Land Use Recommendations and Feasibility Study for Punto Verde PT

An Interactive Qualifying Project Report
submitted to the Faculty of
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in partial fulfillment of the requirements for the
Degree of Bachelor of Science
by

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Abstract

This report was prepared for Punto Verde $_{PT}$, a worker owned and operated economic development corporation. The project goal was to recommend outdoor uses for green space that would be synergistic with Punto Verde's commitment to education, the environment, and community; economically sensible; feasible on the given land; and attractive to many different audiences. Through research and interviews, we determined a nature playground, nature trail, and butterfly garden met the criteria.

Authorship Page

This document has been written with equal participation from Malia Aull, Robert Desmarais, and Jeffery Holt. At the conclusion of the project it is impossible to determine a single author for each section due to the unified effort of the team.

Acknowledgements

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Table of Contents

ABSTRACT ..... **II**

AUTHORSHIP PAGE ..... **III**

ACKNOWLEDGEMENTS ..... **IV**

TABLE OF CONTENTS ..... **V**

LIST OF TABLES ..... **VI**

LIST OF FIGURES ..... **VII**

EXECUTIVE SUMMARY ..... **VIII**

CHAPTER I: INTRODUCTION **1**

CHAPTER II: BACKGROUND **3**

CAUSES OF COMMUNITY PROBLEMS 3
PREVIOUS COMMUNITY BASED CENTERS 8
MISSION AND BUSINESS PLAN OF PUNTO VERDE PT 9
THE ORGANIZATIONAL STRUCTURE OF PUNTO VERDE PT 11
DEVELOPMENT PLANS FOR PUNTO VERDE PT 12

CHAPTER III: METHODOLOGY **15**

DETERMINING KEY CRITERIA, STAKEHOLDERS, AND AUDIENCES 15
GENERATION, EXPLORATION, AND EVALUATION OF LAND USE IDEAS 16

CHAPTER IV: FINDINGS AND RECOMMENDATIONS **18**

RECOMMENDATION #1: CONSTRUCT A NATURE PLAYGROUND 19
Rationale *19*
Implementation *20*
RECOMMENDATION #2: CONSTRUCT AN EDUCATIONAL NATURE TRAIL 27
Rationale *27*
Implementation *28*
RECOMMENDATION #3: CONSTRUCT A BUTTERFLY GARDEN 36
Rationale *37*
Implementation *38*

CHAPTER V: IMPLEMENTATION PLAN **48**

APPENDIX A: LIST OF INTERVIEWEES ..... **A**

APPENDIX B: CHARACTERISTICS OF LOOSE-FILL MATERIAL ..... **C**

APPENDIX C: LIST OF INFORMATIONAL GUIDES ..... **D**

APPENDIX D: NATURE TRAIL SIGN SUGGESTIONS ..... **E**

REFERENCES ..... **G**

BIBLIOGRAPHY ..... **J**

List of Tables

Table 4-1: Cost of playground equipment 26

Table 4-2: Accessible trail design standards 30

Table 4-3: Cost of nature trail 36

Table 4-4: Butterfly species 42

Table 4-5: Cost of butterfly garden 46

Table 4-6: Possible income from the butterfly garden 46

List of Figures

Figure I: Land recommendation locations	XI
Figure 2-1: Effects of urban sprawl in Caimito	5
Figure 2-2: Topographical layout of Punto Verde	14
Figure 4-1: Traditional playground at Albergue Olimpico	19
Figure 4-2: Discovery play garden	21
Figure 4-3: Location of nature playground	22
Figure 4-4: Log waterbar	29
Figure 4-5: Nature trail map	32
Figure 4-6: Example educational sign	34
Figure 4-7: Butterfly garden location	39
Figure 4-8: Enclosure at Las Limas	40
Figure 4-9: Chrysalis at Casa Pueblo Butterfly Conservatory	42
Figure 4-10: Museum at Las Limas Conservatory	43

Executive Summary

As a result of Operation Bootstrap, a government initiative started in the 1940s, Puerto Rico has changed from an agricultural to an industrial economy. This change encouraged the onset of urban sprawl and uneven development in San Juan. These two factors have had negative consequences for underprivileged communities such as Caimito and Cupey, whose residents lost the ability to support themselves with subsistence farming and now face many social and economic problems. In response, Punto Verde $_{PT}$, a community-based, worker-owned corporation, has been created with a mission to provide opportunity of training, development, and wealth generation to the residents of Caimito and Cupey.

Because these communities' economies are historically based in agriculture, Punto Verde is building a nature oriented horticulture center for the production and sales of ornamental plants and flowers and will also include other businesses such as a restaurant and small nature shops. Punto Verde is leasing 6.5 acres of land near the communities of Caimito and Cupey. Punto Verde is leaving an area of approximately three acres relatively undeveloped but wishes to uses this green space in a beneficial way.

The goal of this project was to recommend outdoor uses for this area. In early discussions with the Punto Verde board and staff, a list of important criteria was established. We based our land use recommendations on the following criteria, ideas must be:

- Synergistic with the overall mission and goals of Punto Verde
- Economically sound
- Feasible on the given land
- Attractive to many groups of people

These criteria provided the framework for our methodology and were used in research and interviews for idea generation, exploration, and evaluation. We gathered information from internet research and interviews with stakeholders in Punto Verde and the audiences this business and our land recommendations would attract. We determined three ideas as valid and feasible: a nature based playground, an educational nature trail, and a butterfly garden. These ideas are shown in approximate placement in Figure I on page xi.

Nature Based Playground

A nature-based playground uses traditional playground elements made with mostly natural materials combined with designed land and geological features found in the natural environment. These features can include rocks, grassy hills, and sand to promote imagination and association with nature. This playground would attract children and families and help satisfy the demand for public play space in the area. The natural aspects of the design fit well with Punto Verde's nature oriented theme. The overall design should be made with the involvement of the community and area schools to allow peoples opinions and ideas to be heard. Careful use of land topography and existing trees will make it an integral and feasible part of Punto Verde. This playground has a high initial cost ($15,000 to $18,000), but we recommend it due to its compatibility with the other recommended ideas.

Educational Nature Trail

We recommend a quarter mile nature trail loop that will have informational signs to draw attention to particular trees and plants, as well as some of the visible impact humans have had on the natural environment. Schools, families, and individuals can use

this trail as a recreational attraction while keeping consistent with Punto Verde's mission for community education. An educational nature trial is economically sound and suitable for the land because with careful planning minimal work and tree removal is needed and few materials will need to be purchased. Including construction labor, materials, signs and benches this trail should cost under $3,000 to implement and minimal future maintenance would be required.

Butterfly Garden

A butterfly garden is the centerpiece of our recommendations. We recommend the garden be combined with an educational program targeted to elementary school children for fieldtrips designed to bolster classroom learning. This program augments Punto Verde's educational mission and enhances its training goals because the garden will need at least one full time worker who would train to be a butterfly expert. Community children and girls living at Hogar del Niño can also volunteer and learn about the intricate care of butterflies. By charging admission, the butterfly garden could eventually creates an economically profitable operation after an investment of around $30,000.

Implementation

We recommend Punto Verde implement all three of these ideas because they enhance the corporation and when combined they will add a unique, economically sound, and attractive land use to its development. Furthermore, school groups will be able to visit the garden, walk the nature trail, and use the playground for an educational and fun field trip. We recommend implementing these ideas in a three phase plan.

- **Phase I** (8 -12 months): Obtain permission to construct nature trail. Design and build the nature trail while training a butterfly expert and planning the butterfly

garden. The nature trail should be designed according to the given guidelines and its path should be carefully considered to minimize tree removal. This work can start as time and workers allow even before Punto Verde is built. While this work is being done, a butterfly expert needs to be found or trained. Also, design the garden structure and organize a playground committee. The butterfly expert and garden club should help finish the interior garden design.

- **Phase II** (12 months): Construct butterfly garden and information hut. With community involvement, design the elements of the playground. Obtain licensing and permits for playground.
- **Phase III** (2-12 months). Open butterfly garden to begin recouping costs. Construct playground to complement and complete the project. The playground may be built on an element by element basis to reduce upfront investment.

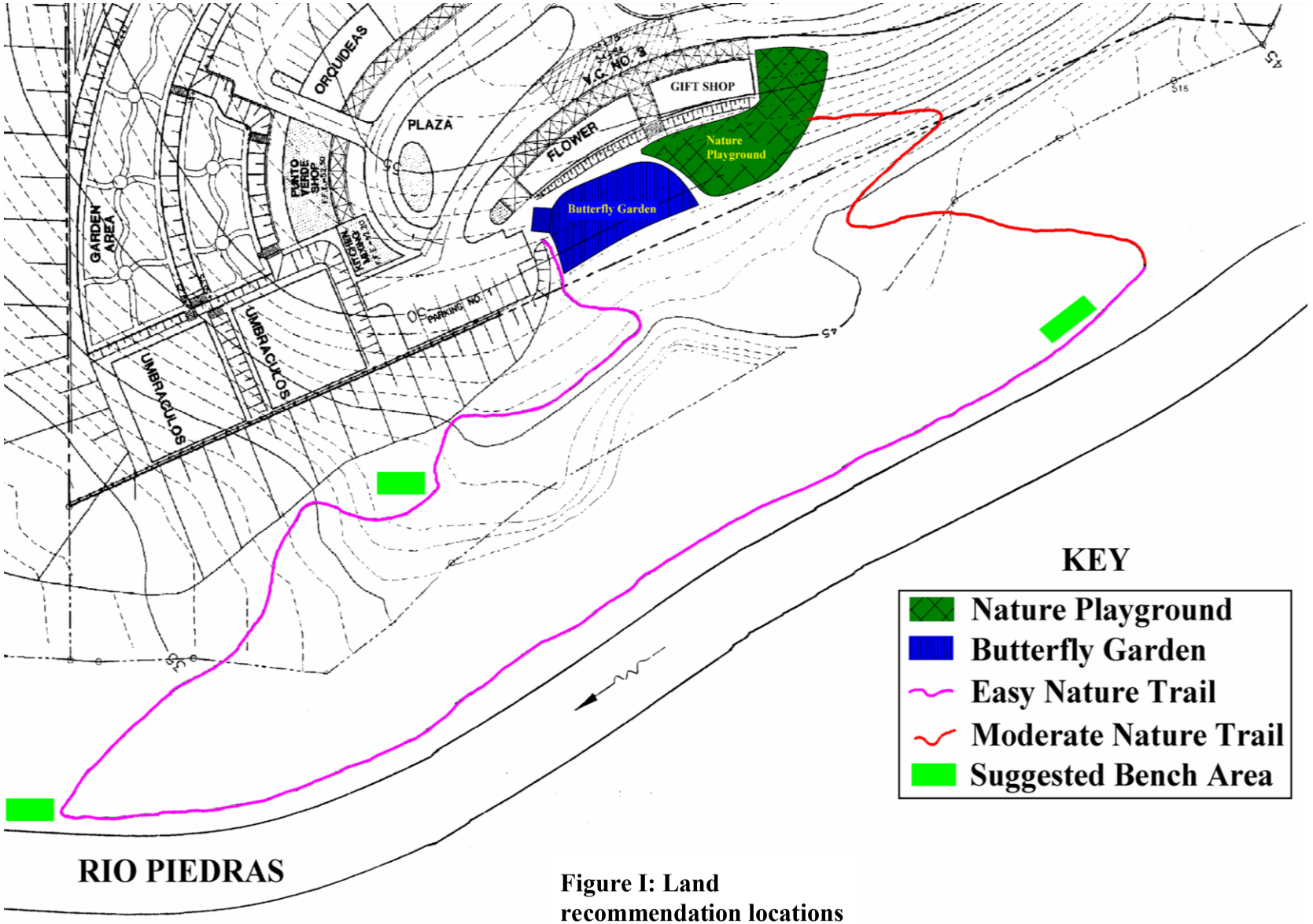


Figure I: Land recommendation locations

Chapter I: Introduction

The effects of urban sprawl and uneven development in San Juan, Puerto Rico weigh heavily on small communities who have recently become part of the San Juan Metropolitan area. San Juan has been expanding since the 1940s, engulfing land that was once used by farming families in small rural communities. Two of these communities are Caimito and Cupey, which are located in the southern part of San Juan. Formerly rural, isolated communities, in the last 10 years Caimito and Cupey have been experiencing pressure for urban development, and the land that had once been used for subsistence farming is now being replaced by housing and commercial buildings. With a relatively high percentage of low-income families, in an area that has become one of the richest sections of San Juan; Caimito, Cupey, and other poor communities are facing a problem of uneven economic development. The wealth gap grew, and social problems have become much worse as these low-income families struggle to find work in this new socio-economic structure. These communities are now experiencing social problems such as delinquent parents, continual robberies, and drug and alcohol addiction.

In response to the problems in Caimito, Cupey, and other small communities, Punto Verde $_{PT}$ (Propiedad de Trabajadores), started in 2000, is a community based economic development project organized as a worker-owned and operated corporation. Its goal is to offer low-wage and unskilled workers a chance to benefit from their mission to provide "opportunity of training, development, and wealth generation." Punto Verde plans to draw its workers from Caimito and Cupey where they will eventually become part owners of the corporation, thereby empowering them to directly influence their job situation. Using Caimito's farming background as the basis of the corporation; Punto

Verde will include the production and sales of ornamental plants and orchids as well as other operations pertaining to natural products including a flower market, gift shop, restaurant, and natural spa (Plan de Negocios, 2000). Punto Verde will strive to meet specific financial goals, such as meeting a certain amount of sales for the first year and maintaining a specific payroll to sales ratio, as well as creating a horticultural and entrepreneurial education center.

Punto Verde arranged the lease of a 6.5 acre plot of land owned by Hogar del Niño, a home for girls placed there by Social Services. A majority of the land will be used for business operations with all construction on an environmentally-sound basis, by utilizing as much as possible the natural resources found at the site. This area will serve as Punto Verde's main source of revenue. Some of Punto Verde's land was left undeveloped. This land combined with bordering public land under the control of the power authority makes an area of approximately three acres that extends down to the Río Piedras. Punto Verde arranged to work with students of Worcester Polytechnic Institute (WPI) to conduct a land use and feasibility study of this designated area. The goal of this project was to recommend outdoor uses that would be synergistic with Punto Verde's commitment to education, the environment, and community; economically sensible; feasible on the given land; and attractive to many different audiences.

Our recommendations will provide the foundation and framework for Punto Verde to begin implementation of the ideas we determine to best fulfill the criteria. These ideas pose the potential to enhance Punto Verde's mission and goals by providing a unique and popular attraction to the area, providing education to children, and helping to preserve the environment with green space in an increasingly urbanized world.

Chapter II: Background

Punto Verde $_{PT}$ is an economic development project created to assist the communities of Caimito and Cupey. We begin this chapter by providing a brief historical background to these communities with a focus on some of the negative results of Puerto Rico's changing economy in the latter half of the twentieth century. Caimito and Cupey are examples of the many small communities that have been acutely affected by these changes and the urban sprawl and uneven development that resulted. With this understanding, we then describe Punto Verde as a response to some of the problems prevalent in the Caimito community. We explain Punto Verde as a broad economic development initiative and then describe its specific organization, mission, and goals.

Causes of Community Problems

The problems and challenges Caimito now faces can be traced back to Puerto Rico's shift from an agricultural to industrial economy, and the rural-to-urban migration that accompanied it. In this section we will explain the government's economic intervention with Operation Bootstrap and the country-wide results. We then explain the consequences this initiative has had on small communities who as a result face urbanization and uneven development. Finally, we describe these results in the context of some of the specific issues and problems facing Caimito including unemployment and poverty.

Puerto Rico governor Luis Muñoz Marín implemented Operation Bootstrap in 1942. United States federal legislation was secured as an economic initiative to bolster Puerto Rico's economy by providing incentives for industrial enterprises. This was accomplished by giving companies large tax incentives to start operations in Puerto Rico

with benefits including exemption from Puerto Rican taxes for 10 to 30 years and provisions for real estate and worker's expenses. United States Internal Revenue Code also provided a federal tax exemption on income earned in Puerto Rico when profits were repatriated. Rapid industrial expansion ensued. For example, in 1947 there were only 13 U.S. factories operating in Puerto Rico. By 1980 there were over 2,000 U.S. factories (Puerto Rican Economy, 1997).

The focus on industry created an economic model based on capital import and manufacturing. At the same time, the agricultural sector that had become mainly U.S. companies based in sugar and tobacco declined. This resulted in agriculture playing a diminishing role in Puerto Rico's Gross National Product (GNP). In 1934, 43% of Puerto Rico's GNP was from agricultural products and 7% from manufacturing. In 1980, these percentages were completely reversed with 48% the GNP from manufacturing and only 4% from agriculture (Thomlinson, Lyaned, 2000; Dietz, 1986).

Urban Sprawl: This sector shift created rural-to-urban migration; low-income and impoverished hourly and seasonal workers moved out of the country and into Puerto Rico's cities with the belief they would find work. This rapid population increase in Puerto Rico's urban centers caused urban sprawl. There are many definitions available for the term; however, it is commonly thought to result from poorly planned, large-scale new residential, commercial, and industrial developments in areas previously not used for urban purposes (Zhang, 2000; Ewing, 1997).

In Puerto Rico the speed and effect of urban sprawl were further amplified as a result of influence from the United States. Similar to U.S. cities, Puerto Rico's urban model has been built with widespread reliance on personal automobile transportation. A

large percent of the population have personal vehicles and do not use public transportation. This allows families and individuals to move away from crowded urban centers and into nearby developments which in turn pushes the city farther into the country (Rieckehoff, 2002).

Further influence from the U.S. is the idea of "conspicuous consumption" and the way those with wealth, or wish to be perceived as wealthy, choose to show it. One of the fashionable ways to do this is the "suburban lifestyle" (Rieckehoff, 2002). This has created demand for suburban housing developments and further increases the speed of urban sprawl by what is called "leap frog development." Leap frog development is a method used by landowners who acquire land that is well beyond the borders of certain cities. They then market this land for future developments, offering open space and privacy. This area may start out a fair distance away from urban centers; however, once development begins to increase in those particular areas, the land will become just as developed and urbanized as the city that it "sprawled" out of, which can be seen in Figure 2-1. This figure shows an older house which is lying on the doorstep of a new, upper-class residential complex.

Figure 2-1. Effects of urban sprawl in Caimito

Uneven Development: In addition to urban sprawl, Operation Bootstrap caused uneven development. According to John Weeks, author of *The Expansion of Capital and Uneven Development on a World Scale*, the uneven development that occurs within a capitalist country is the result of "competition and the adoption of technical innovations within the social relations of capital," (Weeks, 1999). This uneven development is between industries and regions within the country and has its root in the exploitation of wage labor.

> The development of wage labor resulted, and continues to result, from the separation of workers from their means of production. The most obvious form of this separation is the dispossession of agricultural producers from the land … Having been dispossessed, producers are reunited with the means of production via the agency of capital. They become, in effect, the instruments of capitalist production (Weeks, 1999).

The catalyst of Weeks' uneven development is technical innovation creating differences in profit margins between industries (Weeks, 1999). Furthermore, it is reliant on a workforce of wage laborers. In Puerto Rico, the adoption of Operation Bootstrap, in effect, created these forces as they had never been seen before.

Unskilled agricultural workers, believing Operation Bootstrap was creating many jobs in the city, moved out of the country. However, jobs were not created fast enough and many workers still struggled to survive. This created a large population of wage laborers. Furthermore, Operation Bootstrap allowed new companies larger profits with tax incentives and sector inequality; Weeks' (and Marx's) theory executed in practice.

The country-wide economic result of these changes was a steadily increasing Gross Domestic Product (GDP), averaging around a 5% annual growth (Fotheringham, 2000). However, this growth was combined with increasing unemployment and poverty for the working population. The working class has always struggled to survive; however,

even as the overall economy grew, and more money was generated in Puerto Rico, unemployment was high. This has allowed working-class oppression (low wages for long hours) and created higher profits for the elite; thus a wealth gap grows.

Small Communities: The negative effects of urban sprawl and uneven development can be extensive, especially in the neighborhoods of San Juan such as Caimito and Cupey. Rural residents once lived in small, tight-knit communities that consisted of low-income families surviving on farming and low-scale agricultural sales. The lack of higher education and experience in business and industry prevents these once small farming communities from succeeding in new urban environments. These communities are now surrounded by middle to upper-class communities like Los Paseos, a large gated housing development.

Furthermore, these new developments have been built directly next to longtime low-income residents. Just 20 years ago, Caimito was relatively far from the dense urban environment of San Juan, and land was inexpensive. However, at the beginning of the 21st century, Caimito's land was highly valuable and this area had become one of the richest sections of San Juan (Rieckehoff, 2002). Rising land prices and a changing economic structure have created a struggle for families that have lived and worked in these areas for generations.

The community of Caimito presently has many problems including drug abuse, theft, young single mothers, and delinquent parents (Rieckehoff, 2002; Nazario, 2002). This was not always the way of life for the people of Caimito. In the last 20 years Caimito has found its community deteriorating and its land disappearing.

There is a great need for a community based economic development to help the people of Caimito and Cupey survive and rebuild a sustainable way of life. In response, one of the goals of the Punto Verde $_{PT}$ project is to provide community members an opportunity to learn new skills, generate wealth, gain experience in cooperative management, and help rebuild their community.

Previous Community Based Centers

The Punto Verde Corporation is a worker-owned and operated corporation which seeks to address some of the problems in Caimito and Cupey. Punto Verde's mission is to be an "economic development program which has as its goal establishing a community based agricultural profitable operation." Punto Verde's mission and goals, however, have deep roots in some of the previous economic community projects on the island of Puerto Rico.

Some of the first community-based organizations structured to help the low-income people throughout the island of Puerto Rico were set up through the works of Sor (Sister) Isolina Ferré. In 1969 Sor Isolina was confronted with increasing poverty in her native area of Ponce. In response to this poverty, Sor Isolina created a network of community action centers in many of the poor neighborhoods throughout Ponce. Her goal was to provide the people of Ponce with the tools to create a future for themselves. From these simple beginnings, Sor Isolina established a network of facilities to empower the poor. Today there are five Centros Sor Isolina Ferré in Puerto Rico. The centers provide high school equivalency education and job training, as well as programs dedicated to strengthening families and stopping juvenile delinquency. With 350

employees and a combination of public and private funding, the Centros Sor Isolina Ferré help 10,000 people every year (Puerto Rico Herald, 2000).

One of these centers is located in the poor community of Caimito. However, this center is different in organization and mission. This center houses Vivero Caimito an economic development program whose original goal was to establish a community based profitable agricultural operation. This program engaged in the production of horticultural products for both the wholesale and retail markets. The program's success increased dramatically when Sor Isolina hired Ms. Angelita Rieckehoff to be the Executive Director in 1997. Ms. Rieckehoff requested that Vivero Caimito be an autonomous program of the Centro Sor Isolina Ferré in Caimito, to serve as a model of what a community-based profitable business venture could be. Under Ms. Rieckehoff, Vivero Caimito experienced increased sales from around $60,000 to over $300,000.

Mission and Business Plan of Punto Verde $_{PT}$

Punto Verde started when Ms. Rieckehoff left her position at Vivero Caimito. Ms. Rieckehoff wanted to further the work of empowering the community started at Vivero Caimito through an autonomous workers' organization. She utilized her experiences from her work at Vivero Caimito and directed this knowledge into creating a project called Punto Verde.

The Punto Verde Corporation is an agricultural and community-based project which addresses many of the problems in the surrounding low-income communities of Caimito and Cupey. Punto Verde is a worker owned and operated corporation, whose mission is to be an

> economic development program which has as its goal establishing a community based agricultural profitable operation. Engaged in the production of horticultural material for both the wholesale and retail markets and space rental to concessionaires of related businesses, Punto Verde $_{PT}$ serves as a model of what a community based profitable business venture should be while at the same time it provides persons from the Caimito and Cupey Wards an opportunity for training, development and wealth generation. The economic benefit obtained from the operation benefits its participants and the community (Plan de Negocios, 2000).

Punto Verde seeks to provide education to the community by teaching employees the basics of a business operation and then hiring them to work at Punto Verde, either selling plants or working in the concessions. If the workers prove successful in their endeavors they will be invited to buy their way in as a partial owner of the corporation. These community members will have a say in what they are doing and the way they are conducting their businesses; and with a little help from the Punto Verde staff will become relatively experienced and educated businesspeople. Punto Verde also hopes to establish a horticultural education center for young adults. This would provide an early start to the proper education needed to work in sales.

Punto Verde's main objective is to become a premier provider of horticultural products and a popular destination for the sale of other products and services related to nature. Punto Verde has many goals it hopes to accomplish within its first two years of operation:

- Reach $650,000 in sales in the first year and $775,000 in the second year
- Contribute at least $70,000 to the Hogar del Niño in rents and social contributions
- Train at least 15 youngsters a year with the education center
- 15,000 person attendance in first year

These goals and objectives may be a challenge to meet; however, with the experienced staff and knowledge they hold, Punto Verde believes the task is attainable.

The Organizational Structure of Punto Verde $_{PT}$

Punto Verde is a corporation organized pursuant to the laws of the Commonwealth of Puerto Rico as a worker-owned corporation to conduct agricultural business. As a result it has been issued an advisory opinion by the Treasury Department giving it tax-exempt status. In order to become an initial investor and worker-owner of Punto Verde, a $4,000 investment is necessary. This investment secures partial ownership of the corporation and a position within the company.

After some of the initial business planning was completed, Ms. Rieckehoff slowly started to add employees to Punto Verde. Ms. Rieckehoff contacted people she felt extremely confident about from previous work experiences.

Ms. Tania Meisner is the Administrative Coordinator of the corporation. Ms. Meisner's background includes a masters degree in accounting. She worked the initial investment off with hours spent at the office. This secured Ms. Meisner's place as a primary investor and employee of Punto Verde. Her job within the company is to secure permits, administer proposals, and manage the financial affairs of the corporation.

Ms. Raquel Soto is the Production Supervisor and is in charge of all the horticultural production and field operations. Ms. Soto came from Vivero Caimito, where she was in charge of general administration and production.

Dr. Teresa Nazario is the Community Coordinator. Dr. Nazario is a previous member of the board of directors for Hogar del Niño and was the original person to contact Ms. Rieckehoff about an available plot of land. She also worked at Vivero Caimito with Ms. Rieckehoff and Ms. Soto. Dr. Nazario has a doctorate in social psychology; and extensive experience with community and administrative work.

Development Plans for Punto Verde $_{PT}$

Around the time of Punto Verde's conceptualization, Hogar del Niño, a center run by a group of nuns to house 6-18 years old abused or homeless girls, was facing financial troubles. The nuns realized that they could no longer rely on government programs and private funding to support 25 girls at the facility. Located in what has become one of the richest sections of San Juan, the mostly unused 32 acres of land Hogar del Niño owns is worth millions. The Hogar del Niño board of directors considered two plans of action to generate the necessary operational costs: sell all 32 acres of land to establish a trust and move to a new location or put some of the land to economic use. The board of directors at Hogar del Niño decided that they were unwilling to move the girls and the facility to a new location and decided to lease the land to a business; however, it was essential that the business be consistent with the mission of Hogar del Niño and has the principles to support the welfare of children.

Negotiations began between Punto Verde and Hogar del Niño to arrange the lease of 3-4 acres of their land. However, after seeing the steep topography of the land, the proposal quickly changed to approximately a 6.5 acre plot of land. The process of negotiating land was a long endeavor for both Punto Verde and Hogar del Niño. After eight months of negotiating, an agreement was made to lease the 6.5 acres of land for ten years at $5,000 a month, starting early 2001.

As previously mentioned, Punto Verde will be creating a horticulture center. However, this center will have many activities. A main part of Punto Verde will be the horticulture production center. This farming area will entail over 20,000 square feet and will consist of green-houses, a shed for mixing the potting medium, storage area, and

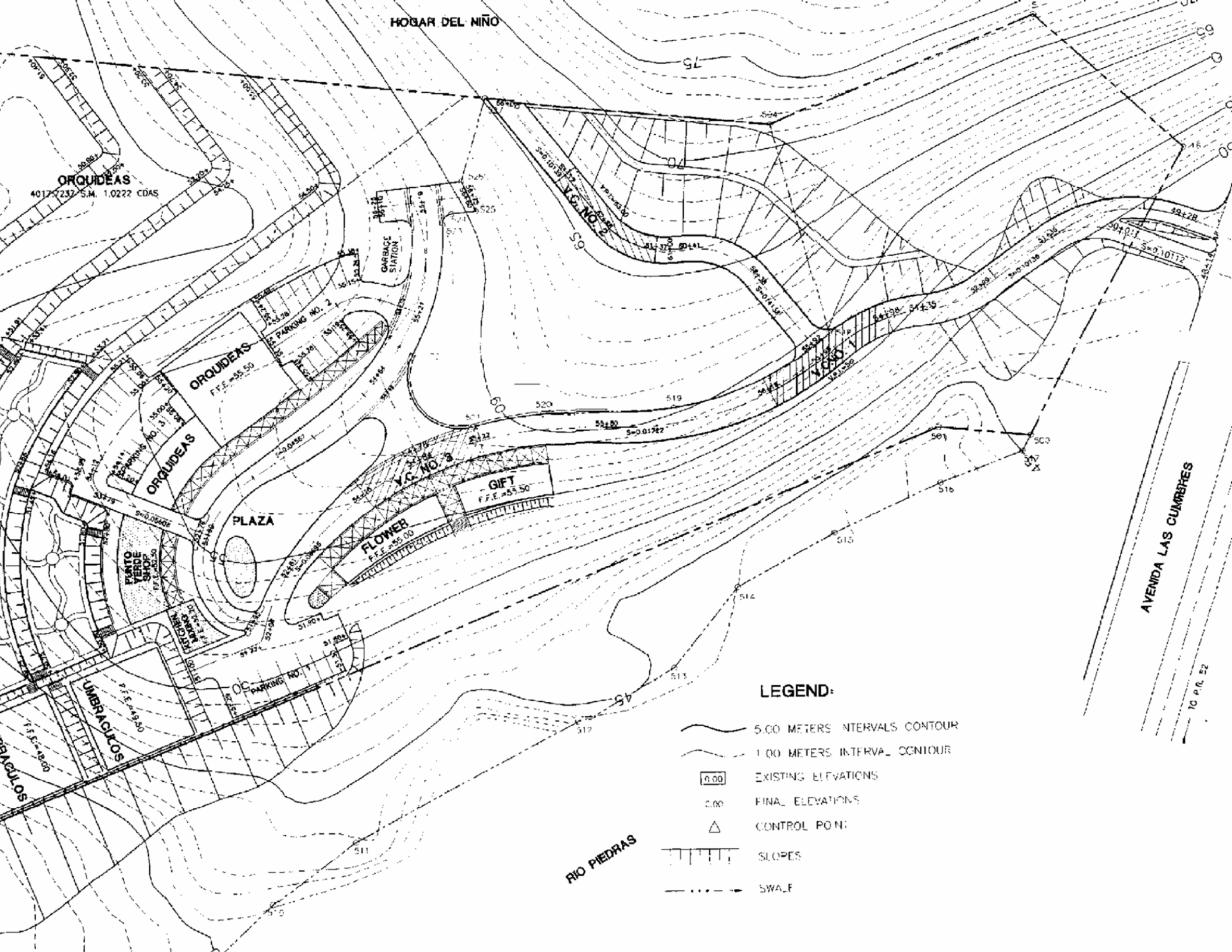
facilities for production personnel. This area will be primarily used for the production of ornamental plants and orchids to be sold throughout the site.

There will also be small shops selling a wide variety of nature-oriented and horticultural products. These will be the primary places where community members will first start work and gain experience in horticultural sales and basic business techniques.

One large attraction onsite will be a restaurant. Similar to all the other attractions at Punto Verde, the restaurant will be designed using as many natural resources as possible. Punto Verde is hoping to use as much wood from the trees removed for construction and to utilize as many natural resources as possible when constructing and decorating these areas. For instance, room partitions will made by weaving small twigs into a frame and in the future many of the large logs will be carved for decorative purposes. The restaurant hopes to attract many people, including local businesspeople for lunches and families for dinners.

In the process of developing this land, Punto Verde has had many obstacles. The topography of the land is extremely steep and therefore hard to construct on (See Figure 2-2, page 14). In May 2002, the project was almost a year behind construction, as a result of the many modifications needed to the proposed roads and the long, tiring, inefficient permit process (Rieckehoff, 2002).

In addition to all the main developed land, Punto Verde has approximately 3 acres adjacent to the site, which they are hoping to find feasible outdoor uses to place on the land. This land is located from the back of the flower and gift shops; and the main road all the way down to the Río Piedras (Refer to Figure2-2). These land uses are to be synergistic with all of Punto Verde's goals and their mission.


HOGAR DEL NIÑO
ORQUIDEAS
4017-7232 S.M. 1.0222 CDAS
ORQUIDEAS
F.F.E.=55.50
ORQUIDEAS
PARKING NO. 31
PARKING NO. 2
GARBAGE STATION
V.C. NO. 1
V.C. NO. 2
V.C. NO. 3
GIFT
F.F.E.=55.50
FLOWER
F.F.E.=55.00
PLAZA
PUNTO VERDE SHOP
F.F.E.=49.50
KITCHEN
F.F.E.=49.50
PARKING NO. 1
UMBRACULOS
F.F.E.=49.50
AVENIDA LAS CUMBRES
RIO PIEDRAS
LEGEND:
5.00 METERS INTERVALS CONTOUR
1.00 METERS INTERVAL CONTOUR
0.00 EXISTING ELEVATIONS
0.00 FINAL ELEVATIONS
CONTROL POINT
SLOPES
SWALE

Chapter III: Methodology

In this chapter we will first explain how we established criteria for our land use recommendations and identified key stakeholders and audiences. Second, we will show how we used the criteria to generate, explore, and evaluate our land use ideas.

Determining Key Criteria, Stakeholders, and Audiences

Key Criteria: Through discussions with the core staff at Punto Verde, we established four main criteria: synergy with Punto Verde's mission, goals, and operations; economic feasibility; attraction to a wide variety of people; and land feasibility.

- *Synergy:* Consistent with Punto Verde's mission and goals our land use recommendation must incorporate community and educational aspects. Part of Punto Verde's mission is to provide economic opportunity and training to low-income community members of Caimito and Cupey; therefore our ideas had to enhance this goal.
- *Economic Feasibility:* At the time of this project Punto Verde was not scheduled to open for at least a year. With the many costs involved in the development of the business aspects of Punto Verde, the ideas we recommended needed to be low-cost and/or profitable.
- *Attraction:* Attraction of a wide variety of people is consistent with Punto Verde's over-all mission of a community-based development project. Drawing a diverse audience to Punto Verde will aid in its success as a business and help ensure continual use.
- *Land Feasibility:* Land topography posed a constraint due to the fact that the majority of land leased by Punto Verde, including approximately three acres of

the land we will be suggesting a land recommendation for, is steep making it difficult to develop. It was important to clearly show how a recommendation would be physically feasible to implement on the site.

Key Stakeholders and Audiences: To evaluate our land use ideas, we needed to identify key stakeholders and audiences so we could utilize their interest and information about the ideas. We defined stakeholders as groups or individuals who would be directly affected by the success of Punto Verde and our project. Audiences were defined as the different groups who would use and bring in other people to use the outdoor activities we recommend. We determined who would be included in these groups by talking to the staff at Punto Verde.

- *Stakeholders* included the staff and board of directors at Punto Verde and Punto Verde's target communities of Cupey and Caimito. Other stakeholders included Hogar del Niño, the overall owner of the land, the girls living at Hogar del Niño who may help with the project, and investors of Punto Verde
- *Audiences* included the residents of Los Paseos and other upper-class housing developments, business men and women who work in the area, schools, children, and parents.

We interviewed people within these two groups in order to gather information, receive feedback, and determine interest in our given land uses. The style of in-depth interviewing provided people's responses as a bigger picture (Doyle, 2001).

Generation, Exploration, and Evaluation of Land Use Ideas

Generation: The initial formulation of ideas for the project was based on outdoor land use ideas that we had seen implemented in Puerto Rico and the United States, as well as

other suggestions from our advisors and liaisons. Ideas that were hypothesized included: aviaries, nature trails, a disc golf course, a dog walk, a giant maze, a historical site, a rock climbing wall, outdoor games, golf driving range, and a sports field.

After brainstorming, we eliminated ideas that did not meet the established criteria. We narrowed our recommendations to four ideas: ropes course, playground, nature trail, and butterfly garden.

Exploration: We researched companies within Puerto Rico that had implemented similar land uses. On-site visits and interviews with these companies allowed us to gain a better understanding of each project as well as gauge the local competition. In-depth research via the Internet also provided information on our land use ideas already established outside of Puerto Rico. Contact was also made with some of these companies to receive more specific information relative to the implementation and costs of these ideas.

Evaluation: Determining if each land use idea met the criteria determined if we would continue further investigation on the idea's feasibility.

We made a cost estimate for each idea after we narrowed our ideas to three land uses. For each idea there is an initial first year estimate of costs to implement each individual recommendation. Initial costs include cost of materials needed for construction, land alterations, tree removal, and any services such as labor, architects, planners, and engineers.

Chapter IV: Findings and Recommendations

This chapter will assess the feasibility of our three recommendations for Punto Verde's land use. We will first explain how we eliminated and narrowed the ideas we had generated to three recommendations. Then we will provide a rationale, a discussion of implementation, and a cost estimate for each recommendation.

When generating, exploring, and evaluating all ideas, decisions were justified by the established criteria. These criteria: synergy with the overall mission and goals of Punto Verde, economically sound, feasible on the given land, and attractive to many groups of people were used not only to generate ideas but also to eliminate ideas deemed unfeasible for Punto Verde.

For example, we decided an outdoor game similar to paint ball or laser tag was not appropriate because the unfriendly nature of the game was not consistent with Punto Verde's mission. Due to the extremely high cost of building an aviary or a rock climbing wall these ideas were deemed not economically feasible. Many ideas such as a disc golf course, giant maze, golf driving range, and sports field were eliminated because they require a lot of space and flatter land and thus not feasible on the given three acres.

A ropes course was a strong potential land use recommendation. This idea had the advantage of attracting corporate training to Punto Verde and possible profit. This idea was rejected; however, after interviewing Joe Ríos at his ropes course. Joe Ríos explained that he had already spent well over $90,000 on his course and insurance costs were extremely high. Furthermore, his ropes course was located less than five miles away from the Punto Verde site. With high initial costs, high recurring cost, and well established competition, a ropes course at Punto Verde was deemed unfeasible.

The three ideas for land use that made it through the processes of exploration and evaluation were a nature-based playground, an educational nature trail, and a butterfly garden. These ideas make up our final recommendations.

Recommendation #1: Construct a Nature Playground

Our recommendation for a nature playground incorporates the idea of a "discovery play garden," along with traditional playground elements made from natural materials. A discovery play garden focuses on the use of the natural landscape and utilizes natural objects such as logs, rocks, and natural greenery to promote imagination (Stoecklin, 2000). A traditional playground, similar to the one seen in Figure 4-1, is the typical type of playground with elements such as swings, slides, and climbing bars. The combination of playgrounds is intended to encourage imagination while providing a traditional playground that many children are familiar with.

Figure 4-1. Traditional playground at Albergue Olimpico

Rationale

A nature-based playground is consistent with Punto Verde's environmentally friendly views by using natural material found on the site or recycled materials. This play area provides a place where surrounding community children and parents can meet and

socialize. Beatriz Arsuaga, Worcester Polytechnic Institute's local coordinator for Puerto Rico, informed us that this playground would provide the only public playground near the development site. The only other playgrounds in the area are found within Los Paseos. These are small private playgrounds that only children in the specific neighborhoods can use. The initial investments to construct a nature playground is expensive, but this idea is compatible with our other recommendations and compliments Punto Verde's corporation.

Implementation

The first step to implement a nature playground is to form a committee of parents, teachers, children, and a playground expert. These committee members should include the community residents of Caimito, Cupey, and Los Paseos housing development. The National Program for Playground Safety (NPPS) suggests that 6-10 people should be included in the committee, where one chairperson and secretary are elected to head and record what is said at the meetings (NPPS, 1995). Forming a committee allows different points of view, expert advice, and can address the needs of the children. Although the complete committee process may take a long time, one to two years, these planning meetings can reduce the cost of the playground in the future by providing a clear design. At one of the initial meetings a neutral consultant should be invited to help with the planning of the playground. It will cost a fee to have a consultant attend but the expertise will also help reduce costs in the end (NPPS, 1995).

This committee should suggest different types of playground equipment to be included in the nature playground. At this point in the planning it is imperative to have children of different age groups express their interests and needs in the playground. There

are different pieces of equipment for different age groups ranging from 0-2, 2-5, and 5-12 and the playground should have equipment for all these age groups.

Not only should the equipment be planned for all age groups but all children. In order for the playground to be accessible to all children it must meet certain guidelines provided by the Americans with Disabilities Act (ADA). These guidelines can be found in the ASTM 1487 guide book. To get a better understanding of what type of children will use this equipment is important to involve community schools and families in the planning process.

Discovery Playground Element

Suggestions for the discovery play garden elements of the nature playground include having a grassy area that is manicured less frequently than the rest of the grounds to allow children to hide and play in the natural greenery like the boy seen in Figure 4-2. Other elements should include mounds of rocks that form a cave, cut down trees that children can climb on or under, and utilization of the rolling topography for children to play on. There are no specific guidelines to these elements, however, they should be designed in such a way to encourage children to use their imagination to the fullest.

Figure 4-2: Discovery play garden (Stoecklin, 2000)

Traditional Playground Elements

For the traditional elements we recommend two to four swings with rubber covered chains. These swings cannot be made of natural material due to safety regulations. We recommend two slides to give a wider variety of equipment. One slide can be either a traditional slide or a wave slide and the second can be a spiral slide. These two slides should be plastic to assure safety. Similar to the swings, the construction material for the slide will not be natural but will provide safety during use. Some other recommendations for the traditional elements include climbing bars and a rope bridge. Due to the topography of the playground location (as seen if Figure 4-3) some pieces may need to be custom made, causing an increase in the cost of implementation.

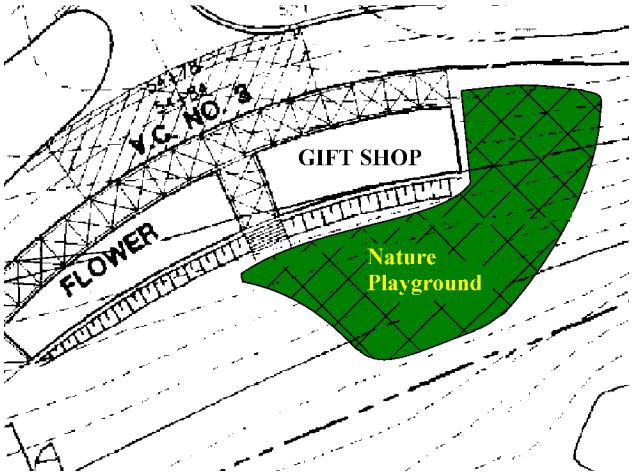


Figure 4-3. Location of the nature playground

Surface for Fall Zones

Fall zones of loose-fill material must extend 6' from the edge of the equipment and provide safe fall surfaces if a child fell from the play equipment. It must be at least 6" deep under swings, slides, and climbers; and equipment higher than 6' must have loose-fill at least 12" deep (Safe Kids Canada, 2000). The ideal type of ground cover is a loose-fill material, which may include sand, wood chips, wood fiber, or recycled tire material. These loose-fill materials each have advantages and disadvantages to their use. Several important characteristics should be noted when choosing a surface material including availability, susceptibility to compaction, reactions due to climate (rain and drought), and

long term sustainability. The advantages and disadvantages of four loose-fill materials can be found in Appendix B. Based on these properties we suggest using wood chips with rubber mats under key fall areas. An added advantage to using wood chips is that they can be produced at a low cost to Punto Verde by chipping the trees they remove. Rubber mats provide extra protection under key fall areas where more cushion is needed during impact. The mats can be placed under the loose-fill material in-order to keep the natural look Punto Verde wants. Mats are less expensive and easier to install than rubber that is melted, poured in place and hardened, called continually poured rubber.

Additional Safety Issues

The United States Consumer Product Safety Commission (CPSC) provides a list of criteria a playground must meet in order to provide safety for the children using the facilities. These include shock absorbent surface materials, critical height, swing and slide requirements, railings and hand rails, entrapments, and accessibility to the disabled (CPSC, 2000; Wardle, 2001). These guidelines are important to promote the safety and enjoyment of all the children who will use the playground area and equipment.

- *Critical Height:* Platforms, climbing equipment, and bridges should not exceed 5' and slides should not exceed 6'.
- *Swings:* Should be independently attached from other playground equipment, such as platforms and climbing elements. Only two swings are allowed to each bay and seats must not be made of hard materials such as wood, plastic, or metal.
- *Slides:* Must provide a hood or bar at the top to encourage children to sit on the slide. The height must not exceed 6', while the height of the sides must be at least

4” high. The exit must parallel the ground and metal slides are discouraged due to the possibility of burns.

- *Railings and handrails:* Railings must be provided for any surface above 18” from the ground and solid barriers must be provided above 20”.
- Entrapments: Any part of the equipment where a child’s body can fit through but not their head is considered an entrapment. These areas must be less than 3.5” or greater than 9”

(CPSC, 2000; Wardle, 2001)

Local licensing, permits, and insurance are needed for the development of a playground. Licenses to build a playground are applied for on a two year basis at no charge through the Department of Social Services. The application can be obtained through the department. Maresol Rodrajuaz, at the Department of Social Services, told us seventeen permits through various agencies must also be obtained at a cost of $30-40 each. Permits would also determine at what points the playground’s construction inspections would need to be performed (Wardle, 2001). General insurance would cover basic costs for incidents such as: bodily injury, damage to another’s property, immediate first aid, and legal costs if the company is sued (Volker, 1992). Punto Verde’s insurance company, Del Nido Associados Inc., estimates an additional yearly cost of $2500 for general insurance based on their current insurance premium.

Cost

The costs involved in implementing a nature playground are fairly expensive due to construction, obtaining permits, and insurance. However, it can be built in a ways that can save money.

When building the equipment Punto Verde could decide to have every piece custom made based on the topography of the land or they could buy certain elements and attach them to a frame. In either decision Punto Verde should build the playground in a way that retains as many of the trees as possible. However, materials to build the frame of the traditional elements and create the natural land features can be materials that are removed from the developed sections. The actual playground equipment can be bought from different companies; however, the warranty may be void if attached to other equipment and careful planning must be considered when designing the playground.

Labor costs would include the initial cost of clearing the land and the cost of constructing the playground. Some of these labor costs can be reduced by involving community members who would like to volunteer their time and expertise. The maintenance of the playground would require a worker who would inspect the play equipment once a week, clean the area every day, and inspect the area frequently. Some of the maintenance jobs would include: keeping the grass at a reasonable level for children to play in, clearing unwanted debris, and maintaining the structural stability of the traditional elements. Guidelines to inspecting the playground can be found from the NPPS in Appendix C. These jobs would not require full time work so we suggest that a worker be hired to maintain the playground area and the butterfly garden along with occasional maintenance of the nature trail. A full-time employee for these jobs would be hired at approximately a monthly rate of $1200 (Meisner, 2002).

We received an estimate from Emilio Martinez and Rafael Ramírez, the architects for Punto Verde. This estimate suggests that the playground would cost approximately $18,000 to design and build excluding insurance and permit costs. Mr. Martinez and Mr.

Ramírez have both designed playgrounds in the area. Constraints on this cost estimate include the fact that custom made pieces may be better suited for the topography of the land and these costs can only be found by bringing a detailed design to contractors that build custom made pieces.

Due to the high costs of building and maintaining a playground we suggest that Punto Verde implement fundraising activities to help with the finances. Some sources of funding may be found through local community and civic groups. There is also funding through the government to make playgrounds handicapped accessible.

Some of the costs for implementing a nature playground are listed in Table 4-1 below. This is only a rough estimate of the prices due to the many variables in designing a playground.

Table 4-1: Cost of playground equipment

Type of Equipment	Description	Dimensions	Costs
Prep Land			$3,000
Swings	Belt seat	6" wide	$20/each
Slide	Double wall wave slide	72"H, 128" slide run, 26"W	$448
	Spiral slide 360 degree	5'	$1,255
	Double wall slide hood	40"W x 38"H x 16"D	$148
Surfacing	Rubber mat	48" x 72" x 2"	$155
	Loose-fill material		$110-150
Tree House			$3,000
Landscaping			$5,000
Winding Trail			$3,000
Construction			$2,000
Other	Mounting Brackets		$15/each
	Standard slide foot		$80/each
Maintenance			$1200/mon
Insurance			$2500/yr
Permits (17)			$30-40/each

(Costs obtained from American Park and Recreation Company, 1999. http://www.apark.org/; Angelita Rieckehoff, 2002)

Recommendation #2: Construct an Educational Nature Trail

Throughout this project we believed a nature trail would be consistent with Punto Verde's overall project. However, one important aspect was determined in order to fully meet the criteria: the trail must have educational characteristics. This would involve informational signs to highlight particular plants, animal habitats, and visible human impact on the environment. On completion we envision Punto Verde will have an educational and recreational attraction for many visitors.

Rationale

An educational nature trail fulfills the criteria of synergy with Punto Verde's mission and goals. It will be open to the public and accessible to the surrounding communities, families, and schools. This trail will use the natural resources found on site in several ways. First, the trail will preserve these resources by not requiring a significant amount of earth movement or needing many trees to be removed. The trees that are cut down can be made into benches for rest areas and railings for steep sections. Second, by using the natural resources as features of the trail itself; trees and plants provide beauty, the topography provides challenge and variation, the river provides scenery and different animal habitats, and all these natural features provide an opportunity for education.

Nature trails can be important educational tools. The elementary school located at the Interamericana Universidad campus in San German, PR has a short nature trail built in the woods behind the school building. Principal Dr. Ruth Landrón explained that science teachers take students along this trail to reinforce classroom learning. She believes that this type of physical, hands-on experience, as well as learning about Puerto Rico's natural environment, is an important part of students' education. However, not all

users of this trail will have the benefit of a knowledgeable teacher or guide, and therefore we recommend a series of educational signs.

A nature trail is also economically feasible. There are few materials that need to be purchased and the labor costs will be minimized by the short length of the trail, no significant earth movement, and no need for any bridges or other structures.

Implementation

Implementation involves many different aspects. This report is unable to provide all the information needed in order to fully construct this nature trail, and further careful planning and design will be necessary. This report does, however, provide background information and direction for further work in designing the trail, providing educational signs, and estimating some of the costs that will be involved.

Permission

The first step to develop this trail is to obtain permission from the Puerto Rico Electric Power Authority (PREPA). This must be done because the proposed path crosses under power lines and runs along the edge of the power easement that lies between Punto Verde's land and the river (see the indicated area on the full trail map; Figure 4-5 on page 32) . The proposed path will maintain a distance of three meters from the Río Piedras and will thus stay off the land controlled by the Department of Natural and Environmental resources. To obtain permission from PREPA, Punto Verde must contact Jesus Echevarria, an electrical engineer and supervisor at the Office of Studies and Estimates. There is no formal permit for using power line easement land; however, Mr. Echevarria stated that Punto Verde can request a study which will involve a site inspection. Permission can then be granted and design work on the nature trail can begin.

Function

Nature trails provide a unique outdoor experience and it is important to determine the function of a trail so the components can be designed appropriately. Our trail's primary function is to be educational; however, it will also be available for use by individuals and families for recreation and exercise.

Trail Design

After determining the function of the trail it is important to examine the land the trail will be located on. Specific details such as accessibility, safety, and land erosion must be scrutinized. Soil erosion and flooding aspects are important for environmental and habitat concerns as well as the longevity of the trail. Some soil types are more easily eroded than others, and a trail next to a water source could be prone to flooding during long rainfalls. In some cases, drainage structures must be built and other anti-erosion measures need to be implemented to prevent erosion of the path. For an example of anti-erosion measures see Figure 4-4. This log waterbar simply stops water from running down the trail by diverting it off the path. This helps prevent major erosion during long rainfall and Punto Verde should implement similar measures on all slopes.

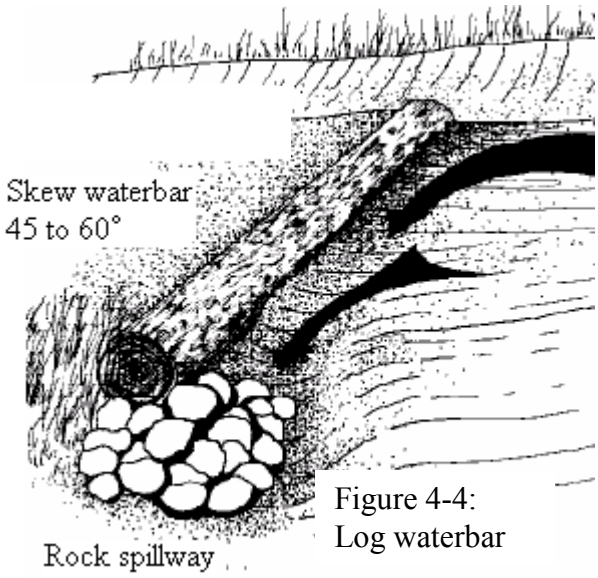


Figure 4-4:
Log waterbar

Recreational Forest Trails: A Plan for Success:
North Carolina Cooperative Extension Service,
North Carolina State University

Carefully choosing the path can help minimize the effects of erosion. The path we suggest was carefully planned and sited (both on by studying the topographical map and walking the physical area) to avoid natural water runoff areas. This helped eliminate the need for more extensive erosion control such as culverts or raised walkways. Also, Julio Rodriguez from the U.S. Geological Survey (USGS); Water Resources Division, explained that this section of the Río Piedras rarely floods and the trail near the river can expect minimal flood damage.

Since this trail is accessible to the public, it should meet guidelines provided by the Americans with Disabilities Act (ADA). These guidelines include providing well-packed surfaces and sloping topography, forming a loop from start to finish, and varying in length from half a mile to two miles (AMC, 2002). An overview of some of these guidelines is displayed in Table 4-2.

Table 4-2: Accessible trail design standards

	Easy	**Moderate**
Width	4 feet (48 inches) 1	3 feet
Maximum grade	8% (1:12 slope)	10% (1:10 slope)
Distance allowed at maximum grade	30 feet maximum	50 feet maximum
Cross slope	3% maximum	3% maximum
Surface	Hard surface (i.e. pavement, or packed gravel)	Very firm, compacted surface
Small level changes	½ inch maximum	½ inch maximum
Rest areas2	400-foot maximum interval	900-foot maximum interval
Passing space	200-foot maximum interval	300-foot maximum interval

Source: Based on A Design Guide For Universal Access to Outdoor Recreation, PLAE, Inc., Berkeley, CA. 1993.
1 If route must pass through significant geologic features (rock formations) or between aesthetically important vegetation (large trees), the width may reduce to 36 inches for a maximum distance of 10 feet.
2 Rest areas or landings are required at the top and bottom of each maximum grade segment and where trails change direction on maximum grade sections. (Landings must be a minimum of 60 inches long and the width of the trail).
(Adapted from Recreational Forest Trails: Plan for Success, 1994)

We recommend separating this trail into two sections, built based on the ADA's guidelines; "easy" shown in pink and "moderate" in red on Figure 4-5, page 32.

This decision was based on the varying land typography, a desire for a loop path, and the desire for a low impact design while providing access for all users to the majority of the trail. It is important to understand that the difference between the easy and the moderate categories is minimal, just 2% difference in maximum slope and about a foot difference in width. In practice this trail will be a full loop and accessible to the vast majority of users.

We recommend starting from the butterfly garden, travel down to the river, then up along the river bank. This section (700 feet long, 55 feet in elevation change) is not too steep, allowing full width and maintaining an acceptable slope under the easy guidelines. With a carefully packed surface this section will be accessible to more physically challenged users and since it passes a variety of habitat, including the river, it can include the majority of the educational aspects.

In order to create a loop path, the trail will need to cover more undulating terrain looping up from the river and back to the nature playground. This section (500 feet long, about 40 feet elevation change) should be made based on the moderate guidelines, and erosion control must be carefully considered. The complete loop will be about 1200 feet or approximately ¼ mile.

We recommend using a packed gravel surface instead of pavement. This decision was based on several factors. The staff a Punto Verde thought a paved surface would take away from the natural aspects desired in this trail. Furthermore, pavement is vastly more expensive to install than gravel and packed gravel is still considered a suitable hard surface according to the ADA.

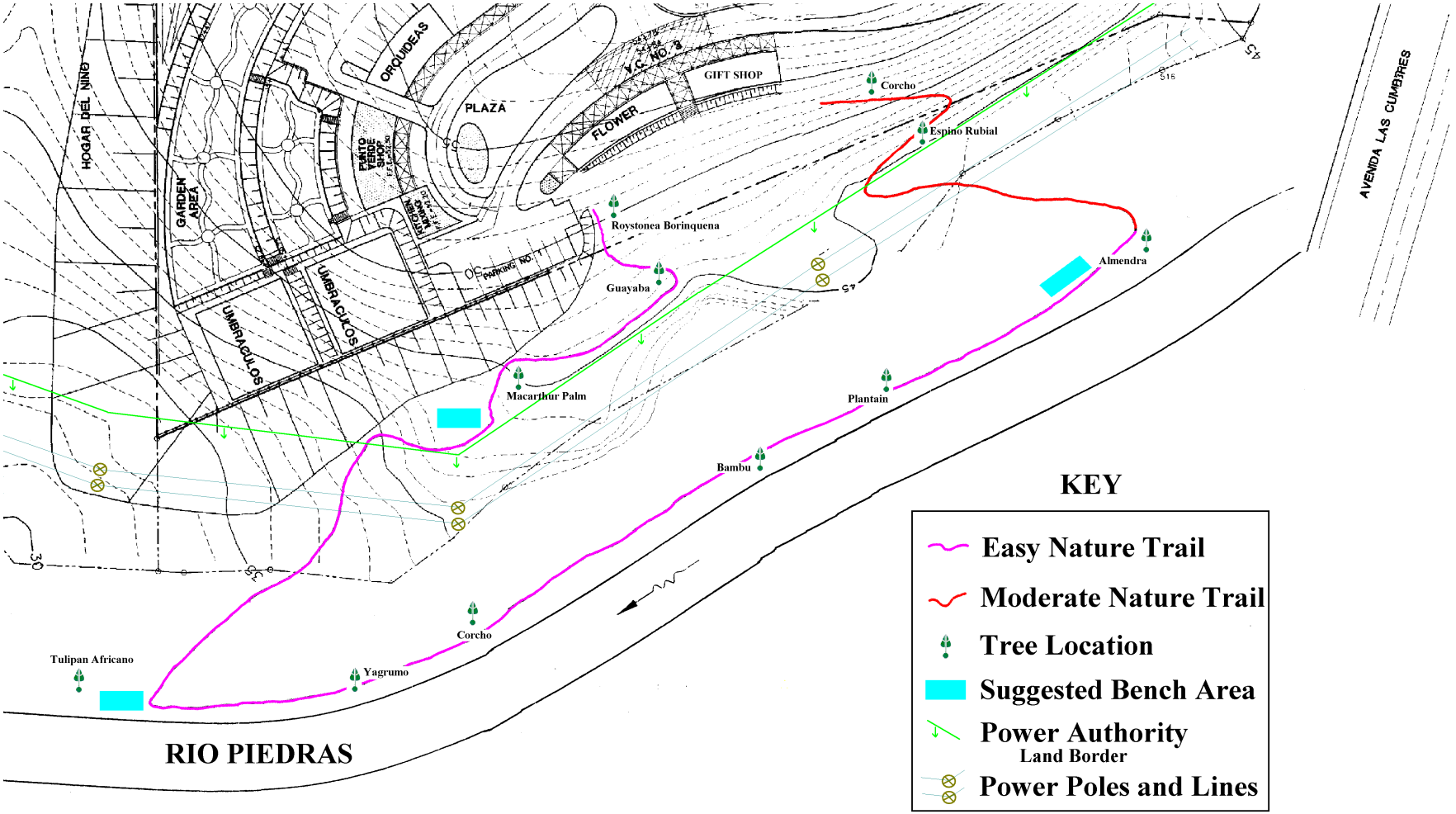


Figure 4-5: Nature trail map

Trail Construction

The total construction of this trail could take as little as a week depending on how concentrated the labor effort is. Roger Bell, president and owner of Nature Trial and Bridge Technologies, has been building trails in California for over 30 years. He stated that a good crew can finish about 30 feet of trail per person-hour. The total length of the trail is 1200 feet which translates to 40 person-hours. We suggest that this figure is ambitious and that the main work on the trail will take around 50 person-hours.

In order to work quickly, it is necessary to utilize machinery to help move the gravel. We recommend renting a skid steer which is a small loader type machine that can move the gravel and also help smooth the path, pack the gravel, and do the small amount of earth movement that will be needed.

For additional information on all trail design and implementation factors we suggest following the guidance of RARE: Center for Tropical Conservation in their handbook *Trails: Conservation that Makes Dollars and Sense,* or by visiting *Recreational Forest Trails: A Plan for Success* and the other links in Appendix C.

Education

This trail's main function is education, and this aspect will be primarily geared for elementary students and, as such, be understandable to most users. Dr. Landrón stated that an educational fieldtrip (for example to a butterfly garden) could be enhanced by taking students on a nature trail. Therefore, we suggest creating this trail as an opportunity for hands-on learning.

We suggest creating and placing a series of signs to point out various plants and animal habitats. These signs can contain information and history. Figure 4-6 contains a sample sign for a Macarthur palm, a tree found in abundance on Punto Verde's site. Other trees that are currently found on the Punto Verde site are identified on the map in Figure 4-5. Furthermore, we suggest that planting important native plants near the trail can highlight the educational aspects by providing examples of plants that may not be previously found directly near the path. Whenever possible these plants should be transplanted from other areas of the Punto Verde site.

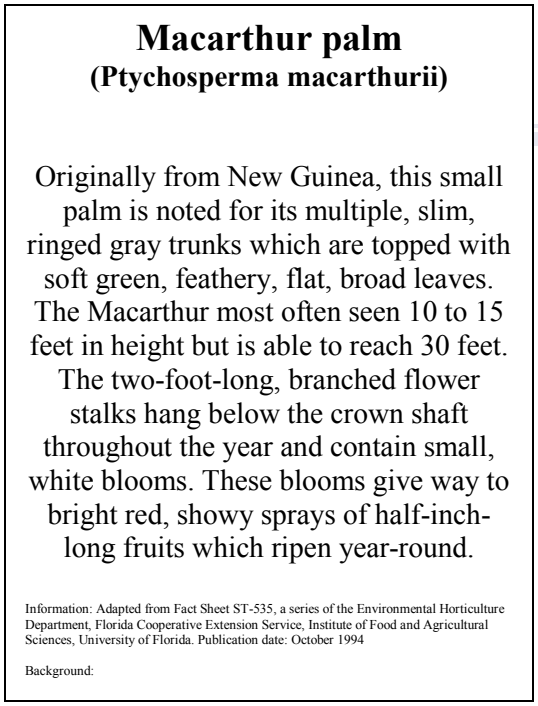


Figure 4-6: Example educational sign

We suggest that the signs also provide an opportunity to educate people on some of the environmental impact human development has had on this area. For example, Julio A. Rodriguez told us that the Río Piedras is polluted. In researching this situation we spoke with Fernando Eomez from the USGS Water Quality Division. He explained that several factors contribute to the pollution. High human population density combined with an extensive stream network creates a situation where most Puerto Ricans live less than a couple hundred feet from a stream or other water source. Low public awareness, poor septic practices, and high personal water use causes the rivers and streams to become polluted with fecal colliform and fecal Streptococcus, (Eomez, 2002). Furthermore, there

is a fair amount of trash in the stream that gets washed there during heavy rainfall. A sign could explain these pollution problems and ask the reader to be more conscious of personal water use, and littering, as well as help change the overall attitude of Puerto Ricans toward the environment.

More example signs can be found in Appendix D, and further work should be done, possibly by arborist-in-training Raquel Soto, to design others. We suggest using these as the basis of the educational program on this nature trail. Appendix D also identifies some of the plants that are found on the trail path (seen also in the nature trail map, Figure 4-5 on page 32) and suggests some other plants that should be located and strategically planted. Some of the plants we suggest planting near the path are ornamental plants that will also be found in the Punto Verde shops.

Costs

It should be noted that because the trail will be short and it was important to attract a wide variety of visitors, it was deemed unsuitable to charge people to use it. As a result these initial costs and further maintenance will be direct expenses to Punto Verde. However, these costs are not prohibitive because this trail will be an important part of Punto Verde and will work in conjunction with our other recommendations. With possible profit from a butterfly garden an overall loss will be minimal or a profit may be realized with time. Furthermore, according to the National Park Service USA 1982, 75% of park construction, in our case trail construction, goes into local wages and thus helps the local community and Punto Verde's goal of wealth generation.

Table 4-3 identifies the costs involved in nature trail construction and gives relevant descriptive information about that cost. This table also gives an approximate total for that cost and when needed the source of that information.

Table 4-3: Cost of nature trail

Cost	Description	Total	Source
Labor	Trail construction should take 50 man-hours (1200 feet at ~30 ft per person hour plus 10 hours extra)	$400	Roger Bell, President and Owner: Nature Trial and Bridge Technologies
Gravel	Trail surface: 3 inches packed. 25 feet per cubic yard, 48 yards total at ~$17 yard	Gravel: $816 Delivery: $50	
Skid Steer loader	Needed for moving gravel and any earth. Rent for one week	$400	Cosco Equipment Sales and Rentals, Cataño, PR
Signs	Custom made and ordered for educational information, 10 signs at ~$50 each	$500	Approximated from research into various companies online
Benches	3 total for resting areas. $150 each	$450	
		Total $2,916	

This estimate is a high approximation; costs can be lowered by building the benches out of trees cleared in making the trial, volunteer construction labor, and contracting the signs to a local artist. These savings could lower the total cost to construct this trail to around $2,000.

Recommendation #3: Construct a Butterfly Garden

Our last recommendation for Punto Verde will be the construction of a butterfly garden. This will be a large mesh enclosure that will house many different species of plants and butterflies. For an admittance price, visitors will be able to walk on a winding

path weaving throughout the landscaping with butterflies fluttering around them. We recommend a waterfall made from river stones flowing into a small pond be located in the middle of this landscape. This attraction is consistent with the criteria we have determined for our recommendations.

Rationale

The construction and implementation of a butterfly garden on the land near Punto Verde's main site can enhance their overall project in many different aspects. An educational based butterfly garden fits in perfectly with all of Punto Verde's main goals and mission.

This garden will have an educational system implemented within it. A group of students can visit the butterfly garden, view a presentation, speak with the butterfly expert, see the butterflies at their different stages of life in the breeding containments, and follow a guided tour through the garden. We suggest the main target audience are elementary schools because they can visit the garden as an educational field trip. After an interview with Dr. Ruth Landrón (Principal of San German Elementary School) we know that students learn about butterflies and some basic nature orientated topics throughout the second and third grades. With only one other commercial butterfly garden on the island there is low competition for this type of educational attraction. Las Limas Mariposario has approximately 100 to 300 students visit each week for field trips (Torres, 2002).

In adherence with Punto Verde's mission of being "community based," local residents will be encouraged to volunteer their time in assisting with the everyday upkeep associated with a butterfly garden. Volunteers can be any age and will have the

opportunity to learn the different aspects about butterflies and either help out with maintenance of the garden or leading tours throughout the garden. This will also provide a great place for the girls at Hogar del Niño to visit, learn, and volunteer. One of the employees of the butterfly garden should be in charge of recruiting, coordinating and training these volunteers.

This attraction would not only appeal to the school children, it would be visited by families and other groups. One of the goals of the restaurant, which will be located in Punto Verde, is to attract many of the local businesspeople for lunches. If the restaurant is successful in doing this, many of them will see signs for the butterfly garden and have the potential to bring their family to visit; "Puerto Rican people are very curious, if they see something new they will most likely check it out at least once" (Renendez, 2002). This will help by providing verbal publicity and help to attract a wide variety of people to Punto Verde.

This recommendation is economically feasible even though there is a relatively high initial cost involved with building a butterfly garden including expenses such as: design, materials, training, and labor. A cost estimate shows some of the detailed costs associated with building this attraction and as previously mentioned the revenue produced will help offset these costs and possibly produce profits.

Implementation

There are many issues and details that must be researched in the implementation of a successful butterfly garden.

Design of Enclosure

One of the first issues in constructing this will be based on the land topography. We have determined that the best location for this will be behind the flower and gift shops (as seen in Figure 4-7). We concluded that this area was close to the main Punto Verde site and would make it eye catching for people to see and visit. Also, the land is not as steep here as in other parts of the land. We also recommend that the main enclosure flow with the topography of the land which will minimize earth movement and help it appear integrated with the area. This enclosure can also be built to work around the main trees that in this proposed area.

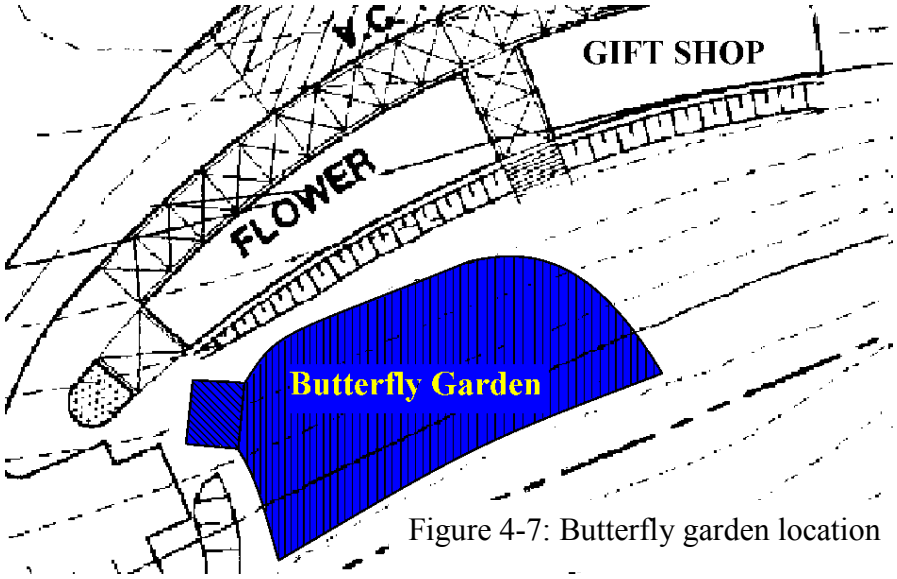


Figure 4-7: Butterfly garden location

An important aspect in caring for these butterflies is providing them a healthy and safe environment which includes protection from predators. When designing the main enclosure it is important that not only the butterflies cannot get out, but more important that no creatures can enter the cage. Insects and lizards consume caterpillars and butterfly eggs which could cause problems in the breeding cycle and reduce the quantity of butterflies in the garden. The main material enclosing the butterflies should be a finely knit mesh. After speaking with Alexis Marsols at the Casa Pueblo butterfly conservatory,

he informed us that mice can chew through this material which allows other predators to enter the garden. To prevent this we propose a thick, sturdy metal mesh be located two feet underground and two feet above ground. This will provide a barrier against predators and increase security for the butterflies inside.

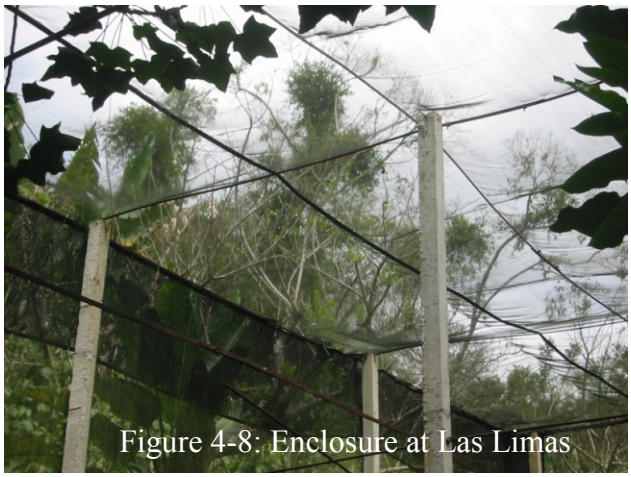


Figure 4-8: Enclosure at Las Limas

The main structure will need to be sturdy in order to survive the weather that it may encounter. The structure will be able to use a mix of trees and cement posts as the main supports (see Figure 4-8). Due to the unevenness of the land, we recommend an architect to design the structure so it will conform to the topography of the land.

Inside a cobblestone path will weave in and out of the landscaping. The entrance and exit will be a double door structure that creates a chamber between the doors so butterflies can not escape and predators can not enter.

Aside from the main enclosure there will be an educational area which will consist of a roofed hut and benches built in the hill looking into the hut. This is where the educational program will take place, tickets can be bought, and general customer service issues can be addressed.

Plants and Species

There are over 18,000 species of butterflies, some are local to certain areas and some exist in many locations (Magic Wings). Deciding which species to house in the garden is a difficult task. This is due to the fact that in addition to water and shade,

butterflies need two specific plants in order to live and reproduce. After speaking with members of the Garden Club, we were told that they have a garden design committee. This committee will be in charge of designing the internal landscape of the garden with the appropriate plants and their placement.

The first type of plant required is called a host plant, and these are specific to each type of butterfly. This plant serves two main purposes: the plant that female butterflies search for and lay their eggs on, and the plant that the caterpillars eat. For example, the monarch butterfly will only lay its eggs on the milkweed plant.

The second plant necessary is the nectar plants in which the adult butterflies feed off of. Nectar plants are not as specific to species like host plants, however, as any animal, butterflies do have preferences. Some examples of nectar plants popular with many species are alfalfa plants, marigold flowers, rabbitbrush, milkweed and clover. It is recommended to group different flowers together to make them more enticing to butterflies which will in turn cause them to fly around these open areas more and be more visible to visitors. Punto Verde should also include different types, sizes, and heights of nectar flowers throughout the blooming season creating a 360º line of sight for the butterflies (Magic Wings). Table 4-4 shows a few of the species that live throughout Puerto Rico which Punto Verde will be able to house in their garden. The table also shows their scientific name and which host plants are necessary. Punto Verde is not limited to only these species for their garden; they also have the option to import different species of butterflies for their garden, specifically from Costa Rica. For the health of the butterflies it is essential that no pesticides be used on any plants in the garden.

Table 4-4: Butterfly species

Common Name	Scientific Name	Host Plant(s)
Monarch	Danaus plexippus	Herbs and vines in the milkweed family
Julia	Dryas iulia largo	Vines in the passion flower family
Black Swallowtail	Papilio polyxenes asterius	Herbs in the carrot or Umbellifer family
Cloudless Sulphur	Phoebus sennae	Herbs, shrubs, and trees in Bean family
Buckeye	Junonia coenia	Herbs in the snapdragon, Plantain, Vervain, and Acanthus Families
Zebra	Heliconius charitonius	Vines in the passion flower family

Breeding

The butterfly life cycle is a very delicate metamorphosis and great care must be taken for them to survive in captivity. The main garden needs to be monitored daily for eggs and caterpillars. Once found, eggs or caterpillars must be placed in a separate containment cage outside of the main garden. This cage will only contain an abundance of host plants and water. The caterpillars will remain in here until they begin to pupate (form a cocoon). Once the chrysalis (cocoon) is formed it will be removed and placed in another cage which will be located in the main garden (see Figure 4-9). The chrysalis will be attached to the roof of the cage and will remain there until the fully grown adult butterfly is formed and released to finish its life cycle.

Figure 4-9: Chrysalis at Casa Pueblo Butterfly Conservatory

For the initial population of butterflies we recommend that Punto Verde capture eggs and caterpillars found throughout their wooded area and breed them throughout their stages of life. This will prevent Punto Verde from having to purchase butterflies when the garden is built.

Educational Program

The educational program will be catered towards elementary school children and therefore the detail levels would be comprehendible for visitors of all ages. We recommend the general educational aspects to include an educational pamphlet, viewing materials such as dried butterflies and insects (seen in Figure 4-10), pictures, posters, and a multimedia presentation. This presentation would include such material as pictures and videos of the life cycle of a butterfly, anatomy, behavior, and reproduction. This presentation would be constantly running throughout the day for people to view and learn.

Figure 4-10: Museum at Las Limas Conservatory

We also recommend a separate educational program geared specifically towards elementary school field trips. This would be a more personalized visit with the butterfly expert talking about butterflies followed by a guided tour through the garden and breeding areas, pointing out the important aspects that go along with it.

Hours of Operation and Staffing Considerations

We recommend that the butterfly garden be open five days a week running from Wednesday to Sunday. The recommended hours of operation will be Wed.-Fri. 9am-5pm and Sat. and Sun. 10am-6pm. The main reason behind the five day work week is this will prevent Punto Verde from having to hire two full time workers. This will save Punto Verde a significant amount of money in yearly salaries.

As previously mentioned, the main worker will be the butterfly expert. Punto Verde has two options for this task, the first is to find and hire a current butterfly expert and the second to find an extremely committed community member or two who would be trained in this field. In order to follow Punto Verde's mission, we recommend the option of training a community member. Many butterfly gardens in mainland United States and Costa Rica offer internships for people to learn about butterfly gardening. One example is the Monte Verde butterfly garden in Costa Rica. Monte Verde provides all volunteers free room and board in return for their volunteer hours. Throughout their training (which lasts between 4-6 months) they also receive the equivalent of a college-level entomology class. This would be an economically sound option for Punto Verde and the person would exit the training qualified to run the butterfly garden at Punto Verde.

Punto Verde will also need to hire a part-time employee for the garden. This person will not require the background and knowledge of the expert and will mainly be in charge of the organizational aspects and maintenance that go along with the garden. This includes organizing the volunteer program, scheduling field trips from schools, selling tickets, and other administrative work.

These two employees coupled with volunteers will provide Punto Verde with an adequate work force to successfully run and maintain the butterfly garden.

Cost

Based on researching many different butterfly gardens, primarily in the mainland United States, we have concluded that Punto Verde will be able to charge $5 for adults and $3 for children and senior citizens.

Punto Verde also has another option to produce revenue with a butterfly garden. Punto Verde's main site will have the appropriate buildings and services to hold weddings near the restaurant. There are many butterfly breeders that sell adult butterflies to be released at weddings. In the beginning Punto Verde will not be able to sell butterflies to weddings held elsewhere because this would require a more in depth breeding program, with more employees and resources; however, it would be easy for Punto Verde to include them in wedding packages held on site. The average price for one dozen monarch butterflies is approximately $90.00 and selling them has the potential to increase the revenue from this part of the project. In research, we were unable to find any breeders of this type on the island. "I get a lot of calls from Puerto Rico from people looking to buy butterflies for weddings, I was hoping someone down there would start this soon" says Melanie McCarthy, owner of Monarch Butterfly garden and breeders in Massachusetts.

Punto Verde's staff has great skills in raising money between donations, grants, and loans. This type of project also has the opportunity to have services and materials donated which has the opportunity to reduce the initial investment needed.

An approximation of the implementation costs and recurring annual costs can be seen in Table 4-5. These figures represent a high estimate associated with this recommendation. As previously mentioned, earth and tree removal will be kept to an extreme minimum and are included in the design and construction costs.

Table 4-5 Cost of butterfly garden

Implementation Costs	
Design and Construction of main enclosure (40'x80' @$8/sqft)	$ 25,600
Design and Construction of information hut (20'x10' @$50/sqft)	$ 10,000
Breeding enclosures (x2)	$ 158
Tools (nets, cleaning tools, etc.)	$ 50
Plants	$ 500
Educational Supplies	$ 500
Total Implementation Cost:	***$36,808***
Recurring Costs	
Full time employee salary	$14,400
Part time employee salary	$7,200
Plants and maintenance	$1,000
Total Recurring Cost:	***$22,600***

As previously mentioned, this attraction will produce revenue. Table 4-6 shows estimated yearly average attendance based on a 40 week operational year. The majority of the attendance from children will come from school field trips.

Table 4-6 Possible income from the butterfly garden

Visitors	**Per week**	**Per Year**	**Income**
Adults	80	3200	$16,000
Children & seniors	250	10000	$30,000
Weddings		5	$450
		Total Income:	***$46,450***
Two year costs:	***$82,008***		
Two year Income:	***$92,900***		
	Profit	***$10,892***	

With these figures the two year costs, including the initial investment and regular annual debits, will be approximately $82,000. If Punto Verde sees attendance similar to that in Table 4-6 they have the opportunity to produce approximately $93,000 in the first two years. This income would completely pay off the initial investment and could leave them with a profit of almost $11,000. This can be extremely beneficial for Punto Verde in assisting to pay for the previous two recommendations.

Chapter V: Implementation Plan

We recommend that Punto Verde should utilize their adjacent land by constructing three outdoor uses, nature-based playground, educational nature trail, and butterfly garden. The three outdoor land activities are complimentary to each other and due to the time requirements to develop each, we recommend that Punto Verde implement all ideas based on three phases. These phases have an implementation plan to allow Punto Verde time to gain funds and to properly implement each idea while keeping the activities' construction within a condensed time frame.

Phase I:
Design and build nature trail while beginning the butterfly garden (8-12 months)

- Obtain any permits to build in the area near the Río Piedras. Design and build the nature trail. A nature trail is fairly low cost and easy to construct giving Punto Verde an outdoor land use while planning the butterfly garden.
- Due to the lengthy time in designing a butterfly garden, hire or train a person to be the butterfly expert to determine the specific types of butterflies and plants to go into the garden (4-6 months).
- Clean the land areas for the butterfly garden and nature playground.
- Hire an architect to design the butterfly garden; butterfly expert and garden club should organize the interior garden landscape.
- Organize a committee for the nature playground plans.

Phase II:
Build butterfly garden and design playground (12 months)

- Place the pylons for the frame of the butterfly garden and pour the slab for the information/ticket hut.
- Obtain any licensing and insurance needed for the nature playground.
- Hire an architect and contractor for the design elements of the nature playground.

Phase III:
Open butterfly garden and construct nature playground (2-12 months)

- Open the butterfly garden to the public and allow revenue generation for Punto Verde.
- Construct the playground. Can be installed on an element by element base in order to construct as money is available.

A decision to recommend all three of the ideas was made due to the fact that they all complement each other. Our main target was to attract school groups that would visit the butterfly garden on a field trip. A walk on the nature trail would also provide an educational experience; lunch can be provided by the restaurant and the children can have a break to use the playground. Furthermore, these land uses will provide a unique attraction for many other audiences including area communities, families, and individuals. These ideas work together to compliment Punto Verde and, although they require a large initial investment of time and money, the project has the ability to produce long-term revenue and could help attract more people to Punto Verde. These recommendations and our implementation plan fulfill our goal and fully meet all the criteria we established.

Appendix A: List of Interviewees

Beatriz Arsuaga: Local Coordinator, Worcester Polytechnic Institute. April 11, 2002

Roger Bell: President, Nature Trail & Bridge Technologies. April 24, 2002

Elaine Cortez: Garden club member. April 9, 2002

Tinti Deyá Díaz: Casa Pueblo. March 21, 2002

Jesus Echevarria: Electrical Engineer and Supervisor, Puerto Rico Electric Power Authority, Office of Studies and Estimates. April 23, 2002

Fernando Eomez: U.S. Geological Survey Water Quality Division. April 23, 2002

Professor Malcolm Fitzpatrick: Civil Engineer, Worcester Polytechnic Institute. January 18, 2002

Del Nido Associados Inc.: Punto Verde's insurance company. April 25, 2002

Dra. Ruth Landrón: Principal, La Escuela de Universidad Interamericana. April 2, 2002

Emilio Martínez: Punto Verde architect, Juan Ayguabibas Civil Engineer. April 16, 2002

Rivera Martínez: Public Relations, Albergue Olimpico. April 2, 2002

Alexis Masols: Casa Pueblo. March 21, 2002

Melanie McCarty: Monarch Butterfly Farm April 10, 2002

Tania Meisner: Administrative Coordinator, Punto Verde PT. March 25, 2002

Teresa Nazario: Community Coordinator, Punto Verde PT. Former board member of Hogar del Niño. March 27, 2002 & April 4, 2002

Rafael Ramírez: Juan Ayguabibas Civil Engineer. April 16, 2002

Maria Renendez: Garden club member. April 9, 2002

Angelita Rieckehoff: General Manager, Punto Verde PT. March 25, 2002

Maresol Rodrajuaz: Department of Social Services. April 26, 2002

Joe Ríos: Speaker, JoeRíos&Associates Experiential Education. April 4, 2002

Julio Rodríguez: Hydrotech, U.S. Geological Survey Water Resources Division. March 18, 2002

Anita Rosario: Los Paseos resident. Garden club member. April 9, 2002

Raquel Soto: Production Supervisor, Punto Verde PT. March 25, 2002

Maria Torres: Las Limas Mariposario. April 25, 2002

Appendix B: Characteristics of Loose-Fill Material

	Wood Chips	Sand	Gravel	Shredded Tires
Initial Cost	Low	May be high due to low resources on the island	Low	Medium
Installation	Easy	Easy	Easy	Easy
Drainage	Good	Low	Medium	High
Abrasive	Less abrasive than sand	Abrasive to floors and plastic materials	Yes	No
Availability	High	Low	Low	Only two tire recycling plants but would need treatment
Climate	Rain and humidity reduce effectiveness	Rain significantly reduces effectiveness	Extreme climate reduces effectiveness	
Depth	Can be reduced over time	Can be reduced over time	Can be reduced over time	Can be reduced over time
Decomposing/ Pulverization	Decomposes over time and compacts	Compacts over time	Compacts over time	Does not decompose but can compact over time
Flammable	Can be during drought	No	No	Yes
Microbial Growth	Susceptible when wet	Not Ideal	Not Ideal	Not Ideal
Other	Subject to theft to use as mulch	Susceptible to fouling by animals	Difficult to walk on	May contain steel wires from steel belted tires

(Adapted from American Rubber Technologies Inc. (2000). Characteristics of Loose-Fill Playground Surfacing Materials. Retrieved April 15, 2002, from the World Wide Web: http://www.americanrubber.com/rubberstuff/index.html)

Appendix C: List of Informational Guides

Recreational Forest Trails: Plan for Success
http://www.ces.ncsu.edu/nreos/rrea/rectrailstoc.html

Trail Design, Construction, and Maintenance References
http://www.trentu.ca/academic/trailstudies/constbib.html

RARE Center for Tropical Conservation
Trails: Conservation that Makes Dollars and Sense

The Butterflies of the West Indies and South Florida
D. Smith et al.

Mariposario Las Limas in Guayama

U.S. Consumer Product Safety Commission
http://www.cpsc.gov/

National Program for Playground Safety
http://www.uni.edu/playground/home.html

Appendix D: Nature Trail Sign Suggestions

Sign suggestions for plants currently found on site on trail path

Tulipan Africano "Meaito"
(Spathodea campanulata)

This tree originally from Equatorial Africa and grows quickly to a height of 80 feet. This is an ornamental tree for the tropics with soft wood. Nicknamed flame of the forest because of its bright orange flowers. The unopened buds are filled with water that squirts out when punctured. The bark of the tree is also used for traditional medicine in Ghana.

Information and Picture: Adapted from Tropilab Inc. 2002. Largo, FL

Common Bambu
(Bambusa vulgaris)

This is the most common species of bamboo in the world and can grow as much as one foot in 24 hours. It is thought that bamboo has been used by humans for at least the last 50,000 years for building construction, dinnerware, and irrigation. In Puerto Rico bamboo has been planted by the Highway Department because it is very good in wet places for soil erosion control. It has bitter edible shoots

Information: http://www.tropical-treehouse.com/historicalperspective.html

Yagrumo
(*Cecropia peltata*)

Originally from Africa, the Yagrumo can grow more than 20 meters and has smooth gray bark with awkward branches. It is used in tropical landscaping for shade. The tree blooms with small yellow flowers. The buds can be cooked and eaten and the leaves can be used in medicine.

Information: Adapted from Floridata 2000
Picture: http://www.hear.org/pier3/cepel.htm

Plantain
(Musa acuminate and **Musa balbisiana)**

Technically plantain and banana plants are the world's largest herbs although they have the appearance of trees, reaching several meters in height with broad leaves that are spirally arranged. Plantains are a good source of Vitamin A, B6, C, and Potassium and provide carbohydrates.

Information: http://www.ladex.com/mayaplantains/htm/plantainworldlargestherb.htm
Picture: http://www.hawaii-nation.org/canoe/maia.html

Plants found on trail (cont):

Guayaba
(*Psidium guajava* L.)

This small tree, 33 feet, from the West Indies is distinguished by it smooth, thin, copper-colored bark that can flake off that shows its green layer beneath. This evergreen tree has oval shaped leaves that are aromatic when crushed and small white faintly fragrant blooms. This tree also produces a pear-shaped light-yellow fruit that can be eaten raw or more often eaten cooked in desserts.

Information: Adapted from Morton, J. 1987. Fruits of Warm Climates: Miami, FL
Background: California Rare Fruit Growers, Inc. 1996.

Other plants found on trail:

Corcho
Almendra
Espino rubian
Royistonea borinquena
(many many others)

Recommended pollution sign:

The Rio Piedras River

Due to Puerto Rico's high population density and extensive watershed network most people live close to a water source. Poor public awareness and inadequate sewage management allows waste to pollute our rivers and streams. Furthermore, litter washes into the rivers during rainfall. You can help by conserving water, picking up litter, and trying to create environmental awareness.

Birds found at Punto Verde

Gauraguao	Zoral
Garia Común	Ruiseñor
San Pedrito	Judío
Tórtola	Pitirre
Reinita	Carpinteno

Sign suggestions for plants not currently found on trail
(We recommend that these be planted)

Moca Blanca
(Andira inermis)

The Moca Blanca is often found along riverbanks and can grow to 35 m in height and more than 90 cm in diameter. It has a dense and spreading crown with bright tan young leaves and shiny green mature leaves. It has a drupe-like fruit with one seed. It has two flowering seasons, one between January and February and the second one between May and September, a fact unique to Puerto Rico.

Information: FACT Sheet
http://www.winrock.org/forestry/factpub/factsh/AINERMIS.htm

Parrot's Beak
(Heliconia psittacorum)

Indigenous to the Amazon rainforest, parrot's beaks are exotic, abundantly bloomers all year long. The orange - red bracts arise from a central point on the stem and the long pointed leaves are shiny green with a red edge. The flowers have ¾ to 1 inch long penduncles that rise above the pointed bracts. Parrots beak

Information: Tropilab inc, http://www.tropilab.com/parrotsbeak.html

Other plants that should be planted:

Roble
Maria
Caoba
Orchids
Fruit trees
Other Palms

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