective - was important in the determination of key issues of sustainable development in Maracas Valley from the perspective of the Valley's residents. As intended, these consultations were "participatory, inclusive and accommodating" so as "to give every member of the community an opportunity to participate in the consultations."

Every community and resident had the opportunity to participate as the meetings were widely and publicly advertised. A total of seven consultations were held, the format and details of which are presented in the body of this report. The process was challenged in a number of ways; however MVAC remained committed to ensuring the widest possible people participation and so found mitigating strategies to achieve the stated objective.

When the expressed views stated in all the meetings are collated, the following are the most critical environmental/land use and socio-economic issues - in order of priority - facing the Valley and in need of urgent attention:

Environment/land use

1. Quarrying
2. Deforestation
3. Illegal/unplanned development
4. Land tenure
5. Garbage in river

Socio-Economic

1. Road access/maintenance
2. Drugs/crime
3. Water supply
4. Recreational and community centre facilities
5. Fire services/hydrants

These findings taken in tandem with those of the other aspects of the overall study on "Issues of environmental stability for the Maracas Valley" should form the basis on which future projects are defined and prioritized.

This report provides the details of the stakeholder consultations conducted in the Maracas St. Joseph Valley over the period March 2009 to June 2009. It outlines the methodology used, discusses difficulties encountered, explains the community grouping process and format of the meetings and presents the issues raised and the priority listing which emerged. The report ends with an overall analysis and recommendations.

6.2 THE METHODOLOGY

The methodology employed incorporated four approaches to consultations. This "multiple approaches" strategy became necessary when difficulties were encountered in the initial approach of community groupings (explained below). In order to ensure maximum participation and feedback from the community, different strategies were needed, hence the four strategies approach.

Firstly, an initial introductory session was held at which leaders from all the valley communities were invited to participate. The objective was to sensitise leaders on the purpose of the project, explain the role and format of the consultations, determine leadership views on the key environmental and social issues facing their respective communities and secure buy-in, commitment and organizational involvement in the process of community consultations.

The second approach involved sub-grouping of the communities into six consultations based on geography, inter community socio relations and inherent cultural commonalities.

The third approach – used where approach two failed - involved one-on-one conversations with residents of the communities to determine the issues they believed were critical to environmental sustainability and community development. This was conducted by providing interviewees with a list of issues (informed by approach two

consultations) and asking them to rank in order of priority the three most pressing environmental and three most pressing socio-economic concerns they believed were facing their respective communities.

The fourth approach involved piggy-backing of a community council meeting. The organizers allocated the last hour to MVAC. This was used in the Acono community because the residents of upper Acono refused to attend a scheduled MVAC consultation organized in concert with a "rival" community leader of lower Acono.

It should be noted that with the exception of the third approach, all the others involved community leaders at the organizational level in areas such as advertising, soliciting the services of a community resident to provide refreshments (for which MVAC met the cost) and preparing the venue.

The consultation process at meetings was conducted by experienced facilitators trained to encourage honest and open dialogue from most persons present.

6.3 DIFFICULTIES ENCOUNTERED

In implementation several factors outside the control of MVAC were encountered, these included:

- Community leaders not following through on organizational commitment made. This resulted in a no resident showing at El Luengo, notwithstanding MVAC's regular contact with the leader in question.
- Ineffective advertising by community leaders. To ensure participation MVAC had to take charge of this aspect, using street side boards, loud speakers and direct personal contact.
- Community defacement and removal of advertising sign boards.
- No show by some communities because of the location of meetings.
- Conflicts among community leaders which resulted in partisanship and so people's unwillingness to attend meetings perceived as organised by opposing sides.

6.4 COMMUNITY GROUPINGS

As indicated above, the first consultation was a meeting of leaders and so leaders from all valley communities were invited. Only Maracas Valley was not represented at this meeting. Leaders were very enthusiastic about the project and participated vibrantly in the discussions.

The second meeting combined Wharf Trace, La Baja, Poolside, La Mango and Balata Trace.

The third and fourth consultations involved residents from Acono. This was necessary because of split leadership resulting in residents supporting one or the other and so would not attend a meeting called by the rival faction. In effect, MVAC piggy-backed on an ADVAC meeting in order to consult with Upper Acono and then held a second consultation to facilitate Lower Acono.

The fifth meeting combined Valley View, USC and El Tucuche Gardens.

The sixth meeting combined Alta Gracia, Waterfall Road, Santa Barbara, El Chorro, La Rue Pomme and Maracas Royal Road.

The "one on one approach" was used in El Tucuche and El Luengo. In the case of the latter, several attempts were made to organize the traditional consultation; a first was cancelled due to a death in the community and the second resulted in a no show by residents. In the case of El Tucuche , residents had difficulties in finding the venue on the USC campus and so only one resident turned up. This approach was subsequently used to ensure input from this community.

6.5 FORMAT OF CONSULTATIONS

Community grouped consultations were conducted in a common fashion. They were opened with welcoming and project introductory remarks by the President. She then introduced the facilitator/s for the session. The primary facilitator outlined the rules of engagement and then invited participants to briefly introduce themselves.

This was followed by short overviews by MVAC technical experts on the broad parameters of environmental/land use and Socio-economic issues.

Participants were then invited to share their view on what were the pressing environmental/ land use and socio-economic issues facing their respective communities. A designated note taker summarized the issues raised onto flip chart sheets. The facilitator got confirmation that the summary reflected the issue raised.

At the end of general discussions, participants were invited to vote on the three most pressing environmental/land use and the three most pressing socio-economic issues facing their respective communities. This allowed for the determination of a group consensus on the priority issues for the communities present.

At the end of all the consultations, the results were collated to derive the top five environmental/land use and the top five socio-economic priorities for the Valley as a whole.

6.6 ISSUES RAISED

The following are all the issues raised during the process of consultation

6.6.1 Environmental/Land Use

- Quarrying
- Illegal and unplanned development
- Hillside development
- Poor sewage
- Deforestation with the attendant land slide and flooding
- Garbage in the rivers
- Drying up of the river
- Poor drainage
- Loss of agricultural lands
- Slash-and-burn agriculture
- Poor land tenure
- Water shed destruction
- Little assistance in ecotourism development
- Squatting

6.6.2 Socio-economic

- Drugs and crime
- Security
- Road access and maintenance/bridges
- Inadequate Water supply
- Shortage of fire hydrant/service
- Insufficient pavements
- Insufficient recreational/community centre facilities
- Underemployment
- Youth unemployment
- Insufficient pre-schools
- Health centres
- Poor insect/vector control
- Inadequate public transportation
- Utility poles
- Youth illiteracy

6.7 CONCLUSIONS AND RECOMMENDATIONS

The stakeholder consultation provides the major issues which the residents of Maracas Valley determine as the priority challenges facing the valley both from and environmental/land use and socio-economic perspective. The major environmental/land use issues are; quarrying, deforestation, illegal/unplanned development, land tenure and garbage in river and the major socio-economic issues are; road access/maintenance, drugs/crime, water supply, recreational and community centre facilities and fire services/hydrants.

These findings can inform the development of targeted projects. Further it can inform policy formulation for the sustainable development of the Valley in a way that meets the needs of the people.

7. SUMMARY OF THE QUALITATIVE ECONOMIC VALUATION REPORT

7.1 ECONOMIC COST ASSESSMENT

The cost of environmental degradation can be understood as a measure of lost welfare of a nation due to environmental degradation. Such a loss in welfare includes (but is not necessarily limited to)[2]

1) Loss of healthy life and well-being of the population (e.g.: premature death, pain and suffering from illness, absence of a clean environment, discomfort).
2) Economic losses (e.g.: reduced soil productivity and reduced value of other natural resources, loss of income generating opportunities, lower tourism).
3) Loss of environmental opportunities (e.g.: reduced recreational value for lakes, rivers, beaches, forests).

A State of the Environment Report prepared by the Environmental Management Authority of Trinidad and Tobago (2004) identified the following forces currently affecting the Maracas Valley;

a) Demographic: urbanization and pressure for housing space.
b) Economic: search by some groups for livelihoods and housing space; increasing incomes by others creating demand for superior housing sites.
c) Land use: permitted land use inconsistent with land capability studies and characteristics; unauthorized housing and agriculture (slash-and-burn)
d) Institutional: lack of rules or rigorous application in planning and authorization of developments
e) Cultural: increased demand for recreational opportunity; misuse of environment; lack of understanding, care and sensitivity by users.
f) Environmental: increasing variability in weather patterns.
g) Public policy: lack of holistic plan; absence of co-ordination; ineffective management; no monitoring or accountability for impacts.

[2] Maria Sarraf "Cost of Environmental Degradation, The Case of Lebanon and Tunisia (World Bank, DC. 2004)

The Millennium Ecosystem Assessment programme under the United Nations[3] devised the framework known as the Millennium Ecosystem Assessment Conceptual Framework for use in measuring the impact of environmental degradation. It identified five key components of human well–being; (MA 2005).

1. Basic material needs for a good life
2. Health
3. Good social relations
4. Security
5. Freedom and choice

The Northern Range Assessment conducted by the EMA adapted aspects of human well-being from the MA framework and selected for priority attention:[4]

a) Livelihoods
b) Housing
c) Health and nutrition
d) Recreation
e) Personal/environmental security

In assessing the impact of environmental degradation in the Maracas Valley, we will use these aspects as our reference points.

A Lebanon and Tunisia study that examined the cost of environmental degradation provides the following three step approach to valuing environmental degradation:[5]

1) Quantification of environmental degradation (e.g. monitoring of ambient air quality, river/lake/sea water quality, soil pollution).
2) Quantification of the consequences of degradation (e.g. negative impacts on health from air pollution, changes in soil productivity, changes in forest density/

3 For more information on the Millennium Ecosystem Assessment, see the Millennium Ecosystem Assessment website - www.millenniumassessment.org.

3

4 EMA SOE report 2004.

5 Maria Sarraf "Cost of Environmental Degradation, The Case of Lebanon and Tunisia (World Bank, DC. 2004

growth, reduced natural resource based recreational activities, reduced tourism demand)

3) A monetary valuation of the consequences (e.g. estimating the cost of ill health, soil productivity losses, reduced recreational values).

Any robust valuation of the impact of environmental degradation must include both the biophysical and the socio-economic dimensions. Economists have developed a range of indices (see section 2.1 and 2.2 of full report in Volume 2) to measure the various consequences of environmental degradation. In the final analysis, it is for the analyst to determine which methods are best suited to the specific variables under study.

7.2 APPLICATION OF MEASUREMENT TOOLS TO THE MVAC/UNDP PROJECT

The key components of the MVAC/UNDP study can be summarized as follows:

A. The Land Use/GIS study provides findings with respect to changes in the following variables
   - population
   - land cover
   - built environment
   - road network
   - elevation, slopes and soils in the study area.

B. The River Quality study evaluated the quality of the river for bathing and in particular the impact of faecal discharge into the rivers from developments.

C. The Water Quality component of the study analysed the Valley's capacity to meet domestic water demand and the impact of the existing Coosal Quarry and potential impact of a proposed quarry at Ortinola on the water quality of the Valley.

D. The Traffic Count study sought to determine the carrying capacity of the road network and to further ascertain how close current usage is to peak capacity.

E. The Stakeholder Consultations elicited from the Valley's residents what they determined to be the priority issues affecting both the environment and socio-economic development

F. The Socio-Economic Survey used a more scientific sampling approach to provide an updated profiling of the socio-economic structure and issues confronting the Valley.

In applying the methodology to the findings of the Maracas Valley/UNDP project on issues of sustainable development, the Land Use/GIS study identified the following as the major variables negatively impacting the environmental sustainability in the Maracas Valley:

- major housing expansion in recent years on slopes that are prone to erosion; educational institutional expansion, particularly that proposed by the University of Southern Caribbean;
- present and proposed quarrying activities;
- low water supply;
- reduction in forest cover;
- loss of biodiversity;
- degradation of water quality;
- disruption in water supply;
- increase in noise and dust pollution;
- increase in traffic congestion;
- damage to existing road infrastructure;
- slash and burn farming;
- soil erosion and flooding.

This is reinforced in large part by both the stakeholder consultations and the socio-economic survey:

- Flooding (36.3%)
- Landslides (27.7%)
- Destruction of forest (27.6%) (#2 stakeholder consultation)
- Water pollution (24.4%)
- Quarrying (21.3%) (#1 stakeholder consultation)
- Air pollution (21.4%)
- Uncontrolled housing construction (17%) (#3 stakeholder consultation)
- Fire hazards (13.1%)
- 'Other'- e.g., drainage/soil erosion/dumping- (12.9%), squatting (6.6%), sewerage (5%). (#4 stakeholder consultation)

Unfortunately, the data sets emanating from these studies do not allow for the quantification of the economic costs resulting from environmental degradation in Maracas Valley. They do allow us to make informed qualitative assessment and make recommendations as to the way forward for quantitative determination.

Having reviewed the findings of the studies outlined above, the following framework has been designed to outline firstly the key causal factors impacting the environment of the Valley and then to identify the range of consequences which must be estimated to derive the cost function. These are listed as follows:

Table 2: Findings of Study to be Valued

CAUSAL FACTORS	NEGATIVE IMPACTS
Unplanned Development on the slopes (Housing/University)	1. loss of forest cover 2. soil erosion 3. flooding 4. traffic 5. loss of agricultural lands

	6. forest fires 7. loss of recreational use of rivers 8. water catchment 9. loss of biodiversity 10. loss of income (Farmers/Fishermen)
Quarrying	1. loss of forest cover 2. soil erosion 3. flooding 4. noise and air pollution 5. health related problems 6. increased costs of health care 7. impact on carrying capacity of road 8. loss of biodiversity 9. water catchment 10. quality of water 11. water borne diseases
Population Growth	1. pressure on existing service grids 2. drugs, crime and safety 3. changed rural/urban dynamic
Inadequate sewage systems	1. degradation of rivers (sewage) 2. poor water quality 3. water borne diseases

In addition to estimating values for the above using the appropriate costing method (Table 1 in full document), it is also necessary to estimate the costs of remedial work to reinstate the environment not necessarily to its original state but to one that will allow for greater protection and sustainability. Because consequences can emanate from more than one causal factor, it is difficult to clearly segregate valuations. In effect the rest of this paper concentrates on discussing in the broadest and qualitative sense what the findings of the various reports mean with respect to the economic costs of the degradation found

to have occurred in Maracas Valley with recommendations towards moving to quantitatively estimating these costs.

7.3 THE ECONOMIC COSTS OF ENVIRONMENTAL DEGRADATION TO MARACAS VALLEY

The Land Use/GIS study revealed an 86% increase in built-up areas between the 1970s and 1994, and 17% increase between 1994 to 2005 with a roughly 250 % increase in building construction in the study area over the 40-year period. Noting that the TCPD approval system designates land for approved building below the 91m level, the increasing trend (63 dwellings in 2009) to build above the 213m (700ft) contour line (a demarcation used by TCPD to leave land at such elevation under forest) is evidence of increasing costs in economic terms. In addition, within 152-213 m elevation there was 1000% increase in building construction. This in effect contributed to the 17.5% loss of forest cover between the 1970's and 2005.

To value in dollar terms the economic costs of the loss of forest cover caused by increased buildings, we would need to conduct a study to determine the total economic value of the approximately 500 ha of forest cover lost. This would include using a Contingent Valuation Method which seeks to determine people's willingness to pay to protect the forest cover, the use of travel cost method to estimate the recreation value lost (site-seeing, hunting, camping etc) which may have been lost, and a productivity method to ascertain the loss of income that might have resulted to those who earned a living from the natural resources of the forest.

With respect to issues of soil erosion and flooding, the study found that the dominant soil series found in the built-up areas is the Maracas/Matelot sandy clay loam, covering 54 % of the study area, and the Acono fine sandy loam, covering 17% of the study area. The built-up areas are characterized by River Estate fine sandy loam which is ideally suited for agriculture. This accounts for 10% of the soils under built-up areas. These soils are prone to slight to severe erosion. In effect, here is evidence of agriculture sacrificed for residential development. The productivity costing method would be employed to

determine the value lost as a consequence of agricultural displacement. This would involve an estimation of the number of farmers and farms displaced, type and value of crops lost, farmer income lost, where displaced farmers go on social welfare programmes; the cost to the State of providing such support.

Soil erosion has negatively impacted river siltation levels and caused damage to property through land slippage and flooding, particularly during the rainy season. It would be necessary to survey those affected to determine the level of losses incurred. Issues such as forest fires, loss of recreational use of rivers, water catchment, and loss of biodiversity, loss of income by farmers which were not estimated or referred to in any of the other studies will have to be determined for the purpose of economic cost assessments. Further the costs of recovery to a state of sustainability will have to be established with regard to all negative fallouts.

The evidence from others study segments suggests that the costs are high. Quarrying negatively impacts the following; forest cover, soil erosion, flooding, noise and air pollution, health related problems, increased costs of health care, impact on carrying capacity of road, loss of biodiversity, water catchment, quality of water and water borne diseases. In effect, part of the 17.5% forest cover loss has resulted from quarrying and if plans to introduce additional quarries as in Ortinola are pursued, we can see expect greater loss of forest.

The socio-economic survey asked whether persons suffered air pollution related diseases, the response was negligible, 71% suffer no health problems identified on questionnaire, 15.5% had asthma, 4.8% skin infections, 3.4% bronchitis, 2.5% cancer, 6.2% 'Other' (e.g. lung infection, headache, wheezing, chest problems). This could have been because the survey sampled the entire valley. Even the stakeholder consultations did not reveal any significant findings, though intuitively it is felt that there has been a worrying amount of negative health-related consequences due to quarrying. What is required is the use the averting behaviour (revealed preference) approach which will seek to isolate the immediately affected population around the quarry and survey that population to determine the health-related impact from quarrying. Such a survey would also elicit

information on items such as costs of health care that persons have incurred due to infections.

With respect to the impact of quarrying, the Land Use study found a significant 283% increase in size from 1970s to 2005. The Water Quality study found that the impact of the Coosal quarrying operations has led WASA to abandon their second Acono River Intake (on the branch of the river passing through Coosal's quarry) as a result of the degradation of river water quality in both dry and rainy seasons, notwithstanding the sediment traps installed by Coosal. Also, whenever the Acono River (from Coosal's quarry) overflows into the Ortinola River (upstream of WASA's intake on the Ortinola River) during significant rainy events, WASA is obliged to interrupt water abstraction from the Ortinola River due to the severe degradation of river water quality.

This has negatively impacted the Valley's ability to meet the demand requirement of its population. The study showed the trend between 2007 and 2010. In 2007, total water supply was 5,764 m3/day and total water demand 6,084 m3/day resulting in a supply deficit of 12%. In the 2010 rainy season, water balance shows a 38% deficit of water supply as demand (6,500 m3/day) exceeds water supply (5,800 m3/day). Even worse, the 2010 dry season saw a 76% deficit in water supply (3,700 m3/day) over demand (6,500 m3/day).

In effect, the associated economic costs will require an estimation of people's expenditure re tanks and pumps in order to deal with the situation. Further, we will have to estimate the remedial costs to clean up the river course in order to bring equilibrium between supply and demand. It should also be noted that the supply deficit could be much larger as the water quality study made no allocations for water being used to service out-of-valley demand. This would mean that the costs to Valley residents to secure a reliable water supply would be even higher.

The study noted that the sediment traps put in place by the quarry operators are ineffective and that the Acono River downstream of the quarry has a high turbidity content and the situation is exacerbated when it rains and there is run-off from the quarry which impedes infiltration and exacerbates run-off and erosion. The study concludes that if quarrying continues, reclamation is impossible. The economic costs of meeting water demand are further increased especially when the population growth element of the valley is factored in.

There has been a 134 % increase in the population of the Valley from 1970s to 2009, and an overall increase in population density from1.25 persons/ha to 2.9 persons/ha over the same period. While this gives the impression that there is a low population density for the area, when the population density for 2008 was calculated for areas within 91m (300ft) elevation (greatest number of buildings found), the population density figure showed values ranging from 26.8 persons/ha for Maracas/St. Joseph to 190.4 persons/ha for Acono . These population densities are consistent with the urban construct of the East – West Corridor thus emphasizing the urban nature of Maracas Valley. In addition, there was an overall increase of 250 % in the number of buildings constructed over last 40 years, accompanied by an increase of 117% in the built- up areas between 1970 and 2009, indicative of increased building density.

Much of this construction has been unplanned and the impact on the quality of the river water as a consequence of direct sewage flow was examined in the River Water Quality study. The results have serious cost implications both for the sustainability of the Valley and the health of its inhabitants. The study found that only 7% of the Valley's population is currently connected to a sewerage package plant while 93% rely on household septic tanks and soakaways. The study further estimates that close to 3,150 equivalent habitants discharge effluents directly or indirectly into the Maracas River between the junction of the Upper Maracas/Acono Rivers and the Silver Bridge;

The four package plants operating in the Valley are poorly designed, operated and maintained resulting in discharges of poorly treated sewage into the Maracas River. Additionally, a number of large institutions (including USC) discharge poorly treated sewerage directly into the Maracas River. Measurements have shown that BOD5 (a parameter indicative of biodegradable pollution) discharges to the Maracas River levels between the Acono junction and the Silver bridge are twice as high as the maximum levels given in the Water Pollution Rules -2001. The Maracas River is therefore unfit for bathing.

Estimating the economic costs of this situation would entail applying travel cost, averting behaviour, productivity and human capital methods of costing. It would entail estimating the recreational value lost due to this level of pollution by surveying what people pay for transportation and, if appropriate, entrance to an alternative bathing river, persons' willingness to pay for restoration of the river, confirming the incidence of water borne diseases, costs of health care, cost of preventative measures, the loss to fishermen in terms of fish, cost to fishermen of changing vocation or finding alternative fishing sources. In addition, it would be necessary to factor in the costs of mitigation (regardless of who bares the cost), the costs of upgrading current treatment plants and installation of new plants to remedy the situation.

The road network analysis of the Land Use study found a 226 % increase overall in the road network between 1970 and 2009 in the study area as follows, a 117 % increase in areas within 91m elevation, 207 % increase between 91-152 m, 500 % increase between 152 m – 213 m and 108 % increase above 213 m in the study area. The highest increase in the road network has occurred between 152 – 213 m (500-700ft) and is equal to 500%. This indirectly reflects the gradual encroachment of housing along the valley's slopes, above the height generally approved by the TCPD for development.

The Traffic Count study sought to determine capacity usage given the population, development and quarrying increases which have taken place. It estimated a carrying capacity of the Maracas Royal Road - based on its characteristics- to be between 800 to 1000 vehicles per hour. It found a significant increase in the percentage of heavy vehicles

on the Maracas Royal Road from 4.5% in 2007 to 17.5% in 2008. This is likely attributable to the increased quarrying activity in the Maracas Valley to meet the increased demand for aggregate for the construction sector. It confirmed two peak periods, morning and afternoon, and that during the morning peak, the Maracas Royal Road has approximately 750 vehicles in the southbound lane. The road is therefore operating close to the peak capacity on mornings.

An economic cost assessment would aim to determine the loss of productivity due to extended time spent on the road during the morning peak period, safety implications of having only one major road in and out of the Valley, the cost of constructing an alternative, whether the increased incidence of heavy vehicles impacts the integrity of he road, implications for safety and the life of road.

7.4 CONCLUSIONS AND RECOMMENDATIONS

It is evident from the above qualitative assessment that the economic cost resulting from the environmental degradation of the Maracas Valley as a consequence of unplanned development particularly on the slopes, quarrying, population growth, poor sewage disposal and removal of forest cover have been and continue to be significant. The impacts are evidenced by the soil erosion and flooding, poor and insufficient water quality, unhealthy river water levels, loss of agriculture and loss of recreational facilities. In addition, the cost of recovery and restoration will indeed be high.

To move to the level of quantitative costs assessment can be undertaken as a follow-up stage of the project. This would entail several steps including; the determination of the period over which to collect data and the crafting of appropriate target survey instruments to collect primary data as there is no established institution to which one can get data, for example on the number of fishermen 20 years ago and the number today, or the number of users of the rivers for recreational purposes then as compared to now.

This would then be the first stage of the data collection. The format of the questionnaire would also be guided by the choice of costing method. If for example a willingness to pay approach is adopted, the questions would have to be crafted to solicit appropriate answers. On the issue of the health impact of quarrying, there would be the need firstly to scientifically determine the range within which the catchment population would be affected, then to survey this population to ascertain the incidence of air-borne diseases and the expenditure on associated health care using a human capital approach.

While it is evident even from the qualitative assessment that the cost to the country of poor environmental management of Maracas Valley has been and continues to be high, a quantitative valuation is important to really state the monetary loss suffered. This though is a very expensive follow-up step which would involve experimental techniques, it is not exact in nature though credible enough to get the job done.

Indera Sagewan-Alli

8. CHALLLENGES AND MITIGATION MEASURES

8.1 INSTITUTIONAL

8.1.1 Introduction

Relevant to any study of the sustainable development of Maracas Valley is the input of the government institutions which have the authority to affect change**,** to offset negative trends and reverse them if need be. One problem may be the fact that there are many such institutions which have authority of one kind or another but there is neither one supervisory body nor one unified plan to which all institutions adhere.
Relevant Institutions:

- Ministry of Housing and the Environment
- Ministry of Energy and Energy Affairs, Quarries Division
- Ministry of Food Production, Land and Marine Affairs
- Ministry of Works and Transport
- Ministry of Local Government
- Ministry of Legal Affairs
- Environmental Management Authority
- Water and Sewerage Authority
- Tunapuna/Piarco Regional Corporation
- Town and Country Planning Division
- Central Statistical Office

8.1.2 Reports on Hillside Development in the Northern Range 1981-2007

- **Government Initiated Policies**

Hillside Policy Committee 1981-1988

In 1981 a committee was formed to formulate a policy for hillside development in the country because of recognition by the government that the previous guidelines for development, which specified that there should be no building above the 300ft contour or on a 1:6 slope, was impractical and being generally ignored. Their report was eventually published in 1988.

It was recognized by the Committee that there were some serious problems arising from unregulated development on hillsides in the Northern Range, and there were potentially serious conflicts in the use of land. In Maracas Valley it was noted that much agricultural land had been withdrawn for residential urban-type settlement; that the Royal Road[1] "has unquestionably been burdened by traffic resulting from increased residential and even industrial development" and the St. Joseph River bears evidence of "deterioration as a water source and as a once prominent feature of this valley environment". The Committee went on to state that "the Maracas Valley may be in danger of being permanently damaged by a more recent but ruthless menace—the unauthorized cutting and excavation of hillsides". They noted the continuation of the slash-and-burn method of agricultural practice with its attendant fire hazard. They also noted that Coosal's quarry in Acono had expanded and was a nuisance to the community.

The Committee noted that some developers have paid little attention to avoiding unnecessary disturbance of land and also seemed to be unconcerned about the downstream impacts of their development. The committee, therefore, recommended that there should be technical experts in a Development Control Agency.

The Committee recognized that although there is a National Plan which "stresses protection of critical area for soil and water conservation as well as protection of fertile agricultural lands", and advocates restrictions of non-agricultural land uses in the Northern Range, there are a number of problems connected with the proper preservation and development of the Northern Range including Maracas Valley:

- The question of land ownership and illegal occupation of land or squatting
- The administration and enforcement of an effective national policy in relation to land use among the conflicting stakeholders.

The Committee recommended that there should be areas consigned to forestry, to conservation and to agriculture; that housing should be confined within the limits of existing settlements, and on lands specifically allocated; that there should be no housing on slopes greater than 1:6; that quarrying should also be restricted to no nearer than five kilometres from settlements if there is blasting and one kilometre if there is not.

[1] The Report of the Committee on Northern Range Hillside Development Policy, October, 1988

The Committee also recognized the necessity of cooperation among the many governmental bodies with authority in the Northern Range and that there should be a standing committee to effect this cooperation.

8.1.3 Report of an Assessment of the Northern Range Commissioned by the EMA in 2005

This assessment did not involve any new research but a gathering of already existing data.

This committee first made clear the value of the Northern Range to the well-being of the country as a whole. "The watershed areas of the Northern Range are the most significant contributor to fresh water supply (80 % from the Northern Range). It is also an important amenity area for the population and provides a range of occupations and space for housing".

The committee found that the problems identified in the governmental committee's report in 1988 were now present in a more acute form: unauthorized housing, deforestation, slash-and-burn clearing of land, degradation of the watershed and threats to biodiversity.

This committee emphasized the lack of holistic public planning and lack of proper regulations and effective enforcement of existing legislation. They also thought that the low level of public understanding of the value of the natural environment to human well-being was an important factor in its degradation and this needed to be improved through systematic public education.

The lack of proper administration of protective measures for the Northern Range as a whole, they thought, was due in part to the fragmentation of authority; that there needed to be much more cooperation and collaboration among the various governmental bodies, as listed above, and for this to happen there also needed to be an overseeing body appointed by government.

One solution to the problem of administration might be, they believed, to put the supervision in the hands of the local governments involved, in the context of a clearly defined government policy.

The Committee also recommended that there should be transparency in relation to the activation of the Green Fund; that the public should be informed about any developments

taking place and there should be continued research and evaluation of the developmental policy and its administration in the Northern Range.

- **8.1.4 Town and Country Planning Division Proposals of 2007**

In 2007 the Town and Country Planning Division, recognizing that the policy of 1988 had been generally ignored, it being too general and too impractical, suggested a number of proposals towards a new policy to regulate development in the Northern Range.

For the first time it was recognized that this new policy should be based on [2]"the premise that there exists a development threshold beyond which we exceed sustainable limits of development and experience negative impacts" and that this limit was "the carrying capacity".

Conservation areas would also be an important feature of the overall plan.

Development has already taken place on slopes greater than 1:6. It was recommended in these proposals that the limit should be 1: 3 and be very strictly adhered to.

Developments had already taken place above the 300ft contour so these proposals put strict controls on development beyond the 400/500-foot contour line. Only eco-type developments would be allowed.

Some guiding principles included aesthetics and design, zoning in relation to appropriateness for development (e.g. prime agricultural land (categories 1-3) should not be used for housing), protection of the watersheds. (40% natural vegetative cover mandatory)

In relation to the administration of development and use of land generally, there would be stricter controls to avoid unnecessary erosion, scarring of the landscape and sedimentation in the river.

It was thought necessary to insist on proper drainage systems for each new development at the initiation and central, properly maintained sewage systems for each area of the Northern Range to help to offset the problems of flooding and river pollution respectively.

These proposals have not been formally adopted.

[2] Hillside development in Trinidad and Tobago; Policy and Development Standards, Town and Country Planning Division of the Ministry of Planning and Development ,January 2007

8.1.5 Quarrying of Limestone in Maracas Valley

Quarrying in Trinidad and Tobago and thus also in Maracas Valley is still governed by the 2000 Minerals Act.

This Act in general terms seeks to regulate the issue of licence for quarrying, the conduct of the quarrying activity and the rehabilitation of the land thereafter.

It requires both a performance bond and a rehabilitation bond to be lodged with the Ministry by the licensee which would be forfeited if the regulations were not met.

It speaks in general terms of the need to protect watercourses, flora and fauna of the area, natural amenities for the community and archaeological sites. There was an awareness of the danger of pollution and the need to control dust and debris and the possible problem of traffic congestion. Cabinet Ministers, however, seem to have the power the power to make exceptions and to allow quarrying in locations which would normally be unacceptable if the Minister thought there was a more pressing national interest at stake.

The Act states, however, that the licensee should have an Environment Impact Assessment and a Certificate of Environmental clearance from the Environmental Management Authority.

In April 2005 the Ministry issued a Draft Quarry Policy for Trinidad and Tobago: A Green paper. It voiced some serious concerns about illegal quarrying, loss of revenue, lack of control over the process of extraction and inability of government to enforce proper practice and the rehabilitation of land used in quarrying. This document suggested that the flaws in the 2000 Act lay with the absence of specific and detailed regulations to prevent abuses. It is expected, therefore that the new Act , not yet before Parliament will seek to address these issues, in part by bringing into being a Quarries Authority to regulate all quarries.

The statement that "conflicts with existing legislative provisions e.g. the Environmental Management Authority Act" was one of the shortcomings of the 2000 Act seems to have led to the 2007 amendment in parliament to the EMA Act as it dealt with quarries.

Amendment to Activity 23 of the Environmental Management Act was brought to Parliament as a negative resolution. This meant that unless a motion was laid in Parliament to object to this within 40 days of it being laid, it would automatically become law. It was laid in the House of Representatives on July 13th 2007 and in the Senate on 23rd August, 2007. There was discussion in neither House. This amendment to Activity 23 in the EMA Act means that a CEC is no longer required for a quarry of less than 150 acres. It is well known that most quarries fall in the category of less than 150 acres. It appears that the EMA who uses the measure, hectare, rather than acre, was not consulted.

This seemed to be an alarming precedent at a time when environmental issues are even more urgently requiring redress and it was felt that vigilance was required to avoid any further dilution of the protective measures of the EMA Act

Under the EMA Act a CEC was still required for Clearing, excavation, grading and land filling

(a) The clearing , excavation, grading or landfilling of an area of more than 2 hectares during a two-year period

(b) The clearing of more than half a hectare of a forested area during a two-year period

(c) The clearing, excavation, grading or land filling of any area with a gradient of 1:4 or more.

In December 2008, however, a further Amendment to the EMA Act was laid before the House of Representatives on 1st day of December, 2008 and on 2nd day of December in the Senate by the Minister for Housing, Planning and Environment as a negative resolution.

It was called The Certificate of Environmental Clearance (Designated Activities) (Amendment) order 2008 and it removed the requirement for a Certificate of Environmental Clearance for the clearing of any land, even forested land, once the clearing was for the purpose of mining and the land involved was under 150 acres.

The Minister stated apropos the paper laid at the Senate sitting:

"May I advise that a Statutory Instruments Committee considered this - The Certificate of Environmental Clearance (Designated Activities) (Amendment) Order, 2008 – and found that there was nothing to which the attention of the Senate should be specially drawn."

The Report of the Committee on Northern Range Hillside development policy, 1988, had recommended that there be no quarrying

(a) within preservation areas

(b) less than 5 kilometres from the nearest approved settlement or village sites, where blasting is intended or

(c) less than 1 kilometre from the nearest settlement or village, for other methods of extraction.

The EMA - commissioned Hillside Report of 2005 recommended that good practices in the industry be enforced, that priority be given to rehabilitation and creation of amenity sites. They also recommended that there should be a moratorium on quarrying in the Northern Range and that aggregate be sourced from abroad.

Clearly none of the recommendations of these reports were heeded by the relevant Ministries.

8.1.6 Quarries in Maracas Valley

Coosal's Quarry in Maracas Valley has been in operation for approximately 75 years and has expanded its operations in recent years. It is the only quarry currently operating in Maracas Valley. Viking Caribou had applied for a license which was since withdrawn. Caribbean Quarries applied for a license in December 2007 after the amendment to the EMA Act against the opposition of the many stakeholders in the community. A meeting was organized by the Ministry of Energy on 16th October 2009 to discuss the application for a quarry license by Caribbean Quarries Ltd. at which a number of stakeholders were

present, including MVAC and members of the Acono community. These community stakeholders made it clear that it was the general consensus of the community of Acono and Maracas Valley as a whole that more quarrying activity in the Valley would be insupportable. There were concerns about watershed damage, air and noise pollution, and its affect on health, traffic nuisance of large trucks on the narrow roads and the general despoiling of the hillsides.

- **8.1.7 Blue limestone as a Source of Aggregate**

- The blue limestone quarried from Maracas Valley is a sedimentary rock composed primarily of carbonate minerals. It is an important component of the aggregate for the making of concrete for the construction industry. This aggregate can be sourced from other source materials but limestone is considered a valuable ingredient in the aggregate for concrete in the superstructures of buildings.

- **8.1.8 Importation of Aggregate as an Option**

- The operation cost of quarrying limestone locally involves a capital cost, an operating cost and a transportation cost. In addition and more importantly for the purposes of this study there is a heavy cost to the inhabitants of the Valley and to the nation as a whole. Quarrying local aggregate takes a toll on the environment (loss of vegetative cover, habitat, and damage to watershed and to the river) and local road network (increased maintenance) and contributes significantly to increasing traffic congestion**.**

Importing aggregate means the use of foreign exchange to pay for the imported aggregate cost and freight. On the other hand local production does also require foreign exchange for capital cost of imported plant and equipment and operating spare parts.

It may, therefore be more economical on a National cost to import aggregates from a more efficient producer.

8.2 CHALLENGES IN THE MARACAS VALLEY COMMUNITY

These are mainly associated mainly with rapid expansion of the construction and quarrying activities in the area and the lack of a holistic approach to deal with associated problems such as

- Lack of necessary improvements in infrastructure in order to keep up with demands from an increasing population
- Loss of recreational activities as a result of the destruction of the River environment
- Loss of a food source for residents as silt covers the feeding grounds for fish, resulting in loss of aquatic life associated with the river environment
- Loss of forest cover
- Increase in flooding

8.3 CHALLENGES IN THE WIDER COMMUNITY OF TRINIDAD AND TOBAGO

Major spin off effects of the above involve flooding of areas downstream from the activities of quarrying and construction

8.5 RECOMMENDATIONS

- That a land use policy for Trinidad and Tobago be put into operation
- That the Minister's discretion particularly in matters concerning the protection of the environment be exercised only in the public interest and a report must be laid in Parliament for its approval showing justification for the exercise of that discretion.
- That there should be a moratorium on major construction and further quarrying activities in Maracas Valley until a holistic land use policy is put into operation
- That all institutions, owners of defective Waste water treatment plants etc which pollute the rivers should be made to pay towards the rehabilitation of the rivers.

- That quarries and construction companies should be charged for all silt and debris which lands in waterways and also be forced into suitable rehabilitation programme.

9. CONCLUSIONS AND RECOMMENDATIONS

17.1CARRYING CAPACITY

Carrying capacity refers to the number of individuals who can be supported in a given area within the limits of existing natural resources such as the food, habitat, water and other necessities available in the environment without degrading the natural social, cultural and economic environment for present and future generations. For the human population, more complex variables such as sanitation and medical care must be considered as part of the necessary infrastructure. The carrying capacity for any given area is not fixed. It can be altered by improved technology, but mostly it is changed for the worse by pressures which accompany a population increase. As the environment is degraded, carrying capacity actually shrinks, leaving the environment no longer able to support even the number of people who could formerly have lived in the area on a sustainable basis. No population can live satisfactorily beyond the environment's carrying capacity for very long. We must therefore think in terms of "carrying capacity" not land area.

17.2CONCLUSIONS

The results of the studies carried out indicate that over the study period:

Construction, quarrying, slash and burn farming, squatting have caused the following:

- Loss of land available for agricultural purposes
- Loss of forest cover on fragile hillsides
- Blocked roads, drains and river courses
- Loss of habitat and food sources leading to a loss of biodiversity, both land based and aquatic
- Reduction in water supply

- Rise in level of river beds, with subsequent loss of pools for recreation purposes and the covering of large rocks which assisted in checking the flow of flood waters
- Higher peak river flows in rainy season and lower base flows in dry season
- Flooding in the St. Joseph, Valsayn and Caroni Plain areas

Increase in construction activities has also resulted in:

- Rapid increase in population
- Necessity for improvement in infrastructure which has not kept pace with demand
- Increased stress on road network - morning peak traffic flows measured in 2008 indicated that the Maracas Royal Road was operating close to maximum capacity
- Rivers are polluted by sewage and soil erosion

Concern has also been expressed about:

- Building on steep slopes and above the 100m contour
- New road construction, especially above the 100m contour and on steep slopes
- Seemingly inconsistent and ad hoc approach to approvals for construction
- Damage to existing properties and land in the vicinity of new developments
- Security of tenure for long-term squatter communities
- Influx of new squatting activities particularly on steep slopes

17.3RECOMMENDATIONS in Relation to the Watershed

- Enforcement of Construction Regulations
- No additional Quarries
- Protection of Water Catchments
- Reforestation of Denuded Hillsides
- Establishment of Centralised Sewerage System in Maracas Valley
- Effective Monitoring of the Maracas River
- Establishment of an autonomous authority to manage water resources in an integrated manner
- That all institutions, owners of defective Waste water treatment plants etc which pollute the rivers should be made to pay towards the rehabilitation of the rivers.

- That quarries and construction companies should be charged for all silt and debris which lands in waterways and also be forced into suitable rehabilitation programmes

9.4 GENERAL RECOMMENDATIONS

- That a land use policy for Trinidad and Tobago be put into operation.
- That the Minister's discretion particularly in matters concerning the protection of the environment be exercised only in the public interest and a report must be laid in Parliament for its approval showing justification for the exercise of that discretion.
- That a mechanism be created for the enforcement of existing laws
- That existing laws be updated to be more environmentally friendly.
- That there should be a moratorium on major construction and further quarrying activities in Maracas Valley until a holistic land use policy is put into operation
- That there be more transparency and public participation with respect to applications for Planning Permission
- That public consultations and site visits to be mandatory with respect to applications for Planning Permission for proposed changes in land use.
- That measures be put in place to effect regularization of tenure for existing communities.
- That there should be ongoing education for the community in relation to the value of the natural environment
- The Green Fund which was set up to facilitate environmental projects should be made more accessible to community groups.

10. THE WAY FORWARD

Future MVAC Projects Arising out of the Study

- Organising lectures about terracing for farmers
- Informing the community about current developments and projects through use of boards, electronic systems etc.
- Taking part in reforestation in collaboration with other groups
- Helping to organise community groups to fight bush fires.
- Educating in relation to garbage disposal and grey water management
- Providing contact information in relation to common problems such as reporting someone dumping garbage or sewage in the River.

APPENDIX I - FLORA

Family	Genus	Species	Common Name	Status	Lifeform
Convolvulaceae	*Evolvulus*	*sericeus*	Silver dwarf morning glory?	native	climber
Adiantiaceae	*Adiantum*	*sp.*	Maidenhair fern	?	herb
Asteraceae	*Emilia*	*sonchifolia*	Tassel flower	Native weed	herb
Cyperaceae	*Cyperus*	*rotundas*	nutgrass	native	herb
Cyperaceae	*Kyllinga*	*monocephala*		voucher needed	herb
Euphorbiaceae	*Euphorbia*	*hypericifolia*	Petit-lait	native	herb
Iridaceae	*Trimezia*	*martinicensis*	calenda, walking iris, wild iris	native	herb
Piperaceae	*Peperomia*	*pellucida*	Shining bush, zeb couresse	native	herb
Poaceae/Gramineae	*Acroceras*	*zizanioides*	Oats grass	native	herb
Poaceae/Gramineae	*Andropogon*	*bicornis*	Fox-tailed grass	native	herb
Poaceae/Gramineae	*Axonopus*	*chrysoblepharis*		native	herb
Poaceae/Gramineae	*Axonopus*	*compressus*	Savanna grass	native	herb
Poaceae/Gramineae	*Chloris*	*inflata*	Savanna grass/Purple top Rhodes Grass?	native	herb
Poaceae/Gramineae	*Cynodon*	*dactylon*	Bermuda grass or devil grass	native	herb
Poaceae/Gramineae	*Digitaria*	*horizontalis*	Finger grass	native	herb
Poaceae/Gramineae	*Eleusine*	*indica*	Foot grass, iron grass, yard grass, goose grass	native	herb
Poaceae/Gramineae	*Leptochloa*	*scabra*	Rough sprangletop	native	herb
Poaceae/Gramineae	*Panicum*	*fasciculatum*	Bird seed grass	native	herb
Poaceae/Gramineae	*Panicum*	*rudgei*		native	herb
Poaceae/Gramineae	*Paspalum*	*fasciculatum*	Bamboo grass	native	herb
Poaceae/Gramineae	*Paspalum*	*virgatum*	Razor grass	native	herb
Schizaeaceae	*Lygodium*	*venustum*	Fiddle bush	native	herb
Scrophulariaceae	*Buchnera*	*virgata*		voucher needed	herb
Umbelliferae	*Eryngium*	*foetidum L.*	Shadow beni	native	herb
Asteraceae	*Pterocaulon*	*alopecuroides*		native	shrub
Lamiaceae	*Hyptis*	*lanceolate*		native	shrub
Leguminosae	*Desmodium*	*incanum*	sweethart, wild pinder	native	shrub
Leguminosae	*Eriosema*	*violaceum*		native	shrub
Leguminosae	*Mimosa*	*pudica*	Shame bush, sensitive plant, T-Marie	native	shrub
Leguminosae	*Senna*	*occidentalis*	Wild coffee	Native	shrub
Malvaceae	*Wissadula*	*periplocifolia*	Maholtine	native	shrub
Melastomaceae	*Miconia*	*stenostachya*		native	shrub
Melastomataceae	*Clidemia*	*rubia*		native	shrub
Melastomataceae	*Miconia*	*macrothyrsa*		native	shrub
Anacardiaceae	*Spondias*	*mombin*	Hog plum	Native	trees
Annonaceae	*Annona*	*montana*	Wild soursop	Cultivated	trees
Araliaceae	*Schefflera*	*morototoni*	Jereton	Native	trees
Arecaceae	*Attalea*	*maripa*	Cocorite	Native palm	trees
Bignoniaceae	*Tabebuia*	*rosea*	Poui (pink)	Cultivated	trees
Bignoniaceae	*Tabebuia*	*serratifolia*	Poui (yellow)	Native	trees
Boraginaceae	*Cordia*	*alliodora*	Cypre	Native	trees
Boraginaceae	*Cordia*	*collococca*	Bois lay-lay, Clammy cherry	Native	trees
Burseraceae	*Protium*	*sagotianum*	Gommier	Exotic/cult	trees
Cecropiaceae	*Cecropia*	*peltata*	Bois canot	Native	trees
Clusiaceae	*Calophyllum*	*brasiliense*	Galba	Native	trees
Clusiaceae	*Garcinea*	*macrophylla*	Soiebo	voucher needed	trees
Combretaceae	*Buchenavia*	*tetraphylla*	Olivier (yellow)	Native	trees
Combretaceae	*Terminalia*	*amazonia*	Olivier (white)	Native	trees
Combretaceae	*Terminalia*	*ivorensis*	Olivier (African)	Exotic	trees
Dilleniaceae	*Curatella*	*americana*	Chaparro, rough leaf	native	trees
Euphorbiaceae	*Hieronyma*	*alchorneoides*	Tapana	Native	trees
Euphorbiaceae	*Hura*	*crepitans*	Sandbox	Native	trees
Hernandiaceae	*Hernandia*	*sonora*	Toporite	Native	trees
Lauraceae	*Aniba*	*panurensis*	Laurier canelle	Native	trees
Lauraceae	*Ocotea*	*eggersiana*	Laurier mattack	Native	trees
Lecythidaceae	*Eschweilera*	*subglandulosa*	Guatacare	Native	trees
Leguminosae	*Abarema*	*jupunba*	Puni	Native	trees
Leguminosae	*Andira*	*inermis*	Angelin	Native	trees
Leguminosae	*Clathrotropis*	*brachypetala*	Black heart	Native	trees
Leguminosae	*Delonix*	*regia*	Flamboyant	Cultivated	trees
Leguminosae	*Dipteryx*	*odorata*	Tonka bean	Introduced,cultivated	trees
Leguminosae	*Enterolobium*	*cyclocarpum*	Devil's ear	Cultivated	trees
Leguminosae	*Erythrina*	*poeppigiana*	Immortelle	Cultivated, Naturalised	trees
Leguminosae	*Mora*	*excelsa*	Mora	Native	trees
Leguminosae	*Ormosia*	*monosperma*	Jumbie bead	Native	trees
Leguminosae	*Peltogyne*	*floribunda*	Purple heart	Native	trees
Leguminosae	*Pentaclethra*	*macroloba*	Bois mulatre	Native	trees
Leguminosae	*Platymiscium*	*trinitatis*	Roble	Native	trees
Leguminosae	*poeppigiana*	*courbaril*	Locust	Introduced/naturalized	trees
Leguminosae	*Samanea*	*saman*	Samaan	Naturalised	trees
Lythraceae	*Lagerstroemia*	*speciosa*	Lagerstroemia	introduced	trees
Malpighiaceae	*Byrsonima*	*coriacea*	Serrette	Native	trees
Malvaceae	*Ceiba*	*pentandra*	Silk cotton	Native	trees
Malvaceae	*Hibiscus*	*elatus*	Blue mahoe	exotic	trees
Malvaceae	*Ochroma*	*pyramidale*	Bois flot	Native	trees
Malvaceae	*Sterculia*	*pruriens*	Mahoe	Native	trees
Meliaceae	*Carapa*	*guianensis*	Crappo	Native	trees
Meliaceae	*Cedrela*	*odorata*	Ceder	Native	trees
Meliaceae	*Swietenia*	*macrophylla*	Mahogany	Intruduced	trees
Moraceae	*Ficus*	*yoponensis*	Figuier	Native	trees
Myristicaceae	*Myristica*	*fragrans*	Nutmeg	introduced/cultivated	trees
Myristicaceae	*Virola*	*surinamensis*	Cajuca	Native	trees
Myrtaceae	*Pimenta*	*racemosa*	Bay rum	introduced/Cultivated	trees
Myrtaceae	*Syzygium*	*malaccense*	Pomerac	introduced/Cultivated	trees
Pinaceae	*Pinus*	*caribaea*	Pine	introduced/cultivated	trees
Rubiaceae	*Genipa*	*americana*	Juniper	Native	trees
Rubiaceae	*Nauclea*	*diderrichii*	Opepe	exotic	trees
Rubiaceae	*Warszewiczia*	*coccinea*	Wakamy, Chaconia	Native	trees
Rutaceae	*Zanthoxylum*	*martinicense*	L'epinet	Native	trees
Sapindaceae	*Melicoccus*	*bijugatus*	Chennet	Native	trees
Sapotaceae	*Chrysophyllum*	*argenteum*	Wild kaimit	Native	trees
Sapotaceae	*Manilkara*	*bidentata*	Balata	Native	trees
Simaroubaceae	*Simarouba*	*amara*	Marouba	Native	trees
Verbenaceae	*Gmelina*	*arborea*	Gmelina	Cultivated	trees
Verbenaceae	*Tectona*	*grandis*	Teak	Introduced	trees
Verbenaceae	*Vitex*	*divaricata*	Fiddlewood (Black)	Native	trees

APPENDIX II - Fauna

Birds observed in lower Maracas Valley 2009/2010

Common name	Latin name	Status
Black vulture (corbeau)	*Coragyps atratus*	Abundant, resident
Turkey vulture	*Cathartes aura*	Common, resident
Osprey	*Pandion haliaetus*	Common, migrant
Black-crowned night heron	*Nycticorax hoactli*	Common resident of nearby swamps
Cattle egret	*Bubulcus ibis*	Abundant, widespread
Grey-lined hawk	*Asturina nitida*	Common, widespread
Zone-tailed hawk	*Buteo albonotatus*	Common, widespread
Peregrine falcon	*Falco peregrinus*	Fairly common visitor
Merlin	*Falco columbarius*	Common visitor
Ruddy ground dove	*Columbina talpacoti rufipennis*	Abundant, widespread
White-tipped dove	*Leptotila verreauxi*	Common, widespread
Grey-fronted dove	*Leptotila rufaxila hellmayri*	Uncommon, widespread
Orange-winged amazon parrot	*Amazona amazonica*	Abundant, widespread
Green-rumped parrotlet	*Forpus passerinus viridissimus*	Common resident
Short-tailed swift	*Chaetura brachyura*	Very common
Fork-tailed palm swift	*Tachornis squamata*	Common
Copper-rumped hummingbird	*Amazilia tobaci erythronotus*	Very common resident
Black-throated mango hummingbird	*Anthracothorax nigricollis*	Common resident
Rufous-tailed jacamar	*Galbula ruficauda*	Uncommon
Green kingfisher	*Chloroceryle americana croteta*	Common resident
Lineated woodpecker	*Dryocopus lineatus*	Common, widespread
Barred antshriike	*Thamnophilus doliatus fraterculus*	Common, widespread
Great kiskadee	*Pitangus sulpharatus trinitatis*	Abundant, widespread
Tropical kingbird	*Tyrannus melancholicus satrapa*	Abundant, resident
Golden-fronted greenlet	*Hylophilus aurantiifrons saturatus*	Very common resident
Grey-breasted martin	*Progne chalybea*	Very common, widespread
Southern rough –winged swallow	*Stelgidopteryx ruficollis aequalis*	Common, widespread

Southern house wren	*Troglodytes musculus albicans*	Common, widespread resident
Long-billed gnat wren	*Ramphocaenus melanurus trinitatis*	Common resident
Tropical mocking bird	*Mimus gilvus tobagensis*	Very common widespread resident
Bare-eyed thrush	*Turdus nudigensis*	Very common, widespread
Cocoa thrush	*Turdus fumigatus aquilonalis*	Common
White-lined tanager	*Tachyphonus rufus*	Very common, widespread
Blue-grey tanager	*Thraupis episcopus nesophilus*	Very common, widespread
Palm tanager	*Thraupis palmarum melanoptera*	Abundant, widespread
bananaquit	*Coereba flaveola luteola*	Abundant, widespread
Blue-black grassquit(Johnny jump up)	*Volatinia jacarina splendens*	Abundant, widespread
Greyish saltator	*Saltator coerulescens brewsteri*	Common, widespread
Yellow warbler	*Dendroica petechia aestiva*	Common, widespread visitor
Crested oropendola(corn bird)	*Psarocolius decumanus insularis*	Very common, widespread
Yellow oriole	*Icterus nigrogularis trinitatis*	Common, widespread
Carib grackle	*Quiscalus lugubris*	Abundant, widespread
Shiny cowbird	*Molothrus bonariensis minimus*	Very common, widespread
Giant cowbird	*Molothrus oryzivorus*	Common resident
Smooth-billed ani	*Crotophaga ani*	Very common, widespread
Lesser swallow-tailed swift	*Panyptila cayennensis*	Uncommon, widespread This spotted in the Alta Gracia area

Bird Count by Ishmael Angelo Samad

December 2009
7 a.m. to 6 p.m.
Ortinola/Tucuche/ Lluengo loop (12 mile-trail)
51 species

Common name	Latin name	Numbers
Black vulture	*Coragyps atratus*	8
Channel-billed toucan	*Ramphastos vitellinus*	1

	vitellinus	
Lineated woodpecker	*Dryocopus lineatus lineatus*	1
Buff-throated woodcreeper	*Xiphorhynchus guttatus*	1
Plain-brown woodcreeper	*Dendrocincla fulginosa meruloides*	2
White-bellied antbird	*Myrmediza longipes*	1
Silver-beaked tanager	*Ramphocelus carbo magnirostris*	1
Trinidad euphonia	*Euphonia trinitatis*	1
Green-rumped parrotlet	*Forpus passerinus viridissimus*	7
White bellbird	*Procnias albus albus*	1
Yellow-legged thrush	*Turdus flavipes*	2
Bay-headed tanager	*Tangara gyrola veridissima*	1
Little hermit	*Phaethornis longuemareus longuemareus*	1
Stripe-breasted spinetail	*Synaallaxis cinnamomea carri*	2
Golden-olive woodpecker	*Piculus rubiginosus trinitaris*	9
Grey-throated leaftosser	*Sclerurus albigularis zamorae*	1
Golden-crowned warbler	*Basileuterus culcivorous olivascens*	2
Golden-fronted greenlet	*Hylophilus aurantiifrons saturatus*	5
Boat-billed flycatcher	*Megarhynchus pitangua pitangua*	1
Golden-headed manakin	*Pipra erythrocephala erythrocephala*	3
Bright-rumped attila	*Attila spadiceus spadiceus*	1
White-tailed trogon	*Trogon viridis viridis*	1
Tropical peewee	*Contopus cinereus bogotensis*	2
Bearded bellbird	*Procnia averano carnobarba*	3
Barred ant-shrike	*Thamnophilus doliatus fraterculus*	2
Black-faced ant-thrush	*Formicarius analis saturatus*	1
Great ant-shrike	*Taraba major semmifasciatus*	2
Violaceous euphonia	*Euphonia violacea rodwayi*	1
Northern water-thrush	*Seirus noveboracensis*	3
White-flanked antwren	*Myrmotherula axillaris*	5

	axillaris	
Rufous-browed pepper-shrike	*Cyclarhis gujanensis flavipectus*	1
Red-crowned ant-tanager	*Habia rubica rubra*	5
Long-billed gnat-wren	*Ramphocaenus melanurus trinitatis*	1
Rufous-breasted wren	*Thryothorus rutilus rutilus*	3
Tropical mocking- bird	*Mimus gilvus tobagensis*	2
Rufous-breasted hermit	*Glaucis hirsutus insularum*	1
Grey hawk	*Asturina nitida nitida*	1
Tropical king-bird	*Tyrannus melancholicus satrapa*	1
Bananaquit	*Coereba flaveola luteola*	15
Crested oropendola	*Psarocolius decumanus insularis*	2
White-lined tanager	*Tachyphonus rufus*	6
Orange-winged parrot	*Amazona amazonica*	10
White-tipped dove	*Leptotila verreauxi*	3
Southern beardless tyranulet	*Camptostoma obsoletum venezuelae*	1
Ruddy ground dove	*Columbina talpacoti rufipennis*	1
Yellow oriole	*Icterus nigrogularis trinitatis*	2
Southern house wren	*Troglodytes musculus albicans*	5
Great kiskadee	*Pitangus sulphuratus trinitatis*	5
Palm tanager	*Thraupis palmarum melanoptera*	4
Carib grackle	*Quiscalus lugubris lugubris*	7
Grayish saltator	*Saltator striatipectus perstriatus*	1

List of observed fauna in the Acono area of Maracas Valley 1970 – 2010; submitted by Elizabeth Chin

MAMMALS			
Common name	**Scientific name**	**Frequency**	**Remarks**
Agouti	*Dasyprocta leporina*	I	May see one if disturbed
Fruit bat		C	Feed on sapodilla.
Insectivorous bat		C	
Collared peccary,	*Pecari tajacu*	I	Observed once on a

quenk			hike
BIRDS			
Common name	**Scientific name**	**Frequency**	**Remarks**
Bananaquit	*Coereba flaveola luteola*	C	All these are common garden residents or are frequently seen from the garden.
Ruddy ground dove	*Columbina talpacoti rufipennis*	C	
Palm tanager	*Thraupis palmarum melanoptera*	C	
White line tanager	*Tachyphonus rufus*	C	
Silver beaked tanager	*Ramphocelus carbo magnirostris*	C	
Blue Grey tanager	*Thraupis episcopus nesophilus*	C	
Southern house wren	*Troglodytes musculus albicans*	C	
Bare eyed thrush	*Turdus nudigens nudigens*	C	
Cocoa thrush	*Turdus fumigatus aquilonalis*	C	
Greyish saltator	*Saltator coerulescens brewsteri*	C	
Tropical Mockingbird	*Mimus gilvus tobagensis*	C	
Great kiskadee	*Pitangus sulphuratus trinitatis*	C	
Crested oropendula (Yellow tail)	*Pasarocolius decamanus insularis*	C	
Copper rumped hummingbird	*Amazilia tobaci erythronotus*	C	
Little hermit	*Phaethornis longuemareus longuemareus*	C	
Flycatcher, unidentified species		C	Flock together on telephone wires
Swallow or swift, species unknown		F	These are seen less often but regularly
Blue black grassquit	*Volatinia jacarina splendens*	F	
Yellow oriole	*Icterus nigrogularis trinitatis*	F	
Orange winged	*Amazona amazonica*	F	

amazon parrot			
Parrotlet, possibly Lilac tailed parrotlet	*Touit huetii*	F	
Lineated woodpecker	*Dryocpus lineatus lineatus*	F	
Barred antshrike	*Thamnophilus doliatus fraterculus*	I	
Smooth billed ani	*Crotophaga ani*	I	Used to be seen regularly in small flocks, infrequently seen now since the buffalo are no longer at the nearby Ortinola farm.
Kingfisher uncertain of species		I	Seen from time to time above the Maracas R.
Common black hawk	*Buteogallus anthracinus anthracinus*	I	
Greater ani	*Crotophaga major*	I	See smooth billed ani
Fork-tailed flycatcher	*Tyrannus savana savanna*	I	Numerous at certain time of the year
Shiny cowbird	*Molothrus bonariensis minimus*	I	See anis
Giant cowbird	*Molothrus oryzivorus oryzivorus*	I	See anis
Carib grackle	*Quiscalus lugubris lugubris*	new	Seen occasionally in the last year or two since the valley has become more built up, not seen before that.
Turquoise tanager	*Tanagra mexicana*	R	Not seen for many years
Black throated mango	*Anthracothorax nigricollis nigricollis*	R	Not seen for many years
Ferruginous pygmy owl	*Glaucidium brasilianum phalaenoides*	R	Not seen for many years
Tropical screech owl	*Megascops perspicillata trinitatis*	R	Not seen for many years
Yellow bellied elaenia	*Elaenia flavogaster flavogaster*	R	Not seen for many years
REPTILES			
LIZARDS			
Common name	**Scientific name**	**frequency**	**Remarks**

Streak lizard	*Gonatodes vittatus*	C	
Zandolie or common ground lizard	*Ameiva ameiva*	C	
Geckos 2 spp.		C	
Iguana	*Iguana iguana*	I	See iguana and matte less frequently now that there is less vegetation in the area. Recently saw iguana being sold near La Mango.
Matte	*Tupinambis teguixin*	I	
Skink		I	
Unidentified lizard		C	Common on some trees in the garden. Blends in well with the bark.
SNAKES			
Macajuel	*Boa constrictor constrictor*	R	Not seen for some years
Horsewhip	*Oxybelis aeneus*	I	May be seen in the garden.
Lora or Parrot snake	*Leptophis ahaetulla coeruleodorus*	I	May be seen in the garden
Common coral	*Micrurus lemniscatus diutius*	R	One sighting
Trinidad burrowing snake	*Typhlos trinitatus*	R	Not seen for some years

AMPHIBIANS			
Common toad	*Bufo marinus*	C	Especially in wet weather and when the termites fly.
Flying frog.	*Racophorus sp*	I	One of these observed being swallowed by a parrot snake.

Key to Frequency: **C** Common, everyday sightings
F Observed frequently and regularly but not every day
I Intermittent or infrequent sightings
R Rare May be seen very infrequently or not have been seen for several years for various reasons.

new one new or recent sighting

Sightings if Fauna – Reports Received February/March 2010

Area	Mammals	Date of Sighting	Comment
Valley View	Matte, Iguana regular Manicou, Agouti Irregularly	Present	
Valley View	Iguanas, Matte, Agouti and Manicou	Present	
Maracas Gardens	Manicou	30th March 2009	
La Seiva, Riverview Gardens	Anteater Ocelot Matte Iguana Rat snake	10 years ago 8 years ago November 2009 2007 6 years ago	Caught after bush fires Killed for meat
La Baja	Iguana and Sally Painter (Lizard)	Regular sightings	
Ortinola area*	1 iguana 1 manicou	See Log*	I have a log of wild animal sightings that I will share with you, while I have only seen 1 iguana and 1 manicou, I have times and locations. I also have a bird list which I started, which I would share with you too.
Valley View	Agouti Matte	Jan/Feb Feb 19th	
Mountain View	Agouti and Manicou or mongoose	Within the last 6 months	1 sighting of each as they pass from the forest to the river
Maracas Village Santa Barbara	Matte live in her yard Iguana	 1 year ago	Dogs kill them Treed by villagers who were trying to catch it.
Maracas Gardens – away in the back ~600ft	Manicou Iguana	Recent Within last 6 months	Recently saw a dead manicou on the road inside of MGRA. There are also some youths who go into the bush behind

	Matte Deer	Yes, but not recently 2003	us to hunt iguana. Have seen a couple myself in the last 6 months. Used to see a few matte near my house, there probably was a family nearby but have not seen them in the last year or so. In 2003, when we were building, a deer came down to drink from a leaky tank, it was a very dry season.
Belle View Acono	Agouti Matte, Iguana, Manicou porcupine	Dec 2009 No specific date No specific dates given	 Occasional sightings Occasionally caught by neighbours
Alta Gracia	Matte Iguana Agouti, manicou, squirrels Deer Monkeys Anteater Tarantulas Scorpion	Seen recently and regularly Last seen about 5 years ago Seen frequently 20- 25 years ago 15 years ago Heard frequently 25 years ago ~1987 Last seen about 1 year ago 1 in river 1988/9	 Used to see occasionally Sightings have gradually decreased over the years. Agouti last seen about 1-2 years ago, Was being hunted. It came into our house and we kept it until the hunters left the area several hours later. Disappeared after a series of forest fires. Seen regularly up to about 15 years ago, numbers have gradually decreased as more houses built. Note – also had tree boas as recently

			as last year; Mapapire valsain last spotted about 8 years ago; coral snakes, false coral, grass snakes until land around cleared
El Luengo	Anteater Tyra? Agouti, squirrels, manicou, lots of iguanas Monkeys	Caught 10 years ago Regular sightings Regular sightings Frequently heard/seen 20 years ago Numbers decreased until only a small troop left 5 years ago	 Highwood dog feeds on Tonka bean Should note that Ishmael Samaad had an eco-tourism establishment in El Luengo, but was burned out about 5 years ago.
Mountain View Valley View	Agouti Iguana, Matte, squirrels Lappe Banded porcupine Spectacled owl Field mouse	Many sightings (black, brown, grey) Regular sightings 2 spotted ~2 years ago June 2006 2006 2010	Very territorial; feed on cassava. Need water Watching baby hamsters on porch On a banana plant

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APPENDIX III - BIBLIOGRAPHY
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APPENDIX IV - ABBREVIATIONS

AVDAC	Acono Village Dynamic Action Committee
BOD	biological oxygen demand
BOD5	The amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter.
CARIRI	Caribbean Industrial Research Institute
CEC	Certificate of Environmental Clearance
CEPEP	Community-Based Environmental Protection and Enhancement Programme
COD	chemical oxygen demand
COI	cost of Illness
CSO	Central Statistical Office
CUC	Caribbean Union College
CVM	Contingent Valuation Method
EIA	Environmental Impact Assessment
EMA	Environmental Management Authority
EMR	Eastern Main Road
GEF	Global Environment Facility
GIS	Geographic Information System
GoRTT	Government of Trinidad and Tobago
GPS	Geographic Positioning System
HDC	Housing Development Corporation
LBWA	Loire-Brittany Water Authority
MVAC	Maracas Valley Action Committee
NGO	Non-Governmental Organization
NH3	ammonia
P2O5	phosphate
SGP	Small Grants Programme
TCPD	Town & Country Planning Division
TEV	Total Economic Value
TSS	total suspended solids
T&T	Trinidad and Tobago
TOR	Terms of Reference

UNDP	United Nations Development Programme
URP	Unemployment Relief Programme
USC	University of the Southern Caribbean
USDA	United States Department of Agriculture
UWI	University of the West Indies
VOSL	Value of Statistical Life
WASA	Water and Sewerage Authority
WRA	Water Resources Agency
WTA	Willingness to Accept
WTP	Willingness to Pay
WWTP	Wastewater Treatment Plant