Feasible Restoration Proposal of El Yunque National Forest Structures

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Abstract

The United States Forest Service was working in El Yunque National Forest to restore historical structures for recreational use. The goal of this project was to create design plans for Baño Grande, Baño de Oro, and the army barracks in the forest. By surveying locals and tourists as well as conducting interviews with USFS employees, restoration ideas were obtained. Field measurements and rendering software were used to create final design proposals, visual renders, and cost analyses.

Acknowledgements

This project was greatly influenced by the support and assistance of several individuals whom we would like to acknowledge. We would like to begin by thanking the United States Forest Service for the opportunity to work on this project, along with our sponsor, Raymond Feliciano, for all the help and guidance he has given us. From transportation to translation, providing access to blueprints and surveying equipment, as well as aiding in the production of our final proposal. Without his support, this project would not have been successful.

Next we would like to take the time to thank the employees of the United States Forest Service as well as the workers of El Yunque National Forest. The USFS staff took time out of their busy schedules to answer any and all questions we had. They additionally helped us by answering our interview questions and revising our surveys, as well as sharing their knowledge of the forest and the structures. Their assistance and hospitality were invaluable throughout this project.

Finally, we would like to thank our advisors from Worcester Polytechnic Institute, Frederick Bianchi and Karen Troy for their guidance and input the past four months that greatly improved our project, along with Sarah Crowne for her resources and writing preparation.

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Executive Summary

El Yunque is a popular destination for both tourists and locals, with an average of 1,250,000 people visiting per year. Roughly half of these visitors are Puerto Rican residents, the other half are people that visit from all over the world (USDA, 2013). As impressive as it might be to have a wide variety of tourism in the forest, there are disadvantages to accruing so much foot traffic within the forest each day. The forest spans 29,000 acres, yet people will visit the same popular spots causing localized congestion. With the restoration of old recreational structures, this would allow for dispersion of visitors and more of a variety of activities in El Yunque (Feliciano, 2016). The United States Forest Service (USFS), an agency that provides forest protection and resources for El Yunque, proposed to restore three sites: Baño Grande, Baño de Oro, and an old army barracks. These would be restored into new recreational sites that would help disperse the foot traffic in the forest, while also creating revenue. Restoration in the forest has been proposed in the past but has never been successfully completed. Our team has been brought in to work with the USFS to come up with a restoration plan for each structure that is feasible and pleasing to the public.

Methodology

In order to complete our project goal, we developed the following objectives:

1. *Find feasible uses for the structures*
2. *Create a restoration plan and design while keeping the historical integrity*
3. *Please the public and potential investors*
4. *Allow for recreation expansion*

To find feasible uses for the three structures in El Yunque, began by surveying the sites. We assessed the land with field measurement tools to determine the different dimensions and

amount of space each building had available before refurbishment could be done. We were also informed that we had to keep the historical integrity of each structure by preserving the feeling that the buildings bring and maintaining the structural aspects of each building. Once we assessed the areas we were working with, we created a large range of ideas of what these structures could be restored into, keeping in mind that the buildings should facilitate some form of recreation for the visitors of the forest. As the options were narrowed down, the ideas were presented to the public in the form of a survey. In both English and Spanish, we asked questions pertaining to each structure and what they would like to see happen to these structures in the future. We added background questions to find out information about how often they had been to the forest and whether they were residents or tourists. Along with surveying the public, we conducted interviews with the USFS employees of El Yunque National Forest to learn why proposed projects for these sites had not been carried out in the past and any other insight they had about the structures. Once that information was gathered, we analyzed the data and found the two most popular ideas for each structure, allowing us to develop restoration plans for each by conducting cost analyses. The cost analyses provided us with the information to determine which of the top two ideas were the most feasible and would obtain the attention of investors as well as community members. As the cost analyses were being conducted, sketch-ups in Autodesk programs were being created for our top idea for each of the structure sites. We designed a visual interpretation of how the restored structures would look. Once these renders were complete, they were part of the key deliverable of our final product, a pamphlet. The pamphlet included the feasibility analysis of each design, the revenue that could be generated from each idea, and the visual aids.

Findings/Results

Through evaluation of our survey, interview results, and cost analysis tables, we were able to develop our findings regarding the restoration process and the three structures.

1. *Why proposed projects have not been successful in the past*

After interviewing the staff of the USFS, we were able to gather information from multiple employees in different departments to determine why restoration projects such as ones regarding our specific structures have not been implemented in the past. Based on the discussions with these employees, prior management was a big factor in the halted progress of previously proposed projects. In any instance of an obstacle, the projects would be discontinued to avoid further issues. Recently there has been a change in higher management and both restoration and the revised Forest Plan are again a major aspect of what the USFS is aiming to work on to facilitate safety and recreation in El Yunque. Along with management, there has been a lack of follow up with projects when they are proposed. Not one person would be in charge of the restoration, resulting in the project being pushed aside and forgotten. Finally, a lack of funding has hindered any restoration plans being completed. No investors have put in money for the ideas, keeping them from even beginning.

2. *The most feasible idea for the structures of Baño Grande*

From the interviews, personal surveys, and online surveys, it was determined that a recreational swimming pool was the most favored idea for Baño Grande pool, followed by leaving the site as it is. For the Baño Grande bathhouse, the most favored ideas were a changing room to accompany the recreational swimming pool, or a cafe. For these four ideas, we then conducted a cost analysis. The cost analyses included estimations for plumbing, electric, materials, labor, construction, yearly expenses, revenue, and return on investment. From this, we

determined the most economically viable option for both the pool and the bathhouse. For the pool, leaving it as a scenic viewing area was the most feasible option because it costs less to restore and is already a very popular location that people visit daily in the forest. There are also many hidden costs accompanied with reopening Baño Grande as a recreational swimming pool because there are many more safety standards that must be abided now compared to when the pool was in use many decades ago. For the bathhouse, the most feasible idea is to turn the building into a cafe that would be used regularly, as it is in a highly populated area of the forest. These ideas will generate the most revenue with little construction cost.

3. *The most feasible idea for the structures of Baño de Oro*

From the interviews, personal surveys, and online surveys, it was found that the most popular ideas for Baño de Oro pool were a wading pool or a flower garden, and for the Baño de Oro bathhouse, the most popular ideas were a concession stand or a flower exhibit to go along with and educate the public about the garden. With that information, we created cost analysis tables that broke down specific aspects needed for each idea which included plumbing, electric, materials, labor, construction, yearly expenses, revenue, and return on investment. After creating both tables for the pool and for the bathhouse, it was apparent that the most feasible option for the pool was to restore it into a wading pool, which can be paired with the bath house being made into a concession stand with changing rooms. These options in tandem with one another, will generate the most revenue with minimal construction costs.

4. *The most feasible idea for the army barracks*

From the interviews, personal surveys, and online surveys, it was found that the most favored ideas were the hotel and hostel for the army barracks. With that information, we created cost analysis tables that broke down specific aspects needed for each idea which included

plumbing, electric, materials, labor, construction, yearly expenses, revenue, and return on investment. After creating the table, the hostel was the most feasible option between the two. Although it would make less money than the hotel, it requires less construction, and will not have to staff as many employees.

It is acknowledged that our procedures are not completely accurate. Our lack of time spent at the sites had some affect our results. We have minimal experience with surveying and interviewing, and have never calculated cost analyses before. The limited time given hinders the amount of surveys we were able to obtain, as well as the accuracy of our feasibility analyses. In addition to this, we were not present during the peak of the visitor season, so we were not able to obtain as much input. Readers of this paper should be aware of the limitations we faced in order to to gauge the credibility of our findings and the following recommendations.

Recommendations

Based on our findings and results, we have developed recommendations for each site, as well as where to go next with the project. These recommendations are purely suggestions based on our research and data:

1. *Final ideas for each site*

For each site, we recommend one final idea for restoration based on all our findings. For Baño Grande pool, we recommend cleaning the area and leaving it as is, creating a space that is more pleasing to the eye as a photo stop. For Baño Grande bathhouse we recommend that it be restored into a cafe because of the location and revenue it would incur. For Baño de Oro pool, we recommend restoring it back into a wading pool with handicap accessibility, and for Baño de Oro bathhouse we recommend it be restored into a concession area. Finally, for the army barracks, our recommendation is that the structure be restored into a hostel.

2. *How to carry out construction*

In order to carry out the restoration of each structure, we recommend that a local contractor be hired. They will have better access to workers as well as the materials needed to refurbish these spaces, as well as the leadership and knowledge to carry out these types of projects. Along with the contractor, we recommend hiring an architect and engineer to work together and optimize the results of each structure. Together, they will restore the structures into up to date buildings, while also keeping the historic integrity.

3. *Where to start*

Once the design plans are finalized, we recommend that the restoration begin at either Baño Grande or Baño de Oro, as these sites have less construction and involvement than the restoration of the army barracks. These are already well known and visited by forest goers, so starting the restoration there will begin to facilitate revenue while the plans for the army barracks are being created and third party investors and businesses are contacted.

4. *Community involvement*

At its current state, the community around El Yunque is separate from the forest itself which creates a divide. In order to facilitate community involvement, we recommend that the people in the community aid in the restoration projects. They would be able to help out with the beginning stages of restoration such as foliage removal and the painting of the structures. Once restoration is complete, the jobs that will be created through these new recreation structures can be given to community members. Jobs could potentially include working the concession, cleaning the pools, and lifeguarding. This will facilitate visitation to the sites as well as unity between the community and El Yunque National Forest.

Our suggestions, if implemented, can create a dynamic atmosphere of restoration in El Yunque. It will create recreation and revenue for the forest and it is our hope that the research and recommendations done by our team can impact the community as well as the economy of Puerto Rico in the future.

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1.0 Introduction

Thousands of people visit El Yunque National Forest every day, yet fail to appreciate all of its amenities due to the fact that they do not have the chance or knowledge to do so. Among many others in this rainforest, there are three historical sites that are currently not being used to their full potential. These include Baño Grande, Baño de Oro, and an army barracks. Baño Grande and Baño de Oro are Civilian Conservation Corps era sites built within natural creeks for recreation purposes in the 1930's. The army barracks were used during the World War II as housing for the military personnel operating the radar and communications systems located on top of El Yunque Peak. These structures are not in the most ideal condition, but with the help of the United States Forest Service (USFS) and third party investors, they can be restored and used for alternative purposes.

Restoration of these structures would potentially help disperse visitors throughout El Yunque as well as bring in more revenue. However, money is scarce and so are materials that would be needed for restoration due to the fact that Puerto Rico has to import all goods through the United States and their distributors. The structures are also surrounded by foliage and fragile ecosystems that could be damaged if disruptive construction were to happen. These circumstances make it rather difficult to refurbish these sites which is the alternative to their continual deterioration.

Restoration in El Yunque National Forest is dependent on many factors. These include local opinion, historical preservation liability, success of past projects, and resources available to use throughout the restoration process. Locals may be apprehensive when it comes to altering the structures of El Yunque so it is important that the overall renovation goals include their opinions because it is crucial that new restoration generates revenue and interest. When considering the

historical importance of each structure, the architects in charge of the refurbishment must follow the historical aspects of the buildings as strict guidelines. Rather than having the historical importance hinder the new design, they will use it to their advantage. The history remains important, but the structures will also become more practical and inevitably help the economy of Puerto Rico.

It is important to look at projects done in the past to determine how best to approach a new plan, looking into the correlation between completed projects, and what was done to make them successful. If a project was not successful it would be beneficial to take into account what may have gone wrong during the course of the project so that it can be avoided in the future. It is known that some of the structures have been restored in the past into other useful buildings. For example, the army barracks were converted into an aviary in the 1980s, and the bathhouse had been a public restroom for a short period of time. However, neither building brought money into the forest, which is now an important consideration that needs be factored into future projects.

The goal of our project was to develop a design that would feasibly restore the structures into recreational areas that not only the visitors would approve of, but the employees of USFS and investors would as well. Our first objective was to inspect the land surrounding each structure, and take measurements to get a better understanding of what could be done to each place. Next, we surveyed visitors of the forest to get a better perception of what they would prefer to see the buildings become. USFS employees were also interviewed to get their professional input on the project at hand. We then developed a restoration plan of all possible ideas for the structures with cost analysis and surveying variables factored in. This included plans for plumbing, electricity, materials needed, and estimated labor as well as the data taken from the interviews and surveys conducted. Three-dimensional renderings were then created, making the designs easier to

visualize. Once ideas were finalized for the three structures, a pamphlet was created to entice investors and layout the options. The pamphlet displayed all possible refurbishment ideas, the cost considerations of each, and the physical designs of the new recreational areas.

If the investors are in favor of the outlined designs, it is likely that they will provide the grants needed, which could result in the actualization and construction of our project. If completed, it is anticipated that the newly restored structures could help disperse visitor foot traffic, increase recreational offerings, and generate potential revenue for El Yunque and the community.

2.0 Background Literature

2.1 Introduction

This background section will cover various aspects of restoration including previous successes and failures, how restoration projects have changed over time, the role of culture, economy, and environment, as well as the financial aspects of construction. This chapter will further highlight the history of the United States Forest Service and their past projects. It will also cover the history and description of El Yunque National Forest and its structures and will conclude with the current considerations for restoration. This information will provide a foundation for determining the most feasible ways to restore Baño Grande, Baño de Oro, and the army barracks.

2.2 Overview

When renovating historic buildings there are frequently two different approaches, to restore or to rehabilitate. Restoration is the process of returning something to its original condition, or something similar to its original condition (Cambridge University Press, 2016). Rehabilitation is the altering or adding on to a historic area to meet the need of the newest use of the space while retaining the site's historical characteristics (USNPS, N.d.). The historical integrity must be preserved by law in some cases so there may be hindrances when attempting to reconstruct with a new design.

Undoubtedly, the main goal of restoration is for it to be successful. A successful restoration project could mean many things including sustainability, longevity after completion, profit and revenue, and more. An example of a historical building restoration project would be the work done on Ulm Turner Hall in Minnesota (Westcott, 2006). The project entailed fixing

damages acquired from overuse, creating more handicap ramps which provided accessibility to all levels of the structure, and adding a handicap bathroom (Westcott, 2006). Although the motivations for all example projects differed from restoring the environment to creating accessibility for the handicapped, the outcomes had numerous benefits, some of which were the generation of new jobs, an increase in property value, and the betterment of an area for the use of the local community.

2.3 Restoration Approaches Over Time

Restoration approaches are constantly changing. Traditionally, when restoring a structure, it is a goal to keep its original feeling, such as authentic materials and detailing, so the memory of the structure lives on (Higgs *et al.* 2014). However, more recently, this idea of a more conservative refurbishment has been altered to suit more beneficial designs. These designs will look at the historical background more as a negligible guide than a template for design, and will very lightly consider the original architecture so that there is ability to create a more useful end product (Higgs *et al.* 2014). The reason for the updated approaches is to be more practical when refurbishing a structure into something that can be useful again, and not to have a building be depleted of its full potential. This change in patterns of restoration is especially important in a country like Puerto Rico, where money and resources are scarce, so practicality is crucial (Higgs *et al.* 2014).

Another factor as to why agencies do not focus so much on keeping the historical integrity of buildings as of late, is because they may be in poor condition. In a tropical environment like Puerto Rico, it is difficult to maintain a historical building from a constantly changing environment and weather over the years. “Community planning” has also been integrated more into restorations of structures in recent years (Swagerty, 2014). Agencies want the residents of the

area to be more involved in what a structure becomes and feel that if the citizens have more input, they will be more likely to be in support of the refurbishment (Nick Wates Associates, 2011). This involvement can lead to a higher morale in creating the structure, and potentially intrigue some investors, seeing that so many citizens are in favor of the restoration.

One example of a building that has been restored but has kept its entire historical integrity is the Old North Church in Boston (Polizzotti, 2016). Created in 1775, it is the oldest church in Boston, and was also the location of the famous "one if by land, two if by sea" signal (Polizzotti, 2016). Today, the building is still used as an Episcopal church, but also has a museum section that people visit frequently (Polizzotti, 2016). This building has been refurbished, but only to update and maintain its aesthetic. The church looks almost identical to when it was first created.

An example of a structure that was refurbished into something completely new and did not keep its historical aspect, is an army bunker in Vieques, Puerto Rico (Muse, Soltero, & Suarez, 2015). In 2015, a group of fellow Worcester Polytechnic Institute students worked with Para la Naturaleza, a nature protection agency in Puerto Rico that works towards environmental sustainability. This organization is geared toward the contribution they can make to the social capital of all Puerto Ricans by being volunteer oriented and focused on natural resources and the protection of their land (Para la Naturaleza, 2016).

In WPI's collaboration with Para la Naturaleza, they focused on the refurbishment of an abandoned army bunker and designed something useful that could help produce some revenue for the island of Vieques, which is a very poor area of Puerto Rico (Muse *et al*., 2015). They developed the idea of a mushroom farm that was to be started by the project team, but would eventually be run and maintained solely by the residents, even after the IQP project was completed (Muse *et al*., 2015). The group researched electricity and water resources, as the

bunker had neither (Muse *et al*., 2015). They came up with solar panels for electricity, and a collection system that would accumulate rainwater (Muse *et al*., 2015). As for the farm itself, they measured the square footage of the bunker, and calculated out how much room mushrooms would need to grow (Muse *et al*., 2015). They also figured out how many mushrooms that could grow per year, in order to get the most product out of each harvest (Muse *et al*., 2015). With the completion of the project, the mushroom farm not only created a new resource that would bring in revenue, but offered jobs to the citizens as well, which integrated "community planning" (Muse *et al*., 2015). This project is a good example of what can be done with an old building, and could be used as a helpful resource to other restoration projects that will take place in Puerto Rico. It is important to look at projects done in the past to determine how to approach a new plan in the best manner.

Another illustrious example is the case study of the Cuartel de Ballaja in Old San Juan. The structure which once served as the Military Quarters for the Spanish Army during the 19th century and later as the Headquarters for the U.S. Army during the first few decades of the 20th century had fallen in complete disrepair by the 1980's. Then in the late 1980's and early 1990's the historic property was submitted to a large scale restoration and refurbishment project. The restoration work helped rescue the property from demolition and now serves as office space, a museum, restaurant and retail space, as well as grounds for various activities (Feliciano, 2016). By looking into the parallel between successful projects and what was achieved to make them favorable to all parties, it may suggest how to proceed with future projects with similar intentions.

2.4 Role of Culture, Economy, and Environment

Culture could be defined as the way of living of a particular people; it refers to the ideas, customs, and social behavior of a certain society (Oxford University Press, 2016). Culture brings

a sense of integrity to a community and its members, and Puerto Rican culture is extremely diverse. When Spain occupied Puerto Rico, they attempted to populate the island by intermingling with the Taino people (Rivera, 2016a). Later, African slaves were imported to help with labor and the maintenance of crops and subsequently immigrants from all over the world migrated to the island to work in the cultivation of the main agricultural cash crops during the 18th and 19th centuries. After Puerto Rico became a territory of the United States, there was an influx of American people but the most significant instance of immigration was when Cubans came to escape the Communist state induced by leader Fidel Castro in 1965 (Rivera, 2016a). Because of these influences, Puerto Rico is quite diverse and citizens regard themselves as a distinctive island nation regardless of their colonial condition and the fact that they are American citizens (Advameg Inc., 2016). This acceptance of different cultures will aid in how they view restoration efforts, as they will most likely be open to many different approaches of the ideas for El Yunque.

In part, culture is molded by the introduction of industry, and cultural development has been correlated to business and commerce. In the 1930s, Puerto Rico experienced an economic and political reconstruction led by the U.S. after the decline in the production of their main export, sugar (Bonilla & Campos, 1981). Workers left the sugar plantation fields for the factory jobs presented by American companies and thus foreign capital in Puerto Rico quickly increased. This drastically affected the way of life for the residents, reducing the incipient agricultural system the coexisted with the pseudo-feudal plantation system in exchange for a blue collar, manufacture based economy of production and consumption of foreign goods.

Currently, the economy in Puerto Rico is not in an appropriate state to fund any major restoration mainly due to the decade-long economic depression they have been and are still currently enduring (Walsh & Moyer, 2016). Many things factor into Puerto Rico's unstable

financial situation, but it mostly derives from the island's incapability to become self-sufficient (Walsh, Moyer, 2016). It is difficult for Puerto Rico to thrive on their own because they are so reliant on imports from other countries. Their main exports include pharmaceuticals, electronics, canned tuna, rum, beverage concentrates, and medical equipment, while their imports include chemicals, machinery and equipment, clothing, food, fish, and petroleum products (Sandbox Networks Inc., 2016). Although there are many exports, they do not create as much revenue as imports that they receive.

Additionally, the government's action of accumulating a massive public debt has been an integral factor that has lead to Puerto Rico's financial situation (Walsh, Moyer, 2016). 46.2% of Puerto Ricans live below the poverty line due to the troubled government and massive amount of layoffs (Chappatta, 2016). This crisis was brought on by the end to corporate tax breaks in 2006 which were initially put in place to help the economy grow and to create jobs (Walsh, Moyer, 2016). After the expiration, many companies fled elsewhere to expand their business because it was cheaper and in a better environment (Walsh, Moyer, 2016). This caused the official unemployment rate to skyrocket to 11.8%, which is more than double the national U.S. rate (Long, 2016). Congress has put Puerto Rico in a terrible situation by stripping their Chapter 9 bankruptcy rights in the 1980s. Now they are struggling to pay off over 70 billion dollars of debt (Long, 2016). With the current situation regarding the national debt crisis, it is unlikely that any restoration projects will have any federal support due to the also negligible economic situation of the United States government and the decreasing funding allocation by Congress to the Forest Service programs beyond fire suppression.

The environment also plays a large role in construction projects. Puerto Rico follows the laws of the U.S. Environmental Protection Agency (EPA). The EPA provides strict policy for

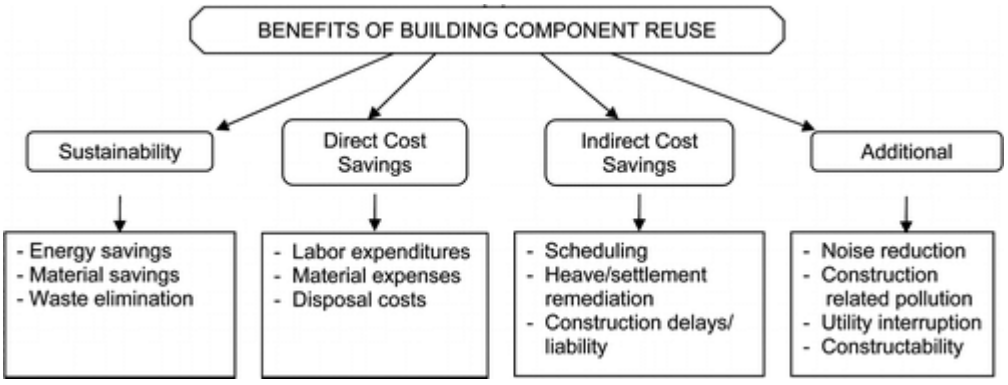
construction including laws and regulations, such as, topics like demolition waste compliance and the prohibition of certain toxic discharge such as motor fuel (USEPA, 2016). All agencies that plan on doing construction must prepare a written statement of the environmental impact of their proposed actions and have it approved by the EPA (Domenech, 2004). The environmental impacts in which the agencies have to take into consideration include: land, air, water, minerals, flora, fauna, noise, and the historical significance of objects or areas (Domenech, 2004). Specific to Puerto Rico, the first steps an agency must go through to start building are to request recommendations and determination of environmental compliance from the San Juan Permits Office of Municipality, obtain recommendations from Natural and Environmental Resources Department, and then proceed to get the proper permits (The World Bank Group, 2016). The environment and policies protecting it present many restrictions that must be followed meticulously so that a project can be carried out on time while also abiding the local and federal law (USEPA, ND).

2.5 Cost of Construction

After evaluation, rehabilitation must be motivated by practicality, financial feasibility and historical protection. This would be the alternative to total reconstruction of the structures (Laefer, Manke, 2008). Rehabilitation refers to the process of rebuilding a structure to improve its condition and efficiency by enhancing old function or creating new ones (Paules, Watts, 1971). Reconstruction would present challenges because there may have to be building above and below the ground level. This may be too invasive to the forest floor and disruptive to the local ecosystems. By opting to reuse the existing structure, there would be many beneficial outcomes including reduced debris generation inside the forest, amplified savings of materials, and minimal need for outside resources (Laefer, Manke, 2008).

An example of cost analysis for rehabilitation projects is the estimate given for the area of Tucson, Arizona. If rehabilitation were to be performed by professionals on nineteenth century historic structures in Tucson, the cost for public use would be around $20 per square foot. If a building was restored for private use in the same area, the costs for rehabilitation would average between $10 and $20 per square foot and the cost would be lower if the buildings were only partially restored (Paules, Watts, 1971). The most expensive aspect of any construction is the addition of air conditioning systems, plumbing, electrical lines, and any other mechanical system. Complete building replacement would have a longer timeline for construction and project completion and would therefore also accrue more cost. This is why the proposal of partial rehabilitation over demolition would be the most ideal. The direct savings from reuse of any part of the structures could be considerable (Figure 1).

Figure 1: Benefits of Building Component Reuse



Source: (Laefer, Manke, 2008)

2.6 El Yunque and the USFS

El Yunque National Forest is a large part of Puerto Rico, located in the northeastern section of the island. At 29,000 acres, it is considered to be one of the smallest tropical rainforests

in the world, yet one of the most diversified in regards to the wildlife and vegetation found within (USFS, 2016b). El Yunque was first declared a forest reserve in 1876 by the Spanish Crown; it was one of the first land reserves of its time and has remained virtually untouched since. In 1898, the land was passed to the United States from Spain when they acquired control over Puerto Rico after the Spanish-American War (Fossweb Staff, 2003). This came at a time known as the Era of Concern, when people realized the nation had limited resources, and needed to create a sustainable society. They would need an agency such as the United States Forest Service to control and maintain their natural resources as well as lead the way to a more tenable way of living (USFS, N.d.).

The United States Forest Service (USFS) is an agency under the United States Department of Agriculture established in 1905 by Theodore Roosevelt and Gifford Pinchot to provide needed forest protection and resources throughout the United States, and later Puerto Rico (USDA, 2013a). The agency began protecting El Yunque National Forest in 1907 when it was under a different name of Luquillo National Forest (USDA, 2013b). The USFS is an exceptionally large agency, protecting over 150 national forests nationwide, almost 200 million acres of land (USFS, 2016a). They work to manage resources and protect and maintain the natural beauty that is left in the United States so everyone is able to enjoy it, now and for years to come. The USFS also collaborates with countless other partners such as private landowners and tribes to preserve the ecosystems that could be damaged by tourists and other local visitors (USFS, 2016c). The USFS is fundamental in providing support and resources for national forests and reserves throughout the United States and Puerto Rico and because El Yunque National Forest is the only area in Puerto Rico protected under the agency, they work diligently in making sure the forest is maintained and continues to stay healthy and prosperous through restoration.

Today, El Yunque is a hotspot for tourists and locals alike, with an average of 1,250,000 people visiting per year. Half the visitors are locals, the other half being people from all over the world (USDA, 2013). People living on the island tend to visit more in the summer months, while tourists visit more often in the winter and spring. However, year round visitors enjoy the numerous recreational activities that the forest has to offer. This includes camping, hiking, swimming, sightseeing, as well as enjoying the history that comes from structures within the forest itself.

2.7 USFS Mission

The United States Forest Service's mission is, "To sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of the present and future generations" (USFS, N.d). This mission can be summarized by their slogan, "Caring for the land and serving people", which clearly expresses the purpose of the organization (USFS, N.d.1). To fulfil the mission the USFS is divided into five major groups (USFS, N.d.1). These include: research and development, national forest system, state and private forestry, international programs, and business operations (USFS, N.d.1). These five subgroups have multiple focus areas to ensure that the agency's mission is always the top priority. The focus areas are comprised of: healthy forests, recreation management, water and quality support, partnerships, markets for ecosystem services, and informed citizenry (USFS, N.d.1).

The agency follows a strict strategic plan that has seven goals (USFS, N.d.1). The strategic plan's goals include: restoring, sustaining and enhancing the nation's forests and grasslands, providing and sustaining benefits to the American people, conserving open space, sustaining and enhancing outdoor recreation opportunities, maintaining basic management capabilities of the forest service, engaging urban America with Forest Service programs, and

providing science-based applications and tools for sustainable natural resources management (USFS, N.d.1).

2.8 Past USFS Projects

A restoration effort done by the USFS was the Watershed Restoration Program, done in 2011 (USFS, 2016d). Although it was not the refurbishment of structures, the agency worked to better the condition of watersheds around the country, which is also considered restoration (USFS, 2016d). A watershed is land space that funnels rainwater and snow into a waterway, marsh, or lake to be caught and saved for later use (Forsefield Inc., 2016). The project goal of USFS was to improve the physical and biological conditions of the watersheds, making sure that they functioned correctly and did not have any contaminations that would affect the water supply. Watersheds are important to maintain because they contribute to 20% of all water supply in the United States, and if contaminated, can affect things such as drinking water for many Americans (USFS, 2016d). The sub projects that were done with the overall restoration of the watershed included stream, riparian, and road restoration (USFS, 2016d). The streams were stabilized by being decontaminated, had side streams added for fisheries and riparians, and added spawning gravel for fish to lay their eggs in side streams (USFS, 2016d). Riparian areas, better known as floodplains, had new foliage planted around them that would aid in stream shading for the fish, as well as keep away invasive species of plants (USFS, 2016d). And roads were reconstructed to help with drainage and reduce sediment from contaminating the water (USFS, 2016d). This restoration led to improved watersheds throughout America, which in turn led to improved sources of water.

In the recent past, there has been a similar, if not identical, proposal to restore the abandoned Baño Grande structures, which include a pool and bathhouse in El Yunque National

Forest. The idea was originally proposed in 2002, revised in 2003, and then finally proposed again in 2006 by a forest supervisor named Pablo Cruz (Cruz, 2006). He came up with the idea to restore the bathhouse into a souvenir shop with bathrooms, as well as making the structure wheelchair accessible (Cruz, 2006). He also proposed some minor restoration projects in the surrounding area. These projects included restoring the 18 ft. deep Baño Grande pool into a recreational swimming area, re-doing the nearby trails, and adding a small bridge to make the structure more accessible (Cruz, 2006).

With the proposal, came some obstacles. Most Puerto Rican locals were in support of the proposal, but some expressed their concerns. One of the main topics the people brought up was hopes of minimizing damage to the surrounding forest. If destroyed, it would affect the ecosystem and potentially harm wildlife such as birds, lizards, and coqui. The locals also expressed concern with how the restoration would affect the visitation to the area. The new restoration would most likely increase foot traffic to the area the structures are located in. While being a good thing, this could also lead to too many people and a higher possibility of pollution or harm to El Yunque (Cruz, 2006). In addition, the locals were concerned about assuring the structures maintained some of their historical features, seeing as the buildings were built in the 1930s and early 1940s (Cruz, 2006). The public seemed to be in favor of refurbishment, but they preferred that the entire building not be destroyed so some of the past was still able to be recognized.

This project was unfortunately never completed. Although the specific reasons are unknown, there are a couple possibilities as to why the proposal never became more than just that. One reason may have been a lack of funding. The USFS typically works with a third party investor that will provide money if they believe the idea is exceptional, so it is possible that whomever was investing in this particular project did not approve of the restoration, therefore

abandoning it completely (USFS, 2016). Another possibility may be that the agency could not figure out an appropriate time to refurbish the structures. Because Baño de Oro and Baño Grande are such popular locations to visit in El Yunque during the summer, it would be difficult to perform the restorations then. The contractors would also want to avoid the wet season in Puerto Rico, as constant rain would be a nuisance to deal with during any construction. The rainy season generally lasts from the beginning of June to the end of November, further reducing the time they could possibly use to do the restoration (Frommer's, 2016).

2.9 El Yunque Structures

Throughout El Yunque National Forest, there are a few historic structures that have not been used in many years and were created in the Civil Conservation Corps (CCC) era. The CCC was a United States agency that operated during the Great Depression from 1933 to 1942 that provided jobs to single men and was used to improve roads, parks, and other various recreational structures (Foundation, 1996). Since they were built, Baño Grande and Baño de Oro have been great tourist spots located in the forest, but the army barracks is less known to visitors because it has never been open to the public. Baño Grande, used from roughly 1936 to 1968 as a bathing pool, was built on top of a creek with stairs leading to a bathhouse. The pool was eventually closed to swimmers and turned into a scenic visitation spot, presently it is slightly overgrown with vegetation, but remains in extremely good condition (Feliciano, 2016). The bathhouse was reopened in the 1970s as a restroom, but was only in use for a few years (USFS, N.d.2). Baño de Oro pool and bathhouse were in use in the 1940s, the pool as a public swimming pool, while the bathhouse was used as changing rooms and restrooms. Both structures are overgrown with vast amounts of vegetation because they have not been in use for almost 70 years.

The army barracks, located a short distance uphill from Baño Grande and Baño de Oro via an access road, was used in the 1940s as quarters to house the crew operating the radar and communications installations located at the top of El Yunque Peak. (Feliciano 2016). In the mid 1980s the barracks was turned into an aviary by the Fish and Wildlife Service, to house the Puerto Rican Parrot (Feliciano, 2016; USDA, 2013). There were hatcheries as well as the main office space for the workers, while the surrounding area had a multitude of cages for the breeding program. About fifteen years ago, the aviary was closed because the temperatures were too cold on the top of the mountain for the birds to live comfortably (Feliciano 2016). The USFS made a new aviary on the lower elevation of El Yunque and the old building has been unused ever since (Feliciano 2016). For pictures of the structures, see Figures 2-8. For more photos of the sites, see Appendix A.

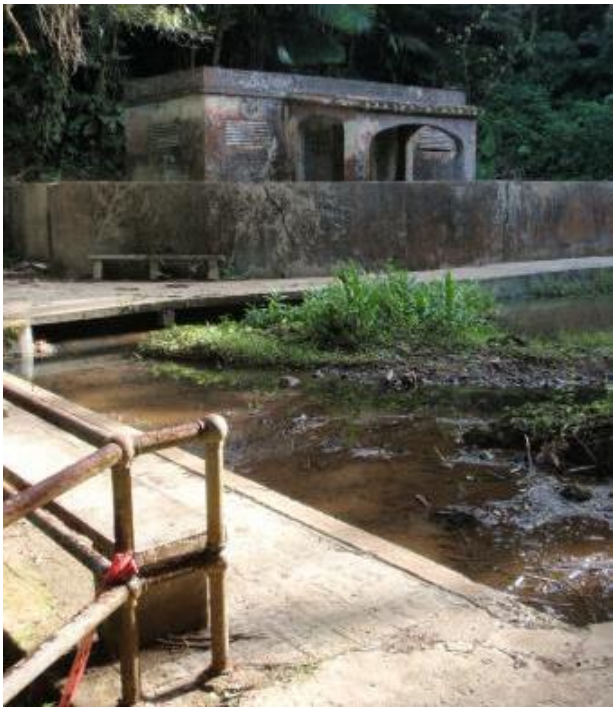
Figure 2: Baño Grande Pool

Source: (McTigue, 2005)

Figure 3: Baño Grande Bathhouse

Source: (Salmon, 2016)

Figure 4: Baño de Oro



Source: (Trip Advisor, 2016)

Figure 5: Baño de Oro Bathhouse

Source: (Salmon, 2016)

Figure 6: Baño de Oro Pool

Source: (Weeks, 2016)

Figure 7: Army Barracks

Source: (Feliciano, 2016)

Figure 8: Inside of Army Barracks

Source: (Maiola, 2016)

These structures are considered historically significant. Specifically, Baño Grande and Baño de Oro which are listed in the National Register of Historic places. These structures, along with the others, are considered historic, so there are certain protocols that must be followed during restoration. The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association. When a structure is classified as being historic, it must fall under one of four separate criteria for evaluation: a) associated with events that have made a significant contribution to the broad patterns of our history; b) associated with the lives of persons significant in our past; c) the structure must embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; d) or finally, that have yielded, or may be likely to yield, information important in prehistory or history (Feliciano, 2016). The El Yunque structures, will fall under criteria (a) and (c), and must narrate the history of the structures as well as keep the integrity of the buildings, whose aspects include location, design, setting, materials, workmanship, feeling, and association.

2.10 Conclusion

Overall, the research presented in this chapter suggests that restoration is a process that can take many forms and different approaches. Each approach will be dependent on the economy and the culture of the area in which it will occur, as well as the cost of construction itself. The restoration in El Yunque National Forest is dependent on many factors including what the residents of Puerto Rico and USFS want, the historical and environmental constraints, the success of past projects, as well as what resources will be available throughout the restoration process. It

is essential that the right plan is chosen for these structures or construction may be delayed, similar to earlier efforts for their renovation.

3.0 Methodology

The methodology chapter highlights the steps taken once we arrived in Puerto Rico. Our project goal was to efficiently and feasibly create restoration plans for Baño Grande, Baño de Oro, and the army barracks inside El Yunque National Forest. To fulfill this goal we visited the sites of the structures and took field measurements to better understand the potential of the structures and sites. In addition to this, we observed the geography and conducted surveys and interviews with the public and staff of the United States Forest Service (USFS). This was to determine fitting refurbishment ideas that would be favored by all. The feedback and data from these surveys and interviews aided in the process of narrowing down the list of possible restoration ideas. Next, we gauged the feasibility of these ideas and the financial constraints that would hinder their application. Finally, we sketched and rendered our project ideas into Autodesk systems. The course of our project and tentative plan is outlined in our timeline, which was followed as a guideline for our accomplishments the duration of our time in Puerto Rico (Appendix B). The completed project was then presented to the USFS and they would have authority to show potential investors.

3.1 Physical Design

3.1.1 Field Measurements

In order to develop a restoration plan, we assessed the land of El Yunque and the state of the structures. This was done by surveying and measuring horizontal distances, elevations, directions, and altitudes. It was important that we closely observed the area that we worked with

in order to determine what needed to be modified on the structures before inciting solid ideas for the restoration.

When we visited these sites, we brought field measurement tools that we obtained from our sponsor which included: measuring tapes, which are useful for measuring long distances; a leveling kit, which is used for observing elevations of uneven land; a tripod, which can be a center point for data as well as taking measurements of the terrain with various attachments; a tape measure, which takes the measurements between two points up to thirteen feet; and a protractor, which was used to accurately take the angles between the structures for better rendering. These tools were very important for taking field measurements which included the heights and widths of the structures and their walls, the distances between the structures, as well as ceiling and level heights to determine the amount of space there is to work with. With this information, we were able to determine what could be done with the spaces. We had a better idea of what could fit in each structure, helping determine what said structures would become.

3.2 Personal Communication

3.2.1 Interviews

Within the first four weeks of being in Puerto Rico, we conducted interviews with the USFS workers as well as other workers in El Yunque. We interviewed the employees at the USFS office located in El Yunque. The interview questions were focused on obtaining previously identified ideas and eliciting new ideas (Appendix C1). Majority of questions we asked were to get to know the workers, and the final two questions asked what their opinions were about each site and why in the past some structures have failed to be restored. These professional opinions were taken into consideration because they have years of experience with the forest and are much

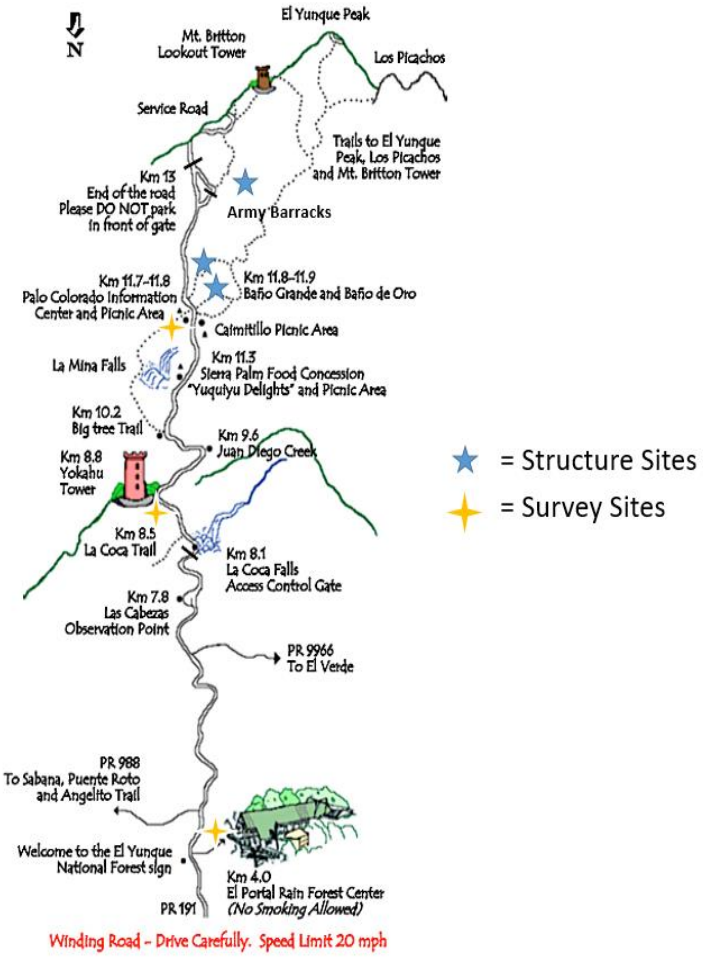
more knowledgeable about what ideas will most likely thrive. Those who are in the forest daily undoubtedly have some ideas of their own for the three structures and may also have received suggestions already for the repurposing of the structures while working in the forest. However, their ideas were also taken with a bit of discretion, as they have worked together for many years, and because of that may have some swayed or biased views. Any new ideas were added before conducting our survey. From this, we began accumulating data to help generate accurate and generalized opinions of what the USFS workers would like to see these structures become.

3.2.2 Surveys

An important consideration for the restorations is visitor recreational enjoyment, but also project feasibility, including the possibility of revenue generation. To better understand what the visitors were interested in, we administered surveys. For the month of November, we surveyed visitors of the forest two to three times per week. The surveys were in English and Spanish so that the residents of Puerto Rico were more apt to participate and have a better understanding of what we were asking. The surveys included 13 questions that helped us find the best possible ideas for the structures to provide to the USFS (Appendix C2. C3). The first several were general questions about who was taking the survey, how often they visit, and how much they would pay to use recreational facilities. The rest of the questions, which were also the most important, asked what they would like to see each structure become. There were photos of each structure on the survey as well, so the participants could get a better idea of what they look like. We listed our top ideas based on the input of our sponsor, and people checked which they preferred. We conducted surveys at El Yunque both prior to visitors entering the forest to make them aware of these structures, as well as approaching them when they were exiting the forest to get more conclusive and informed feedback. We set up a table with photos of the three sites and the structures located

at each, and had English and Spanish paper surveys to give out. Photos of the survey set-up can be viewed in Figures 10 and 11. We surveyed at three different locations: El Portal Visitor Center, Yokahu Tower, and Palo Colorado Information Center. The locations on a map can be viewed in Figure 9, and photos of the sites can be viewed in Appendix D1 - D4. The onsite surveys that we administered (98 total) were taken into account the most because people were seeing the sites firsthand, and we were able to answer any questions they had in regards to the structures, helping their decisions become more informed.

Figure 9: Map of El Yunque



Source: (United States Department of Agriculture, 2013c)

Figure 10: Survey Site Set-up

Source : (Murphy-Cook, 2016)

Figure 11: Close-up of Survey Site Set-up

Source: (Murphy-Cook, 2016)

3.2.3 Social Media

In an attempt to reach as many people as possible, we created an online survey in addition to the paper one. This survey was extremely similar to the paper version that was given out to visitors at El Yunque, and was also available in Spanish. One difference was that there were short descriptions of each structure along with the pictures of the structures, so people who never visited knew a bit more and could make more informed decisions. The other difference was that instead of being a multiple choice question about how much someone would be willing to spend to use a recreational site, it was a fill in the blank. This was done to see what exact amount people would be willing to pay. We used WPI Qualtrics to create the online survey, as it was reliable and simple to use.

We first attempted to put the surveys on the USFS and El Yunque's social media pages, but it was denied, as the clearing process would have taken too long for the short amount of time we are in Puerto Rico. However, the WPI Interdisciplinary and Global Studies Facebook page posted the English version of our survey to share with the WPI community. All of our group and our sponsor also posted the surveys on social media; our group posted the English version, and our sponsor posted the Spanish version. The USFS Communications and Public Outreach employees helped us initially set up the survey and we took over to analyze and interpret the responses that were received. The online surveys shared on social media were taken into account the least, excluding the Spanish versions. Because they were shared on our social media, a majority of participants were family and friends whom have likely never visited El Yunque. They may still have ideas, but because they have never seen the sites in person, it is a bit harder for them to form an educated opinion. We took into account the online Spanish surveys more as it was more likely that a resident were to have filled out that survey as our sponsor was the one who

shared it, giving them a higher chance of having visited the structures before. We were optimistic about putting up an online survey, and hoped it would aid in retrieving a wider pool of people who have been to El Yunque in the past. In total, we received 162 online surveys. The more information that was acquired, the broader the perspective reached, resulting in more accurate decisions when deciding which restoration ideas to work with.

3.3 Implementing Ideas

3.3.1 Narrowing Down Designs

Once we accumulated an adequate amount of survey and interview data, we began our process of sorting through and narrowing down our options for restoration or refurbishment of the three sites. Our first step was to identify the ideas that were selected most frequently in the surveys. These ideas represent the critical input of local residents, tourists, and staff. These were the options we considered most in the next step when assessing our feasibility. For each structure, we then determined the two most popular and theoretically achievable ideas to perform a cost analysis on, and figured out which ideas were the most feasible.

3.3.2 Feasibility

After taking in the information gathered from the surveys as well as interviews, we conducted a feasibility analysis, which deduced how to determine the resources needed to complete the project. It was important to examine the project and determine the need fulfilled by the proposed ideas, how we best took advantage of the space and location of the structure, as well as the obstacles that we faced when carrying out the project. We determined what resources and

labor would be needed for the restoration, where the resources would come from, and whether there are financial constraints that could potentially affect implementation of the ideas.

To easily analyze all variables going into each structure, “cost analysis tables” were constructed (Tables 1-5). These contained considerations such as plumbing, electricity, materials, labor, construction, total cost, yearly expenses, revenue, and return on investment. These tables were integral when overviewing all objects needed, and made it simpler for investors to see exactly what they would be paying for.

3.3.3 Costs of Baño Grande

After conducting the cost analysis for Baño Grande pool and Baño Grande bathhouse, the top two options for each structure are quite feasible. For Baño Grande Pool, the options are to reopen it as a recreational swimming pool or leave it as a scenic picture taking area. The largest costs when restoring Baño Grande into a recreational pool will be the material and labor to turn the pool into a safe swimmable area. In its present state, the pool has a natural slope from the shallower end to the deep end which is 18 feet deep. To make this a safe area to swim, the pool will need to be drained and then the shallow end will need to be raised with concrete and dirt. After that, a concentration grade will need to be created from the shallow end to the deep end. It is at the discretion of the vendor whether or not to raise the deep end to a more manageable depth, without affecting the pool drainage system. Other major expenses will include replacing the metal railings around the pool, and adding ladders and stairs into the pool. All other costs will be spent on cosmetic items to make the area look beautiful again. Even if the cost of the pool doubles in price from what is expected, the pool will still easily break even within the first year just by charging people a minimal amount to swim.

The other option is to leave Baño Grande pool as a scenic picture taking area and clean it up to make it look pleasing to the eye. Costs for this project will be minimal as it only requires cosmetic work: cleaning the concrete, trimming the trees, and replacing the railings. This option is cheaper but will generate no money because you cannot charge people to look and take pictures (Table 1).

For Baño Grande bathhouse the two options are a café and a changing room. The choice for this building will most likely be contingent on what is chosen for Baño Grande pool, as changing rooms will not be necessary without a recreational swimming area. For the cafe, a majority of the expenses will come from running the plumbing and electric. Although it requires minimal plumbing, outlets and lighting, all the building has currently has is one faucet and no functioning electricity. Other than the material and labor prices for the plumbing and electric, other costs will include tile and wall remove from the old setup and adding new paint and windows. Like the recreational swimming pool, the expenses are minimal compared to the profit that can be made by opening a cafe in El Yunque.

The second option is to turn Baño Grande bathhouse into changing rooms. The costs for this project will include cleaning out the building and then running minimal electricity for a few lights. Windows and paint will also be needed. Adding benches and lockers will turn the area into a functioning changing room. This option is slightly cheaper, but the only revenue will come from charging visitors to rent lockers. A third option is possible and will include combining a cafe and changing rooms.

3.3.4 Costs of Baño de Oro

After interviews with United States Forest Service employees along with surveys taken by forest goers, we were able to determine the two ideas that would be best for both the Baño de Oro

bathhouse and pool: a concession stand or flower exhibit for the bathhouse, and a wading pool or flower garden for the pool. When assessing the feasibility of each option for Baño de Oro, we took into consideration the cost of each project idea. Broken down into categories (plumbing, electric, materials, labor, and construction) we were able to estimate the cost of restoration for each idea for the structures, to then be compared and analyzed (Tables 3 and 4).

First, looking at the ideas for the Baño de Oro pool, one option is restoring the structure back into a wading pool with handicap accessibility. The biggest costs that will affect this project fall under the materials and labor. In order to allow this area to be accessible, the present path needs to be reconstructed with concrete as well as widened by about a foot in order to get up to the pool area. Once on site, it can be seen that this pool as well as areas around the bathhouse are currently overgrown with vast amounts of vegetation that need to be evacuated in order to make the area both pleasing to the eye and the pool accessible. Also, there can be a retaining wall put in outside of the pool in order to prevent vegetation and water from overflowing the pool in a storm. As that is completed, the pool will need to be inspected for cracks that the water could seep out of as well as any damage that could have been done to both the interior and exterior of the pool and then repaired. Once the pool is structurally sound, it is necessary to make it accessible for swimmers. With the concrete, the pool floor will need to be leveled to make it six feet at its deepest, to then be angled up into the shallow end. With the step in the shallow end, a handrail will be installed for swimmers to hold on to while getting into the pool, and in the deep end, there will be a ladder for access in that area. Once the pool is cleaned and constructed, it will need to be painted to tell the swimmers the deepness of each end. The expenses for this option are minimal in comparison to the potential revenue that can be brought in through charging people for recreational pool use.

The next option is restoring the structure into a flower garden, which will involve more construction. Like the wading pool, in order to create this flower garden, it is necessary that all of the vegetation is evacuated in order to create a solid base for the construction of the garden. Once that is completed, a mixture of concrete and rocks will be poured into the pool, leaving an area that is about four feet wide around the slab creating a moat that will contain the stream that feeds the pool. After this is installed with mortar concrete, the soil will be deposited on top to create the garden. In this garden, we will grow native flowers that can be acclimated to the rainforest, that forest goers can take pictures of and enjoy. With this option, however, revenue cannot be generated as charging those looking at the flowers is something that would not be feasible (Table 3).

Next, looking at the ideas for the Baño de Oro bathhouse, one option is restoring it into a concession stand. The first step before any construction or labor is the extermination. At the bathhouse, there are wasps and termites that are infesting the area. With that, extermination will have to be done naturally and by hand as it cannot harm the forest, so eco-friendly wasp spray and liquid nitrogen will have to be used in order to get rid of the unwanted insects. The next steps for this project are the stall wall demolition, plumbing removal, gutting tiles, debris removal, and then the cleanup. On both sides of the bathhouse, there are stalls for changing and the bathrooms, and in order to create and open space for the concession area, they must be demolished, and the plumbing removal. All of the debris that comes from that demolition as well as the present debris must be removed before the cleanup can occur. With that cleanup comes power washing, making both the interior and exterior visually pleasing and ready to be restored as well as painted. There will then need to be window installation, removing the shaded windows that were in use when it was a changing area, and installing regular windows as well as a new skylight to let in natural

light. Rewiring and outlet installation must occur in order to have artificial lighting along with new lighting panels. The lights for these panels will need to be LED, to be the highest performance. With the concession stand, there will need to be storage tables and shelves for the snacks and drinks that will be sold. Outside of the concession area, there will be concrete leveling for the area that concrete picnic tables will be constructed for a seating area, as well as a ramp to get to the concession stand. This option will generate revenue based on the amount of goods sold, such as snacks and drinks, with minimal construction costs.

The next option for this space is a flower exhibit, which is dependent upon whether the pool is turned into a flower garden. This space will be created in the same way as the concession stand would be, without shelving spaces for the food as well as less seating space outside. The initial costs will be for creating an exhibit in that space. An example of what will be in this exhibit is a picture of a flower that will be in the garden, along with a description, in both Spanish and English (Appendix E). In this area as well, there will be a space where visitors can purchase the seeds of the flowers in the garden. This option is feasible, but dependent on if the garden implemented (Table 4).

3.3.5 Costs of Army Barracks

Once the interviews and surveys were coming to an end, there was a general trend for which ideas were most popular for the army barracks. Employees, tourists, and locals all were most in favor for the army barracks becoming either a hotel or hostel. The next step was to analyze the cost of each building idea, and determine which would be more feasible to implicate. When creating the cost analysis table, it was broken up into categories that included plumbing, electric, materials, labor, and construction. With these numbers, we were then able to estimate

total cost of restoration, revenue, and return on investment to figure out which option would be most ideal.

The hotel and hostel have the same general construction set up, as the two are quite similar buildings with similar living situations, one is just more private than the other. Because the building has not been in used since it was an aviary in the 1990's, almost every single part of the building must be repaired. All new power would need to be brought in or installed, including water heaters, generators, and inverters. We also planned for the building to have solar power to be more energy efficient, so solar panels will need to be installed. However, the structure will still need to be on the grid, because the electricity generated by the solar panels will not be enough to completely power the building. The whole structure needs to be cleaned, meaning maintenance on things such as the paint, walls, windows, tiles, outside landscape, and more. This will be done with some painting, power washing and excavating, because the structure does not need to be perfect; part of its feel is that it is rough and in the forest.

The most expensive part of the restoration will be redoing the wiring and plumbing in the building. Both are out of date and most likely unusable, so the wiring and plumbing would need to be taken out and reinstalled, without destroying the building. These tasks will take the most time and be the most difficult, but they must be done in order to even consider turning the building into a living space. The three largest construction jobs on both the hotel and the hostel will be the elevator construction, outdoor stair construction, and rooftop roof construction. To make the rooftop accessible, a staircase will need to be added on the side of the building, and to make it handicap accessible, an elevator will need to be added. Having these are key, as we designed a plan to put a bar on the rooftop for both people staying at the hotel or hostel to use, as well as visitors to the forest. The rooftop roof will be made out of concrete, to keep cohesiveness

throughout the building. It will also have six pillars to hold it up. This will be constructed for the outdoor bar located underneath, as well as sitting space.

There are only a few differences between the construction of the hostel and hotel. One difference is the extra construction of walls in the hotel. People staying at it will want to stay in their own rooms, so more walls would need to build to ensure proper privacy. The walls will be created out of concrete, to keep cohesiveness, and re-bar will be added for extra support. Another difference will be that bathrooms will also need to be added to these rooms, as hotel rooms have their own bathrooms. This will require extra plumbing and construction. The third difference, depending on whether the building becomes a hotel or hostel, will be whether the kitchen upstairs stays a kitchen or becomes another room. For a hotel, the kitchen upstairs would be destroyed and turned into an extra room, as there is a large main kitchen downstairs. For a hostel, the kitchen upstairs would stay, and be updated, as people staying in a hostel would make their own food, and having two kitchens would be ideal. All numbers and data for the full cost analysis of the army barracks ideas can be seen in Table 5.

Table 1: Cost Analysis Baño Grande Pool

Baño Grande Pool	Recreational Pool	Leave it as is
Plumbing	None	None
Electric	None	None
Materials	**Cost related to partial foundation removal and dump fee for waste:** $680 + $212.50 = $892.5 **Soil:** **80 tons of soil at $50 per ton:** $4,000 **Stainless steel pool ladder:** $200/ladder **Diving Board:** $400 - $600 **New Railings:** 2" SCH 40 (2.375 OD X .154 wall) A500 ERW Structural Steel Pipe $60/10 ft. - price decreases when bought in bulk 2" SCH 80 (2.375 OD X .218 wall) A-500 Structural Steel Pipe $90/10 ft. - prices decrease when bought in bulk **Informational Signs:** $1,000 total **Concrete Sealer:** $50-$200/5 gal.	**New Railings:** 2" SCH 40 (2.375 OD X .154 wall) A500 ERW Structural Steel Pipe $60/10 ft. - price decreases when bought in bulk 2" SCH 80 (2.375 OD X .218 wall) A-500 Structural Steel Pipe $90/10 ft. - prices decrease when bought in bulk **Informational Signs:** $1,000 total **Concrete Sealer:** $50 - $200/5 gal.
Labor	**Dirt grading:** $50-$70 per hour **Tree trimming:** USFS workers should do $150 - $875/30 - 60 ft. tree **Concrete cleaning:** $257 - $6120/for 5,000 sq. ft. **Soil removal:** $50/cu. yd. **Concrete:** $36/hour 8.61/sq. ft.	**Tree trimming:** USFS workers should do $150-$875/30 - 60 ft. tree **Concrete cleaning:** $257-$6120/ 5000 sq. ft.

Construction	**Concrete pouring:** $100/cu. yd. $60/load -stairs -ramps	
Total Cost	$14,762.5 - $24,660.50 4000 sq. ft. $3.69-$6.17/sq. ft.	$6,257 - $15,520 4000 sq. ft. $1.56-$3.88/sq. ft.
Yearly Expenses*	$30,000	$0
Revenue	100 people/day (<3% of visitors/day) **$3/person** $109,500/year **$5/person** $182,500/year 300 people/day (<10% of visitors/day) **$3/person** $328,500/year **$5/person** $547,500/year 500 people/day (<15% of visitors/day) **$3/person** $547,500/year **$5/person** $912,500/year	$0
Return on Investment ROI = (Net Profit / Cost of Investment) x 100	5 year ROI 56.7% 10 year ROI 68.6%	ROI 0%

Source: (ConcreteNetwork.com, N.d.), (Doheny's Water Warehouse, 2015), (Homewyse, 2016b), (Metals Depot International, 2016), (The Family Handyman, 2016), (Tree Removal, N.d.)

*****Yearly expenses are estimates of how much the vendor would spend per year on employees, maintenance, yearly upkeep, and supplies

Table 2: Cost Analysis Baño Grande Bathhouse

Baño Grande Bathhouse	Café	Changing Room
Plumbing	Has water	Has Water
Electric	Yes	Yes
Materials	**Paint:** $30/gal. **Tiles:** $1/sq. ft. **Lighting:** $10 - $20/25,000 hr. lights **Windows:** $300-$500 each **Wiring and Supplies:** $17.27-$19.64/wiring **Coffee makers:** $500 - $4,000 **Microwave:** $100 - $500 **Concrete picnic table:** $900 - $1,800/table **Skylight:** $300 - $600	**Paint:** $30/gal. **Wiring and Supplies:** $17.27-$19.64/wiring **Lighting:** $10-$20 25,000 hr. lights **Tiles:** $1/sq. ft. **Windows:** $300 - $500 each **Benches:** $95 - $165 each **Lockers:** $50-$100/set **Skylight:** $300-$600
Labor	**Electrician:** $80.20 - $103.96/hr. **Plumber:** $15 - $40/hr. **Painting:** $0.86 - $2.19/sq. ft. **Tile removal:** $3 - $6/sq. ft. **Concrete cleaning:** $257 - $6,120/5,000 sq. ft. **Window Install:** $35 - $65/hr.	**Electrician:** $80.20 - $103.96/hr. **Painting:** $0.86 - $2.19/sq. ft. **Tile removal:** $3 - $6/sq. ft. **Concrete cleaning:** $257-$6120/5,000 sq. ft. **Window Install:** $35 - $65/hr. **Electric Panel Install w/ Parts:** $500 - $1,000 **Plumbing Removal:**

	Electric Panel Install w/ Parts: $500 - $1,000 **Plumbing Removal:** $174 (3 workers/8 hr.) **Skylight:** $400 - $1,300	$174 (3 workers/8 hr.) **Skylight:** $400 - $1,300
Construction	**Wall removal:** $0.95/sq. ft. (for a 4 inch wall)	**Wall removal:** $0.95/sq. ft. (for a 4 inch wall)
	***Leave tile in top left corner, it's from an artist**	***Leave tile in top left corner, it's from an artist**
Total Cost	$11,577.90 - $29,260.44 1500 sq. ft. with patio $7.72 - $19.5/sq. ft.	$10,138.35 - $21,561.80 1500 sq. ft. with patio $6.76 - $14.37/sq. ft.
Yearly Expenses*	$30,000	$10,000
Revenue	<u>100 people/day</u> (<3% of visitors/day) **$3 average purchase** $109,500/year **$5 average purchase** $182,500/year **$10 average purchase** $365,000/year <u>300 people/day</u> (<10% of visitors/day) **$3 average purchase** $328,500/year **$5 average purchase** $547,500/year **$10 average purchase** $1,095,000/year <u>500 people/day</u> (<15% of visitors/day) **$3 average purchase** $547,500/year **$5 average purchase** $912,500/year **$10 average purchase** $1,825,000	<u>50 people/day</u> (<2% of visitors/day) **$2 average purchase** $36,500/year **$3 average purchase** $54,750/year <u>100 people/day</u> (<3% of visitors/day) **$2 average purchase** $73,000/year **$3 average purchase** $109,500/year <u>150 people/day</u> (<5% of visitors/day) **$2 average purchase** $109,500/year **$3 average purchase** $164,250/year (price for renting a locker, everything else is free)
Return on Investment ROI = (Net Profit / Cost of Investment) x 100	<u>5 year ROI</u> 52.7% <u>10 year ROI</u> 66.3%	<u>5 year ROI</u> 27.5% <u>10 year ROI</u> 50.1%

Source: (Belson Outdoors, 2016), (Central Products, N.d.), (Eartheasy, 2014), (Fixr, 2016f), (Fixr, 2016g), (Focus Technology, 2016), (Home Advisor, 2016e), (Homewyse, 2016c), (Homewyse, 2016d), (PayScale, 2016), (Uline, N.d.)

*****Yearly expenses are estimates of how much the vendor would spend per year on employees, maintenance, upkeep, and supplies

Table 3: Cost Analysis Baño de Oro Pool

Baño de Oro Pool	Wading Pool with Handicap Accessibility	Flower Garden
Plumbing	None	None
Electric	None	None
Materials	**Concrete slab**: $90/cu. yd. + $60/load delivery fee (ramp) ($150) **Paint**: Outdoor Additive: $8.99/can Regular paint: $50/gal. (3 gal.) **Concrete sealer:** $50 - $200/5 gal. **Pool ladder:** $200 **Handrail for steps:** $210	**Soil**: $50 per ton (30 tons) = $1,500 **Concrete slab**: $90/cu. yd. + $60/load delivery fee (100 cubic yards) **River stone:** $24 per ton (150 tons) = $3,600
Labor	**Vegetation evacuation**: $50/cu. yd. (300 cu. yd.) **Concrete installation**: $8.61/sq.ft. $36/hr (20 sq. ft) (4 hr.) **Concrete cleaning:** $250 - $6,120 (2,300 sq. ft.) **Power washing:** $360 - $650	**Vegetation evacuation**: $50/cu. yd. (300 cu. yd.) **Concrete installation**: $8.61/sq. ft. $36/hr. (700 sq. ft) (40 hr.)
Construction	**Leak repair**: $300 - $2,500	**Leak repair**: $300 - $2,500 **Raising concrete**: $20/sq. ft. (700 sq. ft.)
Total Cost	$16,888.20 - $22,463.20 2,300 sq. ft. $7.34 - $9.77/sq. ft.	$50,927 - $53,127 2,300 sq. ft. $22.14 - $23.10/sq. ft.
Yearly Expenses	$30,000	$0
Revenue	<u>100 people/day</u> (<3% of visitors/day) **$3 per person** $109,500/year **$5 per person** $182,500/year **$7 per person** $255,500/year <u>300 people/day</u> (<10% of visitors/day) **$3 per person**	$0

	$328,500/year **$5 per person** $547,500/year **$7 per person** $766,500/year <u>500 people/day</u> (<15% of visitors/day) **$3 per person** $547,500/year **$5 per person** $912,500/year **$7 per person** $1,277,500/year	
Return on Investment ROI = (Net Profit / Cost of Investment) x 100	<u>5 year ROI</u> 58.7% <u>10 year ROI</u> 69.8%	<u>ROI</u> 0%

Source: (Cemex, 2016), (The Family Handyman, 2016), (How Much, 2016b), (Fixr, 2016c), (Metals Depot International, 2016)

*****Yearly costs are estimates of how much the vendor would spend per year on employees and supplies

Table 4: Cost Analysis Baño de Oro Bathhouse

Baño de Oro Bathhouse	Concession Stand	Flower Museum/Exhibit
Plumbing	**Remove plumbing (labor)**	**Remove plumbing (labor)**
Electric	Yes	Yes
Materials	**Wiring:** $17.27 - $19.64 per wiring (5 - 10) **LED Lighting:** $35.65/bulb for 50,000 hr. of light (5 -10) **Cost of extermination:** **Wasps:** EcoSmart wasp and hornet spray ($6.99 per bottle) **Termites:** Liquid nitrogen - $0.50 per gallon **Paint**: Outdoor Additive: $8.99/can Regular paint: $50/gal. (3 gal.) **Hydraulic cement to fill cracks:** $14.25/20 lb. (2) **Shelving/cabinets**: $200- $450 **Windows:** $300- $500 each (7 windows) **Concrete picnic table:** $900 - $1,800/table (5 - 10) **New skylight:** $300 - $600	**Wiring:** $17.27 - $19.64 per wiring (5 - 10) **LED Lighting:** $35.95/bulb for 50,000 hr. of light (5 - 10) **Cost of extermination:** **Wasps:** EcoSmart wasp and hornet spray ($6.99 per bottle) **Termites:** Liquid nitrogen - $0.50 per gallon **Paint**: Outdoor Additive: $8.99/can Regular paint: $50/gal. (3 gal.) **Hydraulic cement to fill cracks:** $14.25/20 lb. (2) **Windows:** $300- $500 each (7 windows) **Concrete picnic table:** $900 - $1,800/table (2 - 5) **New skylight:** $300 - $600
Labor	**Cost of Electrician**: $80.20 - $103.96 per hour (10 - 20 hr.) **Adding outlets: (cost/outlet)** 120V: $150 - $250 (5 - 10) **Installing new subpanel:** $500 - $1,000 (1) **Painting and Cleanup:** $0.86 - $2.19/ sq. ft. (500 sq. ft.) **Cost of debris removal:** $165 - $215 **Power washing:** $360 - $650	**Cost of Electrician**: $80.20 - $103.96 per hour (10 - 20 hr.) **Adding outlets: (cost/outlet)** 120V: $150 - $250 (5 - 10) **Installing new subpanel:** $500 - $1,000 (1) **Painting and Cleanup:** $0.86 - $2.19/ sq. ft. (500 sq. ft.) **Cost of debris removal:** $165 - $215 **Power washing**: $360 - $650

	Cost of removing plumbing: 3 workers for 8 hr. at minimum wage: $174 **Gutting tiles:** $2.83 – $6.08/sq. ft. (200 sq. ft) **Window installation:** $35 - $65/hr. (14 hr.) **Install skylight:** $400 - $1,300	**Cost of removing plumbing:** 3 workers for 8 hr. at minimum wage: $174 **Gutting tiles:** $2.83 – $6.08/sq. ft. (200 sq. ft) **Window installation:** $35 - $65/hr. (14 hr.) **Install skylight:** $400 - $1,300
Construction	**Cost of stall wall (4 in.) demolition:** $0.95/sq. ft (200 sq. ft.) **Concrete leveling for pathway/seating area:** $850/100 sq. ft. (500 sq. ft.)	**Cost of stall wall (4 in.) demolition:** $0.95/sq. ft. (200 sq. ft.) **Concrete leveling for pathway/seating area:** $850/100 sq. ft. (500 sq. ft.) **Cost of constructing an exhibit:** $200- $400
Total Cost	$16,369.10 - $36,739.60 500 sq. ft. bathhouse, 1,200sq. ft. patio $9.63 – $21.61/sq. ft.	$14,669.50 - $29,356.10 500 sq. ft. bathhouse, 1,200 sq. ft.patio $8.63 - $17. 27/sq. ft.
Yearly Expenses	$30,000	$30,000
Revenue	<u>100 people/day</u> (<3% of visitors/day) **$3 average purchase** $109,500/year **$5 average purchase** $182,500/year <u>300 people/day</u> (<10% of visitors/day) **$3 average purchase** $328,500/year **$5 average purchase** $547,500/year <u>500 people/day</u> (<15% of visitors/day) **$3 average purchase** $547,500/year **$5 average purchase** $912,500/year	<u>50 people/day</u> (<2% of visitors/day) **$2 average purchase** $36,500/year **$4 average purchase** $73,000/year <u>100 people/day</u> (<3% of visitors/day) **$2 average purchase** $73,000/year **$4 average purchase** $146,000/year <u>200 people/day</u> (<6% of visitors/day) **$2 average purchase** $146,000/year **$4 average purchase** $292,000/year
Return on Investment ROI = (Net Profit / Cost of Investment) x 100	<u>5 year ROI</u> 46.6% <u>10 year ROI</u> 62.6%	<u>5 year ROI</u> -49.1% <u>10 year ROI</u> -44.6%

Source: (All Cost Data, 2016), (CostHelper, Inc., 2016a), (CostHelper, Inc., 2016b), (Eartheasy, 2014), (EcoSMART, 2016b), (Fan, K., 2007), (Fixr, 2016c), (Fixr, 2016d), (Fixr, 2016f), (Fixr, 2016g), (Fixr, 2016h), (Fixr, 2016i), (Home Advisor, 2016e), (Homewyse, 2016e), (Walhimer, M., 2011)

*****Yearly expenses are estimates of how much the vendor would spend per year on employees, maintenance, upkeep, and supplies

Table 5: Cost Analysis Army Barracks

Army Barracks	Hotel	Hostel
Plumbing	**Heat pump:** $550 - $4,000 **Water heater (tank):** $900/40 - 50gal.	**Heat pump:** $550 - $4,000 **Water heater (tank):** $900/40 - 50gal.
Electric	**Solar panels:** $4,000 - $16,000 **Generator:** $9,000 - $30,000 **Inverter:** $150 - $5,500	**Solar panels:** $4,000 - $16,000 **Generator:** $9,000 - $30,000 **Inverter:** $150 - $5,500
Materials	**Paint:** $30 - $50/gal. **Paint additive:** $8.99/gal. **Floor tiles:** $1.00/sq. ft. **Concrete patching:** $50 - $200/5 gal. **LED light bulbs:** $10 - $20/25,000 hr. light **Wiring and supplies:** $17.27 - $19.64/wiring **Plumbing and supplies:** $20,000 - $40,000 **Elevator:** $15,000 - $25,000	**Paint:** $30 - $50/gal. **Paint additive:** $8.99/gal. **Floor tiles:** $1.00/sq. ft. **Concrete patching:** $50 - $200/5 gal. **LED light bulbs:** $10 - $20/25,000 hr. light **Wiring and supplies:** $17.27 - $19.64/wiring **Plumbing and supplies:** $10,000 - $20,000 **Elevator:** $15,000 - $25,000
Labor	**Electrician:** $80.11 - $104/hr. **Electric panel installation:** $500 - $1,000 **Solar panel installation:** $30,000 - $150,000 **Plumber:** $15 - $40/hr. **Plumbing removal:** $7.25/hr. **Heat pump system and installation:** $5,000 - $8,200	**Electrician:** $80.11 - $104/hr. **Electric panel installation:** $500 - $1,000 **Solar panel installation:** $30,000 - $150,000 **Plumber:** $15 - $40/hr. **Plumbing removal:** $7.25/hr. **Heat pump system and installation:** $5,000 - $8,200 **Water heater system and installation:** $1,600 **Generator installation:** $1,089 - $5,568

	Water heater system and installation: $1,600 **Generator installation:** $1,089 - $5,568 **Painter:** $0.86 - $2.19/sq. ft. **Window installation:** $35 - $65/hr. **Concrete cleaning:** $257 - $6,120/5,000 sq. ft. **Power washing:** $360 - $650 **Wall building:** $5 - $7/sq. ft. **Roof building:** $72.88 - $101.65/hr. **Partial building demolition:** $500 - $2,000 **Asbestos inspection and removal:** $800 - $1,700	**Painter:** $0.86 - $2.19/sq. ft. **Window installation:** $35 - $65/hr. **Concrete cleaning:** $257 - $6,120/5,000 sq. ft. **Power washing:** $350 - $650 **Roof building:** $72.88 - $101.65/hr. **Partial building demolition:** $500 - $2,000 **Asbestos inspection and removal:** $800 - $1,700
Construction	**New walls:** $65 -$90/cu. yd. **Re-bar:** $10 - $15/cu. yd. concrete **Wall removal:** $0.67 - $0.97/sq. ft. **New windows:** $300 - $500/window **Cover skylights:** $700 **New roof (labor and supplies):** $10,055.83 - $14,074 **Plant removal:** $150 - $400/hr. **Repave parking lot (gravel):** $1.40/sq. ft. 1in. depth **Stairs:** $1,066 - $3,200 **Elevator installation:** $15,000 - $16,000	**Wall removal:** $0.67 - $0.97/sq. ft. **New windows:** $300 - $500/window **Cover skylights:** $700 **New roof (labor and supplies):** $10,055.83 - $14,074 **Plant removal:** $150 - $400/hr. **Repave parking lot (gravel):** $1.40/sq. ft. 1in. depth **Stairs:** $1,066 - $3,200 **Elevator installation:** $15,000 - $16,000

	New bathroom: $3,000 - $25,000	
Total cost	$178,777.13 - $418,159.40 6,048sq. ft.: $33.67 - $69.14/sq. ft.	$165,267.13 - $394,359.40 6,048sq. ft.: $27.32 - $65.20/sq. ft.
Yearly Expenses	$150,000	$60,000
Revenue	Avg. hotel price: $120/night 15 people/night (<1% visitors/day): $657,000/year 30 people/night (<1% visitors/day): $1,314,000/year	Avg. hostel price: $30/night 30 people/night (<1% visitors/day): $328,500/year 50 people/night (<1.5% visitors/day): $547,500/year
Return on Investment ROI = (Net Profit / Cost of Investment) x 100	5 year ROI 87.5% 10 year ROI 128%	5 year ROI 18.3% 10 year ROI 65.2%

Source: (EcoSMART, 2016a), (Fixr, 2016a), (Fixr, 2016b), (Fixr, 2016d), (Fixr, 2016e), (Fixr, 2016f), (Fixr, 2016g), (Fixr, 2016i), (Fixr, 2016j), (Fixr, 2016k), (Fixr, 2016l), (Fixr, 2016m), (Generac, 2016), (Hostel World, 2016), (Homewyse, 2016a), (Hidden Villa, 2016), (Home Advisor, 2016), (Home Advisor, 2016a), (Home Advisor, 2016b), (Home Advisor, 2016c), (Home Advisor, 2016d), (Home Advisor, 2016e), (How Much, 2016a), (How Much, 2016c), (Price of Travel, 2016), (Solar Electric Supply Inc., 2016), (Wholesale Solar, 2016)

*****Yearly expenses are estimates of how much the vendor would spend per year on employees, maintenance, upkeep, and supplies

3.4 Final Product

3.4.1 3D Rendering

While working on the cost analysis tables for Baño de Oro, Baño Grande, and the army barracks, we created sketches in AutoCAD with accurate measurements we took from the site visits. In AutoCAD we made site plans, to scale, of each of the structures. We then created 3D rendered images of the three sites using the Autodesk Revit. Revit is an architecture design and documentation computer software used for building modeling and is a very useful visual aid (EDULEARN, 2014). The 3D renditions helped get a more accurate visual of what the structures would look like once restoration was completed. This aided in discussing the feasibility plans to

our sponsor as well as all USFS employees. The 3D renditions of the three sites can be viewed in Figures 12-14, and additional, more in depth renditions can be found in Appendix F.

Using AutoCAD, we recreated more accurate versions of the blueprints the USFS had of both Baño Grande and Baño de Oro using our own field measurements. There weren't any existing blueprints for the army barracks available to us because the United States Army did not release them to the USFS. Once the new blueprints were drawn, we used them as an overlay in Revit so the dimensions were consistent. In Revit, we attempted to recreate the structures with the same materials found on site. We used a lot of computerized concrete for our rendered designs because this is one of the materials we found to be least likely to deteriorate quickly in the aggressive rainforest atmosphere. For our Baño Grande design, we rendered an arbitrary version of the pool because that remains unchanged in our plans. The Baño Grande bathhouse was rendered to be painted and rid of excess vegetation around the site. The front patio was extended for lounging and a handicap accessible ramp was added. The final design had two rooms on either side of a café that would be multipurpose rooms to be used by the USFS, boy scouts, or possibly the public.

The design for Baño de Oro started by taking out all of the invasive vegetation and then we added a retaining wall to keep the pool from being invaded again. A ramp was also added in place of one of the stairs up to the platform where the Baño de Oro bathhouse is located. This pool will be reopened for recreation as a wading pool so we made sure it would be handicap accessible throughout the design. There is another lounging area on the patio and inside the building there were vending machines added in the first room. The room on the left was designed for the selling of either fresh food or souvenirs. The room on the right was designed for a changing room or bathroom space.

The design for the Army barracks was to create it into a hostel. Our design exhibits large rooms with multiple beds and communal bathrooms and kitchens. There is a room for a live in employee and a garage for them as well. The roof was converted into a rooftop bar with half of the area covered by an added ceiling for coverage during disagreeable weather. On top of this added ceiling we added solar panels to fuel backup generators in the case of a power outage which can be very common in the mountains of El Yunque. Finally, we rendered images inside and outside of all the structures and created realistic video walkthroughs.

Figure 12: 3D Render of Baño Grande

Figure 13: 3D Render of Baño de Oro

Figure 14: 3D Render of Army Barracks

3.4.2 Pamphlet

Once we completed taking field measurements, surveying and interviewing the people of Puerto Rico, narrowing down our options, figuring costs and resources, and creating 3D models of our structures, our final step was to present our ideas to the USFS. This was done in the form

of a detailed pamphlet that could easily be distributed to the investors. This pamphlet consisted of the finalized possible refurbishment ideas, the estimated cost considerations of each, and the proposed physical designs of the new recreational areas. It was most important that this project was attractive to the potential investors, as all of the funding for our ideas comes from outsourcing of a third party (United States Forest Service, 2016c). It will ultimately be up to them if the restoration projects will even develop. It was key that we met the criteria of what the forest-goers wanted, what the USFS imagined in their future expenditures, as well as those who will be putting money into this project. Pictures of the front, back, and body of the pamphlet can be viewed in Figures 15 and 16. Additional, more in-depth photos can be seen in Appendix G.

Figure 15: Pamphlet Cover and Back

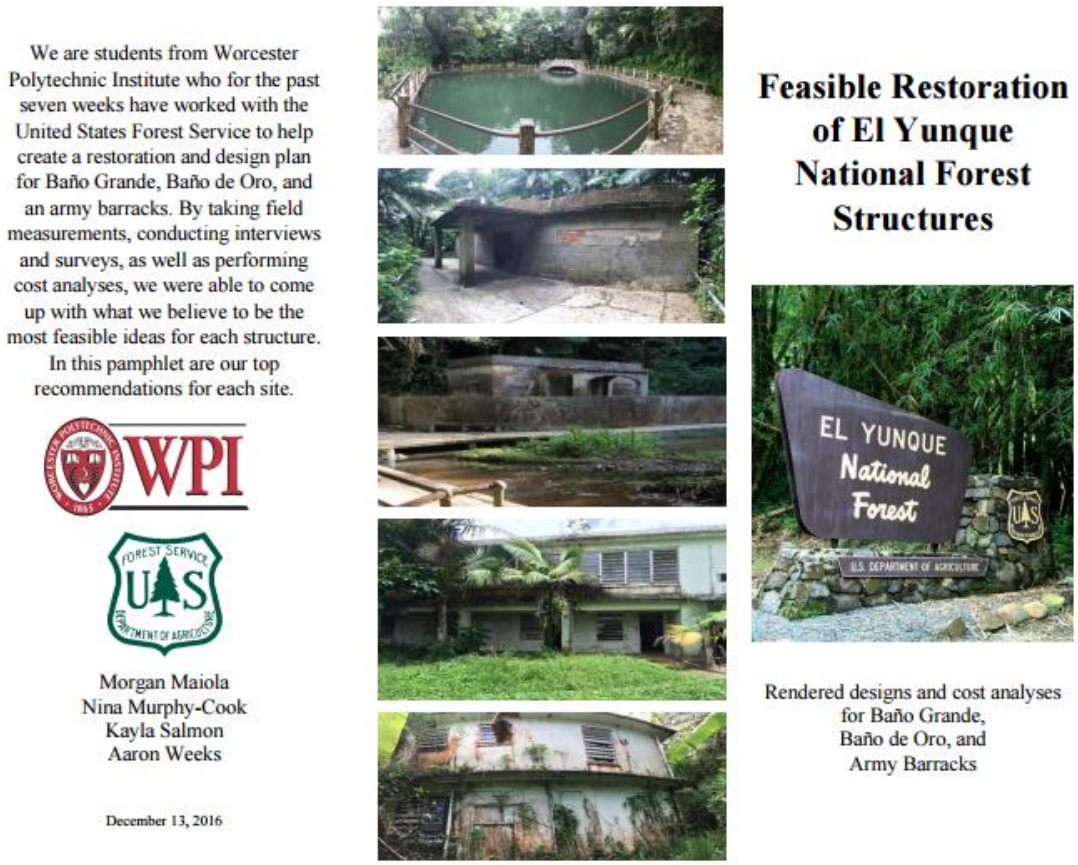


Figure 16: Pamphlet Body

Baño Grande

Baño Grande has an eighteen foot deep circular swimming pool that is reinforced by concrete and fed by La Mina River. Baño Grande was first opened in 1936 as a recreational swimming pool along with a bathhouse for the public. These structures were closed in 1968 and have been out of use since. It is proposed that the Baño Grande pool be kept as a photo spot for safety and ease, but the bathhouse to be restored into a Café to create some revenue for this site.

	Photo Spot	Recreational Swimming Pool
Restoration Cost	[illegible]	[illegible]
Yearly Expenses	$0	[illegible]
Yearly Revenue	$0	[illegible] ([illegible] customers/day) (average purchase: [illegible])
Return on Investment after 5 Years	0%	[illegible]
Return on Investment after 10 years	0%	[illegible]

	Café	Changing Rooms
Restoration Cost	[illegible]	[illegible]
Yearly Expenses	[illegible]	[illegible]
Yearly Revenue	[illegible] ([illegible] customers/day) (average purchase: [illegible])	[illegible] ([illegible] customers/day) (average purchase: [illegible])
Return on Investment after 5 Years	[illegible]	[illegible]
Return on Investment after 10 years	[illegible]	[illegible]

Baño de Oro

Baño de Oro has a rectangular pool that is reinforced by concrete and is fed by an unnamed stream. The pool varies from 18 inches to 8 feet at its deepest point. Baño de Oro is also accompanied by a bathhouse and both were used for a short period of time after the 1930s. The site is currently overcome with vegetation and is in disrepair. It is proposed that the pool is cleaned and reopened as a recreational and handicap accessible wading pool and the bathhouse to be turned into a concession stand.

	Wading Pool	Flower Garden
Restoration Cost	[illegible]	[illegible]
Yearly Expenses	[illegible]	$0
Yearly Revenue	[illegible] ([illegible] customers/day) (average price to swim: [illegible])	$0
Return on Investment after 5 Years	[illegible]	0%
Return on Investment after 10 years	[illegible]	0%

	Concession Stand	Flower Exhibit
Restoration Cost	[illegible]	[illegible]
Yearly Expenses	[illegible]	[illegible]
Yearly Revenue	[illegible] ([illegible] customers/day) (average purchase: [illegible])	[illegible] ([illegible] customers/day) (average purchase: [illegible])
Return on Investment after 5 Years	[illegible]	[illegible]
Return on Investment after 10 years	[illegible]	[illegible]

Army Barracks

The Army Barracks was used as army housing during World War II, and was then used as an aviary for the Puerto Rican Parrot in the 1980s for about ten years. The aviary has been relocated and the army barracks has been out of use since. The building is around 6,000 square feet and approximately 19 rooms. It is proposed to be restored into a hostel.

	Hostel	Hotel
Restoration Cost	[illegible]	[illegible]
Yearly Expenses	[illegible]	[illegible]
Yearly Revenue	[illegible] ([illegible] customers/day) (average purchase: [illegible])	[illegible] ([illegible] customers/day) (average purchase: [illegible])
Return on Investment after 5 Years	[illegible]	[illegible]
Return on Investment after 10 years	[illegible]	[illegible]

4.0 Results

In this chapter, we provide readers with the results of the interviews, personal surveys, online surveys, and the overall data that they produced. For the interviews, we explain the amount of people interviewed, their positions, their views on the structures, and why proposals were not carried out in the past. The survey results provide the data of how many people surveyed on-site versus online, if they were tourists or locals, and their opinions on the structures. The overall data collected from the interviews and surveys paved the path to determine the top options for each structure.

4.1 Results of Interviews

4.1.1 Ideas Preferred and Suggestions

We began the collection of data through interviews of employees of the US Forest Service. Ten employees were interviewed, and were kept anonymous in order to protect them in the chance of some risk becoming involved. We interviewed a range of people, including engineers, the ecosystem team, managers, patrol officers, and tour guides. Our group wanted to get as much data from as many different perspectives as possible. We inquired as to which ideas they preferred, and if they had any other ideas as to what they would like to see the structures become.

From these two questions, we found that they were all in favor of the ideas that we have proposed, they just had some small changes they recommended we add. For the recreational swimming ideas, the employees suggested the idea to make them handicap accessible, that way everyone would be able to use them. Many employees were also strong advocates for getting the community more involved. They suggested for the locals that live around the base of the

mountain to get more involved by volunteering with the painting and cleanup of the structures when first beginning construction, such as clearing foliage. Even when the structures are completed, they suggested that the community could continue to volunteer by maintaining the area around the structures. This would help get them involved and have a newfound love and respect for nature and El Yunque.

Most employees were accepting of any ideas we proposed. However, it was important to them that we kept the historical integrity of the structures. The buildings give the forest a special feel, and all have stories behind them, and to destroy them would take away from everything the people know and love. Other ideas were presented, as several employees endorsed the idea of creating more parking areas, as the forest experiences extremely high traffic in the summer months. Unfortunately, we are not working on this aspect of the structures, so there is nothing we can do for them at this time. From the data we gathered, their ideas coincide with many of ours, meaning the chance our ideas are passed is more likely.

4.1.2 Why Restoration Has Not Occurred in the Past

Some of the most important information we gathered came from asking the employees why restoration ideas and projects were never carried out in the past. These employees gave us a wide range of answers that we were unaware of previously. First, we found out that there were careless acts caused from no supervision at the sites near Baño Grande. In the 1960s, there was a drowning after forest hours in Baño Grande that caused the area to be shut down from use of visitors due to the liability of the forest as well as the inability to always be watching that area, causing the supervisors of El Yunque to be cautious when it came to reopening that area for recreation. Another reason restoration has not occurred was due to unoriginal ideas being brought up. In past years, ideas have been presented to the committee that works to carry them out, but

they were not ideas that could be backed by the US Forest Service, stopping the idea process. If the projects did get started, they were not completed due to past management. If the projects that were being worked on had an issue, they would be pushed aside instead of reevaluated to fix the problem. Projects that were put on the back burner were not followed up on, causing them to never be completed. Finally, the state of economy causing sparse funding was an overall factor as to why the restoration projects have not been carried out before now. Puerto Rico has gone through a severe debt crisis, making the resources and funds that the US Forest Service had access to in order to restore recreational structures limited. This information we gathered from the employees gave us a better insight as to what roadblocks they had hit in the past in regards to lack of restoration, helping us give recommendations to prevent the same scenario from occurring again.

4.2 Results of Surveys

In our time at the forest, we accumulated a total of 98 surveys, 89 in English, and 9 in Spanish. Of those 98 surveys, 71 were taken by tourists, and 27 were taken by residents. Even though more surveys were taken in English, many locals speak both languages and decided to take the English version rather than the Spanish, making it easier for us to read and analyze later. From the online source, 162 surveys were taken, 122 in English and 40 in Spanish. In total counting both onsite and online, 260 surveys were taken, 211 English versions, and 49 Spanish versions. The number results for choices for each structure may be off as the total number of responses counted were based on who answered the question or not, instead of just total surveys started. People were able to stop the survey at any time if they wished to, causing the responses received to be different than total surveys taken. The breakdown of who chose what option for the survey results for each structure, by amount of people, can be seen in Figures 17-21.

Figure 17: Survey Results Breakdown by Amount of People: Baño Grande Pool

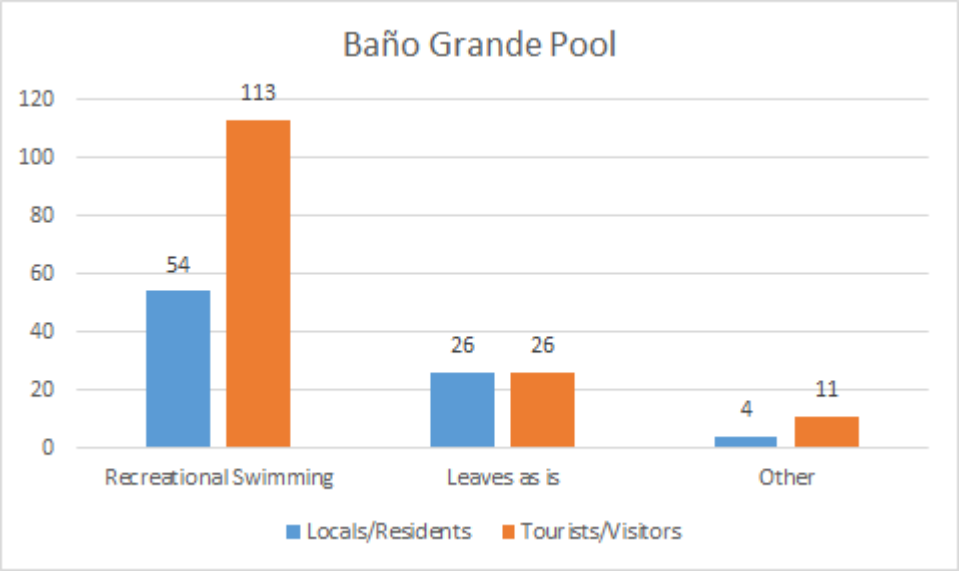


Figure 18: Survey Results Breakdown by Amount of People: Baño Grande Bathhouse

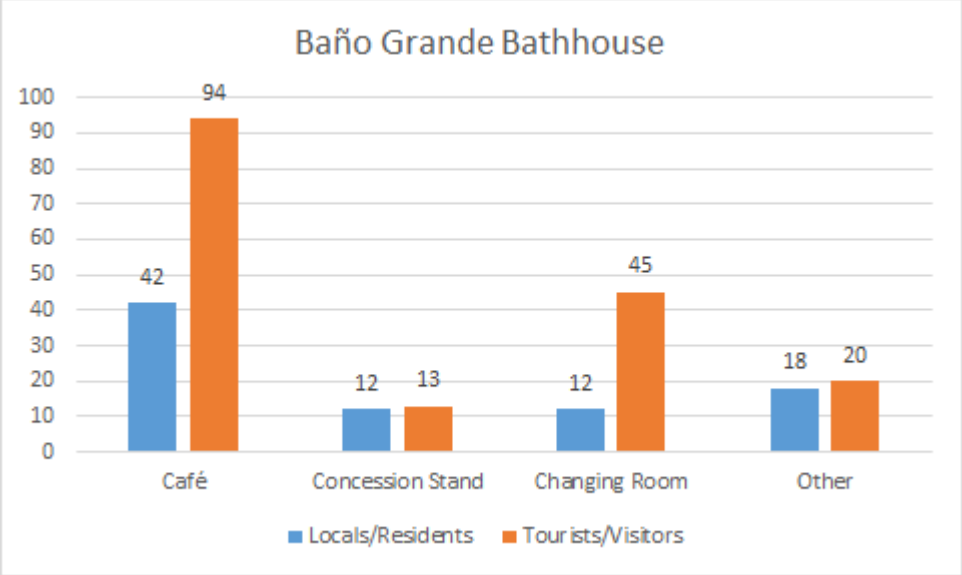


Figure 19: Survey Results Breakdown by Amount of People: Baño de Oro Pool

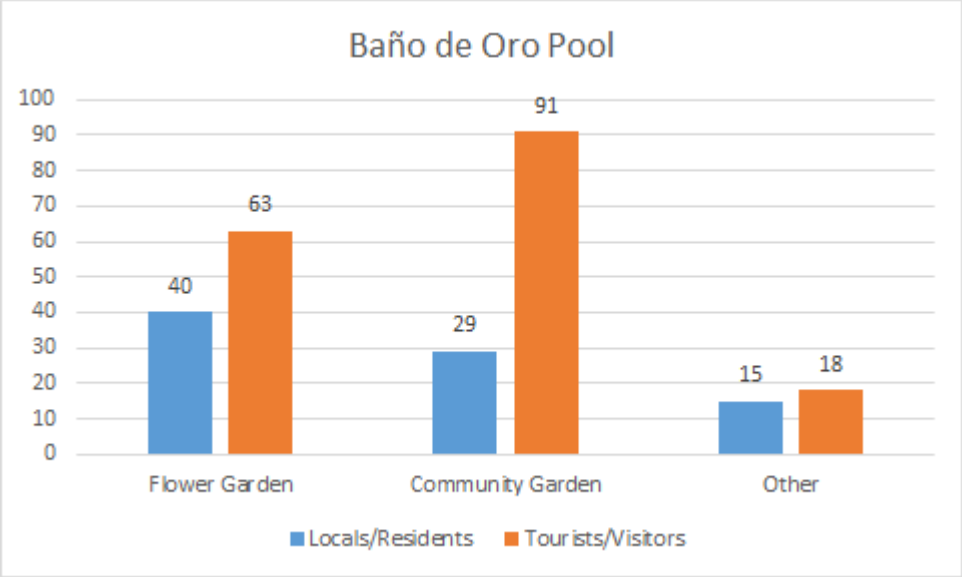


Figure 20: Survey Results Breakdown by Amount of People: Baño de Oro Bathhouse

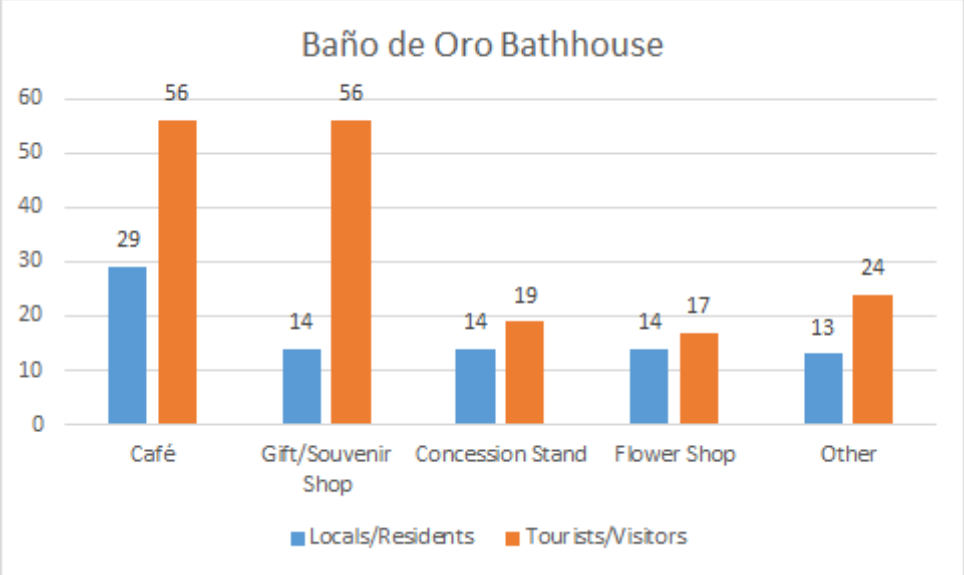
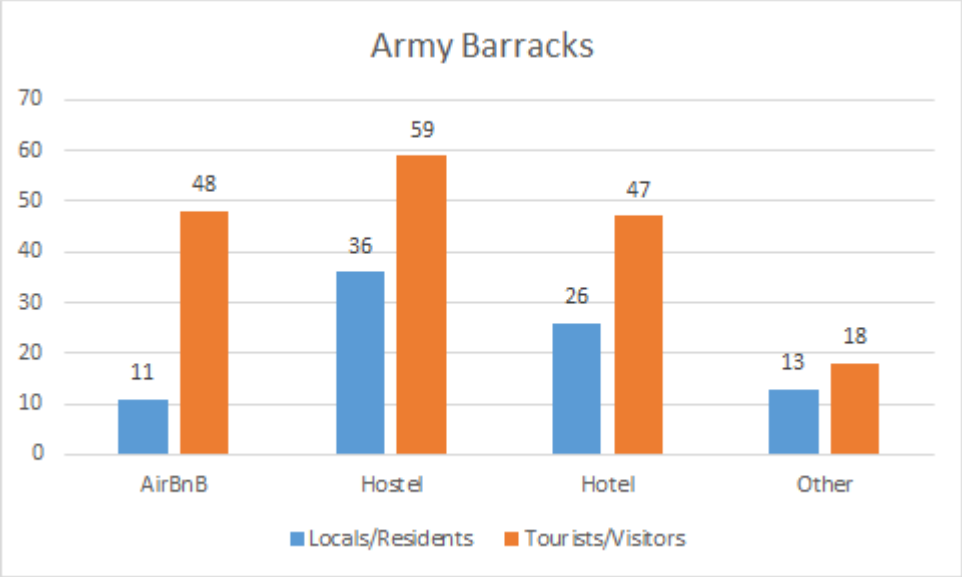


Figure 21: Survey Results Breakdown by Amount of People: Army Barracks



In order to further grasp our survey results and to view our data in a different way, we gathered the percentages of who chose which option, broken down into locals and residents versus tourists and visitors. These results can be seen in Figures 22-31.

Figure 22: Baño Grande Pool Survey Results of Locals and Residents

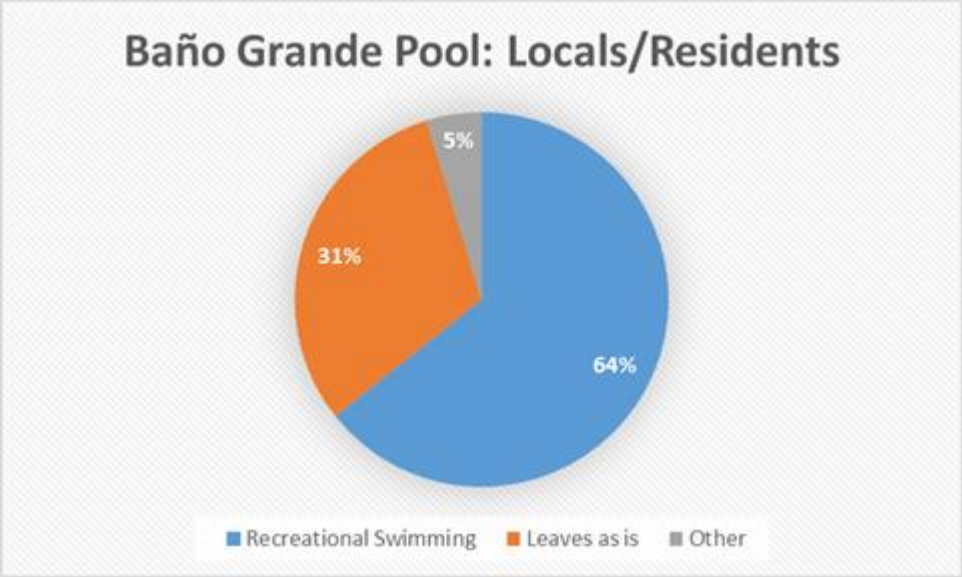


Figure 23: Baño Grande Pool Survey Results of Tourists and Visitors

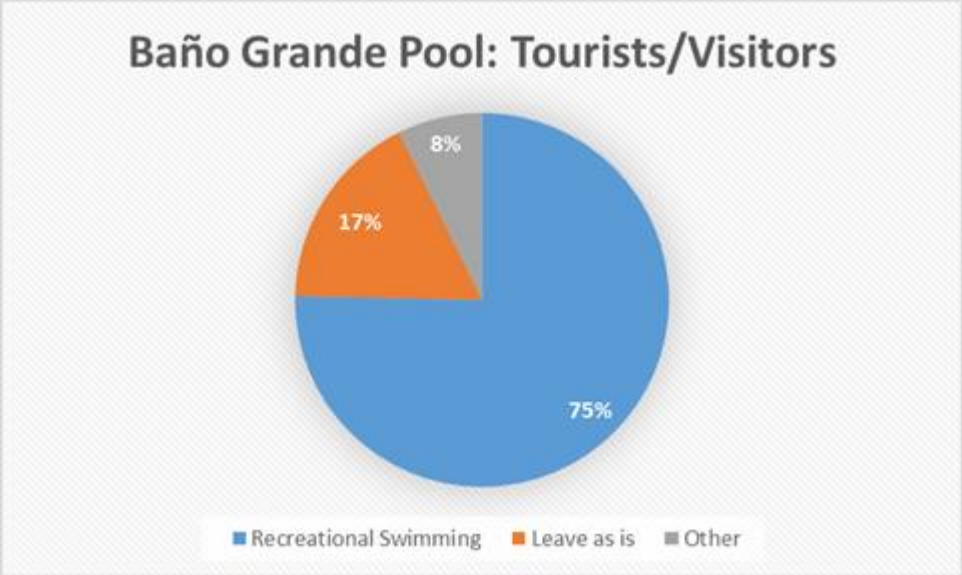


Figure 24: Baño Grande Bathhouse Survey Results of Locals and Residents

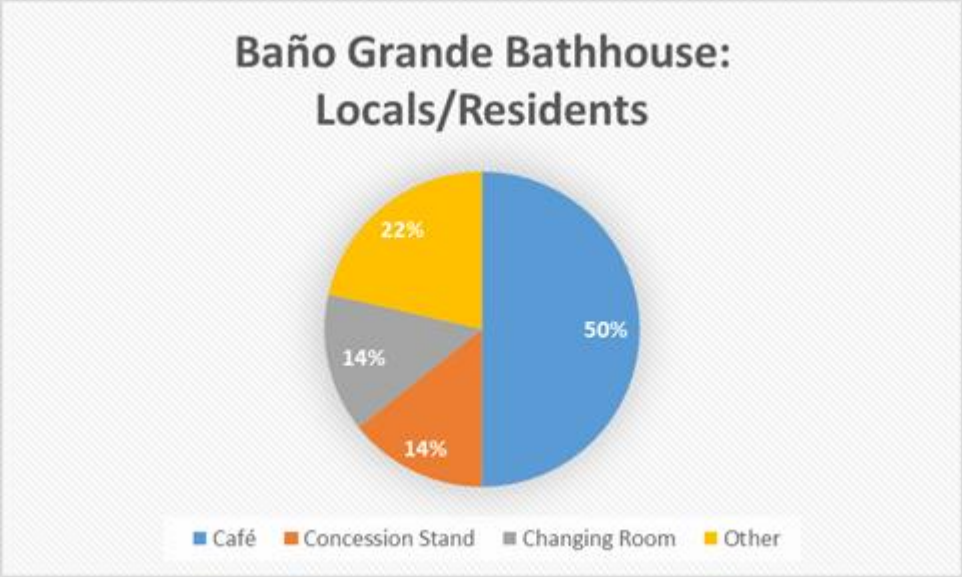


Figure 25: Baño Grande Bathhouse Survey Results of Tourists and Visitors

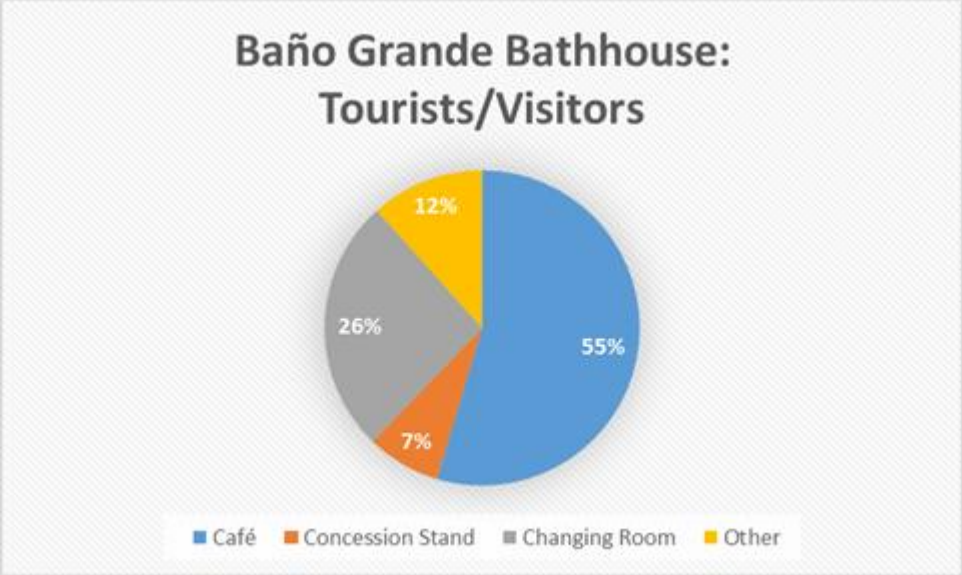


Figure 26: Baño de Oro Pool Survey Results of Locals and Residents

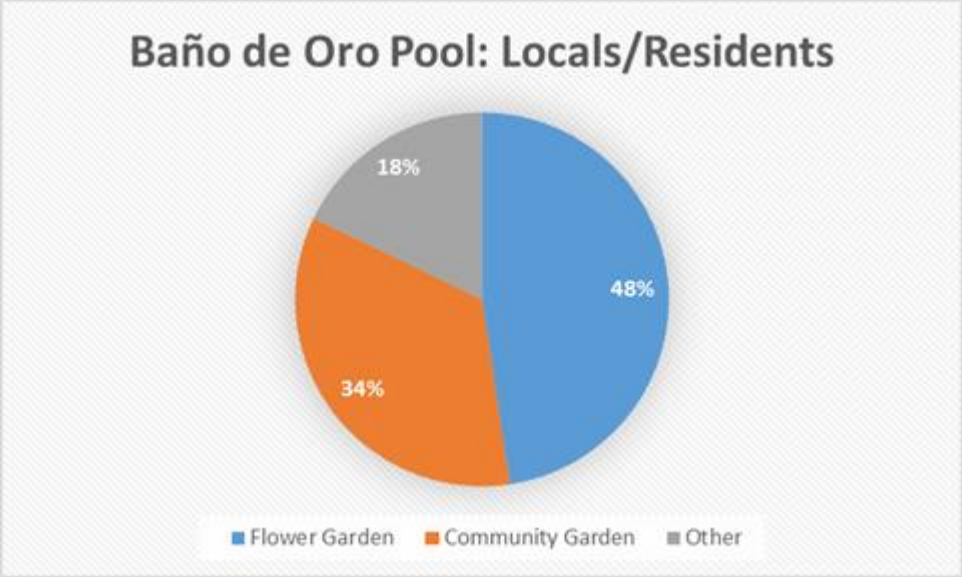


Figure 27: Baño de Oro Pool Survey Results of Tourists and Visitors

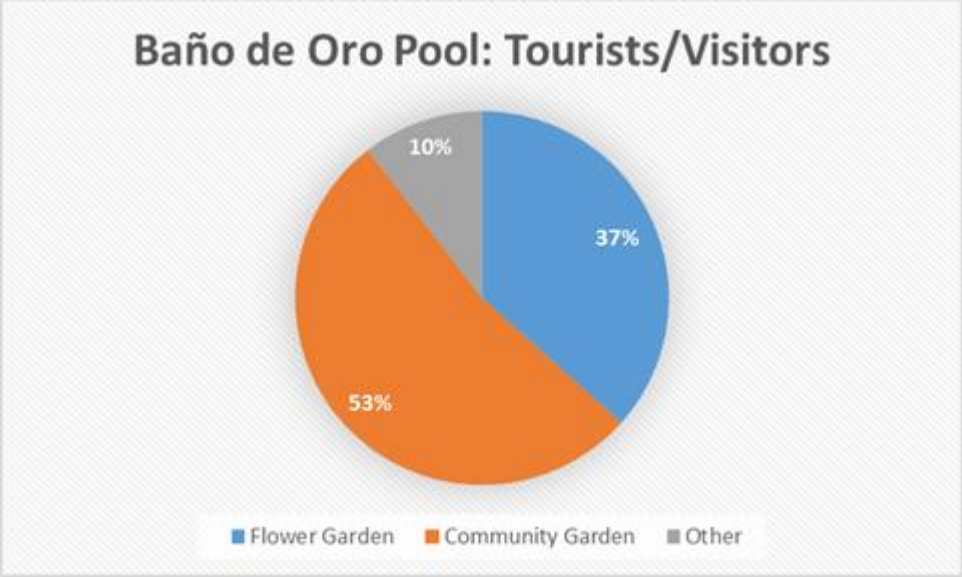


Figure 28: Baño de Oro Bathhouse Survey Results of Locals and Residents

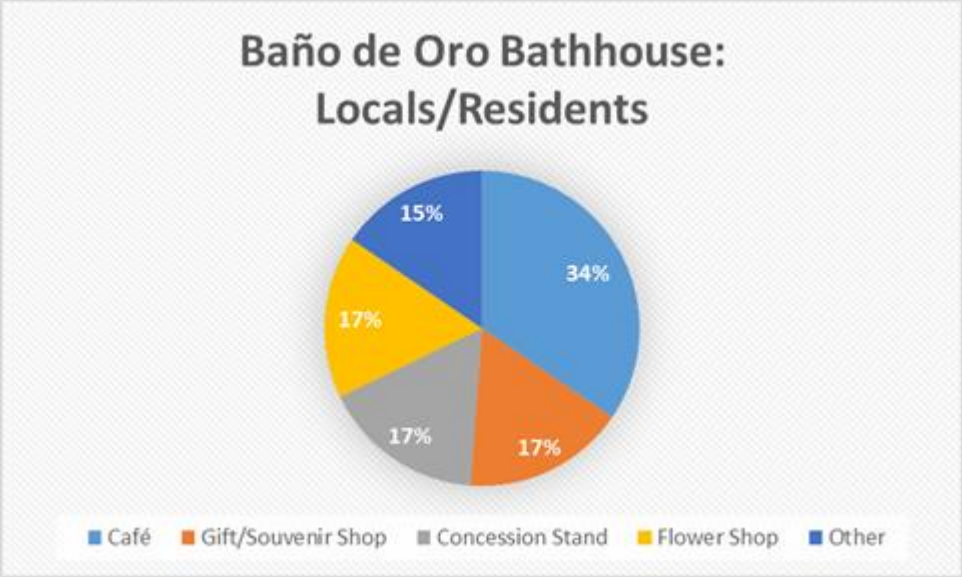


Figure 29: Baño de Oro Bathhouse Survey Results of Tourists and Visitors

Figure 30: Army Barracks Survey Results of Locals and Residents

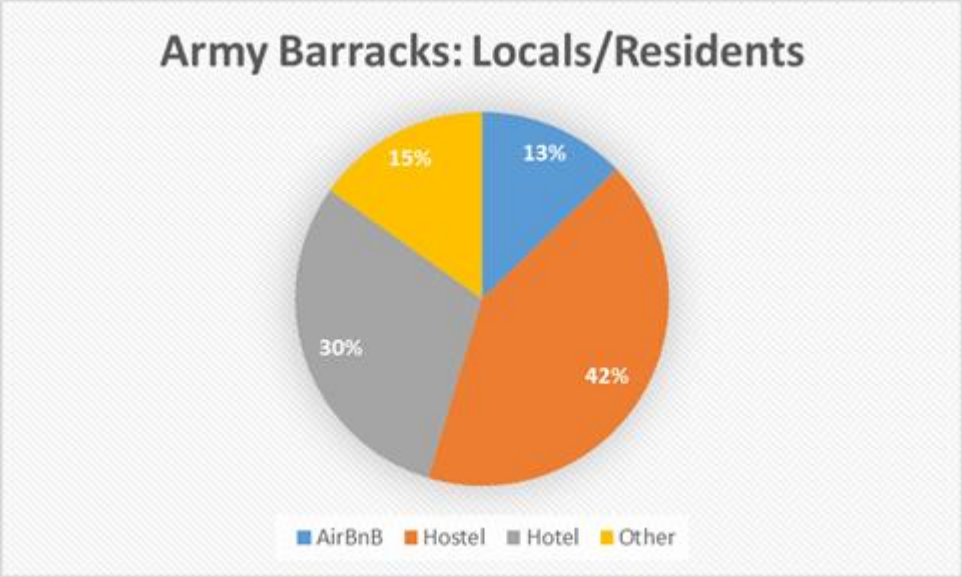
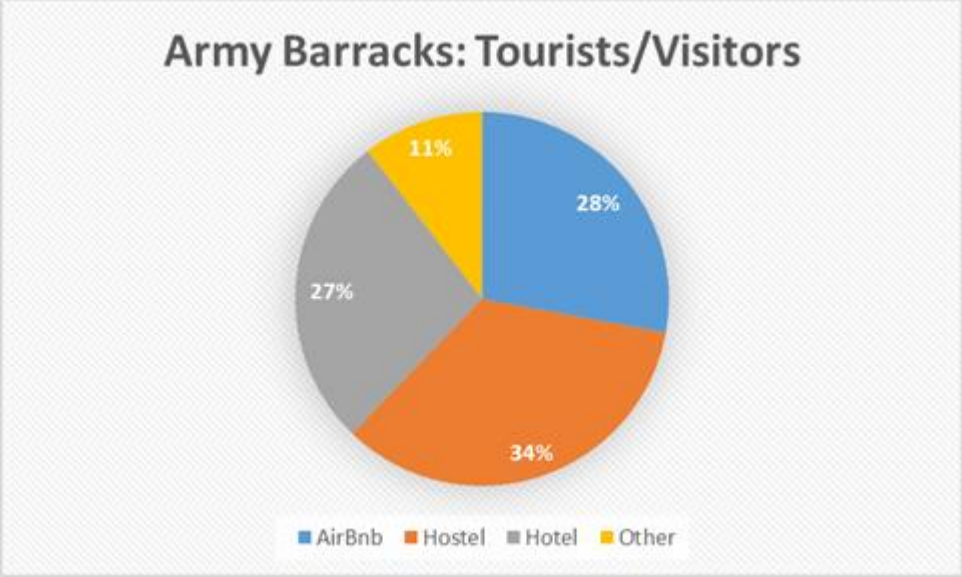


Figure 31: Army Barracks Survey Results of Tourists and Visitors



4.3 Results of Overall Data

Based on the interviews, onsite surveys, and online surveys given out through the month of November, we were able to find a trend in the data received and decide which structure ideas to pursue. For Baño Grande, the top two ideas for the pool were to leave it as is, or to restore it back into a recreational swimming area. For the Baño Grande bathhouse, the top two ideas were to restore it into a cafe or changing room. We planned to have ideas that would correlate, therefore the plans to leave the pool as is and cafe would be built together, and the recreational swimming area would be built with the changing rooms. For Baño de Oro, the top two ideas for its pool were to restore it back into a wading/recreational pool, or to make it into a raised flower garden. As for the Baño de Oro bathhouse, the top two ideas were to restore it into a concession stand or a flower exhibit, explaining the different types of flowers growing in the garden. The concession stand would be built with the wading/recreational swimming pool, and the flower garden would be built with the flower exhibit. For the army barracks, the top two ideas were a hostel and hotel.

5.0 Analysis of Results

The analysis of results explains how our group considered and interpreted the data that was received from the interviews, surveys, and feasibility tables. We analyzed the survey and interview data to understand which opinions we should weigh more heavily to determine the top ideas for each structure. The analysis of the feasibility tables explain the reasons for what we are suggesting as the top options for each structure. This section also describes the obstacles that hindered our group from receiving the most accurate data.

5.1 Interview and Survey Analysis

5.1.1 Considerations of Data

When taking into account all of the interviews and surveys conducted, some data was more heavily favored than others. The online surveys shared on social media were taken into account the least, excluding the Spanish versions. Because they were shared on our social media, a majority of participants were family and friends whom have likely never visited El Yunque. They may still have ideas, but because they have never seen the sites in person, it is a bit harder for them to form an educated opinion. The Spanish surveys were more qualified because they were more likely filled out by residents of Puerto Rico, seeing as our sponsor, who himself is a local, shared the link. They have a higher chance of having already visited, being able to form more qualified opinions.

The interviews of the US Forest Service employees were taken into account, but with some discretion. Although they know the most information and background regarding the structures, the employees have been working together and hearing the same opinions for so many years. This results in their ideas being a bit more swayed and similar than what we want. Their

support for our ideas, however, is important as they will be the ones who follow through on the project, so we needed to keep them in the back of our mind. They did give us extra insight on why projects proposals did not work in the past. This was important knowledge that without their help, we would have never been aware of. With their information, we were able to rule out ideas that were recommended previously but were denied, avoiding repetition.

The onsite surveys were taken into account the most. People were seeing the sites firsthand, and we were also able to answer any questions they had in regards to the structures, helping them make more informed decisions. Both residents and tourists were surveyed, but the residents' opinions were weighed more heavily. The locals who visit El Yunque on a regular basis have the strongest input, as they know more about the structures than the average visitor, but also have not been swayed to think a certain way. Therefore, the unbiased opinions of the residents of Puerto Rico were our best source of ideas when deciding what the structures are restored into. We noticed that when conducting the surveys onsite, some locations produced more useful data than others. When we were at El Portal Visitor Center, we encountered solely tourists who were mostly coming from cruise ships, so they did not stay long in the forest. They also had never visited any of the structures because the visitor center is the first location people arrive at when coming to El Yunque, causing the data that was recorded there was not the most ideal. The other two locations, Yokahu Tower and Palo Colorado Information Center were much better areas to survey at. Most people at the two locations had visited at least Baño Grande, and were able to give more informed decisions. More locals were also around, as they do not feel the need to go to the visitor center as much as a tourist would.

5.1.2 Analysis of Interview and Survey Data

The interview and survey data gave us important information to consider for our feasibility analysis. From the surveys, we were able to determine the most popular choices for each structure. Starting with Baño Grande pool, the option chosen the most was recreational swimming, with 167 people picking the idea, 113 being tourists and 54 being locals (Figure 17). Of the total amount of locals who took the survey, 64% chose recreational swimming, and 75% of tourists chose this as well (Figure 22 and 23). Although this idea was the most favored, we opted for the "leave as is" option instead. This is because through cost analysis and feasibility, we found that Baño de Oro pool would make more sense for recreational swimming. For Baño Grande bathhouse, the cafe was the most picked option with 156 people total, 94 being tourists and 42 being locals (Figure 18). Of the total amount of locals who took the survey, 34% chose cafe, and 32% of tourists chose it as well (Figure 24 and 25). Overall, 53% of total survey takers chose this option, making it the obvious decision for restoration.

For Baño de Oro, the results were a bit more skewed. According to the surveys, a form of garden was most popular, however, the community garden idea could never be carried out due to the community having difficulties reaching the forest regularly enough for the idea to follow through. Instead we looked at the flower garden as the most chosen option from the survey, with 103 total picks, 63 being tourists, 40 being locals (Figure 19). Of the total amount of locals who took the survey, 48% chose the flower garden, and 37% of tourists chose it as well (Figures 26 and 27). With this information along with that from the interviews, we gathered ideas about restoration that caused us to reevaluate our initial ideas. For example, every employee discussed having Baño de Oro as a wading pool with handicap accessibility. However, this option was never present on our survey, causing people to write the idea in the "other" section. As we looked more

at the space of the two sites, and the results for Baño Grande pool, 67% of total survey takers wanted some form of recreational swimming, so we decided that this option would be best for Baño de Oro. We used our judgment and insight of USFS employees to make this decision, rather than relying on survey results alone. Another instance in which we had to take in consideration other factors rather than just the survey results was for the Baño de Oro bathhouse. The survey results showed that the majority of survey takers favored either a cafe or gift and souvenir shop, but we decided to go with the next best choice of the concession stand instead, with 33 people in total, 19 being tourists, 14 being locals (Figure 20). Of the total amount of locals who took the survey, 17% chose the concession stand, while 11% of the tourists chose this as well (Figure 28 and 29). Because of our analysis of the Baño Grande bathhouse results, where we determined that the cafe was the most picked option by a large margin, it would not feasible to have two cafes within a short distance of one another, so we decided on the concession stand even though the survey numbers were low. As for the souvenir shop, there is one located down the road at Palo Colorado Information Center, so it would be unnecessary to have two souvenir shops in the same area.

From our survey, we gathered that the hostel was the most picked option for the army barracks. Our results showed that 95 people who took the survey chose this, 59 being tourists, 36 being locals (Figure 21). Of the locals locals surveyed, 42% chose the hostel, while 34% of tourists chose it as well (Figures 30 and 31). It was clear and concise as to which option was most favored for this structure. Overall, the surveys and interviews were very helpful to determine what exactly the employees and public wanted to see these structures restored into, which helped us narrow down our ideas before conducting the cost analysis, ultimately finding the most feasible options.

5.2 Cost Analysis

5.2.1 Baño Grande Cost Analysis and Feasibility

When comparing the two options for Baño Grande pool of a scenic photo area and a recreational swimming pool, leaving the pool as a photo spot is the most feasible option. From the surveys we conducted online and on-site 29% of survey takers chose leaving Baño Grande Pool as a scenic photo spot. This option was the second most chosen, but because we had to look at Baño Grande and Baño de Oro in tandem due to how close the sites are, we decided that Baño de Oro was the more feasible option for a recreational swimming pool. Based on the cost analysis keeping Baño Grande as a photo spot should only cost $16,000 at the most whereas restoring the pool into a recreational swimming pool could cost $25,000 if the construction goes as planned and has no issues. We are unsure of what obstacles could be faced when draining the pool and partially filling it with dirt and concrete. Because of the low liability, high feasibility, and current standing of Baño Grande pool the best option is restoring the area into a scenic photo area. A summary of the cost analysis table for Baño Grande pool can be viewed in Table 6.

Table 6: Summary of Cost Analysis for Baño Grande Pool

	Photo Spot	**Recreational Swimming Pool**
Restoration Cost	$6,257 - $15,520	$14,762 - $24,661
Yearly Expenses	$0	$30,000
Yearly Revenue	$0	$54,750 (50 customers/day) (average purchase: $3)
Return on Investment after 5 Years	0%	56.7%
Return on Investment after 10 years	0%	68.6%

When comparing the two options for Baño Grande bathhouse of a cafe or changing rooms, the cafe is the more feasible option. Based on the surveys conducted 53% of all survey takers chose the option of restoring the bathhouse into a cafe. At most the restoration will cost $30,000 which is about $9,000 more than the changing rooms, but most of the extra costs for the cafe come from the outdoor seating. The changing rooms would not cost as much to build, but will bring in less than $20,000 annually, as the only source of income would be the use of lockers. If the pool is not reopened then there is less of a desire for changing rooms. We project that the cafe will make about $55,000 at the low end each year. Pairing the costs and yearly expenses of the cafe and the scenic photo area, the cafe will still have an above average return on investment of over 40% after five years making it the most feasible option for Baño Grande Bathhouse. A summary of the cost analysis table for Baño Grande bathhouse can be viewed in Table 7.

Table 7: Summary of Cost Analysis for Baño Grande Bathhouse

	Cafe	**Changing Rooms**
Restoration Cost	$11,577 - $29,260	$10,139 - $21,562
Yearly Expenses	$30,000	$10,000
Yearly Revenue	$54,750 (50 customers/day) (average purchase: $3)	$18,250 (25 customers/day) (average purchase: $2)
Return on Investment after 5 Years	52.7%	27.5%
Return on Investment after 10 years	66.3%	50.1%

5.2.2 Baño de Oro Cost Analysis and Feasibility

When comparing the two ideas for the Baño de Oro pool, the numbers show that the expenses for the flower garden outweigh the zero income that would be generated. The garden

expenses are so great due to the amount of work and concrete it would take to construct, and in such a large area, causing the total restoration cost to be between $50,927 and $53,127, without being able to bring in any money to pay off the costs. The wading pool is a cheaper option, less than half of the cost of the garden, with the ability to bring in $54,750 in revenue, which is the amount of money they would get yearly if at least fifty people were to come to swim at the pool with a minimum swimming fee of three dollars. They would be able to pay off the costs of the restoration after two years at most, getting a 58.7% return on investment after five years, and a 69.8% return on investment after ten years. During the high visitor season, the pool would be able to generate more revenue at a faster pace, making this idea the most feasible option. A summary of the cost analysis table for Baño de Oro pool can be viewed in Table 8.

Table 8: Summary of Cost Analysis for Baño de Oro Pool

	Wading Pool	**Flower Garden**
Restoration Cost	$16,888 - $22,463	$50,927 - $53,127
Yearly Expenses	$30,000	$0
Yearly Revenue	$54,750 (50 customers/day) (average price to swim: $3)	$0
Return on Investment after 5 Years	58.7%	0%
Return on Investment after 10 years	69.8%	0%

When comparing the two ideas for the Baño de Oro bathhouse, the numbers are very similar for both options, as the beginning path of restoration for each is the same involving electric, plumbing, labor costs, as well as materials needed. However, as the wading pool is the

most feasible option for the pool, the concession stand is tandem with that option. This will bring in almost $55,000 worth of revenue from having a minimum of fifty people a day making an average purchase of three dollars at the stand, rather than only $18,250 that could be generated from having twenty five customers a day with an average purchase of two dollars on seeds or flowers at this exhibit. It is not necessarily feasible to sell the seeds or flowers with this exhibit as many people would not want to spend money on something like this. The exhibit would not be able to make back their investment even after ten years of having it in place, when the concession stand would be able to turn a profit after at the most two years. After ten years of having the concession stand in place, the return on investment would be 62.6%, much greater than that of the exhibit, which is negative. This makes the concession stand the more feasible out of the two options, as it fulfills the main objective of generating revenue from the structure. A summary of the cost analysis table for Baño de Oro bathhouse can be viewed in Table 9.

Table 9: Summary of Cost Analysis for Baño de Oro Bathhouse

	Concession Stand	**Flower Exhibit**
Restoration Cost	$16,369 - $36,739	$14,670 - $29,357
Yearly Expenses	$30,000	$30,000
Yearly Revenue	$54,750 (50 customers/day) (average purchase: $3)	$18,250 (25 customers/day) (average purchase: $2)
Return on Investment after 5 Years	46.6%	-49.1%
Return on Investment after 10 years	62.6%	-44.6%

5.2.3 Army Barracks Cost Analysis and Feasibility

When comparing the two ideas for the army barracks, the hostel appears to be more feasible. The construction cost for the hostel would be around $250,000, while the hotel's construction cost would be around $300,000. All construction would be identical for the two ideas, except the hotel would require concrete wall installation to create more rooms, which would cost around $80 per cubic yard. There would also need to be new bathrooms added for each room, which would cost between $3,000 and $25,000 to construct. A hostel would not need this extra construction, as communal bathrooms and large living spaces are common. The yearly expenses for the hostel would be much lower than the hotel, at $60,000 compared to $150,000. For the hostel, expenses would only be spent on maintenance, cleaning, and food. As for the hotel, expenses would include those, but on much higher scales due to more rooms to clean, bathrooms to maintain, and people would likely stay longer and eat all their meals at the hotel. Prices to stay at the two buildings would vary greatly, as cost per night at the hostel would be $30 per night, while at the hotel it would be $120 per night. This is because in a hostel, the customers would be living in a large space with many people as well as the bathrooms being shared, resulting in cheaper prices. In a hotel, each guest would have their own room and bathroom, therefore higher prices per night. Due to factors like this, the hotel would make twice the amount of money per year compared to the hostel, making $440,000 while the hostel would make around $160,000. After just five years, the hotel's return on investment would be 88%, and the hostel's return on investment would be 18%, both extremely high percentages. Based on numbers only, it may seem as if the hotel would be the more feasible option to restore the army barracks into. However, when factors such as the building itself and how it is already set up, as well as the survey results, the hostel is the more feasible option. The hostel would still generate revenue

within the first few years after being constructed, it would be able to hold more guests than the hotel, and it was also the option most chosen on the survey, with 37% overall (Figures 30 and 31). A summary of the cost analysis table for the army barracks can be viewed in Table 10.

Table 10: Summary of Cost Analysis for the Army Barracks

	Hostel	**Hotel**
Restoration Cost	$165,267 - $394,360	$178,778 - $418,160
Yearly Expenses	$60,000	$150,000
Yearly Revenue	$164,250 (15 customers/day) (average purchase: $30)	$438,000 (10 customers/day) (average purchase: $120)
Return on Investment after 5 Years	18.3%	87.5%
Return on Investment after 10 years	65.2%	128%

5.3 Obstacles Faced

5.3.1 Survey Obstacles

Some obstacles hindered us from receiving the highest and most accurate data possible. One obstacle occurred with the online survey; many people taking it had not seen the structures in person. Because of this, it was hard for them to give the best ideas. Seeing the structures only in a photo as opposed to seeing them in person is extremely different. The photos only showed one point of view of each structure, and a person could not understand the true size or specific details of each site. In person, you are able to go inside the structures, and get a feel for what would best fit there. The second obstacle we faced was the public not wanting to participate in our survey.

When sitting at the survey site, we would ask people to take our survey, and more often than not, people would decline. People assumed we were selling them something, were too busy to stop for a few minutes to talk, or just had no interest in taking a survey. We found, however, people were more apt to take the survey when we mentioned that we were students. This was most likely because they then felt that they were helping us, rather than being burdened to take a survey on something that they have no interest in. We were not always able to bring up that we are students, as people would ignore us initially, not allowing for any conversation. The third, and possibly the most distinct obstacle that we faced, was the overall lack of visitors coming to El Yunque. Because our project took place in Puerto Rico during the rainy season, there was a much smaller pool of visitors to the forest. In the peak season, thousands visit daily, but in the rainy season, only several hundred visit each day. This hindered the amount of data we could possibly collect, as we only saw an average of 150 people per day.

5.3.2 Interview Obstacles

Other obstacles that prevented us from being able to gather data occurred with the interviews of the forest workers and USFS employees. Out of the four weeks we were in the forest, we only had the opportunity to interview the employees twice, causing us to have limited time to talk to them. On those days we were able to interview, some workers were busy in meetings, out of the office doing field work, or trying to meet a deadline as the fiscal year was coming to a close, making them less open to speaking with us. Thus, we were only able to interview a little less than half of the employees who work for the US Forest Service.

5.3.3 Cost Analyses Obstacles

The final obstacle we faced was our lack of experience in conducting cost analyses. We did not have one fluid program to gather all of this data in regards to the price of restoration, so our numbers could be off based on our research. We also used national numbers for pricing, as there were not a lot of specific numbers and information about Puerto Rican construction and materials. Therefore, our data is not as accurate is if we had access to a program that could calculate these numbers for us.

6.0 Conclusion and Recommendations

This chapter concludes the results we received from the data collected, as well as recommendations for each of the structures at Baño Grande, Baño de Oro, and the army barracks. During our time in Puerto Rico, the field measurements, surveys, and interviews provided us with an understanding of what could be possible for each structure. We believe that our suggested restoration ideas for each structure are the most feasible and will facilitate recreation and revenue for El Yunque National Forest.

6.1 Conclusion

6.1.1 Final Structure Ideas

After conducting field measurements, interviews, surveys, cost analysis, and our personal opinions, we recommend that Baño Grande pool stays as it currently is, a photo spot with minor refurbishments, and that Baño Grande bathhouse becomes a cafe. As for Baño de Oro, we recommend that the pool becomes a wading pool, and that the bathhouse becomes a concession stand. Finally, we recommend that the army barracks is restored into a hostel.

Based on the survey, 29% of takers wanted Baño Grande pool to stay as a scenic tourist spot. The interviews provided us with information about the liabilities involved with having an 18 foot deep swimming pool open to visitors, there would need to be a lifeguard on duty at all times. The USFS employees also continuously mentioned how they would wanted the pool to be handicap accessible if it were to be reopened, which would be difficult due to the setup of the area around it. Leaving the area as a scenic picture taking spot was the more feasible solution, as it will be cheaper and can be completed in shorter amount of time. Also, the pool will not have not be tampered with so the chances of running into extra costs is greatly decreased (Table 1). Although

this was not the top choice based on the survey, the information gathered from the interviews, the feasibility charts, and the choice to make Baño de Oro a wading pool, made keeping Baño Grande as a photo spot the more reasonable option.

The choice to make Baño Grande bathhouse a cafe was more straightforward. The survey results showed that 53% of people who completed the survey preferred the option of a cafe. From the interviews, we learned that the employees agreed with our idea of the cafe and mentioned that people are always looking for somewhere to get coffee on the mountain and there is no such place presently. Feasibility wise, the hardest part will be running electricity through the building, but other than that all of the costs will be on cosmetics such as painting and cleaning the concrete (Table 2). Building a cafe will facilitate recreation and revenue for the forest and investors, and will disperse the foot traffic of people in El Yunque.

Our group's decision to recommend that Baño de Oro be repurposed as a wading pool with handicap accessibility was decided differently. The option was not on the survey, but 12% of people wrote in the option in the "other" category. From our interviews with the USFS employees we knew that they wanted to see a handicap accessible pool. We also learned that at the maximum depth, Baño de Oro pool is only eight feet deep which is much more manageable than 18 feet deep like Baño Grande. It makes more sense for Baño de Oro to be a swimming pool then Baño Grande after conducting a feasibility analysis (Table 3). Baño de Oro offers a large patio area next to the pool, creating a rest area for people as others are swimming. The pool is also designed in a way that is easier to make handicap accessible because the path to the pool does not have any stairs and the pool itself is shallow. Lastly, turning Baño de Oro into a swimming pool costs less money than the other top option, because it included bringing in more concrete and soil to create a lifted garden that would generate no revenue.

The recommended choice for Baño de Oro bathhouse is a concession stand. Although the survey results show that only 13% of people wanted a concession stand, the numbers were skewed. The top result was a cafe as well, but because the top choice for Baño Grande bathhouse is a cafe we are not suggesting both are restored to this. The other option we looked at in our feasibility table was a flower exhibit, but that option was contingent on the pool becoming a flower garden. Feasibility wise, the concession stand would pay off very fast. Almost all costs will be cosmetic and removing a few bathroom stall walls (Table 4). Most public pools have concession stands, so the Baño de Oro structures will complement each other well.

For the army barracks, the survey results showed that 37% of the takers wanted it to be repurposed as a hostel. After talking to the USFS employees, we learned that a hotel or hostel would be a huge addition to El Yunque, because not everyone likes camping so being able to stay indoors somewhere in the forest would attract more people to stay overnight. A hostel is the most feasible idea for the army barracks; unlike a hotel, there can be public bathrooms and kitchens (Table 5). Also, people can sleep in large rooms with multiple beds, so less bedrooms would need to be created. A hostel would also require less employees and could draw a larger crowd because it costs less money to stay. This will be the most expensive restoration project of the five, but will also be a huge draw for people to come and stay overnight in the forest and bring in more revenue.

6.1.2 Limitations

When gathering data on what the people wanted to see the structures turned into, we faced a few limitations. Whilst surveying onsite, people would not stop to speak with us, or they would decline to take the survey if we asked for a moment of their time. Many visitors did not want to take the time to answer questions, and they also did not know exactly what our survey was about,

hindering them from approaching us. We were also surveying in the off season of El Yunque, meaning there were significantly less people in the forest. This decreased the amount of surveys and data we could even attempt to receive, as only several hundreds of people visited daily, compared to the thousands in the summer months. We never lost data from this problem, we just did not collect as much as possible, resulting in less accurate data.

When creating the cost analysis tables for each structure, we had difficulties finding exact numbers and pricing of different materials and jobs that would be needed. Because of where El Yunque is located, it was difficult to find electricians, plumbers, or contractors that were well priced, or even in the area. Therefore, we compromised by finding and using prices that were US national averages, as it is very likely that the numbers are similar. This impacted our cost analyses by making them not completely accurate. We were able to find all factors that would go into each structure when being constructed, but the numbers may all be slightly off. However, it is still a very good outline to base the restorations off of, as the tables list out all plumbing, electric, materials, labor, construction needed, as well as an estimation on total cost of each project, revenue that would be made, and return on investment. All the limitations faced during our project never resulted in holes in our data, it only affected the amount of data we received, or made data not as accurate as initially expected. No limitations surfaced that hindered the completion of our project.

6.1.3 Implications of Our Findings

Our findings come with few implications. By gathering our information from the surveys, interviews, as well as conducting our feasibility analyses, we determined what it means for our project as well as the real world. From our surveys and interviews, our subjects noted new ideas as well as chose options that we listed in the survey, while few opted to put that the structures

remain untouched. This implicates that restoration is something that people are in favor of for these structures, as well as potentially other structures in different places around the world that are in the same state as the ones we are focused on. Having structures go unused when they have the potential to facilitate revenue as well as recreation is something that the visitors as well as employees of El Yunque and the US Forest Service do not want to see. They would like them to be used as recreational spaces that keep their historical integrity intact as well as be accessible to those of all ages and those who are inclined to a wheelchair. From the results we were also able to figure out which ideas were most favored for each structure, allowing us to be able to propose ideas that many people would enjoy when they visited the forest, such as a swimming area to stay out of the heat. The final ideas can be seen in Table 11. The basis of these ideas came from our cost analyses of each option which we then analyzed to create our proposal of the most feasible option for each structure. Initial predictions changed when calculated the return on investment as well as revenue that could be generated through the restoration of each place. Ideas that were thought to be the most inventive ended up costing the most money without being able to make that money back, implicating that although the people liked a certain option we presented, it would not be possible to put the idea into action without being put into financial distress.

Table 11: Summary Table of Final Ideas

Structure	Recommendation
Baño Grande Pool	Scenic Picture Area
Baño Grande Bathhouse	Café
Baño de Oro Pool	Recreational Swimming Pool (handicap accessible)
Baño de Oro Bathhouse	Concession Stand
Army Barracks	Hostel

6.2 Recommendations

In regards to constructing these sites, we recommend that a contractor, engineer and architect be hired. While we created in-depth cost analysis tables that could be followed, these professionals would have a much better knowledge on where to get materials, and whom the best people would be to hire for electric, plumbing, and construction. They would get a better overall idea for construction costs and the sites in general, and would make the project run smoothly. As for where restoration should start, we recommend that one of the smaller sites, Baño Grande or Baño de Oro should be worked on first. Both of these projects would be finished in a shorter amount of time than the army barracks, meaning they would be able to be used sooner. The hotel would take much longer to restore, as it has many more parts to fix on top of being significantly larger than the other structures. They are also visited more often than the army barracks, as they are in the main tourist area of El Yunque, so they would be able to start creating revenue very quickly.

It was brought to our attention by our sponsor that the community surrounding El Yunque feels very much segregated from the forest, even though they live at the base of the mountain. To help get the people more involved, we recommend that the jobs that will be needed for each site once completed, be given to them. These jobs would include, lifeguards, concession stand and cafe workers, maids, front desk staff, chefs, and more. This way, they are making money while also having the chance to visit the forest on a regular basis. To get even more residents involved, we recommend having volunteers work on the restoration themselves, such as clearing out foliage, or even painting the buildings. This would not only cut costs of construction, but it would give the residents a sense of accomplishment helping in construction of new buildings that millions of people will get to use for many years to come.

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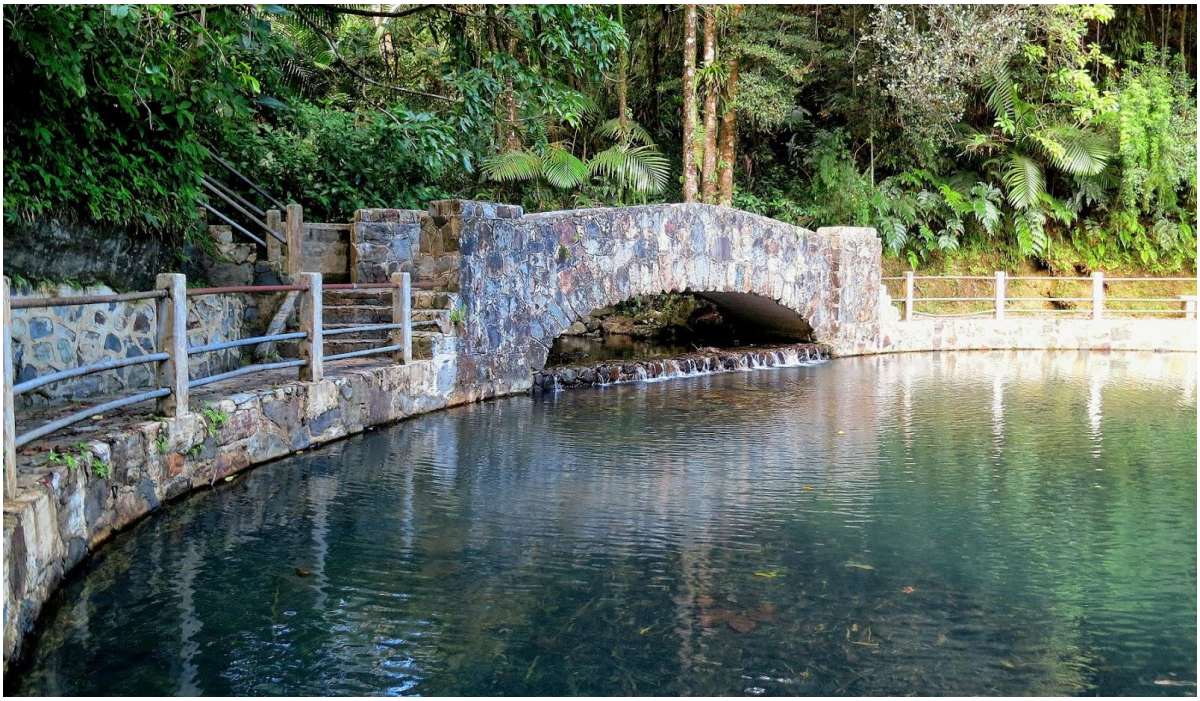
Appendix

Appendix A: El Yunque Structures

Appendix A1: Photos of Baño Grande



Source: (Salmon, 2016)

Source: (Salmon, 2016)

Appendix A2: Photos of Baño de Oro

Source: (Gwenn, 2008)

Source: (Weeks, 2016)

Source: (Salmon, 2016)

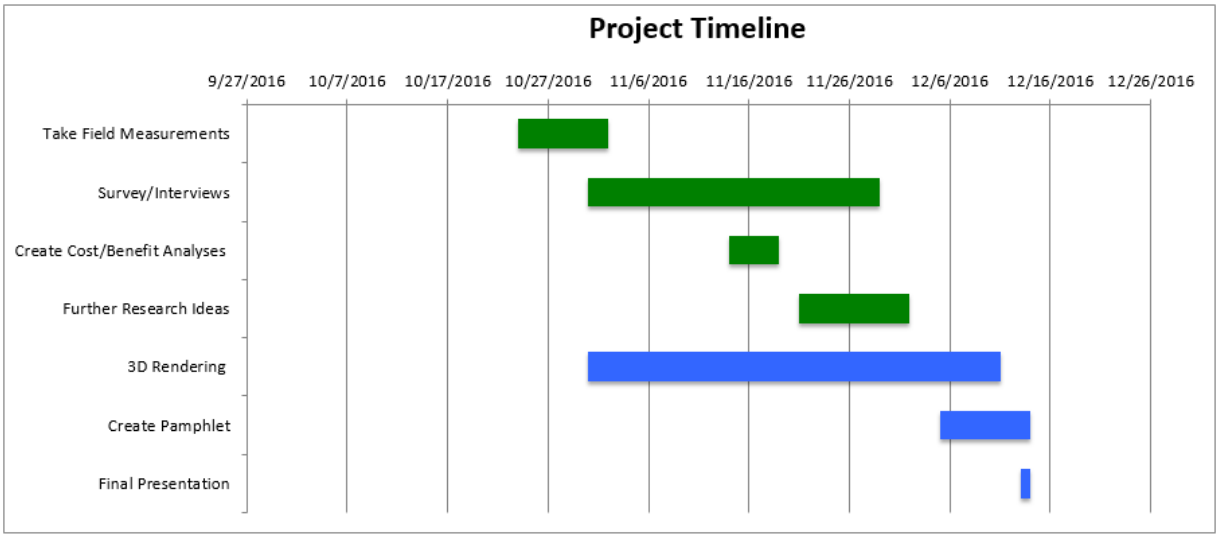
Appendix A3: Photos of Army Barracks

Source: (Maiola, 2016)

Source: (Salmon, 2016)

Appendix B: Project Timeline

Task Name	Start	End	Duration (days)
Take Field Measurements	10/24/2016	11/1/2016	9
Survey/Interviews	10/31/2016	11/28/2016	29
Create Cost/Benefit Analyses	11/14/2016	11/18/2016	5
Further Research Ideas	11/21/2016	12/1/2016	11
3D Rendering	10/31/2016	12/10/2016	41
Create Pamphlet	12/5/2016	12/13/2016	9
Final Presentation	12/13/2016	12/13/2016	1



Appendix C: Surveys & Interview Questions

Appendix C1: Interview Questions

Interview Questions: USFS Employees and El Yunque Employees

1. What is your role for the United States Forest Service?

   _____

   _____

2. How long have you been working here?

   _____

   _____

3. Have you dealt with the these structures before (Baño de Oro, Baño Grande, army barracks)?

   _____

   _____

4. What ideas have been proposed in the past?

   _____

   _____

5. If these ideas weren't able to be carried out, what went wrong? What could have been done to help keep the project going?

   _____

   _____

6. Are there any ideas that you are in favor of?

   _____

   _____

7. Do you have any ideas yourself specifically that you would like to see happen?

   _____

   _____

Appendix C2: Survey (English Version)

El Yunque National Forest Survey

Project description: The United States Forest Service is looking to refurbish three structures into new, usable spaces. We are looking for the best ideas as to what they should be converted into. We would appreciate your help and input in our efforts. This survey is voluntary and anonymous, and you may stop taking part if you wish.

Are you a:

- ❑ Local/Resident
- ❑ Tourist/Visitor

How often do you visit El Yunque National Forest?

- ❑ Once a week
- ❑ Once a month
- ❑ Once a year
- ❑ I have visited once
- ❑ Never
- ❑ Other (if other, give amount of time) _____

How much would you be willing to pay as an extra fee to use a recreational site?

- ❑ $1-$5
- ❑ $6-$10
- ❑ $11+
- ❑ Not Willing to pay
- ❑ Other (if other, give dollar amount) _____

When you visit, would you stay overnight?

- ❑ Yes
- ❑ No

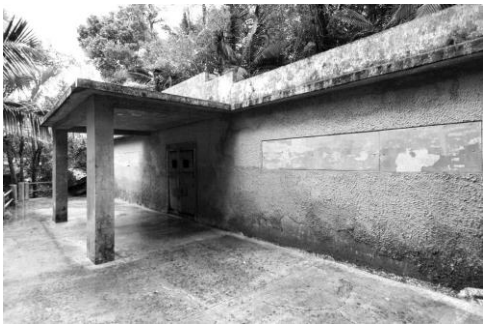
If willing to stay overnight, which option would you choose? (select all that apply)

- ❑ Camping
- ❑ Lodging/Hostel
- ❑ Hotel/Bed & Breakfast
- ❑ I would not be willing to stay overnight

Have you ever visited Baño Grande?

- ❑ Yes
- ❑ No

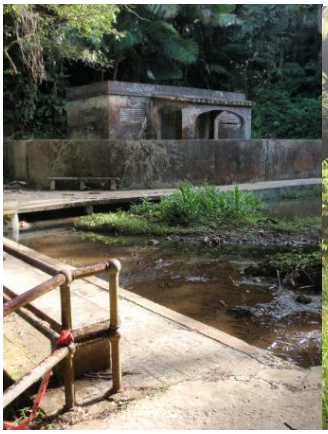
Baño Grande



Baño Grande Building

Have you ever visited Baño de Oro?

- ❑ Yes
- ❑ No



Baño de Oro Pool

Baño de Oro

Have you ever visited the army barracks?

- ❑ Yes
- ❑ No

Army Barracks

In your opinion, what would you like to see Baño Grande turned into?

- ❑ Recreational swimming
- ❑ Leave as is
- ❑ Other (if other, please specify) _____

In your opinion, what would you like to see the Baño Grande building turned into?

- ❑ Cafe
- ❑ Concession stand
- ❑ Changing room
- ❑ Other (if other, please specify) _____

In your opinion, what would you like to see Baño de Oro turned into?

- ❑ Cafe
- ❑ Gift/souvenir shop
- ❑ Concession stand
- ❑ Flower shop
- ❑ Other (if other, please specify) _____

In your opinion, what would you like to see the Baño de Oro pool turned into?

- ❑ Flower garden
- ❑ Community garden
- ❑ Other (if other, please specify) _____

In your opinion, what would you like to see the army barracks turned into?

- ❑ AirBnB
- ❑ Hostel
- ❑ Hotel
- ❑ Other (if other, please specify) _____

Appendix C3: Survey (Spanish Version)

Encuesta Nacional El Yunque

Descripción del proyecto: El Servicio Forestal de los Estados Unidos está tratando de renovar tres estructuras en nuevos espacios, que puedan utilizarse. Estamos buscando las mejores ideas en cuanto a lo que deben ser convertidos en. Agradeceríamos su ayuda y la entrada en nuestros esfuerzos. Esta encuesta es voluntaria y anónima, y es posible que deje de tomar parte si lo desea.

Es usted:

- ❑ Local/Residente
- ❑ Turismo/Visitante

¿Con qué frecuencia usted visita el Bosque Nacional El Yunque?

- ❑ Una vez a la semana
- ❑ Una vez al mes
- ❑ Una vez al año
- ❑ He visitado una vez
- ❑ Nunca
- ❑ Otros (si hay otro, dar cantidad de tiempo) _____

¿Cuánto estaría dispuesto a pagar una cuota de uso para una actividad recreativa opcional?

- ❑ $1- $5
- ❑ $6 - $10
- ❑ $11+
- ❑ No está dispuestos a pagar
- ❑ Otros (si hay otro, dar cantidad en dólares) _____

¿Cuando usted visita, le interesaría pasar la noche?

- ❑ Sí
- ❑ No

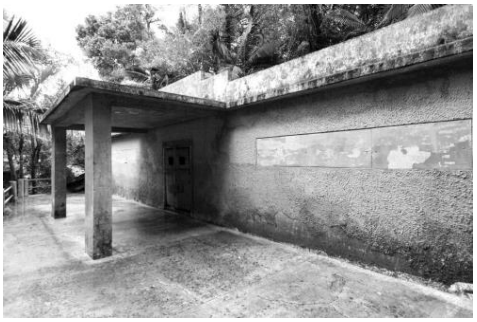
¿Si está dispuesto a permanecer durante la noche, qué opción elegiría? (Marque todo lo que corresponda)

- ❑ Camping
- ❑ Alojamiento/Hostal
- ❑ Hotel
- ❑ No estaría dispuestos a pasar la noche

¿Alguna vez ha visitado Baño Grande?

- ❑ Sí
- ❑ No

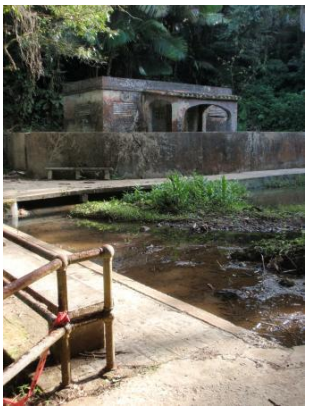
Baño Grande



El Edificio Baño Grande

¿Alguna vez ha visitado Baño de Oro?

- ❑ Sí
- ❑ No



La Piscina Baño de Oro

Baño de Oro

¿Alguna vez ha visitado el cuartel?

- ❑ Sí
- ❑ No

Cuarteles del ejército

En su opinión, ¿qué le gustaría ver Baño Grande convertido en?

- ❑ Natación recreativa
- ❑ Mantener como está
- ❑ Otro (si hay otro, por favor especifique) _____

En su opinión, ¿qué le gustaría ver la casade Baño Grande convertido en?

- ❑ Cafe
- ❑ Puesto de comida rápida
- ❑ Vestuario
- ❑ Otro (si hay otro, por favor especifique) _____

En su opinión, ¿qué le gustaría ver la casade Baño de Oro convertido en?

- ❑ Cafe
- ❑ Souveneirs/regalos
- ❑ Puesto de comida rápida
- ❑ Florería
- ❑ Otro (si hay otro, por favor especifique) _____

En su opinión, ¿qué le gustaría ver la piscina Baño de Oro convertido en?

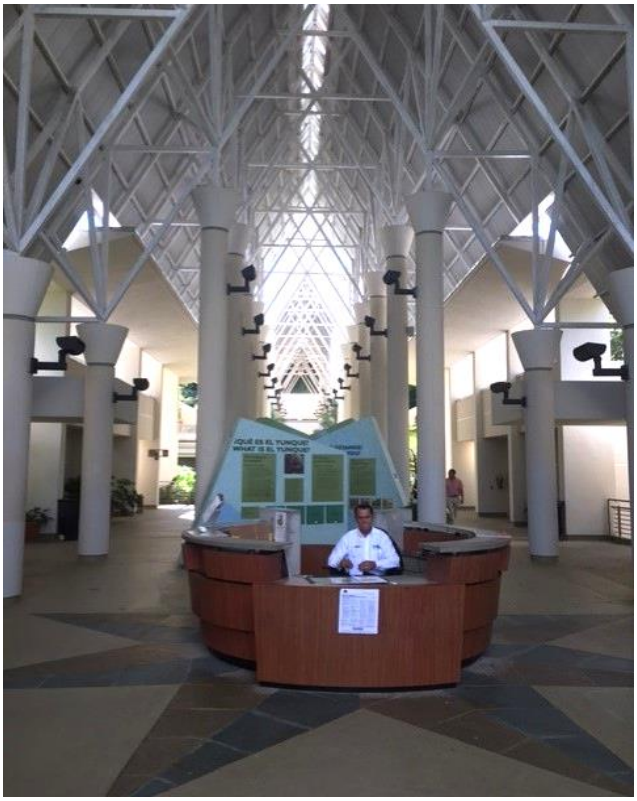
- ❑ Jardín escénico
- ❑ Vivero de plantas operado por la comunidad
- ❑ Area para actividades
- ❑ Otro (si hay otro, por favor especifique) _____

En su opinión, ¿qué le gustaría ver a los cuarteles del ejército torneadas convertido en?

- ❑ AirBnB
- ❑ Hostal
- ❑ Hotel
- ❑ Otro (si hay otro, por favor especifique) _____

Appendix D: Survey Sites

Appendix D1: El Portal Visitor Center - Survey Site



Source: (Maiola, 2016)

Appendix D2: Yokahu Tower - Survey Site

Source: (Karlis, 2015)

Appendix D3: Palo Colorado Information Center - Survey Site

Source: (WordPress, 2016)

Appendix D4: Palo Colorado Information Center - Gift Shop

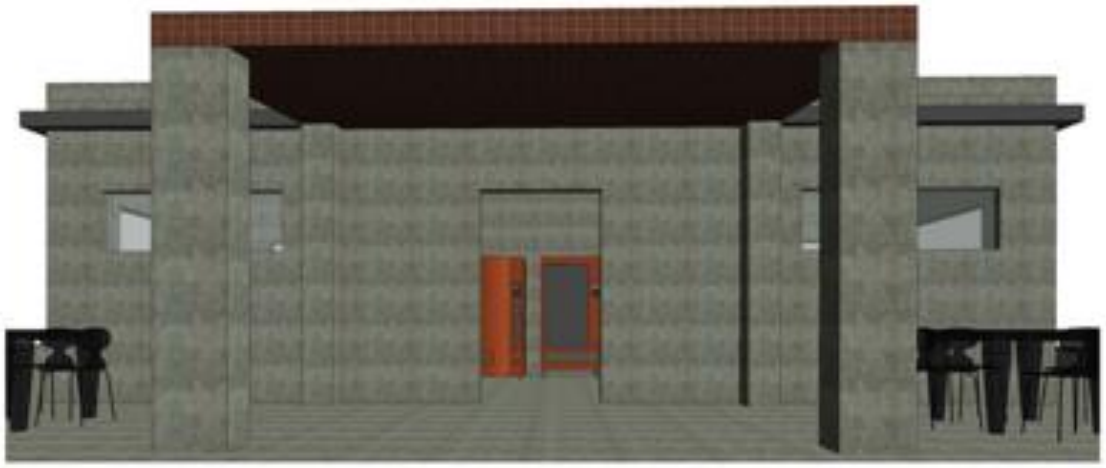
Source: (Richard, 2016)

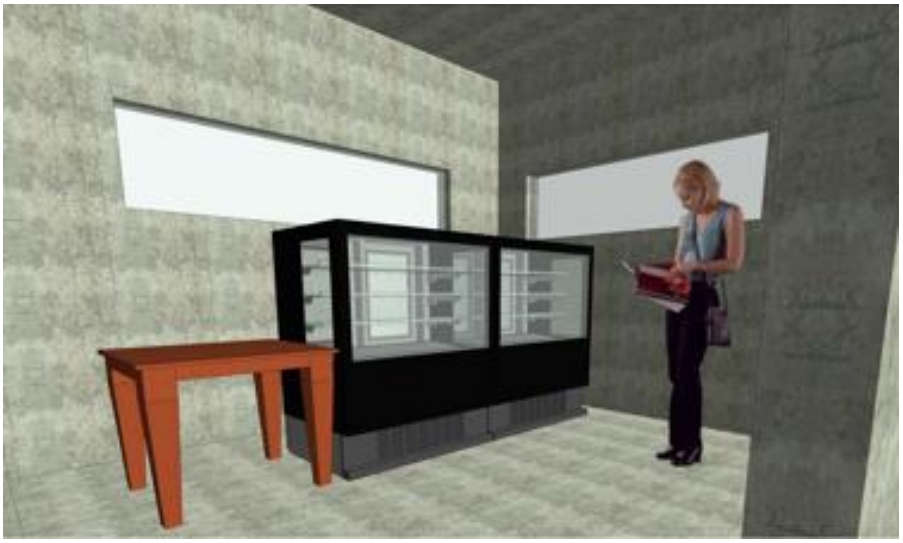
Appendix E: Flower Exhibit Example

The amapola (papaver rhoeas), also known as a poppy flower, are commonly used in bridal bouquets across Puerto Rico. They flourish in the summer months, which is typical of Puerto Rican climate. It can be a symbol of good luck and remembrance. (Crocus, N.d)

El amapola (papaver rhoeas), también conocido como una flor de amapola, se utilizan comúnmente en ramos de novia en Puerto Rico. Ellos florecen en los meses de verano, que es típico del clima puertorriqueño. Puede ser un símbolo de buena suerte y recuerdo.

Appendix F: 3D Renders





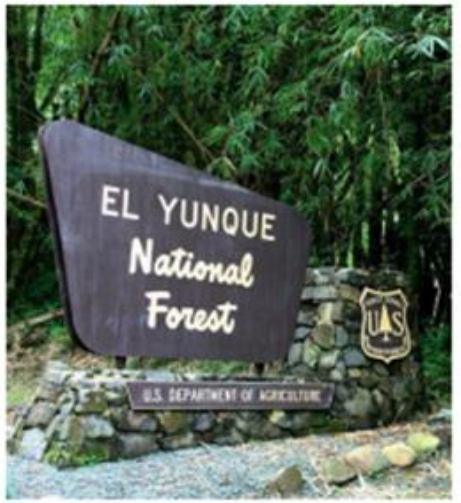
Appendix G: Pamphlet

We are students from Worcester Polytechnic Institute who for the past seven weeks have worked with the United States Forest Service to help create a restoration and design plan for Baño Grande, Baño de Oro, and an army barracks. By taking field measurements, conducting interviews and surveys, as well as performing cost analyses, we were able to come up with what we believe to be the most feasible ideas for each structure. In this pamphlet are our top recommendations for each site.

Morgan Maiola
Nina Murphy-Cook
Kayla Salmon
Aaron Weeks

December 13, 2016

Feasible Restoration of El Yunque National Forest Structures



Rendered designs and cost analyses for Baño Grande, Baño de Oro, and Army Barracks

Baño Grande

Baño Grande has an eighteen foot deep circular swimming pool that is reinforced by concrete and fed by La Mina River. Baño Grande was first opened in 1936 as a recreational swimming pool along with a bathhouse for the public. These structures were closed in 1968 and have been out of use since. It is proposed that the Baño Grande pool be kept as a photo spot for safety and ease, but the bathhouse to be restored into a Café to create some revenue for this site.

	Photo Spot	Recreational Swimming Pool
Restoration Cost	[illegible]	[illegible]
Yearly Expenses	$0	[illegible]
Yearly Revenue	$0	[illegible]
Return on Investment after 5 Years	0%	[illegible]
Return on Investment after 10 years	0%	[illegible]

	Café	Changing Room
Restoration Cost	[illegible]	[illegible]
Yearly Expenses	[illegible]	[illegible]
Yearly Revenue	[illegible]	[illegible]
Return on Investment after 5 Years	[illegible]	[illegible]
Return on Investment after 10 years	[illegible]	[illegible]

Baño de Oro

Baño de Oro has a rectangular pool that is reinforced by concrete and is fed by an unnamed stream. The pool varies from 18 inches to 8 feet at its deepest point. Baño de Oro is also accompanied by a bathhouse and both were used for a short period of time after the 1930s. The site is currently overcome with vegetation and is in disrepair. It is proposed that the pool is cleaned and reopened as a recreational and handicap accessible wading pool and the bathhouse to be turned into a concession stand.

	Wading Pool	Flower Garden
Restoration Cost	[illegible]	[illegible]
Yearly Expenses	[illegible]	$0
Yearly Revenue	[illegible]	$0
Return on Investment after 5 Years	[illegible]	0%
Return on Investment after 10 years	[illegible]	0%

	Concession Stand	Flower Exhibit
Restoration Cost	[illegible]	[illegible]
Yearly Expenses	[illegible]	[illegible]
Yearly Revenue	[illegible]	[illegible]
Return on Investment after 5 Years	[illegible]	[illegible]
Return on Investment after 10 years	[illegible]	[illegible]

Army Barracks

The Army Barracks was used as army housing during World War II, and was then used as an aviary for the Puerto Rican Parrot in the 1980s for about ten years. The aviary has been relocated and the army barracks has been out of use since. The building is around 6,000 square feet and approximately 19 rooms. It is proposed to be restored into a hostel.

	Hostel	Hotel
Restoration Cost	[illegible]	[illegible]
Yearly Expenses	[illegible]	[illegible]
Yearly Revenue	[illegible]	[illegible]
Return on Investment after 5 Years	[illegible]	[illegible]
Return on Investment after 10 years	[illegible]	[illegible]

Appendix H: Figures

Cover Figure: El Yunque National Forest Sign

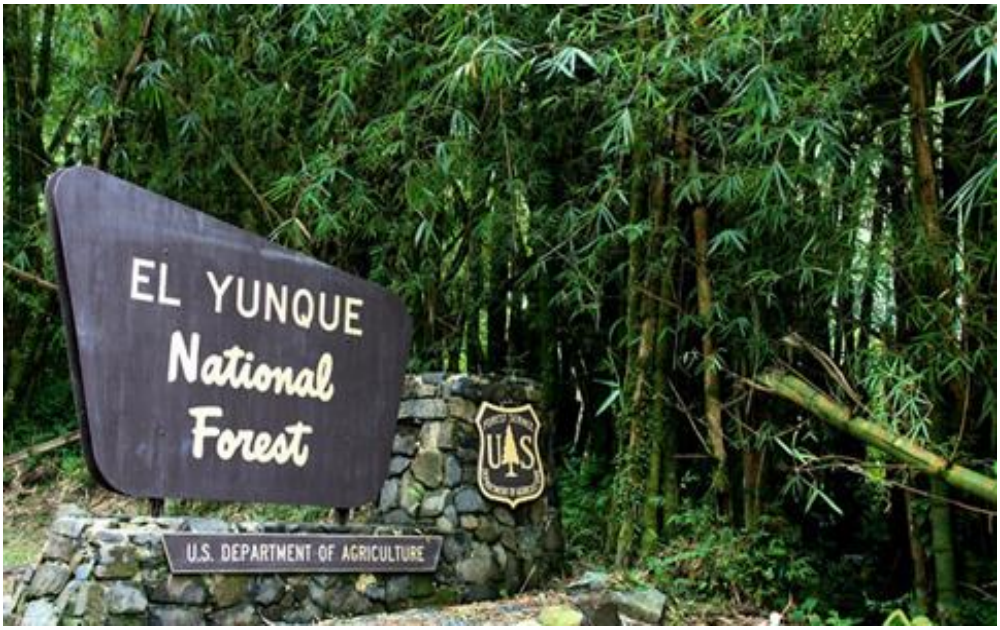


Figure 1: Benefits of Building Component Reuse

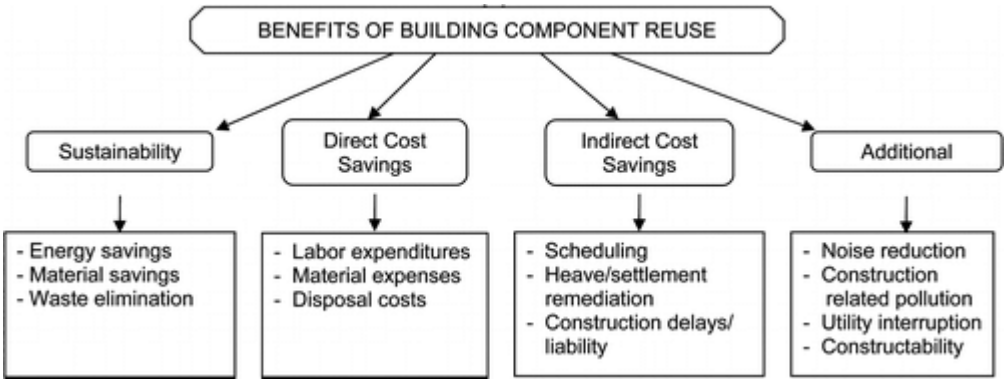


Figure 2: Baño Grande Pool

Figure 3: Baño Grande Bathhouse

Figure 4: Baño de Oro

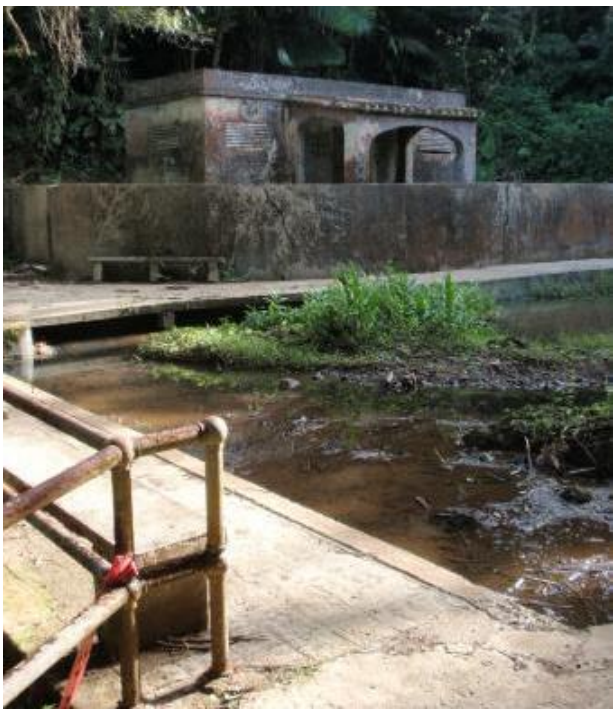


Figure 5: Baño de Oro Bathhouse

Figure 6: Baño de Oro Pool

Figure 7: Army Barracks

Figure 8: Inside of Army Barracks

Figure 9: Map of El Yunque

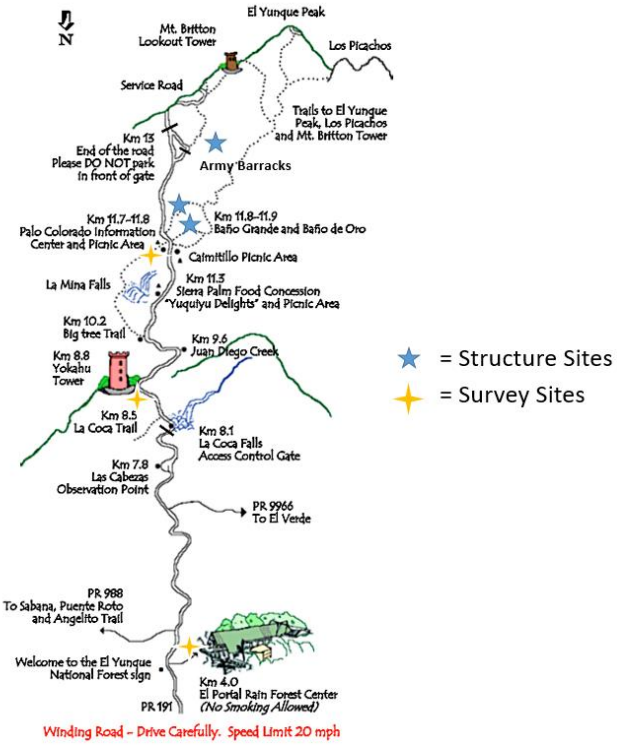


Figure 10: Survey Site Set-up

Figure 11: Close-up of Survey Site Set-up

Figure 12: 3D Render of Baño Grande

Figure 13: 3D Render of Baño de Oro

Figure 14: 3D Render of Army Barracks

Figure 15: Pamphlet Cover and Back

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WPI

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

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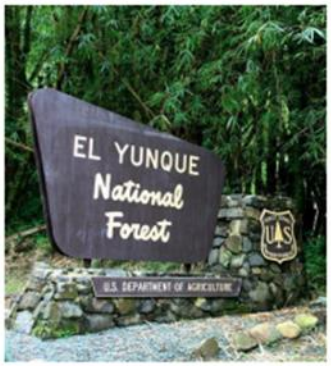

Rendered designs and cost analyses for Baño Grande, Baño de Oro, and Army Barracks

Figure 16: Pamphlet Body

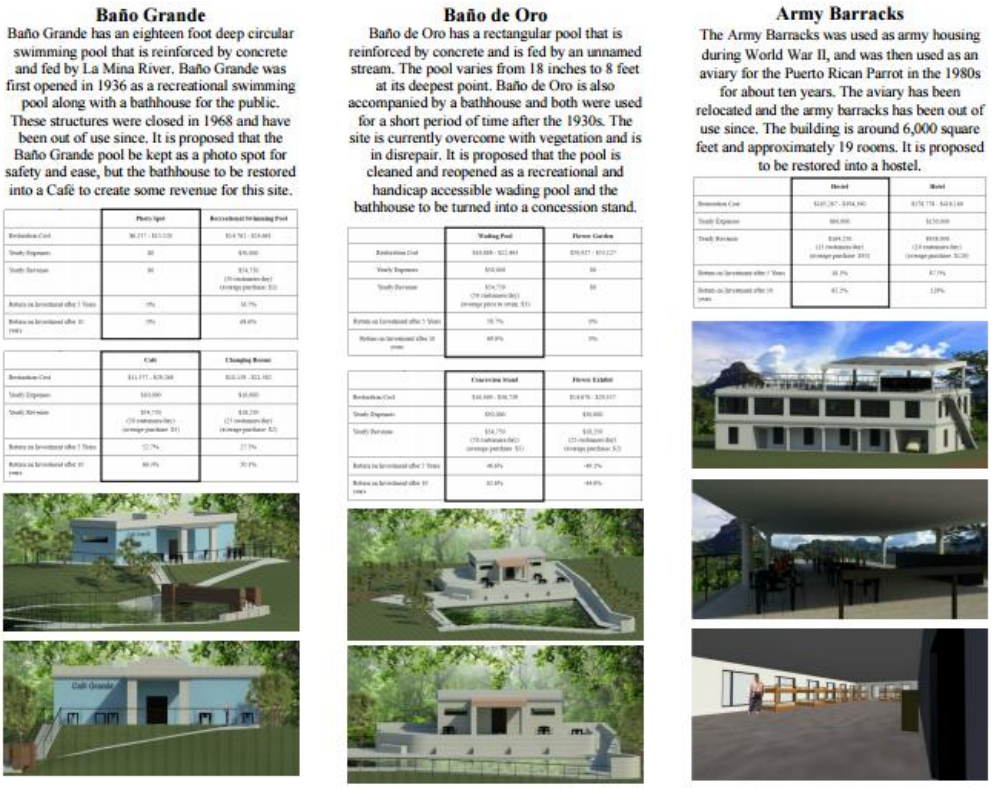

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Figure 17: Survey Results Breakdown by Amount of People: Baño Grande Pool

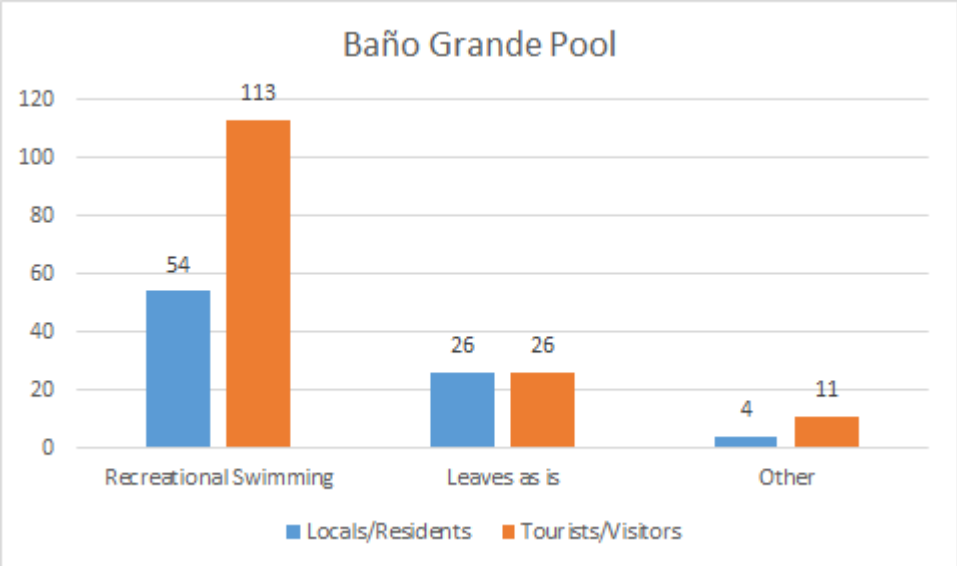


Figure 18: Survey Results Breakdown by Amount of People: Baño Grande Bathhouse

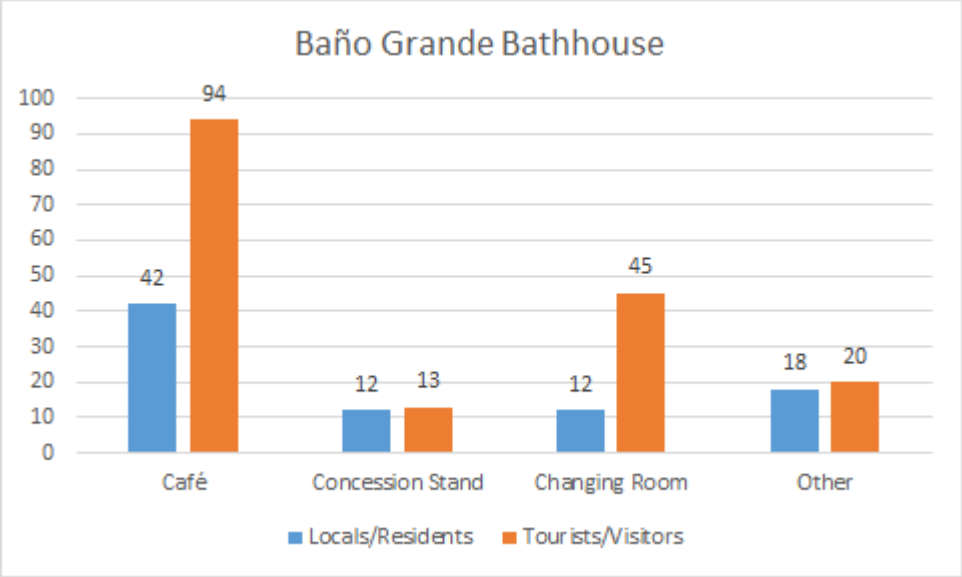


Figure 19: Survey Results Breakdown by Amount of People: Baño de Oro Pool

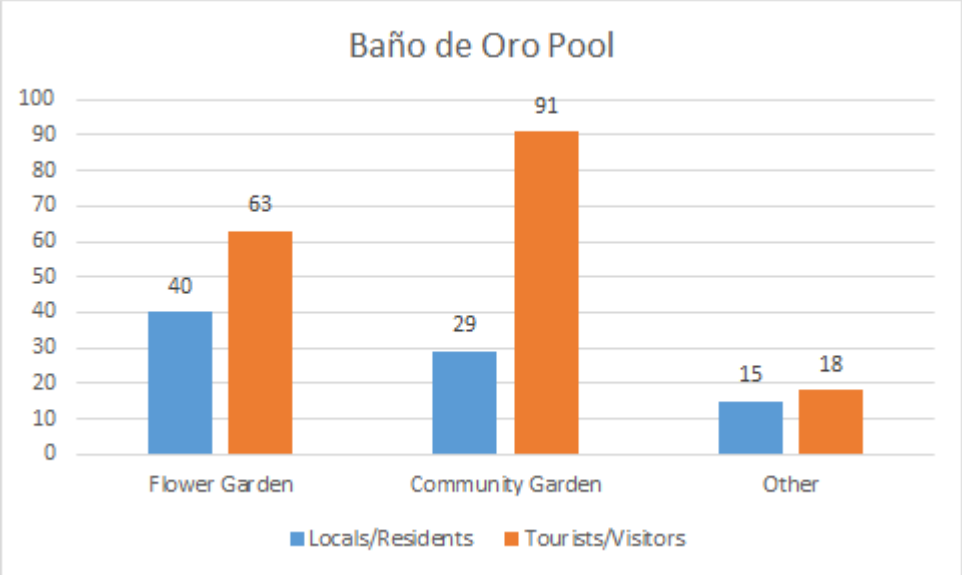


Figure 20: Survey Results Breakdown by Amount of People: Baño de Oro Bathhouse

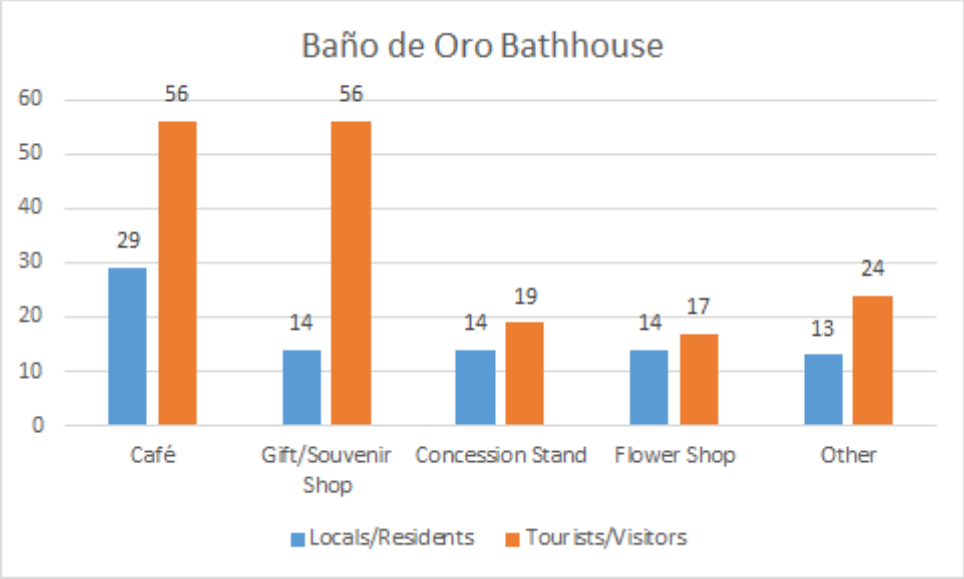


Figure 21: Survey Results Breakdown by Amount of People: Army Barracks

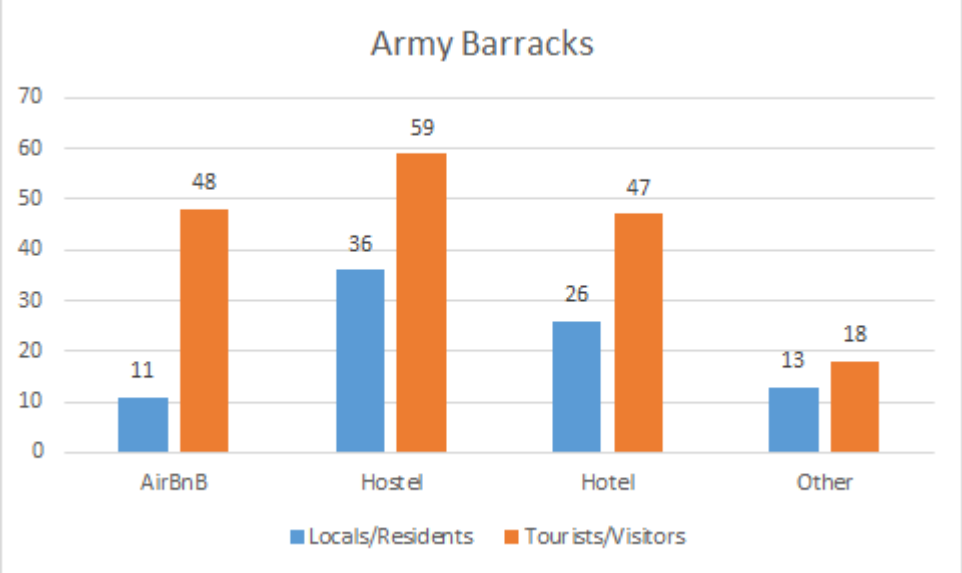


Figure 22: Baño Grande Pool Survey Results of Locals and Residents

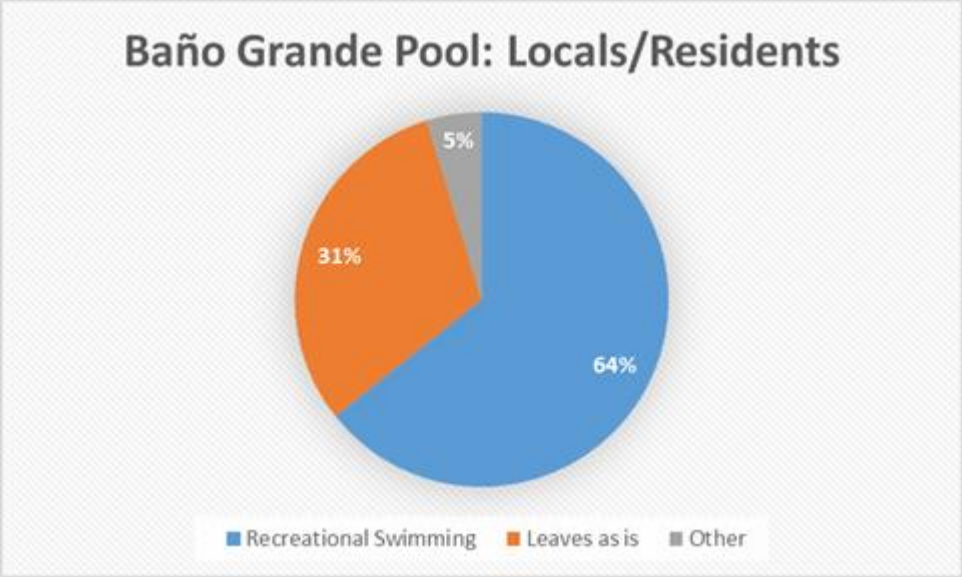


Figure 23: Baño Grande Pool Survey Results of Tourists and Visitors

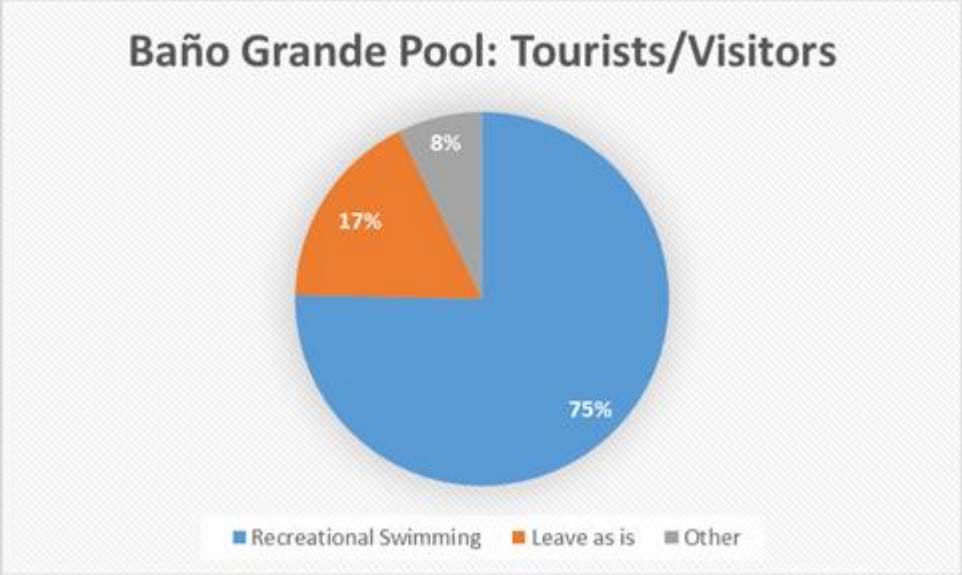


Figure 24: Baño Grande Bathhouse Survey Results of Locals and Residents

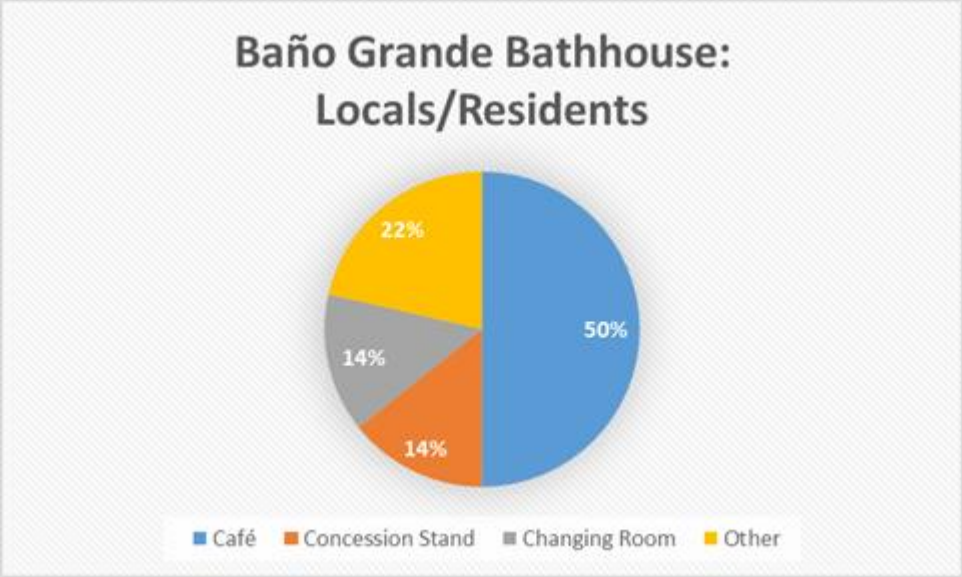


Figure 25: Baño Grande Bathhouse Survey Results of Tourists and Visitors

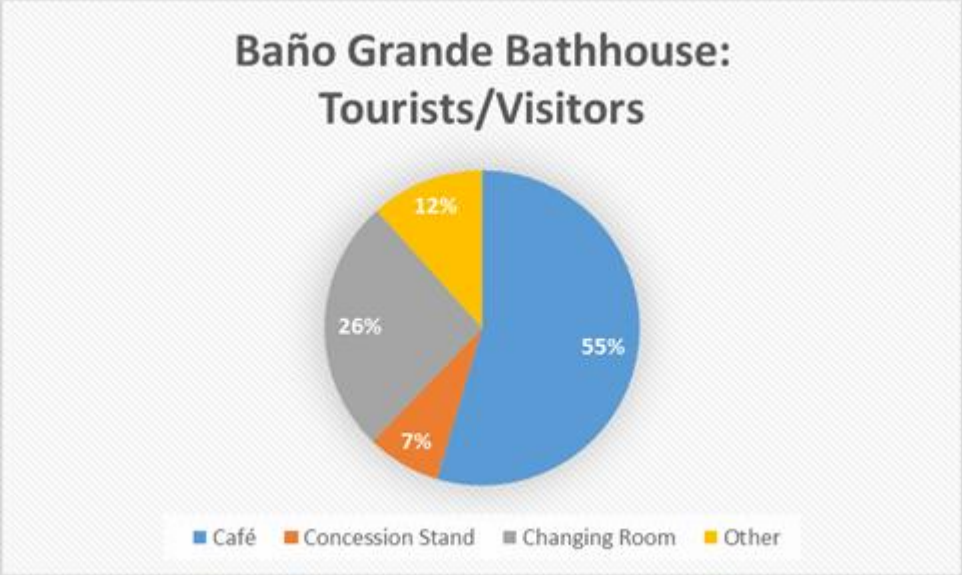


Figure 26: Baño de Oro Pool Survey Results of Locals and Residents

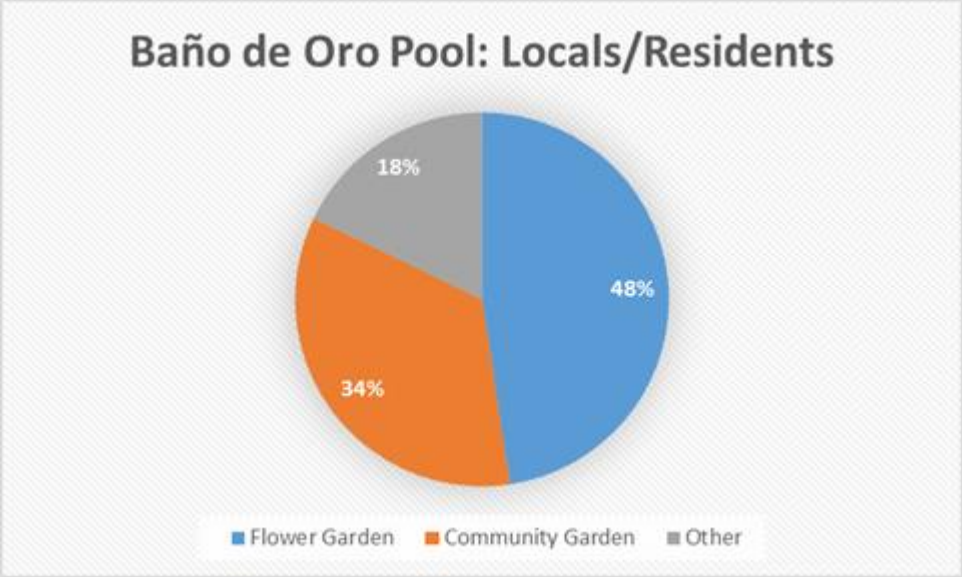


Figure 27: Baño de Oro Pool Survey Results of Tourists and Visitors

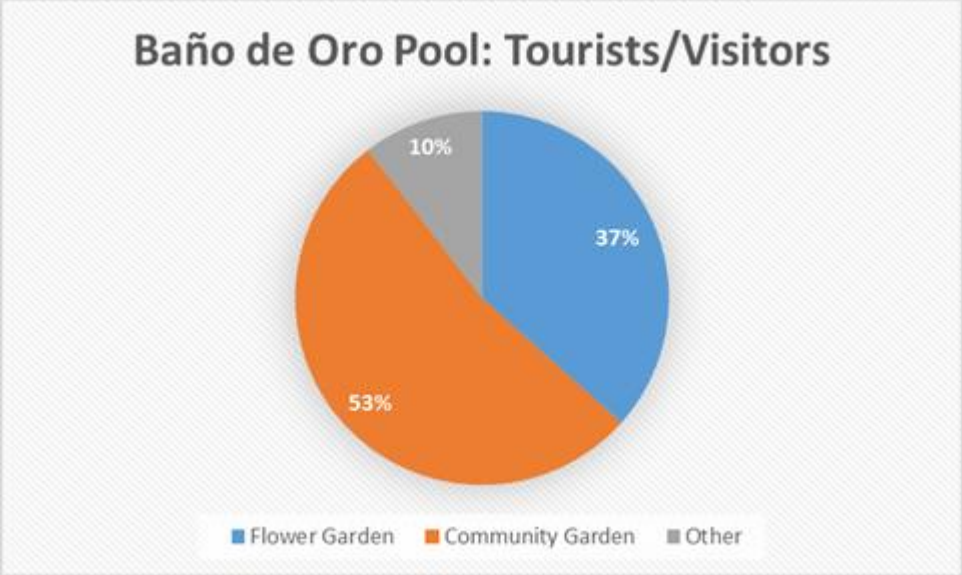


Figure 28: Baño de Oro Bathhouse Survey Results of Locals and Residents

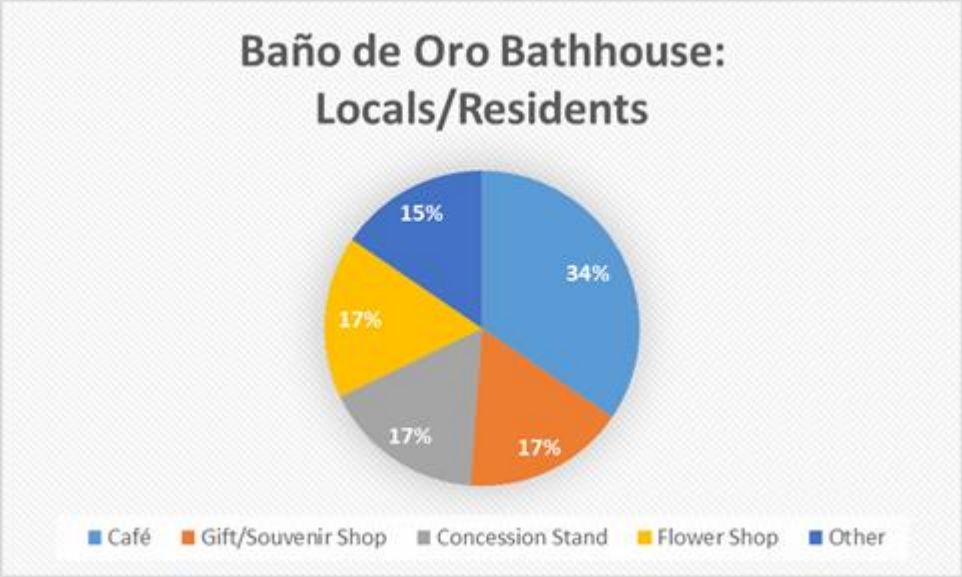


Figure 29: Baño de Oro Bathhouse Survey Results of Tourists and Visitors

Figure 30: Army Barracks Survey Results of Locals and Residents

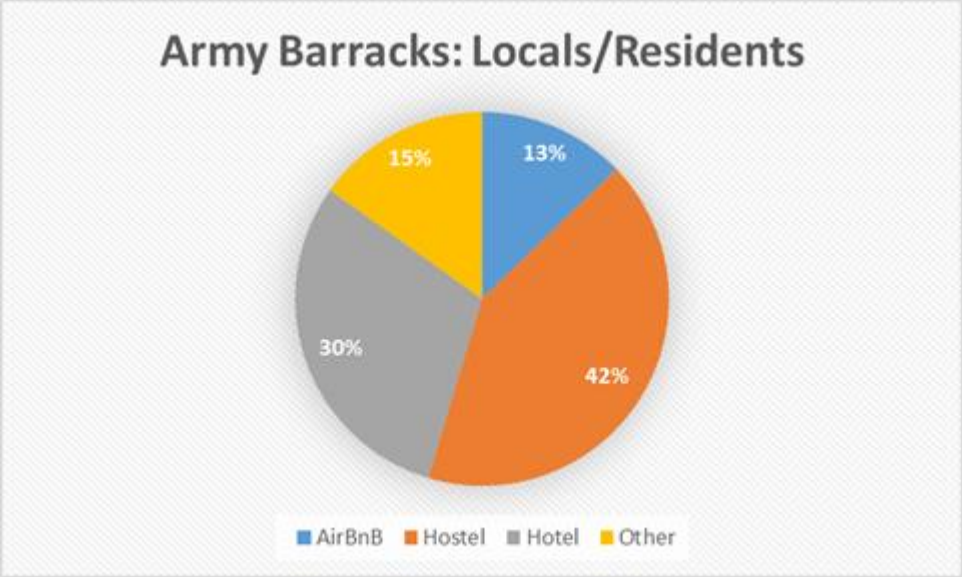
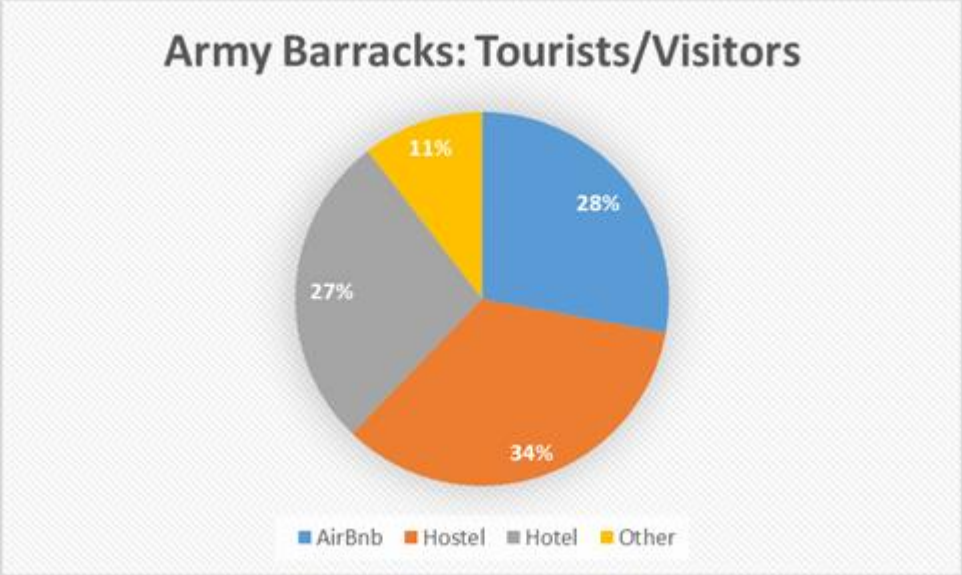


Figure 31: Army Barracks Survey Results of Locals and Residents



Appendix I: Tables

Table 1: Cost Analysis Baño Grande Pool

Baño Grande Pool	Recreational Pool	Leave it as is
Plumbing	None	None
Electric	None	None
Materials	**Cost related to partial foundation removal and dump fee for waste:** $680 + $212.50 = $892.5 **Soil:** **80 tons of soil at $50 per ton:** $4,000 **Stainless steel pool ladder:** $200/ladder **Diving Board:** $400 - $600 **New Railings:** 2" SCH 40 (2.375 OD X .154 wall) A500 ERW Structural Steel Pipe $60/10 ft. - price decreases when bought in bulk 2" SCH 80 (2.375 OD X .218 wall) A-500 Structural Steel Pipe $90/10 ft. - prices decrease when bought in bulk **Informational Signs:** $1,000 total **Concrete Sealer:** $50-$200/5 gal.	**New Railings:** 2" SCH 40 (2.375 OD X .154 wall) A500 ERW Structural Steel Pipe $60/10 ft. - price decreases when bought in bulk 2" SCH 80 (2.375 OD X .218 wall) A-500 Structural Steel Pipe $90/10 ft. - prices decrease when bought in bulk **Informational Signs:** $1,000 total **Concrete Sealer:** $50 - $200/5 gal.
Labor	**Dirt grading:** $50-$70 per hour **Tree trimming:** USFS workers should do $150 - $875/30 - 60 ft. tree **Concrete cleaning:** $257 - $6120/for 5,000 sq. ft. **Soil removal:** $50/cu. yd.	**Tree trimming:** USFS workers should do $150-$875/30 - 60 ft. tree **Concrete cleaning:** $257-$6120/ 5000 sq. ft.

	Concrete: $36/hour 8.61/sq. ft.	
Construction	**Concrete pouring:** $100/cu. yd. $60/load -stairs -ramps	
Total Cost	$14,762.5 - $24,660.50 4000 sq. ft. $3.69-$6.17/sq. ft.	$6,257 - $15,520 4000 sq. ft. $1.56-$3.88/sq. ft.
Yearly Expenses	$30,000	$0
Revenue	<u>100 people/day</u> (<3% of visitors/day) **$3/person** $109,500/year **$5/person** $182,500/year <u>300 people/day</u> (<10% of visitors/day) **$3/person** $328,500/year **$5/person** $547,500/year <u>500 people/day</u> (<15% of visitors/day) **$3/person** $547,500/year **$5/person** $912,500/year	$0
Return on Investment ROI = (Net Profit / Cost of Investment) x 100	<u>5 year ROI</u> 56.7% <u>10 year ROI</u> 68.6%	<u>ROI</u> 0%

Source: (ConcreteNetwork.com, N.d.), (Doheny's Water Warehouse, 2015), (Homewyse, 2016b), (Metals Depot International, 2016), (The Family Handyman, 2016), (Tree Removal, N.d.)

Table 2: Cost Analysis Baño Grande Building

Baño Grande Building	Café	Changing Room
Plumbing	Has water	Has Water
Electric	Yes	Yes
Materials	**Paint:** $30/gal. **Tiles:** $1/sq. ft. **Lighting:** $10 - $20/25,000 hr. lights **Windows:** $300-$500 each **Wiring and Supplies:** $17.27-$19.64/wiring **Coffee makers:** $500 - $4,000 **Microwave:** $100 - $500 **Concrete picnic table:** $900 - $1,800/table **Skylight:** $300 - $600	**Paint:** $30/gal. **Wiring and Supplies:** $17.27-$19.64/wiring **Lighting:** $10-$20 25,000 hr. lights **Tiles:** $1/sq. ft. **Windows:** $300 - $500 each **Benches:** $95 - $165 **Lockers:** $50-$100/set **Skylight:** $300-$600
Labor	**Electrician:** $80.20 - $103.96/hr. **Plumber:** $15 - $40/hr. **Painting:** $0.86 - $2.19/sq. ft. **Tile removal:** $3 - $6/sq. ft. **Concrete cleaning:** $257 - $6,120/5,000 sq. ft. **Window Install:** $35 - $65/hr.	**Electrician:** $80.20 - $103.96/hr. **Painting:** $0.86 - $2.19/sq. ft. **Tile removal:** $3 - $6/sq. ft. **Concrete cleaning:** $257-$6120/5,000 sq. ft. **Window Install:** $35 - $65/hr. **Electric Panel Install w/ Parts:** $500 - $1,000

	Electric Panel Install w/ Parts: $500 - $1,000 **Plumbing Removal:** $174 (3 workers/8 hr.) **Skylight:** $400 - $1,300	**Plumbing Removal:** $174 (3 workers/8 hr.) **Skylight:** $400 - $1,300
Construction	**Wall removal:** $0.95/sq. ft. (for a 4 inch wall)	**Wall removal:** $0.95/sq. ft. (for a 4 inch wall)
	***Leave tile in top left corner, it's from an artist**	***Leave tile in top left corner, it's from an artist**
Total Cost	$11,577.90 - $29,260.44 1500 sq. ft. with patio $7.72 - $19.5/sq. ft.	$10,138.35 - $21,561.80 1500 sq. ft. with patio $6.76 - $14.37/sq. ft.
Yearly Expenses	$30,000	$10,000
Revenue	<u>100 people/day</u> (<3% of visitors/day) **$3 average purchase** $109,500/year **$5 average purchase** $182,500/year **$10 average purchase** $365,000/year <u>300 people/day</u> (<10% of visitors/day) **$3 average purchase** $328,500/year **$5 average purchase** $547,500/year **$10 average purchase** $1,095,000/year <u>500 people/day</u> (<15% of visitors/day) **$3 average purchase** $547,500/year **$5 average purchase** $912,500/year **$10 average purchase** $1,825,000	<u>50 people/day</u> (<2% of visitors/day) **$2 average purchase** $36,500/year **$3 average purchase** $54,750/year <u>100 people/day</u> (<3% of visitors/day) **$2 average purchase** $73,000/year **$3 average purchase** $109,500/year <u>150 people/day</u> (<5% of visitors/day) **$2 average purchase** $109,500/year **$3 average purchase** $164,250/year (price for renting a locker, everything else is free)
Return on Investment ROI = (Net Profit / Cost of Investment) x 100	<u>5 year ROI</u> 52.7% <u>10 year ROI</u> 66.3%	<u>5 year ROI</u> 27.5% <u>10 year ROI</u> 50.1%

Source: (Belson Outdoors, 2016), (Central Products, N.d.), (Eartheasy, 2014), (Fixr, 2016f), (Fixr, 2016g), (Focus Technology, 2016), (Home Advisor, 2016e), (Homewyse, 2016c), (Homewyse, 2016d), (PayScale, 2016), (Uline, N.d.)

Table 3: Cost Analysis Baño de Oro Pool

Baño de Oro Pool	Wading Pool with Handicap Accessibility	Flower Garden
Plumbing	None	None
Electric	None	None
Materials	**Concrete slab**: $90/cu. yd. + $60/load delivery fee (ramp) ($150) **Paint**: Outdoor Additive: $8.99/can Regular paint: $50/gal. (3 gal.) **Concrete sealer:** $50 - $200/5 gal. **Pool ladder:** $200 **Handrail for steps:** $210	**Soil**: $50 per ton (30 tons) = $1,500 **Concrete slab**: $90/cu. yd. + $60/load delivery fee (100 cubic yards) **River stone:** $24 per ton (150 tons) = $3,600
Labor	**Vegetation evacuation**: $50/cu. yd. (300 cu. yd.) **Concrete installation**: $8.61/sq.ft. $36/hr (20 sq. ft) (4 hr.) **Concrete cleaning:** $250 - $6,120 (2,300 sq. ft.) **Power washing:** $360 - $650	**Vegetation evacuation**: $50/cu. yd. (300 cu. yd.) **Concrete installation**: $8.61/sq. ft. $36/hr. (700 sq. ft) (40 hr.)
Construction	**Leak repair**: $300 - $2,500	**Leak repair**: $300 - $2,500 **Raising concrete**: $20/sq. ft. (700 sq. ft.)
Total Cost	$16,888.20 - $22,463.20 2,300 sq. ft. $7.34 - $9.77/sq. ft.	$50,927 - $53,127 2,300 sq. ft. $22.14 - $23.10/sq. ft.
Yearly Expenses	$30,000	$0
Revenue	<u>100 people/day</u> (<3% of visitors/day) **$3 per person** $109,500/year **$5 per person** $182,500/year **$7 per person** $255,500/year <u>300 people/day</u>	$0

	(<10% of visitors/day) **$3 per person** $328,500/year **$5 per person** $547,500/year **$7 per person** $766,500/year <u>500 people/day</u> (<15% of visitors/day) **$3 per person** $547,500/year **$5 per person** $912,500/year **$7 per person** $1,277,500/year	
Return on Investment ROI = (Net Profit / Cost of Investment) x 100	<u>5 year ROI</u> 58.7% <u>10 year ROI</u> 69.8%	<u>ROI</u> 0%

Source: (Cemex, 2016), (The Family Handyman, 2016), (How Much, 2016b), (Fixr, 2016c), (Metals Depot International, 2016)

Table 4: Cost Analysis Baño de Oro Bathhouse

Baño de Oro Bathhouse	Concession Stand	Flower Museum/Exhibit
Plumbing	**Remove plumbing (labor)**	**Remove plumbing (labor)**
Electric	Yes	Yes
Materials	**Wiring:** $17.27 - $19.64 per wiring (5 - 10) **LED Lighting:** $35.65/bulb for 50,000 hr. of light (5 -10) **Cost of extermination:** **Wasps:** EcoSmart wasp and hornet spray ($6.99 per bottle) **Termites:** Liquid nitrogen - $0.50 per gallon **Paint**: Outdoor Additive: $8.99/can Regular paint: $50/gal. (3 gal.) **Hydraulic cement to fill cracks:** $14.25/20 lb. (2)	**Wiring:** $17.27 - $19.64 per wiring (5 - 10) **LED Lighting:** $35.95/bulb for 50,000 hr. of light (5 - 10) **Cost of extermination:** **Wasps:** EcoSmart wasp and hornet spray ($6.99 per bottle) **Termites:** Liquid nitrogen - $0.50 per gallon **Paint**: Outdoor Additive: $8.99/can Regular paint: $50/gal. (3 gal.) **Hydraulic cement to fill cracks:** $14.25/20 lb. (2)

	Shelving/cabinets: $200- $450 **Windows:** $300- $500 each (7 windows) **Concrete picnic table:** $900 - $1,800/table (5 - 10) **New skylight:** $300 - $600	**Windows:** $300- $500 each (7 windows) **Concrete picnic table:** $900 - $1,800/table (2 - 5) **New skylight:** $300 - $600
Labor	**Cost of Electrician**: $80.20 - $103.96 per hour (10 - 20 hr.) **Adding outlets: (cost/outlet)** 120V: $150 - $250 (5 - 10) **Installing new subpanel:** $500 - $1,000 (1) **Painting and Cleanup:** $0.86 - $2.19/ sq. ft. (500 sq. ft.) **Cost of debris removal:** $165 - $215 **Power washing:** $360 - $650 **Cost of removing plumbing:** 3 workers for 8 hr. at minimum wage: $174 **Gutting tiles:** $2.83 – $6.08/sq. ft. (200 sq. ft) **Window installation:** $35 - $65/hr. (14 hr.) **Install skylight:** $400 - $1,300	**Cost of Electrician**: $80.20 - $103.96 per hour (10 - 20 hr.) **Adding outlets: (cost/outlet)** 120V: $150 - $250 (5 - 10) **Installing new subpanel:** $500 - $1,000 (1) **Painting and Cleanup:** $0.86 - $2.19/ sq. ft. (500 sq. ft.) **Cost of debris removal:** $165 - $215 **Power washing**: $360 - $650 **Cost of removing plumbing:** 3 workers for 8 hr. at minimum wage: $174 **Gutting tiles:** $2.83 – $6.08/sq. ft. (200 sq. ft) **Window installation:** $35 - $65/hr. (14 hr.) **Install skylight:** $400 - $1,300
Construction	**Cost of stall wall (4 in.) demolition:** $0.95/sq. ft (200 sq. ft.) **Concrete leveling for pathway/seating area:** $850/100 sq. ft. (500 sq. ft.)	**Cost of stall wall (4 in.) demolition:** $0.95/sq. ft. (200 sq. ft.) **Concrete leveling for pathway/seating area:** $850/100 sq. ft. (500 sq. ft.) **Cost of constructing an exhibit:** $200- $400
Total Cost	$16,369.10 - $36,739.60 500 sq. ft. bathhouse, 1,200sq. ft. patio $9.63 – $21.61/sq. ft.	$14,669.50 - $29,356.10 500 sq. ft. bathhouse, 1,200 sq. ft.patio $8.63 - $17. 27/sq. ft.

Yearly Expenses	$30,000	$30,000
Revenue	100 people/day (<3% of visitors/day) **$3 average purchase** $109,500/year **$5 average purchase** $182,500/year 300 people/day (<10% of visitors/day) **$3 average purchase** $328,500/year **$5 average purchase** $547,500/year 500 people/day (<15% of visitors/day) **$3 average purchase** $547,500/year **$5 average purchase** $912,500/year	50 people/day (<2% of visitors/day) **$2 average purchase** $36,500/year **$4 average purchase** $73,000/year 100 people/day (<3% of visitors/day) **$2 average purchase** $73,000/year **$4 average purchase** $146,000/year 200 people/day (<6% of visitors/day) **$2 average purchase** $146,000/year **$4 average purchase** $292,000/year
Return on Investment ROI = (Net Profit / Cost of Investment) x 100	5 year ROI 46.6% 10 year ROI 62.6%	5 year ROI -49.1% 10 year ROI -44.6%

Source: (All Cost Data, 2016), (CostHelper, Inc., 2016a), (CostHelper, Inc., 2016b), (Eartheasy, 2014), (EcoSMART, 2016b), (Fan, K., 2007), (Fixr, 2016c), (Fixr, 2016d), (Fixr, 2016f), (Fixr, 2016g), (Fixr, 2016h), (Fixr, 2016i), (Home Advisor, 2016e), (Homewyse, 2016e), (Walhimer, M., 2011)

Table 5: Cost Analysis Army Barracks

Army Barracks	Hotel	Hostel
Plumbing	**Heat pump:** $550 - $4,000 **Water heater (tank):** $900/40 - 50gal.	**Heat pump:** $550 - $4,000 **Water heater (tank):** $900/40 - 50gal.
Electric	**Solar panels:** $4,000 - $16,000 **Generator:** $9,000 - $30,000 **Inverter:** $150 - $5,500	**Solar panels:** $4,000 - $16,000 **Generator:** $9,000 - $30,000 **Inverter:** $150 - $5,500
Materials	**Paint:** $30 - $50/gal. **Paint additive:** $8.99/gal. **Floor tiles:** $1.00/sq. ft.	**Paint:** $30 - $50/gal. **Paint additive:** $8.99/gal. **Floor tiles:** $1.00/sq. ft.

	Concrete patching: $50 - $200/5 gal. **LED light bulbs:** $10 - $20/25,000 hr. light **Wiring and supplies:** $17.27 - $19.64/wiring **Plumbing and supplies:** $20,000 - $40,000 **Elevator:** $15,000 - $25,000	**Concrete patching:** $50 - $200/5 gal. **LED light bulbs:** $10 - $20/25,000 hr. light **Wiring and supplies:** $17.27 - $19.64/wiring **Plumbing and supplies:** $10,000 - $20,000 **Elevator:** $15,000 - $25,000
Labor	**Electrician:** $80.11 - $104/hr. **Electric panel installation:** $500 - $1,000 **Solar panel installation:** $30,000 - $150,000 **Plumber:** $15 - $40/hr. **Plumbing removal:** $7.25/hr. **Heat pump system and installation:** $5,000 - $8,200 **Water heater system and installation:** $1,600 **Generator installation:** $1,089 - $5,568 **Painter:** $0.86 - $2.19/sq. ft. **Window installation:** $35 - $65/hr. **Concrete cleaning:** $257 - $6,120/5,000 sq. ft. **Power washing:** $360 - $650 **Wall building:** $5 - $7/sq. ft. **Roof building:** $72.88 - $101.65/hr.	**Electrician:** $80.11 - $104/hr. **Electric panel installation:** $500 - $1,000 **Solar panel installation:** $30,000 - $150,000 **Plumber:** $15 - $40/hr. **Plumbing removal:** $7.25/hr. **Heat pump system and installation:** $5,000 - $8,200 **Water heater system and installation:** $1,600 **Generator installation:** $1,089 - $5,568 **Painter:** $0.86 - $2.19/sq. ft. **Window installation:** $35 - $65/hr. **Concrete cleaning:** $257 - $6,120/5,000 sq. ft. **Power washing:** $350 - $650 **Roof building:** $72.88 - $101.65/hr. **Partial building demolition:** $500 - $2,000 **Asbestos inspection and**

	Partial building demolition: $500 - $2,000 **Asbestos inspection and removal:** $800 - $1,700	**removal:** $800 - $1,700
Construction	**New walls:** $65 -$90/cu. yd. **Re-bar:** $10 - $15/cu. yd. concrete **Wall removal:** $0.67 - $0.97/sq. ft. **New windows:** $300 - $500/window **Cover skylights:** $700 **New roof (labor and supplies):** $10,055.83 - $14,074 **Plant removal:** $150 - $400/hr. **Repave parking lot (gravel):** $1.40/sq. ft. 1in. depth **Stairs:** $1,066 - $3,200 **Elevator installation:** $15,000 - $16,000 **New bathroom:** $3,000 - $25,000	**Wall removal:** $0.67 - $0.97/sq. ft. **New windows:** $300 - $500/window **Cover skylights:** $700 **New roof (labor and supplies):** $10,055.83 - $14,074 **Plant removal:** $150 - $400/hr. **Repave parking lot (gravel):** $1.40/sq. ft. 1in. depth **Stairs:** $1,066 - $3,200 **Elevator installation:** $15,000 - $16,000
Total cost	$178,777.13 - $418,159.40 6,048sq. ft.: $33.67 - $69.14/sq. ft.	$165,267.13 - $394,359.40 6,048sq. ft.: $27.32 - $65.20/sq. ft.
Yearly Expenses	$150,000	$60,000
Revenue	Avg. hotel price: $120/night <u>15 people/night</u> (<1% visitors/day): $657,000/year <u>30 people/night</u> (<1% visitors/day): $1,314,000/year	Avg. hostel price: $30/night <u>30 people/night</u> (<1% visitors/day): $328,500/year <u>50 people/night</u> (<1.5% visitors/day): $547,500/year
Return on Investment ROI = (Net Profit / Cost of Investment) x 100	<u>5 year ROI</u> 87.5% <u>10 year ROI</u> 128%	<u>5 year ROI</u> 18.3% <u>10 year ROI</u> 65.2%

Source: (EcoSMART, 2016a), (Fixr, 2016a), (Fixr, 2016b), (Fixr, 2016d), (Fixr, 2016e), (Fixr, 2016f), (Fixr, 2016g), (Fixr, 2016i), (Fixr, 2016j), (Fixr, 2016k), (Fixr, 2016l), (Fixr, 2016m), (Generac, 2016), (Hostel World, 2016), (Homewyse, 2016a), (Hidden Villa, 2016), (Home Advisor, 2016), (Home Advisor, 2016a), (Home Advisor, 2016b), (Home Advisor, 2016c), (Home Advisor, 2016d), (Home Advisor, 2016e), (How Much, 2016a), (How Much, 2016c), (Price of Travel, 2016), (Solar Electric Supply Inc., 2016), (Wholesale Solar, 2016)

Table 6: Summary of Cost Analysis for Baño Grande Pool

	Photo Spot	**Recreational Swimming Pool**
Restoration Cost	$6,257 - $15,520	$14,762 - $24,661
Yearly Expenses	$0	$30,000
Yearly Revenue	$0	$54,750 (50 customers/day) (average purchase: $3)
Return on Investment after 5 Years	0%	56.7%
Return on Investment after 10 years	0%	68.6%

Table 7: Summary of Cost Analysis for Baño Grande Bathhouse

	Cafe	**Changing Rooms**
Restoration Cost	$11,577 - $29,260	$10,139 - $21,562
Yearly Expenses	$30,000	$10,000
Yearly Revenue	$54,750 (50 customers/day) (average purchase: $3)	$18,250 (25 customers/day) (average purchase: $2)
Return on Investment after 5 Years	52.7%	27.5%
Return on Investment after 10 years	66.3%	50.1%

Table 8: Summary of Cost Analysis for Baño de Oro Pool

	Wading Pool	**Flower Garden**
Restoration Cost	$16,888 - $22,463	$50,927 - $53,127
Yearly Expenses	$30,000	$0
Yearly Revenue	$54,750 (50 customers/day) (average price to swim: $3)	$0
Return on Investment after 5 Years	58.7%	0%
Return on Investment after 10 years	69.8%	0%

Table 9: Summary of Cost Analysis for Baño do Oro Bathhouse

	Concession Stand	**Flower Exhibit**
Restoration Cost	$16,369 - $36,739	$14,670 - $29,357
Yearly Expenses	$30,000	$30,000
Yearly Revenue	$54,750 (50 customers/day) (average purchase: $3)	$18,250 (25 customers/day) (average purchase: $2)
Return on Investment after 5 Years	46.6%	-49.1%
Return on Investment after 10 years	62.6%	-44.6%

Table 10: Summary of Cost Analysis for the Army Barracks

	Hostel	**Hotel**
Restoration Cost	$165,267 - $394,360	$178,778 - $418,160
Yearly Expenses	$60,000	$150,000
Yearly Revenue	$164,250 (15 customers/day) (average purchase: $30)	$438,000 (10 customers/day) (average purchase: $120)
Return on Investment after 5 Years	18.3%	87.5%
Return on Investment after 10 years	65.2%	128%

Table 11: Summary Table of Final Ideas

Structure	**Recommendation**
Baño Grande Pool	Scenic Picture Area
Baño Grande Bathhouse	Café
Baño de Oro Pool	Recreational Swimming Pool (handicap accessible)
Baño de Oro Bathhouse	Concession Stand
Army Barracks	Hostel