April 30, 2003

Mr. Gabriel D, Alcaraz, Special Assistant to the Executive Director
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San Juan, Puerto Rico 00940-2007

Dear Mr. Alcaraz:

Enclosed is our report entitled Aggregate Production and the Environment: Assessing the environmental impacts of the aggregate industry in Puerto Rico. It was written at the Department of Transportation during the period March 8 through May 1, 2003. Preliminary work was completed in Worcester, Massachusetts, prior to our arrival in Puerto Rico. Copies of this report are simultaneously being submitted to Professors Krueger and Looft for their evaluation. Upon faculty review, the original copy of this report will be catalogued in the Gordon Library at Worcester Polytechnic Institute. We appreciate the time that you and your staff have devoted to us during our stay in Puerto Rico.

Sincerely,

Charles Goodman

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AGGREGATE PRODUCTION & THE ENVIRONMENT:
Assessing the environmental impacts of the aggregate industry in Puerto Rico

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This project has been submitted in partial fulfillment of the degree requirements of Worcester Polytechnic Institute. The views and opinions expressed herein are those of the authors and do not necessarily reflect the positions or opinions of DTOP or Worcester Polytechnic Institute.

This report is the product of an education program, and is intended to serve as partial documentation for the evaluation of academic achievement. The report should not be considered as a working document by the reader.

Abstract

This project sponsored by Worcester Polytechnic Institute, has been prepared for Puerto Rico's Department of Transportation and outlines the perspectives of four groups involved with the aggregate industry on the issue of environmental impacts posed by the lengthening of quarry permits. Working from archived data and key informant interviews, we gathered information pertaining to how a longer quarry permit will affect each organization and the perceived environmental impacts associated with a longer quarry permit. We analyzed whether a longer quarry permit would or would not be beneficial to the aggregate industry and the environment.

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Table of Contents

CHAPTER 1: INTRODUCTION 7

CHAPTER 2: LITERATURE REVIEW 10

2.0 - Introduction 10

2.1 - Aggregates 10
2.1.1 - What is an Aggregate? 10
2.1.2 - What Makes a Good Aggregate? 10
2.1.3 - High Performance Concrete (HPC) 11

2.3 – The Production of Aggregate 12
2.3.1 - Quarry Assessment 12
2.3.2 - Methods of Extraction 13
2.3.3 - Primary and Secondary Crushers 13
2.3.4 - Screening Process 14
2.3.5 - Washing/Scrubbing 14

2.4 - Impacts of Mining 15
2.4.1 – Environmental Impacts 15
2.4.2 - Residential Impacts 17
2.4.3 – Economic Impacts 18

2.5 – Quarry Permits 18
2.5.1 - The Department of Natural and Environmental Resources 19
2.5.2 – The Planning Board 19
2.5.3 – The Environmental Quality Board 20
2.5.4 – Reclamation 21

2.6 – Summary 22

CHAPTER 3: METHODOLOGY 23

3.0 – Introduction 23

3.1 – Research Questions 23
3.1.1 – How would a longer quarry permit affect your organization and the environment? 23
3.1.2 - How does the current permit process compare to other models? 24

3.2 - Summary 25

CHAPTER 4: DATA AND ANALYSIS 26

4.0 – Introduction 26

4.1 – Data & Analysis: Question 1 26
4.1.1 – Perspectives of Main Organizations 26
4.1.2 – Discussion 29

4.2 – Data & Analysis: Question 2 34
4.2.1 – Perspectives of Main Organizations 34
4.2.2 - Discussion 38

4.3 – Comparative Case Study 41
4.3.1 – Arizona 41
4.3.2 – California 43
4.3.3 - Puerto Rico 46
4.3.4 – Analysis of Case Studies 50

4.4 – Summary 54

CHAPTER 5: RECOMMENDATIONS & CONCLUSIONS 55

5.0 - Introduction 55

5.1 – Compliance with Environmental Guidelines 56
5.1.1 - Increase fines 56
5.1.2 - Train and Hire Technicians 56
5.1.3 - Random Quarry Visits 56

5.2 – Time Reduction 56
5.2.1 – Coordinated Permit Organization 57
5.2.2 - Electronic Database System 57
5.2.3 – Determination of Permit Length 58

5.3 - Improved Environmental Performance 58
5.3.1 - Dust Controlling Methods 59
5.3.2 - Erosion and Sedimentation Control 60
5.3.3 - Water Recycling 60
5.3.4 - Noise Control/ Site Beautification 61

5.4 – Improving Community Relations 64
5.4.1 – Public Service Events 64
5.4.2 – Upgrading Technology 64

5.5 – Cost Reduction 64

5.6 – Summary 65

APPENDIX 66

Appendix A1 – Ivan Casanova Interview Questionnaire 66

Appendix A2 - Ivan Casanova Interview Notes 68

Appendix B1 - Jesus Burgos Interview Questionnaire 70

Appendix B2 - Jesus Burgos Interview Notes 72

Appendix C1 - Jose Cordero Interview Questionnaire 73

Appendix C2 - Jose Cordero Interview Notes.....76

Appendix D1 - Veronica Santa Rosa Interview Questionnaire 79

Appendix D2 - Veronica Santa Rosa Interview Notes.....81

Appendix E1 - Juan Rosario Interview Questionnaire 84

Appendix E2 - Juan Rosario Interview Notes.....85

Appendix F1 – Roberto Lazaro Interview Questionnaire 87

Appendix F2 - Roberto Lazaro Interview Notes.....88

Appendix G1 - Neftali Garcia Interview Questionnaire 90

Appendix G2 - Neftali Garcia Interview Notes.....91

Appendix I1 - Mario Soriano Interview Questionnaire 97

Appendix I2 - Mario Soriano Interview Notes.....98

BIBLIOGRAPHY 100

List of Tables

Table 4.1 - Organization Effect Table……...30

Table 4.2 - Human Response to Steady-State Sound Levels……37

Table 4.3 - Projected Noise Measures from Various Noise Sources……37

Table 4.4 - Environmental Effect Table…….……39

Table 4.6 - Permitting Comparisons……..…50

List of Figures

Figure 4.1 - Karst Features - Mogote……..…36

Figure 4.2 - Karst Features - Sinkholes…….36

Figure 4.3 - Groundwater Withdraws in the Northern Coast Limestone Region….36

Figure 4.4 – Permit Process Flow Chart……49
Figure 5.1 - Dust and Wet Suppression Systems……...59

Figure 5.2 - Storm Channel System……60

Figure 5.3 - Water Filtration System…….61

Figure 5.4 - Site Beautification……...62

Figure 5.5 - Noise Control Techniques……..63

Chapter 1: Introduction

Quarrying is an important economic activity that provides the raw materials for multi-billion dollar industries in many nations. Like any economy, the aggregate industry's economic structure is influenced by certain elements, one of which is the relationship between supply and demand. Levels of supply are controlled by consumer's wants and needs for a vast range of products requiring the use of particular natural resources. A quarry's ability to produce at an efficient rate, as well as the size of the extractable reserve remaining, makes it possible to meet the required demand.

Our project concerns itself with the environmental aspect of the aggregate industry. It has been argued that the duration of current quarry permits are limiting the aggregate industry from environmental innovation. The problem is that quarries cannot receive the appropriate funds from bank loans due to relatively short permit durations.

A quarry's environmental impact is directly related to the technology and processes used, which also affects the quality of minerals produced. In turn, the technology used for quarrying depends on the type of activities conducted. For example, the ore that is extracted can be processed using various techniques such as crushing, milling, washing, smelting, and chemical leaching. Each of these processes has an environmental effect that can be controlled through certain environmental management techniques and technological innovation.

As a result of quarrying operations, significant environmental issues can be expected; many of which pose serious concern to those issuing the permits. For example, the area must first be cleared of all vegetation from the deposit site. The clearing of vegetation results in the destruction of wildlife habitats dispersing them into other areas. In addition to habitat destruction, quarry operations accelerate the depletion of natural resources much faster than any other naturally occurring process. Finally, various quarry operations can emit large amounts of particulate matter into the water and air, which can have harmful side effects on a wide variety of vegetation and animal species.

The laws and regulations governing quarry operations and aggregate industries determine the functionality of private and individual groups, as well as their relationships with government agencies and the land that operations take place on. These laws and regulations set forth by government agencies can impose tighter or looser restrictions on an industry's ability to operate their facilities. For example, some environmental agencies are responsible for assessing proposed quarry operations and setting forth the optimal land-use plans based on their analysis. From this assessment, the agency can also determine the type and length of permits to be issued to quarry operations. Permit restrictions can establish when, where and for how long quarry operations can take place.

Within the governmental structure, parties and agencies have learned to coexist even though sometimes they operate in contradiction to one another. This can lead to conflict and backlog, as agencies exercise and enforce their regulatory jurisdictions and interests of the people they represent to the best of their abilities. For example, one representative group is the mineral producers whose interests are to minimize the cost of production while selling the product at the highest possible price. On the other hand, the DTOP wants to utilize high performance concrete (HPC) on inland structures while paying the least possible price for it. It is evident from these two examples that policies play a large role in the representation of interests by certain government agencies and parties.

Quarry operations also present social consequences. For instance, mineral production provides raw materials for our modern society; from computer chips to jewelry. Despite this, some people disapprove of quarrying for reasons such as the harmful consequences it imposes on the environment. However, most people are unaware of the legal framework under which quarrying occurs. This is why it is important that mineral producers and their regulatory agencies take the necessary steps to ensure proper regulation of quarrying activities.

The problem at hand is complex, in that any solution requires the analysis of several conflicting, yet interrelated elements. In particular, Puerto Rico's Department of Transportation of Public Works (DTOP) asked us to assess the impacts of a longer quarry permit on Puerto Rico's natural environment. One of the DTOP's many concerns lies in the High Performance Concrete (HPC) being produced on the Island. Because there is only one HPC producer who can meet the required specifications for this material, a monopoly has formed resulting in high prices. The DTOP believes that a longer permit will provide incentive to the smaller producers of HPC to upgrade their production capabilities, and hence create more competition within the industry resulting in lower costs. However, in order to make a reasonable argument as to why longer permits should be issued, it is imperative to analyze the process that goes into granting quarry permits. The DTOP considers the permitting process to be the focal point of our study because the process directly affects the welfare of the environment and the quality of aggregate produced.

There are four main organizations that have important roles in relation to the aggregate industry. The first group is the Aggregate Industry Producers Association (AIPA), which accounts for ninety percent of the aggregate production in Puerto Rico. The AIPA is only comprised of thirty-two quarries of the 132 on the Island. Both the AIPA affiliated and non-affiliated quarries must abide by the rules and regulations set forth by governmental agencies responsible for maintaining the environmental and social well being of Puerto Rico, which may be affected by aggregate production operations.

The second group is the Department of Natural and Environmental Resources (DNER), which is one of three governmental agencies responsible for the task of establishing rules and regulations, in addition to issuing the permits. The DNER is responsible for implementing and overseeing the compliance of the quarry operations with the set regulations. The third major group is the environmental organizations who are the voice of Puerto Rico's communities. The last group is the DTOP, whose position on this issue has already been stated.

In summary, we make recommendations on how the permit process should function and recommend techniques to reduce environmental impacts in order to meet the interests of each major group involved in aggregate production and consumption. Through understanding the different perspectives of each major group, we can analyze the logic behind their perspectives and provide our own logical recommendation.

Chapter 2: Literature Review

2.0 - Introduction

The first two topics we discuss give the definition of an aggregate and describe the characteristics of a quality aggregate. These sections are followed by a description of High Performance Concrete. Next, we explain the production process of an aggregate; from the time it is blasted and drilled to the crushing, sifting, and cleaning phases. Then we discuss the various environmental, residential and economic aspects of aggregate production. This section introduces concerns of residences, environmentalists and quarry owners towards the future of aggregate industries. Lastly, we describe the details of the organizations involved with the approval of quarry permits. The organization and substance of each section will convey the most critical background aspects needed to understand the DTOP's dilemma.

2.1 - Aggregates

2.1.1 - What is an Aggregate?

Aggregates have several definitions. The most appropriate for this project is "a collection of crushed or fragmented mineral rocks extracted and produced through mining or quarrying operations" (Grolier, 2001: 508). Aggregates can be bound together with Portland-cement and water to form concrete and mortar plaster or they can be combined with tar to create hot-mix asphalt pavement. On average, 75% of the concrete's total mass is comprised of aggregates (Grolier, 2001). Similarly, "aggregate comprises 93-96% of the paving mixture" depending on the size and grading of the aggregate (NSSGA, 2003: 1). Throughout most of the world, crushed stone, sand and gravel are the ideal types of natural aggregate, which are used in nearly all residential, commercial and industrial building construction. It is also used in projects such as roads, highways, bridges, dams and tunnels (Pit&Quarry, 2003).

There are two broad classifications of aggregate. The first is called *sand and gravel aggregate* while the second is called *crushed-rock aggregate*. S*and and gravel aggregate* occur freely in nature as a river bed, the ocean floor, a terrace or glacial deposits and are gathered by excavating from a pit. More often than not, only a screening is needed before immediate use because *sand and gravel aggregate* can be found and collected in the desired size. *Crushed-rock aggregate* comes primarily from bedrock reserves, which is obtained through the drilling and blasting of quarry faces. Before this type of aggregate can be used, it must be crushed and screened into the desired size and then cleansed of its impurities (West, 1996).

2.1.2 - What Makes a Good Aggregate?

A suitable aggregate consists of clean, uncoated particles of proper size, gradation, shape, physical soundness, hardness, strength and chemical properties (Pit&Quarry, 2003). The attributes listed above will vary slightly depending on what the

aggregate is being used for, however, the following describes what goes into producing a high quality aggregate;

- *Size and consistency*: The material used needs to be similar in shape and size in order to avoid problems of compaction (NSSGA, 2003).
- *Cubicle particle shape*: Cubical material will produce better stability and increase the substance's workability. Costs will be lowered and higher quality concrete will be produced (NSSGA, 2003).
- *Hardness and strength*: Hardness and strength of an aggregate will affect the ability of the final product to resist breakdown. Such breakdown mainly happens when the aggregate is mishandled (Pit&Quarry, 2003).
- *Low moisture*: Lower moisture content will result in less drying costs and an increase in wearing resistance. The aggregate will also be ready for consumer uses much sooner if the moisture content is lower (NSSGA, 2003).
- *Absorption*: A lower absorption rate results in less aggregate used for a mixture. This results in a significant cost reduction because a company will be able to produce more cubic feet of concrete per ton of aggregate (NSSGA, 2003).

Utilization of quality aggregate will provide a more consistent concrete mix, ultimately, producing a significantly better structure.

2.1.3 - High Performance Concrete (HPC)

High performance concrete (HPC) is the best quality concrete available in today's markets throughout the world. Currently in Puerto Rico, HPC is used in only three percent of the total construction, mostly marine structures such as bridges and piers. HPC concrete is valuable to marine structures because of its low permeability rate, which blocks the chloride ions in saltwater from corroding the steel beams encased by the HPC. Because of the outstanding durability of this concrete, major developers on the Island are trying to move HPC inland and use it in grounded structures. There are many performance benefits associated with this concrete such as ease of placement and consolidation without affecting strength, long-term mechanical properties, early high strength, toughness, volume stability and longer life in severe environments (Goodspeed, 2001). The cost and other miscellaneous benefits include: less material, fewer down-sized beams, reduced maintenance, extended life cycle and aesthetics. The remainder of this section will describe HPC and define the specific characteristics behind its high performance.

There is a choice of two materials that can be added to concrete in order to increase its performance. The first of which is microsilica, an aluminous material having little in relation to the properties of cement. Since microsilica particles are much smaller than those of concrete particles, they are used to fill in voids throughout the mixture, thus increasing density. The only concern with the minute size and chemical properties of microsilica is that it requires large amounts of water to reach its optimal state for mixing in with concrete (Crawford, 2002). This requirement makes it unpopular among ready-mix concrete plants throughout the Island because it can cause uneven water to cement

ratios if not done carefully.

Fly ash, the second performance enhancing material, serves the same purpose as that of microsilica. Fly ash is a finely divided residue that results from the combustion of powdered coal. The major concern involving fly ash is that it takes roughly sixty days, twice as long as typical concrete, to reach its maximum strength capabilities (Crawford, 2002). Currently, fly ash is not available in Puerto Rico so it must be imported. Contractors do prefer this material over microsilica because it is less likely to fail when producing HPC.

In conclusion, HPC excels in saltwater conditions and produces structures that are stronger and more durable than ordinary concrete structures. On average, a HPC structure will last twice as long as that made from regular concrete.

2.3 – The Production of Aggregate

Aggregate is classified into two categories, crushed rock and sand/gravel. Each has similar production stages but differ based on degree of gradation. Generally, sand/gravel aggregate needs to be produced at a higher quality because of its application purposes. In our case, we are concerned with concrete mixtures, which require top grade sand/gravel aggregate. If the proper aggregate production stages are not carried out, then the concrete's physical and chemical properties will suffer, and hence, the final structure will not perform to specification. This section will discuss the basic production stages of aggregate in general.

2.3.1 - Quarry Assessment

The words "reserve" and "deposit" are used to describe the occurrence of natural resources beneath the earth's surface. A reserve refers to a designated land area that has the potential to hold a given amount of natural resource. A deposit is defined as a portion of the reserve that contains the desired natural resource.

There are several factors that come into play when assessing a quarry's reserve other than the initial discovery of the deposit. The first factor is the amount of quality grade rock that can be claimed. Mined rock is useless if it does not possess the required physical and chemical properties. A second factor is whether there are environmental side-effects related to extracting minerals. If there are any major environmental concerns, the permitting process maybe delayed until a solution is found. The last factor is the ease of equipment to extract rock from the site and transport it to the processing facility. If any of these factors are not satisfied, the quarry owner will not reap the full potential from the site (Pit&Quarry, 2003).

2.3.2 - Methods of Extraction

Aggregate is a natural resource material extracted from the earth's surface through either mining or quarrying. Commonly confused with each other, mining involves digging underground for the required natural resource, whereas quarrying, also called surface mining, extracts minerals directly from the outermost layer of the earth's surface (Bowles, 1934). Both methods usually entail drilling and blasting, which breaks down the massive chunks of bedrock into transportable size.

Once the drilling and blasting has loosened the material, power shovels, bulldozers, front-end loaders and tractor scrapers are used to load the heaps of rock into trucks bound for the processing plants. Because transportation costs are expensive, most aggregate processing facilities are situated on site. A decision quarry owners need to make is whether the processing equipment should be portable or permanent, which is primarily dependent on the size of the quarry. Permanently situated plants are employed by quarries with life expectancies of more than ten years. However, to know how long a pit's reserve will last depends on the initial identification and assessment of the site. This identification and research comprises of "outcrop observations, drilling and sampling" (Dusseault & Franklin, 1991:8).

2.3.3 - Primary and Secondary Crushers

Once rock is extracted from the quarry site and transported to the processing facility, it is then fed into crushing machines. This process is carried out by machines called primary and secondary crushers, which are specially designed to break and fragment the rock into smaller pieces. Depending on the use of the aggregate, primary crushers may be the only equipment needed. If, however, a smaller, more uniform-sized aggregate is required, then the use of secondary and tertiary crushers is needed.

There are four basic types of primary crushers to choose from; the Jaw crusher, the Single/Double Impellar impactor, the Gyratory/Cone crusher and the Swing Hammermill crusher (Day & Nichols, 1999). It is crucial to make the right choice in primary crushers because it could mean up to a 30 percent production difference. Factors to consider when choosing a primary crusher include: maximum feed size of the mined/quarried bedrock, product size allowed to be fed to secondary crushers, production rate required yielding this correct size, general characteristics of aggregate, and maintenance availability for the crusher. General characteristics of the aggregate to be crushed depend on type of mineral, hardness, abrasivity, moisture content and reduction ratio (Dusseault & Franklin, 1991). For example, if a smaller-sized aggregate is needed, then a double impellar impact breaker is probably the best choice because it can yield a 40/1 reduction ratio. Another advantage to this type of primary crusher is that it produces a more cube-shaped aggregate with up to a 15 percent reduction in flat and elongated particles (Pit&Quarry, 2003). Once a primary crusher has been chosen it is imperative to find a secondary crusher that is well-suited to the crushed rock size and output rate of the primary crusher.

2.3.4 - Screening Process

The screening process, which is often referred to as the "cash box" of the aggregate plant, separates the crushed stone according to size. Depending on the line of crushers (primary, secondary, tertiary), there are different screening decks corresponding to each crushing stage. These screen decks serve as large sieves to sift out the crushed stone by size. Some screens come equipped with special purposes, such as heat-treating, vibrating and washing/rinsing. The screen surfaces offered include: wire cloth, long-slot wire cloth, perforated plate, profile wire, urethane, rubber and self-cleaning rubber. The choice of screen material should be based on impact resistance, aggregate abrasiveness, required aggregate size, moisture content, noise level and comparative cost to production (Dusseault & Franklin, 1991). For the most part, urethane screens are the most appropriate choice for wet and highly abrasive materials, whereas rubber screens perform better under dry and high impact applications. Wire cloth is generally used for tertiary conditions and high productivity. However, self-cleaning and long-slot screens are recommended for high moisture materials to avoid problems such as plugging or blinding, which are technical terms for clogging effects (Pit&Quarry, 2003).

The Empresas Ortiz Brunet quarry situated in Guaynabo, Puerto Rico, was experiencing clogging problems with its woven wire screens. This problem forced them to shut-down the crushing operations at the facility for an hour twice a day. Vice President of the quarry, Carlos Ortiz Vidal, decided to switch the old woven wire screens to "Flex-Mat High Performance, Self-Cleaning Screen Cloth" made by Major Wire Industries. Using the Flex-Mat screens translated into producing 800 more tons of finished products per day in comparison to the old screens. "Over the 11 months the quarry operates per year, the production gained by not shutting down to clean screens earned the quarry more than US$2.29 million in additional sales" (Major Wire Industries). According to Alan Egge of Portec Construction Equipment, "Never scrimp on the size or quality of a screen" (Pit&Quarry, 2003).

2.3.5 - Washing/Scrubbing

The last stage in the production cycle of an aggregate is known as the washing/scrubbing stage. Depending on the type of aggregate, there are coarse and fine material washers, screw washers and spray washers. The main purpose of a washer is to remove impurities from the finished aggregate product. Impurities can come in the form of dust produced from the crushing stage or even chunks of clay, shale, coal, silt and vegetative matter still attached even after the screening process. To determine which kind of washer best suits the processing facility, two factors need to be taken under consideration: the amount and kind of impurity and the available water supply (Day & Nichols, 1999). Screw washers are designated more for the production of sand because they incorporate a spiral effect, which grinds the sand particles against one another to wash away impurities. Material washers are primarily used for gravel from 1/8" to 3" in size and incorporate a rotary action through welded paddles inside a large drum. Other aggregates just need to be wetted down by spray washers or dewaterers before being placed in kilns to dry-out (Pit&Quarry, 2003).

2.4 - Impacts of Mining

There are many technical factors involved in the aggregate industry, from the extraction of rock, to the operation of heavy equipment and ending with the final product. Although most people only associate mining/quarrying with a purely physical process, there are social processes that are often overlooked from the transformation of nature into raw materials. During this period of transformation, there are several environmental and social implications to address if aggregate industries want to remain successful in such a business. This section will highlight the most common environmental and social impacts associated with the production of aggregate from start to finish.

2.4.1 – Environmental Impacts

The impacts of aggregate production have been a long-standing issue between the quarry industry and environmental officials. Quarry owners believe that quarry operations cause only minor problems to the environment and community, while environmentalists claim more significant and long-term effects. Since stone and other construction materials are usually taken from shallow or naturally exposed deposits and used with little or no processing other than crushing, the environmental impacts are mostly limited to land disturbance at the quarry and relatively few wastes are generated (Young, 1993:18).

Environmentalists and government officials, however, believe that the process of industrial mineral extraction has dramatic long-term effects that may be overlooked or unforeseen at the outset of operations. National governments, UN agencies, development workers and lawmakers have recently discussed at the 2002 World Summit issues regarding the sustainable development and environmental protection of tropical countries. Discussed at the summit were the concerns of increased consumption of natural resources, sedimentation of waters, and destruction of forests. Many that spoke at the Summit believe that quarry operations greatly contribute to these concerns (Worldwatch Institute, 2002). According to Young (1993), much of the damage generated from the extraction of natural resources is usually considered a local problem and is imposed on locals as an unavoidable cost of economic development. Mining of construction materials at the surface level creates problems such as surface disturbance, erosion, air pollution, particulate emissions and disruption of drainage systems (Ripley, 1996). Blasting and drilling operations at these sites also add to the noise and shock to neighboring communities.

Surface Disturbance

Before mining activities can begin, top soil and all vegetation are removed from the site. Some of the environmental concerns of this local surface disturbance are the deforestation of land, the destruction of many natural habitats and the migration of inhabitants. Although there are regulations in place for the protection of national reserves and parks, mining projects now threaten four out of every ten national forests in tropical countries. As a result, wildlife is forced to seek refuge in surrounding urbanized

communities or other populated wildlife habitats causing overpopulation, potential safety hazards and annoyances to people and animals (Sengupta, 1993).

Erosion

Erosion of both coastlines and glacial deposits is a natural process that occurs over an extended period of time. With the occurrence of constant tidal movements and powerful winds and waves, coastlines deplete faster than inland glacial deposits. Sand and gravel mining in coastal areas are cause for concern to environmentalists, especially in the case of island beach sand mining. It is estimated that natural erosion removes approximately 0.3m to 15m of coastlines per year, whereas, mining sand and gravel of beaches and dunes on an island can increasingly deplete the shoreline more than 150,000m³ per year in total. The social and economic growth of island nations has advanced the development of coastlines, which include the construction of community infrastructures and buildings. The constraints placed on an island's geological locale lead construction contractors to extract sand and gravel from beaches and dunes as a primary source of aggregate (Borges, Andrade, Freitas, 2002).

Air Pollution

Dust particulates are the main airborne pollutants caused by aggregate mining. Atmospheric emissions from mining of industrial minerals are released into the air through blasting, drilling, crushing operations and high winds on unmanaged stockpiles. These dust particulates can act as carriers of other toxic and carcinogenic materials emitted from heavy mining equipment and transportation vehicles (WSDE, 2001). In aggregate quarry operations, particulate matter less than 10 microns in diameter is a public health concern and accumulation of particulates can interfere with the photosynthesis process of vegetation.

One of the health concerns to both neighboring communities and miners of industrial aggregates, mainly sand and gravel, is the emission of silica dusts. Silica occurs naturally as quartz in sands. High levels, along with severe long-term exposure to silica dust, can promote an associated disease known as silicosis, a respiratory disease caused by the inhalation of crystalline silica which leads to the inflammation of lung tissue (Ripley, 1996). Tissue soon becomes scared and obstructs the flow of oxygen into the lungs and bloodstream.

A study conducted by Brandt and Rhoades (1972) showed the effects of dust particulates on vegetation. The study found that there were significant changes in the seedling, shrub, sapling, and mature tree strata for the experimental site, and concluded that dust emissions would compel a restructuring and new composition of forest communities. Dust-tolerant species were expected to assume ultimate dominance in the experiment site if dust accumulation continued (Ripley, 1996).

Water Quality

Most of the dust produced by industrial mineral operations is derived from widely dispersed sources. Water is used to control the dust problem in most production machinery and in saturation of stockpiles in order to maintain a low level of particulate emission. In many industrial mineral excavations, contamination of wastewater is by far

the greatest environmental concern. Sand, gravel and dimensional stone are usually chemically inert and usually do not present any risk to drinking water quality due to quarry operations (Hutchinson, Ellison, 1992). Added nutrients and sediments from these operations can, however, have a negative effect on other species that need water.

In sand and gravel operations, wastewater use is estimated at approximately two tons of water per ton of sand and gravel produced with other larger stone aggregate operations using significantly less. Runoff wastewater contains suspended particles of sand, silt, and clay that can account for 1%-20% of the water's composition, which can be carried into local streams, lakes and ponds changing the natural composition of these systems.

Particles suspended in runoff wastewater have been found to have harmful effects on benthic communities, plankton, and the reproductive capabilities and structure of fish and plant populations in these nearby systems (Ripley, 1996). Wastewater that is transported to nearby streams increases the turbidity (cloudiness) of the water and reduces light penetration. Increased cloudiness of water impairs the respiration of fish and other aquatic invertebrates; reduction of light in streams and ponds decreases the possibility of survival for submerged aquatic vegetation. Added nutrients, also contained in this wastewater, can create surface algal scum and unpleasant odors (ASLA, 2002).

2.4.2 - Residential Impacts

Many of the environmental concerns in quarry operations are also concerns to neighboring residences of quarries and pits. One obvious concern is the quality of the drinking water. As explained earlier, the water runoff of quarry operations is saturated with sediment, which finds its way to local lakes and watersheds. Residents who obtain their water from nearby lakes or wells are concerned that this wastewater will have negative impacts on primary aquifers and the water quality. Fortunately, it is rare that sediment added through aggregate quarry operations blocks or disrupts these primary aquifers.

Noise, air shock and ground vibration caused by blasting and drilling operations may have adverse effects on the neighboring environment as well. The magnitude of the problem is dependent primarily upon the depth and type of overburden being blasted, the powder factor, the amount of explosive detonated at a given instant, the population density in the vicinity of the blast site, and the times per day blasting takes place (Sengupta, 1993:4).

Other nuisance factors for nearby residences include displacement of wildlife. Many residents believe that displacement has forced wild animals into their own backyards, increasing the danger of both the animals and the residents. Another complaint that residents have is the glare produced from bright lights when mining at night (Sengupta, 1993). The final concern combines air pollution, noise pollution, traffic, and road destruction, which is caused by the increase of trucking operations entering and leaving sites. Because the weight of the trucks leads to crumbling in the asphalt, Puerto Rican officials are in the process of passing gross weight limits on certain roadways to help address this problem.

2.4.3 – Economic Impacts

The aggregate industry in Puerto Rico accounts for nearly 1,300 jobs and an annual income of $190 M (U.S. BLS, 2002). Lightweight aggregate used for construction tends to be cheap, however, if the supply of aggregate is depleted then resources must be obtained elsewhere. Due to Puerto Rico's geographical constraints, these resources must be imported from nearby islands or other mainland locations. Since transportation costs and tariffs greatly increase the price of imported aggregate, it is crucial that the production of aggregate on the Island maintains low variable costs for road and infrastructure construction.

Surface disturbance contributes to the depletion of the Island's natural beauty, however, reclamation objectives must be met throughout quarry operations. Reclamation, discussed later, is the process of properly maintaining the land during quarry operations so that it may be developed or turned back into its original condition once aggregate production has ceased. Reclaimed lands are usually developed into commercial or residential areas and parks or golf courses, which contribute millions of dollars per year in revenue (Pit&Quarry, 2003).

2.5 – Quarry Permits

The nature of quarrying produces a wide range of environmental impacts. To regulate these impacts in the interest of public welfare, the government of Puerto Rico has established regulatory agencies to oversee quarrying processes, natural resource development, and proper land-use in order to ensure quarrying operations abide by environmental safety and protection laws. These regulatory agencies are also responsible for setting the environmental standards that form the basis of these laws.

The three main regulatory agencies that enforce proper quarry operations and land use in Puerto Rico according to the laws, codes, and legislation that apply to the development and maintenance of quarry sites are the Planning Board, Environmental Quality Board (EQB), and the Department of Natural and Environmental Resources (DNER).

According to the Laws of Puerto Rico Annotated (LPRA), permits are classified as, exclusive or non-exclusive prospecting permits. The former restricts quarry operations to one specific mineral. This permit is limited to an area as well as other factors, such as type of mineral being sought, estimated availability, and commercial value of said mineral. Open-pit extractions or strip-mining methods are prohibited under a prospecting permit. Non-exclusive permits, however, are not restricted to as small an area as exclusive permits, and mining of more than one type of mineral is allowed.

The maximum duration of permits is three years and applicants are entitled to a renewal permit as long as compliance with permit rules and regulations are met. As long as a request for renewal is done within ninety days of the working permits expiration, aggregate production does not need to stop during the application process unless the renewal is rejected (L.P.R. Act No. 143, 1972). However during this period quarry owners are hesitant to spend money on improving technology for environmental and aggregate quality purposes because there is no guarantee that they will be issued another renewal permit.

2.5.1 - The Department of Natural and Environmental Resources

The Department of Natural and Environmental Resources (DNER) was established in 1972 to create a centralized government organization with the interests of conserving and protecting Puerto Rico's environment and natural resources. At the time, many of Puerto Rico's own government organizations were accused of the rapid depletion of Puerto Rico's natural resources. The DNER was created to suggest and help implement effective solutions based on the standards of the Environmental Quality Board for reducing the consumption of natural resources (L.P.R. Act No. 9, 1972).

The Secretary of the DNER heads this organization and is appointed by the Governor of Puerto Rico. Commissions, boards, divisions and committees may be created by the Secretary in order to focus on specific issues that may be raised through governmental or public concern. These commissions, boards, divisions and committees are comprised of government officials, scientists, technicians, administrative workers, and the participation of citizens. In 1977, there was a notable increase in illegal activities which were harmful to the natural resources and the environment. To effectively enforce the laws administered by the Secretary of the DNER, the vigilantes (Ranger Corps) was established (L.P.R. Act No. 1, 1977). The vigilantes have the power to make arrests, searches and seizures for the attempted violations of the laws of the DNER, inspect and request the presentation of a permit for any operation under control of the Secretary, verbally order the immediate cessation of any operation being carried within an area of the Secretary's jurisdiction, and seize and keep any removed materials that are extracted without the Secretary's approval.

The DNER and the Secretary are responsible for advising and making recommendations to the Governor, the legislature, and other government organizations with respect to the implementation of public policy necessary for the protection of natural resources. They may establish regulations, fees for permits, and fines for violations of regulations and permits. One such permit that we are concerned with is the permit for extraction of sand, gravel and stone established by Act No. 144 ratified in 1976. This Act gave the DNER the jurisdiction over the extraction, excavation and dredging of sand, gravel, stone, and top soil. Under this Act, the Secretary arranges the terms and conditions under which extraction permits may be granted. Before issuing or renewing a permit, the Secretary is required under law to notify the public of a proposed permit and hold public hearings if any serious controversies or objections arise. If under the use of an original permit, the result of mining or quarrying impacts the surrounding environment drastically, then the Secretary has the power to withdraw the renewal of the current permit. Basically, the DNER has the final word on the acceptance or denial of a permit application.

2.5.2 – The Planning Board

The first Puerto Rican Planning Board was established in 1942. As the economy shifted rapidly from an agrarian to an industrial economy the Planning Board's mechanisms and structures did not undergo substantial changes until 1975. To respond to

changes in the economic structure, the Board's task to coordinate and integrate the efforts of the different governmental and industrial sectors was finally established (L.P.R. Act No. 75, 1975). The Board did this in an economic manner with respect to the present and future social needs that promote public health and safety as well as make best use of land and other natural resources. The newly revised Planning Board is composed of three associate members appointed by the Governor with consent of the Senate.

A requirement of the Planning Board is that it must counsel the Governor through an Integral Development Plan. Within the plan, the Board supplies information regarding economic indices in relation to the physical environment and society. Included in this plan, the Board makes surveys on the development of the country and the status of critical environmental and physical infrastructures. It is also the responsibility of the Board to provide an analysis of the results and consequences that certain public policies may impose on the environment and society. The Social Economic Board, one of three primary branches under the Planning Board, provides a Construction Permit Indicator, which uses the monthly reports of the Administration of Resources and Permits as a basis for the number of permits to be distributed. When deciding development policies, the Planning Board must follow the set of norms set by Land-Use Plans (L.P.R. Act No. 75, 1975).

Government agencies as well as private industries are required to seek counsel of the Planning Board as to the methodology they propose to follow in the preparation of construction or extraction plans. The land-use plans designate the distribution, location, and intensity of the land uses for mining, industrial activities, and the conservation and protection of natural resources. These plans must also provide evidence that the designated uses are in harmony with the surrounding area and will not disrupt the resources of neighboring communities. Upon the Governor's approval, copies of the land-use plan are submitted to the Legislature, which has 45 days to voice any disagreement it may have (L.P.R. Act No. 75, 1975).

The Board also determines an annual land budget that estimates the quantity and location of land demanded as well as a priority system with a set criterion that determines the amount of land set-aside. In preparation of the land budget, the Planning Board must take continuous inventory on the physical, geological and environmental characteristics of the reserve's natural resources. The budget must also account for the present and future prices, along with the social and economic needs of the land.

2.5.3 – The Environmental Quality Board

The Public Policy Environmental Act of Puerto Rico, ratified in 1970, was proposed to establish a public policy which would stimulate a desirable and convenient relationship between citizens of Puerto Rico and their environment. This Act sought to develop efforts that would hinder and/or eliminate damages to the environment as well as enrich the comprehension of the ecological system and natural resources important to Puerto Rico. Power to implement and enforce environmental restrictions in governmental agencies, commercial industries, and residential communities was given to the Environmental Quality Board (EQB), which was established by this Act.

The EQB is composed of the Secretary of Public Works, the Secretary of Health,

the Secretary of Agriculture, the Chairman of the Planning Board and three members appointed by the Governor. Appointed members must have the required experience and knowledge that enables them to analyze and interpret each aspect of the environment including; awareness of the scientific, economic, social, aesthetic and cultural needs of Puerto Rico, and recommendation of public policy to develop the improvement of environmental quality. The Board may also employ experts and technicians as needed, in to order carry out its functions and prepare its annual report on environmental quality (L.P.R. Act No. 1, 1977).

Section 11 of the Public Policy Environmental Act, explains the functions of the EQB. In our research, we focused on the functions that influence the relationships between government agencies and commercial industries. For one, the EQB can revise and evaluate the various programs and activities of the government in the light of the policy established to improve the quality of the environment with the purpose of making recommendations of policy to move toward higher environmental quality. The Board may establish standards of environmental quality, as it deems convenient and issue orders restricting the discharge of contaminated wastes into water and air systems. The EQB possesses the power to establish regulations that it considers necessary for the prevention, diminishing or control of damage to natural resources. The sources, which in its judgment are adversely affecting natural resources, must report annually to the EQB on the status of the resource. If it is found by the EQB that a person or corporation is imminently dangerous to a natural resource or public health, then the EQB has the authority to reduce or discontinue their activities.

In order for one to begin operations, which may have adverse effects on the environment or natural resource, one must submit to the Board a detailed statement, known as the Environmental Impact Statement (EIS), describing the environmental impacts of the proposed action. Copies of commentaries, declarations and permits from agencies with jurisdiction by law to the proposed environmental impacts, should also accompany the EIS (L.P.R. Act No. 1, 1977).

2.5.4 – Reclamation

In order to be granted a permit, the quarry owner must agree to restore the site back into its natural settings. The reclamation requirement is a regulatory means by which the local community, federal and state governments can verify that a post mining land-use plan is compatible with the overall plan for the area. Besides satisfying local goals and objectives, the mining company may wish to establish their own goals and objectives, such as improving the value of the land, promoting good public relations, or developing other company goals for post-mining land use (Sengupta, 1993:445). The actual use of reclaimed land and the goals set by these companies are influenced by socioeconomic factors of the region, such as: population trends, employment trends, land values, influence of public planners, regulatory constraints, and the availability of cultural resources (Sengupta, 1993).

The quarry reclamation plan should be a significant component of the site selection proposal required by the Planning Board. A reclamation proposal that meets all

regulatory and zoning requirements will satisfy the land use needs of the community and provide economic incentives to operators. Many quarry sites that are not expected to turn profit through construction of housing or industrial communities are filled naturally or artificially with water, revegetated and turned into parks, golf courses or back to original home and breeding grounds for wildlife (Pit&Quarry, 2003).

2.6 – Summary

The purpose of our literature review is to provide credible background information that helps in understanding the issue under assessment. This background information constitutes the foundation of the answers to our research questions.

To analyze Puerto Rico's aggregate industry, one must become acclimated to the current mineral/aggregate situation. The first section defines the constitution of the good and bad qualities aggregate, in addition to describing the production processes behind aggregate. Because our project sheds some focus on high performance concrete, we give a description of the specific components needed to produce it. We also provide information on the environmental effects of mining and quarrying, which is directly related to the regulations written within the permit's guideline. The last section deals with the permitting process in Puerto Rico, including the laws that regulate the process and those who are responsible for enforcing them. This information is imperative to our study because it provides insight into some of the important organizations and regulations that we must understand when analyzing the permit process.

Chapter 3: Methodology

3.0 – Introduction

The key to gathering peoples' perspective associated with the environmental impacts posed under a longer issued permit could be established through the answering of two fundamental research questions. The intention of these questions was to address issues related to general and environmental impacts associated with a longer permit. Our last question pertains to comparing Puerto Rico's permit process to other U.S. models. We found answers to our questions through key informant interviews and archived data retrieval. In this chapter, we discussed the techniques and procedures we used in answering our research questions.

3.1 – Research Questions

3.1.1 – How would a longer quarry permit affect your organization and the environment?

To answer our first research question, we conducted key informant interviews with respondents from four stakeholder groups, AIPA, DTOP, DNER and Environmental groups. We interviewed:

- Ivan Casanova - President of the AIPA
- Jesus Burgos - secretary of the AIPA
- Jose Cordero - AIPA quarry owner
- Veronica Santa Rosa - Geologist for DNER
- Roberto Lazaro – Sub-Secretary for DNER
- Dr. Neftali Garcia - Hydrological Environmental Professor for UPR
- Juan Rosario - President of Industrial Mission
- Mario Soriano – Geological Engineering and attorney at law
- Gabriel Alcaraz - Asst. Executive Director.

We did not encounter any problems with contacts considering we are using a snowball sampling approach, which works by making other samples/contacts through association with initial interviewees (Singleton, 1993). These interviews had a semi-structured format to allow for spontaneous questions that may arise. Some sample interview questions we asked relative to the fundamental question stated above include largest contributing factor to environmental disturbance, which aggregate production groups contribute the most to negative environmental effects, impact of technological upgrade on aggregate industry, and perceived environmental effects of current permit status. We designed these questions to be subtle, but highly informative to the research of the main problem.

Whether it was in-person or over the phone, interviews yielded the best results for information gathering because a more honest assessment of an interviewee's claim is conveyed, whereas techniques over e-mail or through the use of questionnaires can be

taken too lightly. Interviews yielded such high response rates because a person's full attention was given to the interviewer without the distraction of other samples' biases (Singleton, 1993). We believe that face-to-face interviews were the most advantageous for large organizations containing large sample sizes, such as the AIPA, DTOP and the DNER, because one has control over which questions get directed towards which individuals. In person interviews were also more advantageous because visual aids could be utilized. In addition, questions not clearly understood the first time were restated for simplistic purposes, which was crucial due to the language barrier. The only downside we ran into using the snowball sampling approach was the issue of too many references. The more contacts referred to us meant the more time needed to be set aside for face-to-face interviews. It would have been wiser to utilize phone interviews when this scenario occurred (Singleton, 1993).

As Singleton suggested, our snowball sampling approach resulted in a wide "range of characteristics in the target population"; we were thus able to ensure validity. The longer the referral chain, the more insight we would have into the issue of environmental impact posed by aggregate production. Obviously, we had to use some common sense and good judgment to sift through the data we collected, but all in all, we believe that validity was not much of a problem considering our chosen interview techniques.

3.1.2 - How does the current permit process compare to other models?

The permit process was one of the focal points of our project because it directly affected the impact that quarry operations had on the environment, and also played a role in determining the economic structure of the aggregate industry. In order to analyze the permit process in Puerto Rico, we conducted interviews with Roberto Lazaro and Veronica Santa Rosa, the Sub-Secretary and Chief Geologist of the DNER respectively. They conveyed to us the exact steps on how a quarry permit is filed for. The interviews were of a semi-structured format, which allowed for open discussion and spontaneous questions. This was particularly useful when understanding the DNER's perspective on the main issues of the project such as main factors contributing to environmental disturbance, the impact that various technologies had on the environment, the general opinion of the current permit status, and the option of lengthening permits' duration. However, when it came to understanding how the permit process physically functions, we found it difficult to see the big picture from one interview to the next. This problem was solved by acquiring a permit flow chart that details the different sub-organizations that a permit application must follow before the DNER can issue it. We also acquired other useful information that aided us in analyzing the permit process such as a check list that the technicians use to make sure all requirements of the permit application are met, and a list of laws that govern the permit application process.

The snowball sampling technique worked well in this case as we were referred to other major organizations that played a role in the permit process: the Planning Board and the EQB. We utilized similar collection methods to gather information from these groups as we did for the DNER. The detailed information and various perspectives gathered

from these organizations helped to develop a clearer objectives describing the functionality of the permitting process.

In order to assess the permit process for its strengths and weaknesses, we decided to compare it to other permit process models used in various U.S. states. Since we were not able to directly speak to individuals from government environmental organizations and permit programs, we relied on the information gathered from archived sources such as books and state laws. After we analyzed several different models, we compared them to the permitting methods practiced on the Island. Based on our comparison and analysis, we make suggestions and recommendations that Puerto Rico's permit process would benefit from implementing.

3.2 - Summary

The information we received from our key informant interviews enabled us to generate the best recommendations for the environmental side-effects associated with the production of aggregate. Gathering viewpoints from environmental agencies and non-profit groups exposed the major environmental impacts provoked by aggregate quarrying. These research questions also allowed us to focus on the major problems associated with permitting procedures and make recommendations for a more time efficient approval process.

Chapter 4: Data and Analysis

4.0 – Introduction

In the previous chapters we developed clear objectives for retrieving data associated with this project. Through numerous key informant interviews, archived data analysis, and the use of library materials, we assembled an informative report detailing the effects of a longer quarry permit on each organization from both a general and environmental point of view. This section first presents the data collected to answer our research questions, and then it analyzes the data according to the conflicting perspectives of each organization. The four major organizations involved in this data/analysis chapter include: DTOP, AIPA, DNER and Environmentalists. The last section of this chapter details two United States permit process case studies, which will also be analyzed in comparison to Puerto Rico's current permit process.

4.1 – Data & Analysis: Question 1

4.1.1 – Perspectives of Main Organizations

This section presents the main perspectives of the four key informant organizations: the DTOP, AIPA, DNER and Environmentalists. These organizations have been chosen because each plays a unique role in the aggregate industry, from the purchasing and producing of aggregate resources, to regulating the permit process and preserving the environment and its natural resources. The perspective of each organization is crucial because they approach the aggregate quality and quarry permits issues from different and sometimes conflicting perspectives. The purpose of the following sections is to document and analyze these different perspectives in an effort to understand the different organizations' arguments as a means to seek out the issues pertaining to a longer permit. To accomplish this, we have divided the data and analysis section into two main parts, each focused on one aspect of our first research question; the first focus being how a longer permit would affect each organization and the second focusing on the effects it would impose on the environment.

How would a longer quarry permit affect your organization?

This question was meant to be general so that each group could be given the chance to express their overall opinion on the impacts of a longer permit to their specific organization without being limited to environmental issues.

DTOP

After extensive discussion with our liaison, Gabriel Alcaraz, we have an understanding of the functionality of the aggregate industry from his perspective. The DTOP is responsible for the construction and maintenance of all structures used for transportation purposes throughout Puerto Rico. These structures require the use of

materials such as asphalt and concrete, which are heavily dependent upon aggregate resources. Alcaraz has relayed to us that the aggregates used to produce concrete are comprised of roughly 15 % - 20% "fines", according to lab results carried out by the DTOP. "Fines" are the powder content within the aggregate resources that are a result of rock crushing. According to ASTM-33 standards, the optimal amount of fines for any aggregate mix is only 2% - 5%; exceeding this amount can be detrimental to the structural integrity of the final aggregate product. Alcaraz believes the problem of "fines" can be controlled through the use of washers and scrubbers during the aggregate production stages.

Alcaraz believes that the majority of the aggregate industry community does not carry out the necessary processes in creating quality aggregate. It is his belief that a longer permit would provide incentive for aggregate industries to invest in equipment necessary to carry out these processes. In addition to increasing the quality of aggregate, Alcaraz believes a longer permit would also induce competition among producers resulting in lower aggregate costs. An example presented to us by Gabriel Alcaraz justifying this problem deals with HPC. He said, "Currently, there are only two major HPC producers on the Island and prices range from $1300 - $1500 per cubic meter." It is Alcaraz's hope that additional competition would drop prices of HPC to one third of its current cost.

AIPA

We interviewed Ivan Casanova and Jesus Burgos, President and Secretary of the AIPA respectively, because they represent the AIPA's perspective, as well as the administrative functionality. In an effort to gather the perspective of a non-administrative AIPA member, we also interviewed Jose Cordero, an AIPA member for more than forty years. Of the three AIPA members interviewed, each was in agreement that a longer permit would be beneficial to the aggregate industry.

One advantage to a longer permit would be the possibility to reduce the frequency at which paperwork for permit applications must be submitted to agencies such as the DNER, EQB and Planning Board. Paperwork required for renewal permits includes hydrological/geological assessments, topographic maps, site surveys, updated land-use plans, etc. As Casanova stated, "There is just not enough time to gather the necessary paperwork and concentrate on producing aggregate with only a three-year permit." In addition to saving time through less frequent paperwork, Cordero reminded us that money would also be salvaged. The compiling of paperwork costs thousands of dollars to produce; for instance, a typical land survey costs anywhere from $6,000 upward. Moreover, Cordero informed us, "My quarry alone needs 34 individual permits to legally sustain operation, each costing $200-$500."

Ultimately, implementation of longer permits would prompt banks to issue larger loans, which would then provide quarry owners the opportunity to purchase newer, more efficient equipment. Burgos stated, "In order for quarry owners to remain competitive in the aggregate business, it would be imperative to match the leaders of the industry in both technology and process."

Another advantage to issuing longer permits, as pointed out by Ivan Casanova, would be the enhancement of quarry-community relations. Ivan Casanova stated, "In

order for both the community and quarry to coexist over a long period of time, there would have to be strong ties or else the community would be unhappy and the quarry would be unproductive." Complaints raised by surrounding communities as a result of being disturbed or bodily harmed can give reason to government agencies to fine and stop quarry operations. Using his own quarry as an example, he constantly attempts to reach out to the surrounding communities through the use of food drives, educational field trips, and monthly meetings in an effort to strengthen their relationship with one another. However, each of the AIPA members was in full agreement that quarries receive their bad reputation from the smaller operations that do not operate according to the rules. Casanova stated, "Some of these operations even pay-off inspectors and other officials in order to obtain false permits or just simply manufacture false permits themselves." The AIPA places all blame on permit issuers for their lack of enforcement and punishment towards such quarries in bad standing.

In conclusion to our discussion with Mr. Casanova, he emphasized that the securities presented by a longer permit would "allow him to sleep well at night". Because there is no guarantee that quarry owners will receive renewal permits every 1 - 3 years, they are in constant concern for the future of their aggregate operations. And as Burgos questioned, "Why should the DNER or any other government agency be afraid to issue a longer permit if they hold the power to stop quarry operations at anytime they felt it necessary?"

DNER

The DNER has mixed opinions with regards to increasing the duration of quarry permits. The issue of monitoring is used as a reason against longer permits. Currently, Veronica Santa Rosa and Roberto Lazaro, geologist and Sub-Secretary for the DNER respectively, have expressed that the DNER is greatly understaffed and there are only four qualified technicians to evaluate each quarry throughout the Island. To compensate for the lack of technicians, the DNER relies on local "vigilantes" or officials to carry out quarry assessments. However, these officials have very little knowledge concerning quarry operations and do not hold the jurisdiction to enforce permit regulations. Santa Rosa claimed, "Under the given circumstances, the DNER feels incapable of providing the necessary supervision over quarry operations."

Lazaro stated that a longer permit would only help diminish any control the DNER currently possesses over the quarry community. A worry of the DNER is that the security of a longer permit may prompt quarry owners to “cut corners” on crucial environmental issues, such as dust control and water contamination. But, as Santa Rosa stated, "Current permits give the DNER the ability to keep a tighter leash on any illegal or harmful activities found at quarry sites." By a "tighter leash", she meant more diligent enforcement and examination.

Another disadvantage Santa Rosa foresees with a longer permit is its direct relationship to the processing time required for the paperwork of renewal applications; as permit time increases, so would the processing time. The reason behind her thinking is that looking into the future only three years and predicting the effects of quarrying on surrounding communities, land and environment is much easier than predicting the effects for say, ten years. In any case, whether it is the initial or renewal application, it

would require a more extensive and detailed assessment, such as in depth planning of reclamation, geological/hydrological studies, environmental impacts, etc. Santa Rosa worries that "a lengthier, more detailed application would be too difficult for current personnel to handle".

Contrary to what was stated above, Santa Rosa and Lazaro, in a different interview, both said there is the possibility a longer permit could help save time in the permit process. Since only a limited number of quarries would receive longer permits due to reserve size and would have to apply for renewals less frequently, they essentially help free-up more time for permit issuers to concentrate on processing permits for quarries in constant need of renewal. Santa Rosa emphasized, "Time is a major issue for the DNER because currently we are understaffed and cannot process the numerous requests for permits in a fashionable manner." For a permit to be issued the quarry owner's application must be approved by the EQB, who is responsible for an environmental assessment, then passed to the Planning Board, who deals with zoning issues, and finally, to the DNER, who administers earth extraction issues. Lazaro said, "This process can take anywhere from six months to a full year for each of the three agencies to approve the granting of a quarry permit; however, by law permit applications are supposed to be granted within 90 days."

Environmentalists

Environmental groups throughout the Island have similar beliefs and arguments against lengthening quarry permits. Juan Rosario of Mission Industrial declared, "Construction is the engine of Puerto Rico's economy and aggregate is the raw material responsible for its energy source." According to Rosario, the Puerto Rican economy is highly dependent on construction and would not be able to survive without it. The purpose of Mission Industrial is to work with local communities to either help organize protests or push to implement an environmentally sound operation. This environmental group, in particular, sees to it that there is a reasonable solution to every problem, not something as simple as relocating it from one community to the next.

Juan Rosario's main concern with a longer permit is it would allow aggregate industries to expand operations, and thus, further infringe on communities, wildlife habitats, protected forest, and water resources. Neftali Garcia, Hydrological Environmental Professor at University of Puerto Rico voiced, "A longer permit would only place more power in the hands of the quarry owners and would provide little or no incentive to build healthy relationships with surrounding communities." Garcia would support giving up to a five-year permit, but would require these quarries to be heavily restricted and supervised. Both gentlemen agree that longer permits would only provoke further encroachment into peoples' livelihood and would require far too much commitment from the government to enforce laws on quarry operations.

4.1.2 – Discussion

The last section conveyed the perspectives of each organization with regards to a longer quarry permit. The purpose of this section is to compare and contrast those

thoughts and concerns in order to analyze and validate the main points of their arguments. Some viewpoints overlap creating clear and viable information, while other viewpoints contradict making it tough to analyze the information. The following will analyze each of the organizations main concerns in relation to the remaining organizations.

From Table 4.1 below, we have determined that there are three main issues that the DNER, AIPA, and Environmentalists are concerned with regarding the effects of a longer permit on their organization. These three issues are focus points of the arguments posed by each of the organizations. Understanding these issues would be the first step in understanding the rationale behind the organizations' arguments.

Organization	Concerns
DTOP	Decrease aggregate prices
AIPA	More time saved with less frequent permit application submittals
	Overall cost of permits reduced
	Quicken approval process with less frequent permit application submittals
	Purchase newer, more efficient equipment
	Strengthen community relations
DNER	Fewer renewal proposals will result in stricter monitoring of quarries
	More detailed permit proposal required
	Monitoring quarries becomes more difficult
Environmentalists	Mining operations have to be limited
	Natural resources on the Island are running low

Table 4.1 This table summarizes the main arguments of each organization pertaining to how a longer permit would affect their organization

Permit Time

One of the key issues that arise from our data collected on Puerto Rico's aggregate industry is the concern of time needed for aggregate production. Currently, Ivan Casanova and other quarry owners must prepare for permit renewal applications one year prior to expiration. During the permit's final year, more focus is placed on acquiring the necessary maps, surveys, reports, and other documents needed for renewal rather than extracting materials and producing aggregate. After such data is collected and submitted, owners must wait up to a year for the approval of an extraction permit. Whereas the AIPA is concerned with utilizing the allotted amount of permit time for extracting purposes only, the DNER is concerned with salvaging time associated with processing the permits. With the frequency at which quarry owners must renew permits and the issue of being understaffed, the DNER is constantly pressed for time. As stated earlier by Roberto Lazaro, renewal permits should be processed and granted within 90 days of the applications receipt.

The AIPA is in favor of a longer permit because it will increase intervals between permit renewals allowing them to focus more time on quarry operations. The AIPA's thought process is that losing a year out of a ten-year permit to plan and prepare the paperwork needed for a renewal permit is more resourceful than losing that year out of a three-year permit. Jesus Burgos states, "It is a timely process to prepare all the paperwork needed for permit renewals. A longer permit would allow me to focus more on my operations." Jesus Burgos and many other AIPA members are also aware of the backlog of permit applications at the DNER. The longer permit, it is believed, will eliminate the backlog at the DNER and quicken the approval process. Ivan Casanova believes, "A longer would reduce the frequency with which applications and reports are submitted, thus reducing the amount of paperwork DNER officials must examine."

Veronica Santa Rosa and Roberto Lazaro both agree that the current permit process takes longer than it should and a longer permit can potentially reduce this time. Santa Rosa believes that the backlog of permit proposals is due to a combination of things. First, she believes, "Each permit proposal requires an in depth examination, specifically focusing on the scientific data collected." This in depth examination requires the aid of geological technicians, which the DNER is lacking. Santa Rosa explains, "Our budget is tight; therefore, we have a short supply of computers, measuring tools, space, and people in order to evaluate permits in a timely manner." With a longer permit, Santa Rosa believes there will be a reduction in paperwork, which will help compensate for the slim budget. Lastly, during the approval processes many documents are requested by the DNER from other government organizations such as the EQB and Planning Board. It is believed by Santa Rosa and Lazaro that these organizations face the same backlog and budget problems as the DNER. Obtaining information from such organizations can be a timely process; therefore, some of the blame for the lengthy permit approval process of the DNER is placed on these organizations. A longer permit, it is believed, may reduce some of the backlog within these organizations, but will not significantly reduce the amount of time it takes to obtain information from them.

According to the arguments of each organization, there is the possibility that a longer permit could reduce the amount of time focused on preparing and approving permits. By implementing a longer permit the AIPA can submit permit renewals less frequently; therefore, allowing them to focus more time on their quarry operations and less on preparing geological surveys, land surveys, and hydrological assessments. With a smaller influx of permit renewals, DNER technicians will have more time to conduct their field work and the backlog of renewals can be reduced.

Permit Cost

Another issue stated in the chart above is the cost involved with the permitting process. Jose Cordero and other AIPA members believe that the cost of acquiring the appropriate data for extraction permits is too expensive. Also, the costs associated with obtaining other permits required for an extraction permit adds thousands of dollars to each quarry's expense. Currently, every three years AIPA members must submit new topographic maps, land surveys, geological/hydrological assessments, aerial photographs, annual extraction amounts, permit applications and other documents. The DNER and environmental groups argue that the land surveys conducted for quarries are incomplete

and should be more accurate and detailed. Juan Rosario claimed, "Such expenses are negligible compared to the profits quarries make in a single week of production."

Many of the AIPA members we interviewed believe that a longer permit would reduce the frequency with which they would have to reapply for extraction permits, simultaneously reducing the costs associated with permit renewals. For example, conducting land and geological surveys, shooting aerial photographs, redrawing topographic maps and collecting other scientific data every five or ten years would be less expensive than doing the same procedures every three years. Jose Cordero explained to us, "Every time I reapply for an extraction permit, not only do I have to spend $6,000 upwards to $30,000 for all the necessary documents, but also an additional couple thousand dollars for the renewal of other permits required for extraction." It is his belief and the belief of many other AIPA members that these expenses are too large for a short-term permit. With a longer permit, "we will be able to apply these same costs over a longer period of time", Ivan Casanova. The AIPA interviewed believe that the cost of gathering the necessary scientific data will not increase if extraction permits become longer, because the same data used for a three-year permit can be applied over a longer period.

The DNER and environmentalists, however, are concerned that the scientific data currently collected is insufficient and should be more detailed. Juan Rosario commented on the geological assessments submitted to the DNER, "Most are inaccurate and do not reflect the seriousness of environmental and social impacts caused by aggregate production." It is believed that a longer permit would allow quarries to be more destructive to the environment, because the DNER would not have scientific evidence submitted to them every three years to show that regulations are being followed. Mario Soriano suggests, "If a longer permit is issued, then the DNER should either require that the data within such scientific reports be extremely detailed and accurate or that these reports be conducted and submitted on a yearly basis." The first option, he argues, will not reduce overall costs, as some AIPA members believe, but will in fact increase costs, because the scientific analysis of each quarry will have to be elaborate. Submitting the scientific reports on a yearly basis would triple the costs of each quarry, but he believes it would be necessary to ensure that there is environmental control of quarry operations. Veronica Santa Rosa believes that the second option is possible if permits are lengthened; "This approach would require minimal change from both quarries and the DNER, plus help ensure quarries are operating in accordance to regulations."

Based on the arguments above, a longer permit will only be agreed on if quarry owners are willing to invest in more accurate, detailed and expensive geological assessments, topographic maps, aerial photos, land surveys and other scientific data submitted a minimum of every three years. AIPA members think that a longer permit would allow them to extrapolate current costs associated with obtaining this scientific data over a longer period of time. However, they have yet to realize the DNER uses these scientific reports to ensure quarry owners are following regulations. The DNER would most likely prohibit quarry operations to continue for extensive periods of time without submitting these reports on a regular basis. So for example, a quarry that proposes submitting reports every three years for a ten-year permit would have a better chance of being approved by the DNER than a quarry submitting one report every ten

years. AIPA members must realize that the data required for these renewal applications and periodic check-ups are used by the DNER to ensure that environmental regulations are obeyed. From this data, it seems with a longer permit there is no way to reduce the costs associated with collecting such scientific data.

Community Relations

The final issue that arises from our data is the relationship between quarries and neighboring communities. Communities play an integral role in determining the shape of the aggregate industry because they have the ability to impede quarry operations. If a community's welfare is threatened or harmed by a quarry operation, then the community can raise its concerns to the DNER, who is responsible for monitoring quarry operations. The DNER would then evaluate the community's complaints in order to assess whether action should be taken against the quarry in question, depending on the severity of the damage or disturbance. The DNER will take action either by fining the quarry owner or by suspending operations completely. As discussed in our paper, communities can be disturbed by quarry operations in many ways, from polluting water resources through sedimentation to the noise caused from rock blasting. As a result of these potential disturbances, many communities see quarry operations as a threat to their well being.

The AIPA members we interviewed believe that a longer permit would compel quarry owners to strengthen their relationship with surrounding communities. As Ivan Casanova said, "In order for both the community and quarry to coexist over a long period of time, there would have to be strong ties or else the community would be unhappy and the quarry would be unproductive." Ivan Casanova is in good standing with the neighboring communities for two reasons. First, he implements all the necessary process and control methods in his operations to ensure compliance with all environmental regulations, thus minimizing disturbance to the communities. Second, he participates in public services which the communities see as kind gestures, such as food drives and educational field trips. For these reasons, Ivan Casanova has earned himself a good reputation among his fellow neighbors. It is our understanding that Casanova believes one of the main obstacles of issuing a longer permit deals with quarry owners having a bad reputation. As he said, "the smaller quarries in Puerto Rico that do not operate in accordance to rules set by the DNER give legitimate quarry owners a bad reputation among communities and environmentalists." One way to improve the social status of aggregate producers is to push quarry owners to invest in public services, as Ivan Casanova does.

The DNER and especially the environmentalists disagree with Ivan Casanova's argument. They firmly believe that even with a longer permit, quarry owners will continue their quarry operations as usual - showing little concern for the community. Juan Rosario of Industrial Mission suggested, "Incentives to strengthen community ties need to be initiated or else quarry owners will continue to be inconsiderate." One suggested incentive would be to implement stricter monitoring and enforcement of environmental laws. Currently, the DNER does not have enough technicians or environmental officers to monitor all quarry operations properly, which is due to their lack of funding. As a result, many quarry operators find that they can get away with breaking environmental regulations, and therefore, negatively impacting neighboring

communities.

According to the different arguments gathered on this issue, it does not seem possible for quarries to sustain healthy operations without building strong ties with surrounding communities. Communities have the power to debilitate quarry operations by raising their complaints to the DNER, so it is in quarry owners' best interest to establish good relations with their surrounding communities. The main problem is that most small quarry owners are willing to run the risk of being caught and fined for negatively impacting the surrounding community and environment because the associated risks are low. The DNER does not have the manpower to evaluate quarries on a continuous basis and smaller quarries believe that investing in preventative measures for the sake of establishing good community relations would be more costly than accepting the fines issued by government agencies.

4.2 – Data & Analysis: Question 2

4.2.1 – Perspectives of Main Organizations

As stated before, the purpose of the following sections is to document and analyze the different perspectives in an effort to seek out the issues pertaining to a longer permit.

How would a longer quarry permit affect the environment?

This question was chosen to focus the organization's thoughts directly on the perceived environmental impacts of a longer permit. It was our liaison's request to limit the spectrum of our project to environmental issues in order to comply with his agenda.

DTOP

It is the DTOP's request to find the perceived environmental impacts posed by increasing the duration of quarry permits. Therefore, the DTOP does not have any relevant information pertaining to this question.

AIPA

After interviewing various members of the AIPA such as Ivan Casanova, Jesus Burgos, and Jose Cordero, it appears they are in agreement that a longer permit would be beneficial to the environment. They believe the key to receiving longer permits is to demonstrate to the DNER, EQB, and Planning Board that such a permit would in fact decrease environmental impacts of quarrying. The main points in favor of a longer permit are the capability to upgrade equipment, enhance environmental protection methods, and improve community relations.

First, a longer permit would encourage quarry owners to abide by environmental regulations set forth by the DNER and other permit issuers more stringently. The reason behind such a statement is that the cost of fines for "cutting corners" pertaining to the environment over a longer period of time would be far too expensive. As noted by Ivan Casanova, "Currently, quarry owners are willing to pay the fines for such short-term permits because the mindset is to produce quantity over quality, especially since there is no guarantee to be re-issued another permit every three years." A longer permit would

allow for quarry owners to slow down operation and concentrate on producing quality aggregate while maintaining environmental awareness.

A second advantage to increasing the lifetime of quarry permits would be the ability to receive larger bank loans. Casanova assured us that larger bank loans would allow quarries to invest more into their production plants, which would easily reduce the environmental effects posed by facility operations. The AIPA argues that the purchasing of newer and necessary equipment would have an extremely positive effect on the environment.

One environmental effect that can be reduced with the introduction of newer, efficient equipment is the emissions of dust. The introduction of "wet suppression" or dry-hood collection systems, which will be discussed in further detail later on, controls dust emissions with great success. Ivan Casanova recently implemented a water recycling system into his facility, which significantly cuts back on water usage from local wells. Casanova claimed, "Larger bank loans give quarry owners the opportunity to upgrade technology, which in turn would yield positive effects on the environment."

The AIPA poses two valid points on how a longer permit would better the environment; one, quarry owners complying with environmental regulations more closely, and the other, allowing quarry owners to upgrade technology through larger bank loans.

DNER

Despite some positive aspects a longer permit could bring to the DNER, both Lazaro and Santa Rosa believe there would be no environmental gains to a longer quarry permit. It is the general consensus that if permit time increases, the amount of damage done to the environment by quarry operations will also increase. As Santa Rosa explained, "The only time the DNER is in contact with quarry owners is when permits need to be renewed or communities file complaints; other than that, we are completely oblivious to what truly goes on behind aggregate operations." Santa Rosa and Lazaro strongly agreed that shorter permits allow them to monitor quarry activities more easily, especially since the DNER lacks qualified personnel to monitor in the first place.

Something both the AIPA and DNER agree on is that a longer permit would be more environmental friendly if quarry owners were to upgrade technology, by purchasing new or replacement equipment. However, the DNER questions what incentives quarry owners would have in purchasing such equipment, especially since the majority of owners on the Island insist on using the same machinery purchased decades ago. As Lazaro put it; "The mentality down here [Puerto Rico] is, 'If it ain't broke, don't fix it.' And so, I find it highly unlikely that quarry owners would be willing to invest money in new technology when the equipment they use now is still functioning and contractors are continuing to purchase." The DNER poses a valid question considering the stereotype for aggregate producers as being "money hungry". This problem combined with poor monitoring and enforcement is the main issue that the DNER poses against the support of a longer permit being beneficial to the environment.

Environmentalists

Environmentalists are concerned with four major factors: dust pollution,

sedimentation, noise and blasting vibrations, and depletion of natural resources. Dust pollution becomes a concern when quarries are situated within proximity to forests, communities, and waterways. Environmentalists argue that dust pollution adversely affects the health conditions of local communities, vegetation and wildlife, and on a more serious note, pollutes water supplies with sedimentation. Sedimentation is the greatest concern for environmentalists because as Juan Rosario stated, "Currently, Puerto Rico cannot produce drinking water at the same quality and supply as that of any of the States." One of the largest regions of concern is the Northern Karst of Puerto Rico. As expressed by Rosario, "This area is rich in quality limestone deposits and is also the location of the Island's best natural aquifer."

Figures 4.1 & 4.2 Karst features, such as the conical mogote on the left and the sinkholes on the right, are common in the north coast limestone region. These features also support a natural underground water filtration system (USGS, 2001).

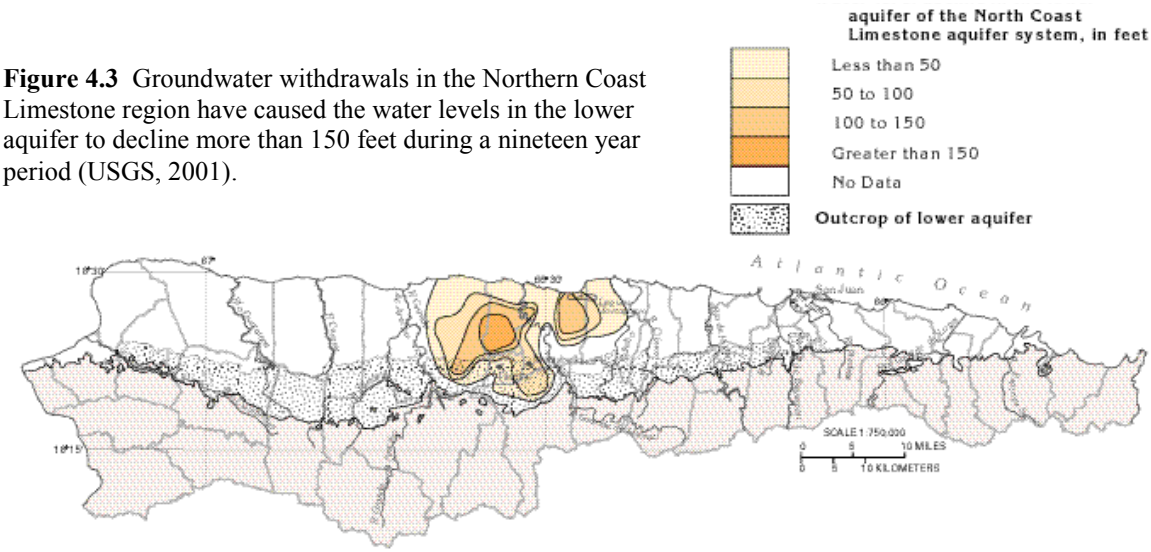

Figure 4.3 Groundwater withdrawals in the Northern Coast Limestone region have caused the water levels in the lower aquifer to decline more than 150 feet during a nineteen year period (USGS, 2001).

As seen in the pictures 4.1 & 4.2, the Karst region is full of sinkholes and small, limestone mountains with a large system of caves and underground rivers and streams.

For many years, environmentalists have attempted to stop quarry operations in this region because of its importance to the water supply. According to Rosario, "The estimated water supply will not be sufficient for Puerto Rico's people if current consumption rates continue. As of now, 15% of the Island's water supply is used for mining and quarrying activities." Even though legislature has been passed to protect this region from quarry operations, there are still numerous illegal mining activities that continue to function. Figure 4.3 details areas in the Karst region, which have already experienced a decline in water levels over recent years. It is assumed that much of this can be attributed to illegal mining activities polluting the water with sedimentation. Rosario's main concern, though, is that a longer permit would encourage more illegal operations to exist and eventually require the mining of this important region.

Other major concerns are the noise levels and ground vibrations due to regular operations. Environmentalists and community residents complain that blasting activities exceed the limit of allowed explosives. This causes great concern because the noise and ground vibrations produced from these activities, as well as the possibility of flying rock, can cause landslides, destruction of homes and even harm to people. Tables 4.2 & 4.3 explain the noise levels of quarry operations and compare it to a human response survey. A longer permit, it is argued, would give way to more blast activities with greater intensities.

Human Repsonse to Steady-State Sound Levels

Sound Source	dBA	Response
	150	
Carrier Deck Jet Operation	140	
	130	Painfully Loud
Jet Takeoff (200ft)	120	Limited Amplified Speech
Auto Horn (3ft)	110	Maximum Vocal Effort
Jet Takeoff (2000ft)	100	
Heavy Truck (50ft)	90	Very Annoying
N.Y. Subway Station	80	Hearing Damage (8hrs. Continuous)
Pneumatic Drill (50ft)	70	Annoying
Freight Train (50ft)	60	Annoying
Freeway Traffic (50ft)	50	Telephone use Difficult
Light Auto Traffic (50ft)	40	Quiet
Living Room/Bedroom	30	Very Quiet
Broadcasting Studio	20	
	10	Just Audible
	0	Threshold of Hearing

Projected Noise Measurements from Various Noise Sources

		Projected Noise Levels		
Noise Source	Measurements	1000 ft	2000 ft	3000 ft
Primary & Secondary Crusher	89 dBA at 100 ft	69 dBA	63 dBA	59.5 dBA
Hitachi 501 Shovel Loading	92 dBA at 50 ft	66 dBA	60 dBA	56.5 dBA
Euclid R-50 Pit Truck Loaded	90 dBA at 50 ft	64 dBA	58 dBA	54.4 dBA
Caterpillar 988 Loader	80 dBA at 300ft	69.5 dBA	63.5 dBA	60 dBA

Tables 4.2 & 4.3 Table 4.2 shows how people respond to different noise levels. Table 4.3 shows the noise levels of different quarry machinery at different distances (National Stone Association, 1991).

The final concern of environmentalists is the issue of depleting mineral resources due to over consumption. Depletion of minerals is a major concern once again because of the over consumption on the Island. Rosario argues that the demand for construction minerals is "exponentially increasing" throughout time. He asserts that construction is the "engine of the economy", and so economic activities such as retail, tourism and housing developments need aggregate for raw materials. The argument, however, is that many construction projects proceed unfinished and are not financed properly, resulting in a waste of aggregate resources.

The environmentalists' second argument pertaining to the depletion of natural resources is with respect to housing developments. It is argued that massive housing development projects eliminate both forested areas and large amounts of mineral resources. Rosario said, "These housing developments are not necessary considering Puerto Rico already has seven houses/apartments per person on the Island." A longer quarry permit is believed to increase the consumption of minerals and the disturbance of land through further construction.

Environmentalists believe there will be no change in environmental impacts if a longer permit is implemented. A longer permit would not spark any incentive to upgrade technology, especially since quarry owners have been practicing the same methods with the same machinery for too long. Even with a longer permit, environmentalists are sure quarry owners will still attempt to cut corners environmentally. They might follow the rules and regulations at the beginning and end of their permit's lifetime, but will seek the more convenient methods in between. Environmental groups foresee nothing but more negative environmental impacts with a longer permit.

4.2.2 - Discussion

The last section conveyed the perspectives of each organization with regards to the environmental impacts of longer quarry permit. Similarly to our analysis of the first research question, the purpose of this section is to compare and contrast those thoughts and concerns in order to analyze and validate the main points of their arguments. From the table above, we have determined that there are two main issues that the DNER, AIPA, and Environmentalists are concerned with regarding the effects of a longer permit on the environment: the issue of upgrading technology and the issue of complying with environmental guidelines. The following analysis, summarized in Table 4.4, is meant to give the reader an understanding of the reasoning behind the arguments pertaining to these two issues.

Organization	Concerns
DTOP	No relevant information pertaining to this question
AIPA	Compliance with environmental guidelines Newer equipment bears positive side effects on environment
DNER	Quarry activities too difficult to monitor No incentive for quarry owners to upgrade technology
Environmentalists	No incentive for quarry owners to upgrade technology No incentive to comply with environmental guidelines

Table 4.4 This table summarizes the main arguments of each organization pertaining to how a longer permit would affect the environment.

Upgrade Technology

Referring to the table above, an issue arising between these organizations is whether or not a longer permit will provide incentive enough for quarry owners to upgrade or invest in missing, but necessary technology. It is hoped that a longer permit will give quarry owners the opportunity to purchase equipment, such as "wet suppression" or dry-hood collection systems, which help mitigate the effects of dust on the environment. In addition to purchasing equipment that protects the environment, it is also hoped that quarry owners will expand upon the aggregate production process by investing in washers and scrubbers, which increase both the quality and grade of aggregate produced. If the aggregate quality standard is increased, then the lifetime of materials such as asphalt and concrete will also increase, which translates into less aggregate consumption for maintenance purposes. Because new-age quarry technology is built with the environment in mind, there is little argument among the organizations whether it will be advantageous or not. However, they do argue whether or not a longer permit will actually spark any incentive for quarry owners to invest in such equipment.

Through our own personal quarry visits and conversations with quarry owners, it is evident that the quarry technology utilized throughout the Island dates back to the "dark-ages". The day we visited Jose Cordero's quarry, he informed us that two of his four main production units on site were shut-down for maintenance purposes, which meant he was only producing to fifty percent of his actual potential, hence losing a lot of money. That same day, Cordero relayed to us that the equipment he used was roughly 1970's vintage and that he just purchased a "used 1969 jaw crusher" to install at his facility. A larger bank loan would give Cordero the opportunity to purchase newer equipment, resulting in less maintenance/repair fees and increased production output. The AIPA realizes that other quarry owners are in the same position as Cordero and believes that this is evidence in support of a longer permit providing incentive for upgrading technology. If that is not enough, then as stated by Casanova, "In order to remain competitive with other quarries, owners would be forced to upgrade technology or

else they would face extinction." By not upgrading technology, quarry owners run the risk of being shutdown for negatively impacting the environment and/or not meeting the required aggregate quality standards.

Contrary to what the AIPA believes, the DNER and environmentalists strongly agree that a longer permit will not result in aggregate producers upgrading technology. They believe quarry owners will continue with the same methods and technology used since the first day of production. As previously questioned by Roberto Lazaro, "If the mentality of aggregate producers is the equipment still operates and contractors continue to purchase the aggregate, why bother investing anymore money in something that works fine?" As Santa Rosa from the DNER said, "A longer permit will not trigger quarry owners to buy new equipment, but the demand for a higher quality aggregate might."

Both the DNER and environmentalists agree that newer, more efficient technology would be beneficial to the environment, but disagree on whether a longer permit would bring about any changes. We believe that without sufficient enforcement of environmental regulations and higher aggregate quality standards, there will be no incentive for aggregate producers to upgrade equipment.

Compliance with Environmental Guidelines

The final issue arising from our data pertains to aggregate producers following environmental guidelines set forth by the DNER and EQB. This issue raises much concern because quarry owners both large and small are willing to pay fines for "cutting corners" and skipping steps that protect the environment just so they can maintain forward progress with aggregate production. Since permit lengths are so short and fines are so cheap, quarry owners would rather concentrate on extracting material and paying the fines for breaking environmental regulations than stop operations and assess the problem before continuing aggregate production. Once again, the AIPA shares a different point of view from the other organizations on how a longer permit would affect this issue.

It is the AIPA's belief that a longer permit would be a motivator for quarry owners to comply with environmental regulations more closely. Their thinking is that quarry owners would not be able to afford paying fines over a longer permit period, therefore, would be forced to abide by environmental regulations to save money. In addition to that reason, Ivan Casanova expressed that "quarry owners would be less focused on extracting resources and more focused on satisfying environmental guidelines." Since a three-year permit does not provide the same security of say a ten-year permit, it is easy to understand why a longer permit would be incentive for aggregate producers to follow regulations more stringently.

In opposition to this argument, the DNER and environmentalists have stated that a longer permit will only give quarry owners more freedom to cut corners in relation to environmental guidelines. As Neftali Garcia states, "You give them an inch, they take a mile." It is clear that aggregate producers have a long history with the DNER and environmentalists because neither one has trust for the other. With that said, we have little hope for any compromise among the groups.

4.3 – Comparative Case Study

The purpose of this case study is to compare Puerto Rico's permit process to that of Arizona and California in order to determine the three processes' critical aspects that could be implemented or improved in Puerto Rico's permit process. To accomplish this, we have categorized the information we wish to compare on the permit processes into six main sections pertaining to the various aspects of the permit processes. The purpose of the first section, Departments and Regulations, is to give the reader an understanding of the laws governing the permit processes, as well as the agencies that administer them. The second section is Application Information, which details the permit application requirements of the three processes in order to assess whether any process has a more extensive and thorough application process. The Process and Procedures section provides an understanding of the functionality of the permit processes. The fourth section, Reclamation details the functionality of the three reclamation and restoration processes and the laws and regulations that they entail. The following section, Monitoring and Enforcement explains how each of the three processes enforces their respective environmental laws, the methods of carrying out site inspections, and the fines that are issued. Finally, the source of monies that the various agencies and departments rely on to operate is discussed in the Funding section.

Arizona was chosen as one of the states for comparison for two reasons. First, the permitting process in Arizona is not very complex as it is mainly administered by the Arizona Department of Environmental Quality. This is particularly useful for comparison with California and Puerto Rico's permit processes, which are both rather complex. Second, operation permits are typically issued for three years, which is similar to Puerto Rico's one to three year permits. California was chosen because we were told by an AIPA member that Puerto Rico's permit process was modeled after California's. At the end of this section, we provided a table that summarizes the main points of each permit process in order for the reader to easily discern between the aspects of Puerto Rico's permit process that need improvement.

4.3.1 – Arizona

Departments and Regulations

Arizona regulates mining primarily through its aquifer protection permit program (APP). This approach requires substantial technical review of the mining technologies utilized by each aggregate producer. The main legal requirement is that quarry facilities that discharge into the groundwater must obtain an APP permit. The main state agency that administers environmental laws and regulations is Arizona’s Department of Environmental Quality (ADEQ). Any person who owns or operates a facility that discharges must obtain an APP. However, the ADEQ is authorized to exempt certain facilities if they have reasonable cause for exemption. In addition, certain low-impact mining facilities may apply for a general permit instead of an individual one. General permits cover discharges of wash water from sand/gravel operations and placer quarry operations (McElfish., Bernstein, Bass, Sheldon, 1996).

Application Information

Information quarry owners must attach to their permit application includes: names and mailing addresses of facility's owner and operator, legal description of facility location, expected operational life of facility, a topographic map of facility's contiguous land area, a facility site plan, facility design plans and other state or federal environmental permits issued to applicant. In addition, they must also describe in their application the best available demonstrated control technology (BADCT) to be utilized in order to achieve the greatest level of discharge reduction and compliance with aquifer water quality standards.

Process and Procedures

The ADEQ has compiled and published a list of existing facilities that are required to obtain an APP. The list contains deadlines for submitting applications, which can be no later than 180 days before the date on which the facility is expected to begin discharging. Applicants may submit proposals for a permit application to explain how they will meet the informational requirements of their application. The ADEQ will then evaluate and comment on the proposal within 30 days to notify the applicant of any missing information. If the application is determined complete, then the project officer begins drafting and preparing a public notice, which gives the public the opportunity to voice their opinion on the matter. The director makes the final decision on whether the permit should be granted or not based on information in the permit application and written public comment (McElfish., Bernstein, Bass, Sheldon, 1996).

When it comes to designing a facility, applicants must submit a proposal of BADCT as part of the application for an APP. The proposal may utilize either a "prescriptive BADCT" or an "individual BADCT". The former is a pre-approved design independent of site specific conditions, while the latter is a performance-based approach in which designs are selected and tailored to a specific facility and site. If an "individual BADCT" is chosen, then the applicant must develop a proposal for the ADEQ to review.

Reclamation

In 1994, Arizona passed the Mined Land Reclamation Act (MLRA), which entailed a legislative study committee to examine and make recommendations on the need for a state department of mineral resources and the appropriate state agency to administer the MLRA. Reclamation of surface disturbances should be done concurrently with an exploration operation. If concurrent reclamation is not practical, reclamation must be initiated within two years after completing exploration, within two years of ending mining activity, or as required by applicable federal law. The director can extend the time available up to 15 years as long as quarry owners can provide proof that the reclamation project would resume. Owners or operators of new or existing exploration operations must file a financial assurance mechanism with the director within 60 days after a reclamation plan is approved. Within 30 days after it is received, the director must make the decision in determining the amount of financial assurance, which is done by considering the costs of approved reclamation measures stated in the reclamation plan. The owner or operator of a new exploration operation must furnish a minimum financial

assurance mechanism to the director equivalent to $2,000 per acre of new surface disturbance. Permissible financial assurance mechanisms include any combination of surety bonds, certificates of deposit, and insurance policy (McElfish., Bernstein, Bass, Sheldon, 1996).

Monitoring and Enforcement

Violators of a reclamation plan are subject to civil penalty of not more than $1,000 per each day of violation, not to exceed a maximum violation of $15,000. Civil penalties of up to $25,000 per day per violation may be issued for violations of any water quality or APP rule. Non-compliance with a remedial action is subject to a civil penalty of no more than $5,000 a day.

Funding

All monies collected as fines under the MLRA are placed in the Arizona General Fund, while all civil penalties (except litigation costs) are to be deposited in the water quality assurance fund. Permit fees through the APP are directed to the state general fund, which is the source of funds for the APP program. Recent legislation requires that $500,000 of the State Water Quality Assurance Revolving Fund (SWQARF) be spent for increasing APP staff levels and subsequent training of 10 additional full-time employee positions for the processing, reviewing, and approving/denying of APP applications for existing facilities. The SWQARF fronts all reasonable and necessary costs incurred in remedial action necessary to prevent, minimize, or mitigate damage to public health and the environment. The SWQARF consists of monies appropriated by the legislature, monies obtained as civil or criminal penalties, and monies recovered from remedial action costs (McElfish., Bernstein, Bass, Sheldon, 1996).

The state mine inspector for the MLRA is authorized to receive federal grant funds and gifts or contributions from public or private sources for purposes of developing regulations (McElfish., Bernstein, Bass, Sheldon, 1996).

4.3.2 – California

Departments and Regulations

The Water Quality Control Boards primarily administer water quality and mine waste aspects through a permitting program. Reclamation on the other hand is overseen at the county or local government level. Regulation of discharges to land is covered under California's Porter-Cologne Water Quality Act, while reclamation requirements are covered under the state's Surface Mining and Reclamation Act (SMARA). The California Department of Conservation and its director conduct oversight for SMARA. The Office of Mine Reclamation provides technical support to operators for reporting and for developing and implementing reclamation plans. Mine operators usually first obtain a local or county use permit incorporating SMARA reclamation requirements. Mine operators must also apply to the Regional Water Quality Control Board (RWQCB) to cover "waste discharge requirements" which govern the discharge of mining waste to

land. Other permits may also be required. (McElfish., Bernstein, Bass, Sheldon, 1996)

Application Information

Mine operators must provide extensive information with their application. First they must submit a Report of Waste Discharge to the RWQCB before engaging in any discharge of mining waste to the land. The board will specify the discharge limits and other requirements. This report must contain information on "waste characteristics, geologic and climatologic characteristics of the surrounding area, installed features, operation plans for waste containment, precipitation and drainage controls, and closure and post closure maintenance plans." Mine operators must also submit a report that includes test results to assess hazard and toxicity of the waste and its potential to cause pollution. Operators are required to use the California Waste Extraction Test (WET) to determine this (McElfish., Bernstein, Bass, Sheldon, 1996).

Process and Procedures

State law declares that the Report of Waste Discharge must be submitted at least one hundred and twenty days before any discharge, however reports are often submitted and approved in a shorter time period. After reviewing the report and determining its completeness, the RWQCB issues draft "waste discharge requirements", which prescribe the design, construction, and operation of the waste units, the monitoring program, financial assurances, and closure and post closure. The board must provide public notice, which may require public hearing prior to issuing the final waste discharge requirements. Based on the public's comments and the information in the reports, the board votes on issuance at its regularly scheduled public meetings.

Reclamation

The county planning board, which has jurisdiction over the mining operation serves as the lead agency under SMARA. The planning board administers its own land use plan, laws, and regulations, which must be consistent with SMARA and the mineral policies set forth by the State Mining and Geology Board. SMARA regulates surface quarry operations of various types including open pit mining and quarrying, however it does not apply to prospecting or mining if the disturbed area is one acre or less and the amount of overburden is less than one thousand cubic yards. SMARA requires operators to submit an application for permit, a reclamation plan, and financial assurances for review by the planning board. The reclamation plan must include the name and address of the operator, the proposed dates of initiation and termination of the operations, the size and legal description of the mining area, the maximum depth of the operation, description of the general and specific geology of the area including the location of roads, streams and rivers, and facilities in proximity of the area, and the names and addresses of all surface and mineral owners. The plan must describe the mining methods to be used and the earliest possible initiation date for reclamation of land on which quarry operations are completed. The plan must also describe post mining land use and provide evidence that all landowners are notified of the proposed use, as well as a description of how reclamation will be accomplished. SMARA also requires that a reclamation plan consider public health and safety based on the current and proposed use of the land,

steepness of slopes, temporary stream diversions, and condition of old equipment. Under SMARA, permit applications are required at least one public hearing. Any project that a state or local agency deems may have a significant environmental impact must be preceded by an environmental impact report (EIR). The EIR applies to quarry operations in order to identify alternative methods to the proposed operations, information on environmental impacts, and feasible mitigation measures.

An operation must have an approved reclamation plan as part of its use permit. In the case that an operation becomes idle, the operator must submit to the planning board or the equivalent local lead agency an interim management plan within ninety days of the operation becoming idle. The purpose of this plan is to specify how the site will be maintained while operations are idle. The plan is effective for no more than five years, after which the lead agency may decide to grant another five years or require that reclamation commences. The planning board or lead agency must review and approve the plan within sixty days. If there are any deficiencies in the plan, the lead agency must notify the operator within thirty days in order to correct the deficiencies, and then approval or denial of the plan will be decided within sixty days after receipt of the revised plan. If an operation is idle for over one year it is considered abandoned and the operator must complete reclamation, unless an interim management plan is pending during that time period.

Under SMARA, financial assurance may be in the form of surety bonds, trust funds, or other forms authorized by regulation except financial tests. Financial assurances must remain in effect for the duration of the surface mining operation and any additional period until reclamation is completed. Like the Porter Cologne Water Quality Act, financial assurances must be adjusted annually to cover newly disturbed areas, reclaimed areas, and the effect of inflation on reclamation costs. All financial assurances must be made payable to the lead agency (usually the planning board) and the department. If an operator is financially incapable of performing reclamation or has abandoned the site without performing reclamation, then the State Mining and Geology Board must notify the operator that it intends to forfeit the financial assurance and gives the operator sixty more days to begin reclamation. If the operator fails to perform within the sixty days, the financial assurance will be forfeited and use the proceeds for reclamation. The operator remains liable for any reclamation costs in excess of the financial assurance amount (McElfish., Bernstein, Bass, Sheldon, 1996).

Monitoring and Enforcement

Under the waste discharge regulations of the state, the RWQCB is responsible for carrying out inspections, which are done by the regular staff of the regional boards at no specific frequency. One example is in the Central Valley Region where about four staff members share permitting and inspection duties for mine waste management units (as well as many other non mine units). SMARA on the other hand requires the lead agency to conduct annual inspections to assure compliance with reclamation plans. Inspections must begin within six months after a mining operation legally declares operating status. The inspections do not necessarily have to be made by a state employee, but may be made by a state registered geologist, civil engineer, landscape architect, or forester, who is experienced in land reclamation. The operator must pay for all inspections. Within

thirty days of completion of the inspection, the lead agency must notify the operator, the director, and the department of any violations and submit a copy of the inspection form.

Under the Porter Cologne Water Quality Act, failure to furnish a discharge report or pay fees is a misdemeanor civilly punishable by the regional board by administrative civil penalty of up to one thousand dollars per day of violation, and in court for up to five thousand dollars per day of violation. If the violation involves hazardous waste and a knowing failure to provide information or to file, the amounts are five thousand and twenty five thousand dollars per day respectively. If the violations are those concerning waste discharge then the amount of penalties that result may be up to five thousand dollars per day administratively, and fifteen thousand dollars per day judicially. If waste cannot be recovered or cleaned up, administrative charges of up to ten dollars per gallon of waste or civil charges of up to twenty dollars per gallon may be imposed. However, if the violation is of an order of the regional board but there is no discharge, the administrative penalty is then limited to a maximum of one thousand dollars per day, but no less than one hundred dollars per day. The civil judicial penalty in this case can be up to ten thousand dollars (McElfish., Bernstein, Bass, Sheldon, 1996).

Funding

The state's water quality programs continue to be funded primarily out of the state's general fund. Fees, charges, and federal grants provide no more than forty percent of water quality funding. Funding for SMARA comes primarily from fees at the county level, but the additional funding supports the state program. Funds are made available to SMARA by appropriation. For example, the first two million dollars that California received from the United States as the state's share of proceeds from the federal Mineral Leasing Act (MLA) is dedicated to implementation of SMARA. However, if the total MLA funds to California are under twenty million dollars, then only the first one million and one hundred thousand dollars is dedicated to SMARA. Penalties collected by the director are also used in implementing SMARA. In 1990, a Mine Reclamation Account was created in which all filing fees for quarry operations were deposited into. The law specifies that the fee for any mining operation may not exceed two thousand dollars, and may not be less than fifty dollars (McElfish., Bernstein, Bass, Sheldon, 1996).

4.3.3 - Puerto Rico

Departments and Regulations

The Planning Board, Environmental Quality Board (EQB), and the Department of Natural and Environmental Resources (DNER) are the three primary regulatory agencies responsible for the governing of quarry operations in Puerto Rico. The Planning Board, established in 1942, is responsible for creating land-use plans that specify how the land should be used, both during and post mining/ industrial activities, to ensure the conservation and protection of natural resources. The EQB is mainly responsible for the protection and conservation of the environment through the enforcement of various environmental laws and regulations. Regulations are made in the form of an environmental declaration and they pass through the EQB, followed by the Department

of the State. Generally, all mining and construction projects are required to submit an Environmental Impact Statement (EIS) as well as an Environmental Assessment form (EA) to the EQB for the purpose of determining the impact of these projects on the surrounding environment and its resources. The EIS and EA form are the basis on which the EQB makes recommendations regarding the use of the land, as well as the issuing or denial of permits. The Department of Natural and Environmental Resources is the main body governing activities of extraction, excavation, and removal and dredging of components of the earth's crust such as stone, gravel, sand, and other minerals. The DNER primarily administers these activities through the Sand, Gravel, and Stone Act (Act No. 144 of June 3 1976) that entitles jurisdiction of said administrative responsibilities to the Secretary of the DNER. Except for the adoption of regulations, the Secretary may delegate the powers vested in him/her to any officer or employee acting under his/her jurisdiction.

Application Information

Basically, any individual, association, or organization must obtain a permit from the Secretary of the DNER in order to excavate, extract, or remove the components of the earth's crust in public or private lands. Every applicant must submit an Environmental Assessment from or an Environmental Impact Statement before being granted a permit. Permit application requirements differ depending on the different extraction types such as private property extractions, river extractions, underground extractions, and water table extractions. Other information that is usually required in an application includes: a 1:20,000 scale aerial shot of the proposed extraction site as well as a topographic map of the extraction area, $250 payment for the permit application, and licenses from the police department in the case explosives will be used. If the applicant is not the owner of the property on which extraction will take place, then the applicant must have a letter from the legal owner giving approval of extraction operations. If the extraction operations are to be done by a corporation, then the corporation must include in the application the names and titles of all the representatives of the corporation. The applicant must also detail the proposed methods of extraction and the type of material to be extracted. Applicants may propose their own methods of extraction, which the DNER will review and make any suggestions, additions, or changes it feels necessary.

Process and Procedures

The length of a permit shall not exceed one year unless the magnitude of the investment required to make the permit feasible or effective may be granted a length of up to three years. In the case of sand and gravel extractions, permits shall not exceed a period of one year. By law, permit applications must be completely processed within 90 days. However, application-processing time usually takes from 6 months to a year. Generally, an application first passes through the EQB in order to assess - by means of the EIS and EA - the environmental impacts that the proposed extraction operations may cause. Then the application, along with the EQB's added recommendations, is passed on to the Planning Board to determine the appropriate land-use plan based on the recommendations and application information.

Prior to issuing a new permit or renewing one, the Secretary shall notify the

public of the permit applications usually by announcing it in the local newspaper, or by any means established by regulation. The Secretary shall hold public hearings in the case that any objections or controversies arise in regards to any application. Within 90 days of submitting the case after the hearing, the Secretary must state in writing his/her decision regarding the application, a copy of which each member involved in the proceeding is entitled to. Any individual affected by the activities or actions authorized by the permit has the right to request the Secretary to order an investigation in order to determine whether said actions have caused harm or disturbance to the community or the environment.

Reclamation

Restoration of the areas affected by extraction operations is administered primarily through the DNER and the Planning Board. The latter creates the land-use plans described previously, while the former specifies the methods for restoring and maintaining the topsoil, vegetation, and general geology of the area. Restoration procedures are supposed to be implemented concurrently with extraction operations. Larger extraction sites - usually ones that are 25 acres or more - may be exempt from this rule because extraction usually lasts at least 25 years before the site is exhausted of its resources. In such cases restoration commences when all extraction operations are terminated or the site is exhausted of its resources. Performance bonds are required in order to ensure financial assurance for site restoration. The Secretary consigns a bond on every issued permit. The amount of the bond is determined by considering the cost of the extraction operation adjusted to the inflationary level in effect at the time the permit is granted or renewed, plus the cost of restoration of the area.

Monitoring and Enforcement

The DNER has 4 technicians that are responsible for processing permit applications as well as carrying out random site inspections. The EQB has 2 technicians responsible for processing forms as well, however they are not involved in any field work or site inspections. In addition to the technicians, the DNER has "vigilantes" or environmental officers that carry out inspections of extraction sites regularly. Unlike the technicians, "vigilantes" are not environmental or geological specialists so they are not as competent at inspections as technicians are. If any deficiencies or regulatory problems that may be violations as defined by the Sand, Gravel, and Stone Act found at an extraction operation, then the operation may be given up to 10 days to correct any problems. The Secretary may impose administrative fines and penalties not exceeding $50,000 for violations of the Act.

Funding

All the money received by the Secretary in complying with his task shall be covered into a Special Fund titled "Special Fund in favor of the Department of Natural and Environmental Resources". This fund is to be used by the Secretary for such functions, proceedings, activities, or administrative acts as are connected with the accomplishment of the purposes and regulations of the Sand, Gravel, and Stone Act. The monies that are received by the Secretary are mainly from fines and application and

processing fees. The main source of funding for the DNER, EQB, and Planning Board is the State General fund.

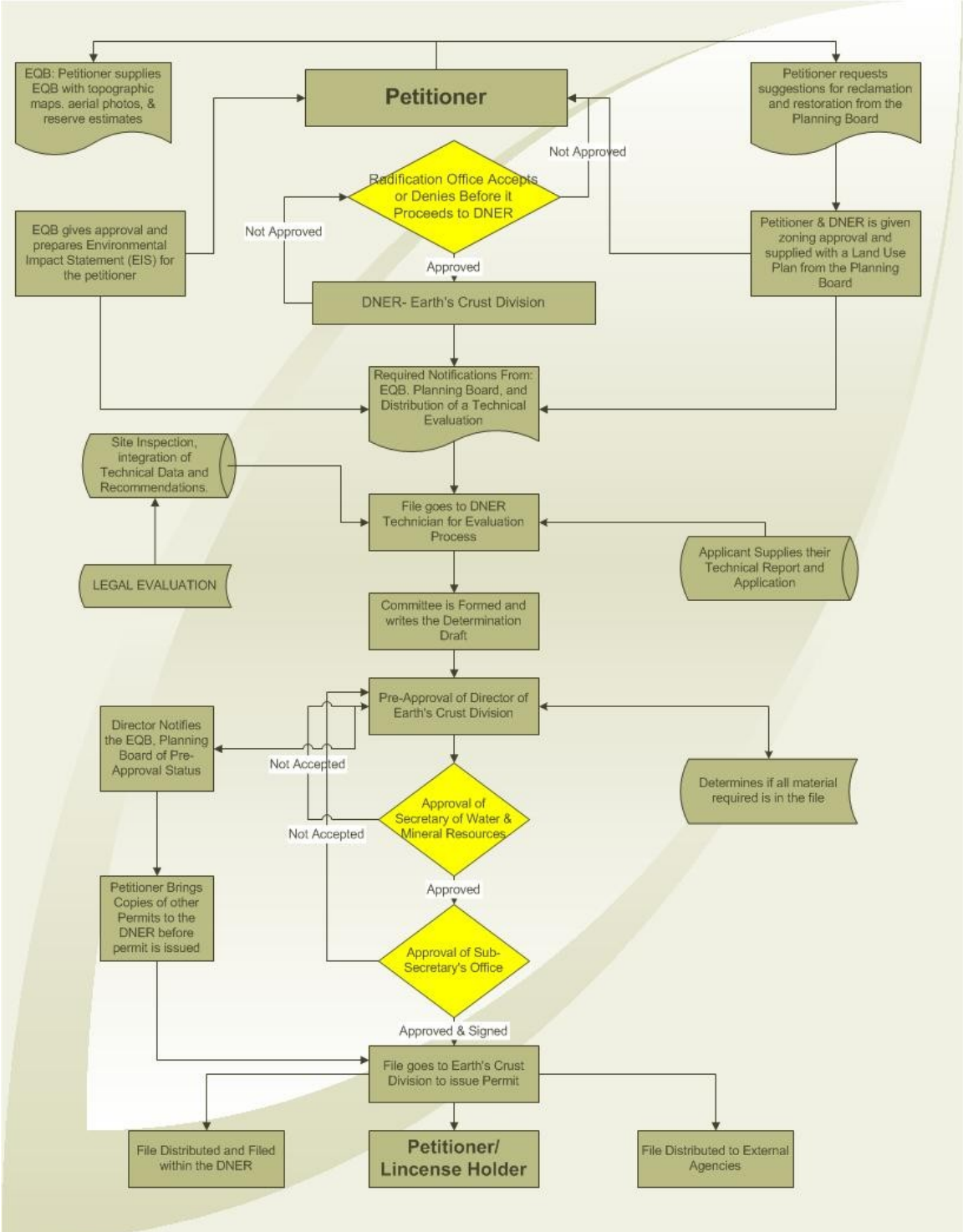

Figure 4.4 The above diagram explains the process for the approval of an extraction permit. A petitioner must first request an EIS from the EQB and suggestions for restoration from the Planning Board. This information is then supplied to DNER for the examination of technicians, Director of the Earth's Crust Division, Sub-Secretary, and Secretary for the approval an extraction permit.

4.3.4 – Analysis of Case Studies

The purpose of the following table is to present the main comparative aspects of the three permit processes in order to make the main aspects easily discernable to the reader. Once again the main points are categorized according to the six main sections described previously.

	Arizona	California	Puerto Rico
Departments and Regulations	• ADEQ administers environmental laws and regulations • Aquifer Protection Permit program • Facilities that discharge must obtain an APP • Requires substantial technical review of mining technologies	• RWQCB covers waste discharge requirements • Surface Mining and Reclamation Act covers reclamation requirements	• Permit applicants must submit an EIS or EA to the EQB • Sand, Gravel, and Stone Act administered by the DNER • Land-use plans and zoning covered by the Planning Board • Restoration overseen by DNER
Application Information	• Extensive application information • Requires BADCT in order to achieve the greatest level of discharge reduction	• Extensive Information • Mine operators requires to use WET to determine toxicity and hazard level of discharge waste • Operation discharges that may affect the quality of water must submit a Report on Waste Discharge to the Regional Quality Control Board	• Extensive information • DNER proposes methods of extraction • Mine operators required to submit EIS and EA • No technical review of mining technologies • No test for toxicity levels
Process and Procedures	• Typical operation length of permit 3 years • ADEQ has compiled and published a list of facilities required to obtain an APP including deadlines for submittals • Applicants may submit proposal explaining how to meet informational requirements	• Report of Waste Discharge must be submitted 120 days before discharge begins - usually approved in shorter period of time • RWQCB issues waste discharge requirements including operation, design, and construction of waste units, monitoring, and	• Permit length can not exceed 3 years - 1 year for sand and gravel extractions • Law requires permit applications to be completed within 90 days - usually takes 6 to 12 months • Typical Permit application flow: EQB → Planning Board → DNER • DNER Secretary must

	• ADEQ reviews proposals and returns them within 30 days notifying applicant of missing information • Director prepares public notice once application is complete	restoration • RWQCB must provide public notice	provide public notice • No published list of quarries or operations on the island • No tracking of number of renewal vs. new permits
Reclamation	• Mined Land Reclamation Act 1994 • Reclamation done concurrently or initiated 2 years after quarry operations completed • Must file financial assurance mechanism with minimum of $2000 per acre of disturbance with director 60 days after reclamation plan approved • Director decides on amount of financial assurance within 30 days of receipt	• The planning board under SMARA administers its own land use plans, laws, and regulations • Financial assurances reviewed by planning board • SMARA does not apply to operations of one acre or less, or if overburden < 1000 cubic yards • Reclamation plan requires extensive information: post mining land use, notification of landowners of proposed use, earliest reclamation date, public safety measures and condition of old equipment • 30 days to notify operator of deficiencies in plan - approval/denial within 60 days of receipt • Interim management plan for idle operations • Operator has 60 days to begin reclamation after determining financial incapability - if reclamation not done within 60 days operator held liable for any reclamation costs	• No reclamation act • Restoration administered by DNER - land-use plans done by Planning Board • Reclamation done concurrently unless operation very large • Performance bonds used for financial assurance • Secretary determines amount of bond • Usually minimum bond is approximately $50000 per every 5 acres • Planning Board and DNER require extensive information to process land-use plans and restoration procedures • No review or measure of old equipment • No Interim management plan • Restoration must commence within 60 days of an operation becoming idle - often takes up to 120 days

Monitoring and Enforcement	• Civil penalty violation of reclamation plan $1000 per day of violation - not to exceed $15000 • Violations of any water quality law or APP rule up to $25000 per day of violation • Non-compliance subject to civil penalty of no more than $5000 per day.	• Central Valley Region four staff members share permitting and inspection duties • SMARA requires the lead agency (planning board) to conduct annual inspections to assure compliance with reclamation plans. • Inspections must begin within 6 months of operation start • Inspections made specialist experienced in land reclamation. • The operator must pay for all inspections. • Civil penalty of $1000 per day of violation for not paying fees or submitting discharge report - $5000 per day in court • $25000 per day if failure to file report hazardous waste violation • Violations of waste discharge $5000 per day administratively - $15000 per day judicially • Specific measures for fees regarding waste that can not be cleaned up	• DNER 4 technicians responsible for application processing and inspections • EQB 2 technicians for application processing - no inspections • DNER environmental officers/"vigilantes" do most inspection work • "Vigilantes" not specialized or experienced in environmental or reclamation issues • operators given 10 days to correct deficiencies in operation • maximum fine amount of $50000 • Typical fine amount $5000
Funding	• Monies collected under MLRA placed in Arizona General Fund • Civil penalties deposited in Water Quality Assurance Fund • Permit fees directed	• Water quality programs funded from State General Fund • 40% of water quality programs funding from charges, fees, and federal grants • SMARA funding	• State General Fund main source of funding for EQB, Planning Board, and DNER • "Special Fund in favor of the Department of Natural and Environmental Resources" - to be

	to State General Fund - Main source of funds • Legislation requires $500,000 of the State Water Quality Assurance Revolving Fund (SWQARF) spent for increasing APP staff levels and training of 10 additional full-time employee positions • SWQARF fronts costs to prevent, minimize, mitigate damage to public health and environment • Funding for SWQARF from legislature, civil - criminal penalties, remedial action costs	mainly from fees and penalties • Mine Reclamation Account established to deposit all filing fees for quarry operations • SMARA funded by appropriation	used by Secretary for improving activities, procedures, and administrative tasks of DNER • Secretary receives monies from application fees and penalties

Table 4.5 This table compares the different permitting methods used in Arizona, California and Puerto Rico.

From this table we can deduce the main points that need to be addressed in order to improve Puerto Rico's permit process. One of the things that would be useful to implement in the process would be a standard or method to constantly review the technologies used in quarry operations in order to minimize waste discharge. The BADCT is one example of such a revision standard. Currently, the DNER requires that permit applicants include a description of the technology and methods used for extraction. However, there is no standard requiring a certain type of technology or process be included in operations, as well as no method to review equipment used at extraction operations. It would also be beneficial to implement a standard test such as the WET that is used in California for determining the hazard level of waste discharge.

Another issue with the permit process is that it usually takes a long time to process permit applications, while with California and Arizona the process is much faster. A major factor contributing to this issue is the limited number of technicians working for the DNER and EQB. However, in California's Central Valley Region, only four staff members share permitting and inspection duties, which suggests that the problem might not necessarily be the limited number of technicians.

One of the main problems that we found with the EQB, Planning Board, and DNER permitting organizations is their lack of funding. The DNER specifically stated that their funding from the State General Fund is being cut back. Despite the DNER

having a "Special Fund in favor of the Department of Natural and Environmental Resources" which is supposed to be used to improve activities and administrative tasks within the DNER - including the hiring and training of more staff - the organizations still suffers from a lack of technicians and specialists to perform inspections and application processing.

4.4 – Summary

This chapter has presented the arguments of the four major organizations associated with this project: The DTOP, AIPA, DNER and environmentalists. The purpose of detailing the different arguments is to discern and analyze the main issues that the organizations are concerned with. First, we presented the main issues as a result of the data collection from our first research question: how a longer quarry permit would affect each of the organizations and the environment. Then we analyzed the main issues in order to determine the points that the organizations agree and disagree on.

The final section of our Data and Analysis, the case study, details the various aspects of three different permit processes. The purpose of the case study is to compare Puerto Rico's permit process to that of Arizona and California with the intention of making the main comparative aspect easily discernible. From our comparison we can make recommendations as to what aspects should be improved or implemented in Puerto Rico's permit process.

Chapter 5: Recommendations & Conclusions

5.0 - Introduction

The previous sections have provided information regarding certain environmental aspects of the aggregate industry. We have looked into how each organization operates according to current permits and analyzed how a longer permit would affect each organization and the environment. It is evident there are certain flaws within the permitting process and enforcement of environmental regulations. In this section we discuss several recommendations that the DNER and AIPA could possibly implement to reduce the perceived environmental impacts of quarrying and improve the permitting process.

We were able to discern the main concerns of the various organizations by analyzing their perspectives, which we believe are related to some aspects of the permit process. From our case study, we were able to pin-point the main issues of the permit process that we believe need to be addressed in order to alleviate some of the organizations' concerns. The purpose of this section is to make recommendations to address the mentioned main issues and concerns.

The recommendations are listed in order of importance of implementation. The first category of recommendations, Compliance with Environmental Guidelines, we believe is the most important because by solving the DNER's problem of a lack of funding, many of the other funding related problems could be solved. With more funds, the DNER can train and hire more technicians, which in turn would speed up permit application processing as well as result in more quarry inspections. The recommendations that we have made under Time Reduction are the second most important. The DNER lacks a lot of important information which could greatly facilitate its functions. Some examples of this are information on which permits are issued as renewals versus first time permits, whether environmental violations were a result of equipment or process, and a list of quarries with their exact locations on the Island and their proximity to neighboring communities. Implementing a database system would help the DNER keep track of pertinent information as well as facilitate and expedite communication and information sharing with the EQB and the Planning Board. Improving the DNER's administrative processes would improve their various functions such as application processing and quarry inspections.

The third category of recommendations, Improving Environmental Performance, is the third most important because in order to minimize harmful environmental impacts from quarry operations, quarry owners must utilize the proper equipment and processes. This in turn could lead to improving relations with neighboring communities because many of these environmental impacts can be harmful to these communities. In the case of Cost Reduction, we can not make any specific recommendations because we believe that the cost of permit applications is not an issue and that costs may increase because the DNER would require more detailed and accurate hydrological/geological assessments, topographic maps, site surveys, land-use plans, etc.

5.1 – Compliance with Environmental Guidelines

According to the DNER, environmentalists and even some AIPA members, most environmental violations occur because there is a lack of monitoring over quarry operations. As mentioned in the data and analysis section, the DNER is understaffed, which makes it difficult to regulate quarries and their procedures. This section recommends possible solutions pertaining to regulatory actions.

5.1.1 - Increase fines

It has been clearly stated that the DNER is unable to receive sufficient funds to appropriately enforce its regulations. They have solicited legislature for more funds, but instead, the DNER has been presented with budget cuts. A feasible alternative **would be to increase the fines for violations of agency regulations**. This procedure would do two things: first, it would increase the funds the DNER would have to work with, and second, it would force quarry owners to follow regulations more closely. To avoid paying costly fines, quarries would undoubtedly have to operate according to reclamation plans, operate within zoning restrictions, and implement more preventative sedimentation and pollution controlling systems.

5.1.2 - Train and Hire Technicians

Currently, the DNER has only four technicians and a handful of well-trained vigilantes with the responsibility of monitoring and evaluating 128 different quarries in Puerto Rico. With this lack of personnel, certain quarries are able to operate either illegally or in violation of many DNER regulations. If fines were to increase, the DNER could afford to employ more technicians or train more vigilantes. **An increase in the number of qualified personnel would create a more stable and reliable system for monitoring and evaluating quarries**. If quarries are strictly monitored, it would force quarry owners to follow environmental guidelines more stringently.

5.1.3 - Random Quarry Visits

Technicians currently visit quarry sites on a routine basis**.** We have been told that it is likely quarry owners clean up problems prior to the technicians visit. **If these technicians were to visit unannounced, quarry owners would not have the chance to clean up their site**. Essentially, this would also require quarry owners to follow the environmental guidelines at all times, not just when scheduled appointments are made.

5.2 – Time Reduction

Members from both the AIPA and the DNER agree that the current permitting process is complicated and unorganized. Numerous technical reports and applications must be submitted to the DNER, Planning Board, and the EQB every one to three years.

From our analysis, we have determined that there is a lack of space, equipment and personnel for all three of these organizations, which mean incoming permit proposals, now clutter the desks of many technicians. In order for an extraction permit to be granted, information must be requested from other government organizations. These requests may take weeks to fulfill because each government agency has the same limited space and organizational problems.

Because the process of preparing a permit proposal and waiting for its approval can take up to a year to complete, AIPA members believe there should be a restructuring of the approval process. They suggest either lengthening the permit or reducing the technical reports required for a permit, so it would allow them to focus more time on quarry operations and less on renewing permits.

Since time is one of the main concerns for the three agencies and the AIPA, we make the following recommendations that can help reduce the time spent on the approval process.

5.2.1 – Coordinated Permit Organization

Currently, permit applications must be approved by three different organizations: the Planning Board, EQB and the DNER. Each organization must approve their section of the extraction permit before passing it on. Permit proposals are examined by many individuals, some of which are not trained or knowledgeable on certain aspects of the proposals and may believe vital information is missing. In this case, they must request additional information from other organizations to justify for the missing data. This creates a bullwhip effect in the entire permitting process, which translates into major time delays.

Our recommendation is to **create a single permit organization by unifying each of the three agencies into one**. This would eliminate the circulation of documents from organization to organization. A centralized permitting office should have trained technicians educated in all fields pertaining to quarry permits. For instance, technicians knowledgeable in water withdrawals would review and approve water use permits; whereas those qualified in soil mechanics would do the same for earth extraction permits.

5.2.2 - Electronic Database System

It is evident from our data and analysis that the permit issuing agencies face similar problems. One problem has to do with how they store permit proposals. After visiting and requesting data, we have noticed that many documents stored at their offices are kept in notebooks and a system of file cabinets, making them hard to access and find. The other problem is that information requested from other organizations can take weeks to obtain. The information we requested took two weeks to receive.

To provide simple solutions to these problems, we recommend that **the DNER and other permit issuers should implement an electronic database system such as Oracle or Microsoft Access within its organization**. We believe this system should be compatible with similar systems within other permit issuer organizations. In this case, information requested from each organization can easily be transferred via an electronic

network. An information system like this can save time transferring and searching for files, plus reduce the storage space needed for such material. Oracle and other database systems have been implemented within many businesses and government organizations and have been known to reduce the processing time for their procedures. We believe that the same will be true for the DNER and the permit approval process.

5.2.3 – Determination of Permit Length

Ever since the DNER was first established in 1968, quarry owners have always been issued one to three year extraction permits. From our data analysis, we have learned that the DNER and AIPA believe that a longer permit may reduce the number of proposals permit issuers must evaluate each year. A longer permit for smaller quarries, however, is not in the best interest of environmentalists because they believe smaller operations are the ones responsible for the majority of environmental impacts.

Looking at our data and analysis, we recommend that **the length of extraction permits be based on the size of the reserve and not restricted to a fixed number of years.** In this manner, quarries with larger reserve sizes would be given longer permits, and therefore, would only have to apply for permit renewals every five to ten years. This would reduce the number of permit proposals for the DNER to evaluate each year and in turn, free-up more time for the approval of permits for smaller quarries. Because smaller quarries would have to renew permits more frequently, the DNER would be able to monitor their environmental impacts more closely. This plan, as some would say, "kills two birds with one stone" because it reduces the time for approving an extraction permit and allows the DNER to maintain control over the environmental impacts caused by smaller quarries.

5.3 - Improved Environmental Performance

The environmental impacts caused by quarry operations are the largest concerns of the DNER and environmentalists. The AIPA members we interviewed believe their operations caused little environmental impact to the surrounding area because most utilize new-age crushers, screeners and washers. However, most aggregate operations including AIPA members have not implemented the necessary equipment or techniques that we recommend in this section. These techniques and equipment have also been suggested by national mining organizations as appropriate ways to reduce environmental impacts. The DNER and environmentalists agree if a longer permit is issued, quarries should be required to implement new methods and equipment to reduce the environmental effects of quarrying. AIPA members said if a longer permit is issued, then they will purchase new equipment. In the following sections, **we recommend equipment and techniques to the AIPA that will reduce dust emissions, water withdrawals, decrease the amount of erosion and sedimentation, and reduce noise levels.**

5.3.1 - Dust Controlling Methods

Environmentalists, such as Soriano, have explained to us that dust particles created from quarrying operations in Puerto Rico have destroyed many forested and agricultural areas. AIPA members said that spraying down stockpiles with water was the only dust controlling methods currently used throughout the Island. Proper dust controlling equipment, they argue is expensive and current permits do not make it feasible to obtain the loans for purchase of this equipment. We, including the AIPA, DNER and environmentalists believe a longer permit will give quarries the opportunity to obtain larger bank loans and purchase appropriate equipment to reduce environmental impacts. Since dust emission is the primary concern for the DNER and environmentalists, we recommend two types of systems to be utilized.

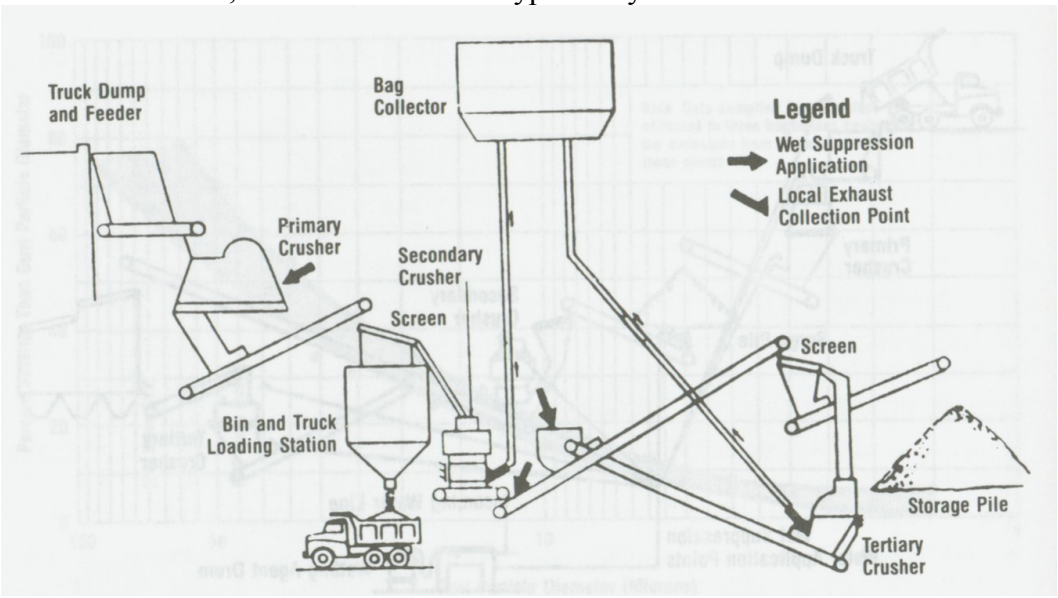

Figure 5.1 Diagram shows how plant dust emissions can be controlled by "wet suppression" and dust collection systems. The arrows show the appropriate places in the production process for either a "wet suppression" system or a dust collector. Sprayers and hoses can be attached to crushers and conveyors to limit dust emissions at those stages. Exhaust fans can also be attached to crushers and screeners to vacuum particles to a collection area (National Stone Association, 1991).

Shown in the above diagrams are a "wet suppression" system and a dry-hood collection system. The "wet suppression" system confines the dust within the dust producing areas by a curtain of moisture. This type of dust controlling system is particularly suitable for pit and quarry processing plants using large crushers, open screeners and conveyor belts. The dry-hood collection system uses a large exhaust system consisting of hoods, ducts, fans and baghouse collection equipment. Each area that emits large amounts of dust is hooded so that a large flow of dust can be moved across the plant through the ducts and into the baghouse. This is where the dust is filtered into large bags and can be later sold as byproduct of quarrying.

5.3.2 - Erosion and Sedimentation Control

Sedimentation is a large problem in Puerto Rico mainly because quarry operations are setup near water bodies. We were told by Rosario and Soriano that the main reason for the sedimentation problem is because most quarries lack a drainage system. Of the AIPA quarries we visited, each utilized some sort of a drainage system. Casanova believed building a system like the one we recommend does not require the funds offered by a longer permit. Constructing a drainage system would easily reduce any sedimentation problems and at the same time be inexpensive to build. Therefore, we recommend quarries that wish to increase their potential obtaining a longer permit to implement a similar sedimentation and erosion control system as mentioned below.

Figure 5.2 This picture shows how the use of a storm channel can be used to control the flow of wastewater and runoff . The gravel drainage ditch shown at the left is one example of a common storm channel (National Stone Association, 1991).

The proper use of the following erosion control techniques can effectively reduce environmental problems as well as complaints raised by neighboring communities. To ensure that the drainage control system works well, the quarry must fit the development and future excavations to the natural contours of the site. Any extractions at the site may dramatically change the topography of the land, so storm diversion systems should be in place. Storm diversion systems comprise of dikes and drainage ditches that intercept runoff from around the perimeter of the extraction site and leads to a collection pond. Excessive erosion of topsoil can be controlled by preserving natural vegetation where possible, covering the grounds with mulch, and planting trees and other strong rooted vegetation. For best results, inspections of the drainage and vegetation systems should occur frequently.

5.3.3 - Water Recycling

A significant amount of the water supply in Puerto Rico is being withdrawn by industrial and quarrying activities. Pollution of water bodies is also a big problem because it is slowly deteriorating natural aquifers and aquatic ecosystems. To reduce the environmental impacts of quarrying, a water recycling system can be introduced. This system can reduce the amount of water withdrawn from any water well each year. In the recycling system, wastewater and storm runoff is routed to one or more collection ponds by storm water diversion channels. Shown below is an example of one of these filtration systems.

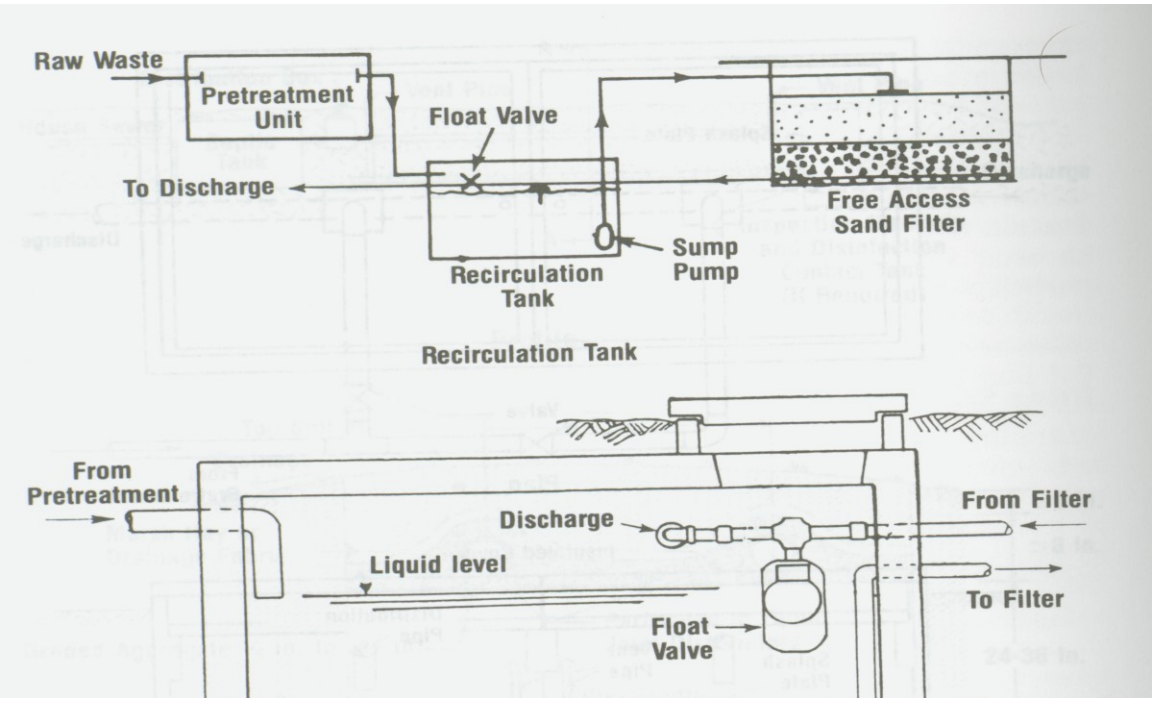

Figure 5.3 Diagram shows how the water filtration systems clean wastewater through a pretreatment unit, circulation tank, and filtration tank. Wastewater is first pumped into the system and pretreated with a cleansing solution. Next, the water is moved to circulation tanks where much of the heavy solids are removed. Finally, it is moved to the filter to remove micron size matter and then pumped back into production (National Stone Association, 1991).

The filtration removes any suspended solids within the water followed by a disinfecting phase so that the water can either be discharged back into the watershed safely or reused in the production process. Solids that are filtered from the water are either discharged into a slurry pond or sold as a byproduct.

5.3.4 - Noise Control/ Site Beautification

The AIPA realizes that noise pollution as well as the appearance of quarries tends to be one of the largest complaints among neighboring communities. Many of the smaller quarries in Puerto Rico, especially in the northern regions, can easily be seen and heard from neighboring houses and adjacent roadways. The diagram and picture below show how quarries can overcome these complaints by reducing noise levels and improving the appearance of the quarry. To reduce the noise levels, we suggest using a double row of thick fauna or large wooden sound barriers encompassing the quarry site. These same systems have been known to work well for reducing the noise and appearance of highways in many of the States. The entrance to the quarry can also be landscaped with tall trees and flowers to hide quarrying operations and give a warm impression to the local community.

Figure 5.4 Site beautification and noise reduction can be achieved by planting tall shrubs or trees around the quarry site. The entrance way above is decorated with a flowerbed and decorative sign. It is believe these techniques can help improve a quarry's image within the community (National Stone Association, 1991).

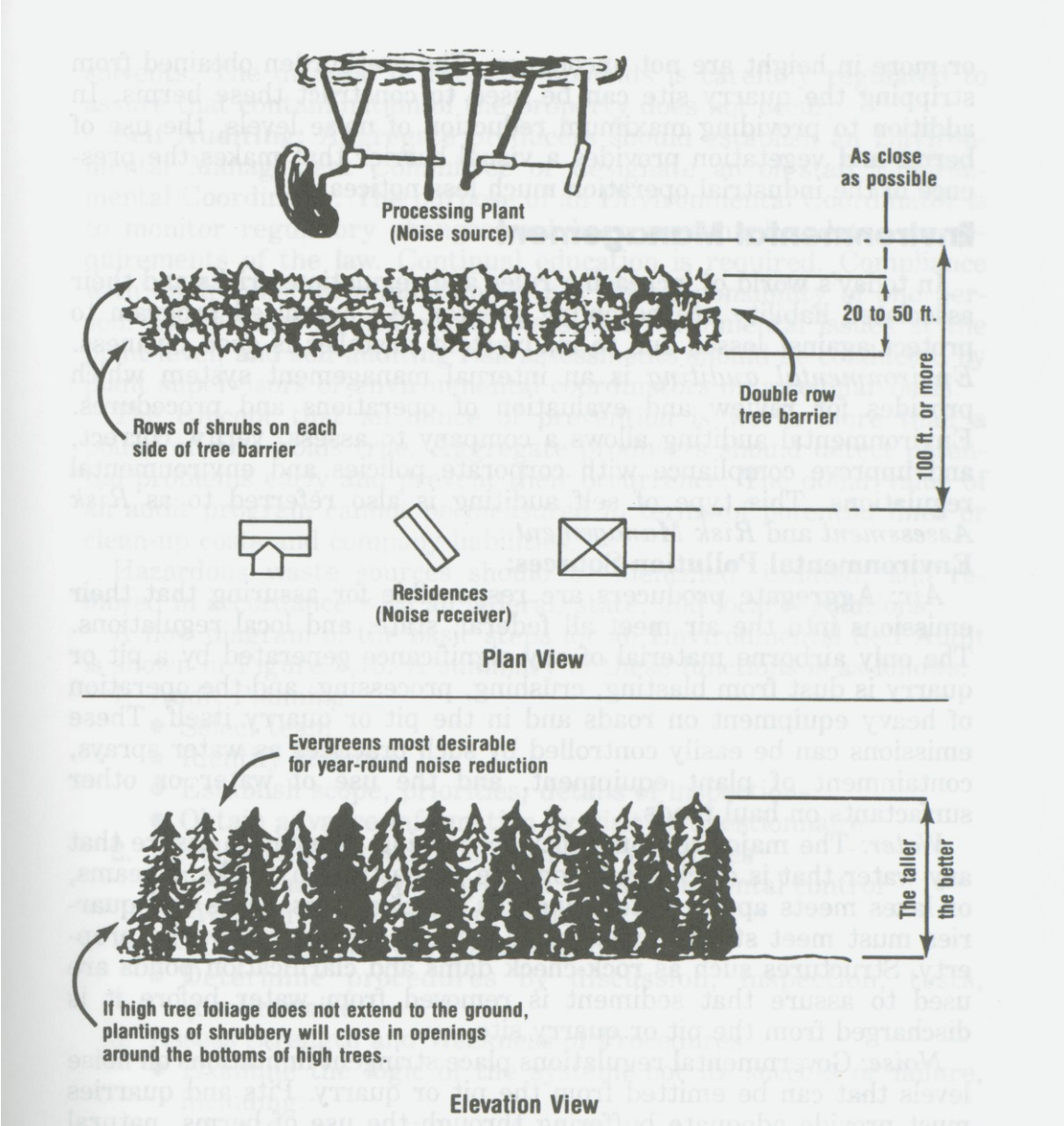

Figure 5.5 The top of this diagram represents a quarry site and below that a barrier of thick fauna to protect the nearby houses from noise caused by quarry operation. The lower part of the diagram explains how taller trees are better for noise reduction (National Stone Association, 1991).

The cost of some of these techniques is minimal. Others, like the implementation of dust control systems and water recycling systems may only be possible through more funding brought by a longer permit. If the AIPA implements these, we believe that environmental impacts will be reduced and community relations improved.

5.4 – Improving Community Relations

In order for quarries and communities to be "friendly neighbors", both must learn to communicate, negotiate and compromise, which is something rarely practiced with today's permits. Many quarry operations are disliked by local communities because in general they have a bad reputation. We have found, however, there are quarries within Puerto Rico that have excellent reputations because they give back to the communities. These same operations have implemented preventative measures to protect the community from environmental impacts and other common disturbances such as noise. Below we suggest methods that quarries in Puerto Rico can implement to improve its acceptance within the local communities.

5.4.1 – Public Service Events

One way in which **quarries can improve neighborly relations is by hosting public service events**. These events may inform the community of the activities that take place at the quarry site. Educating the public on the different processes and preventative measures entailed in aggregate production is a key aspect of these information sessions. These special events do not necessarily have to be limited to information sessions, but also sponsored dinners, site field trips for children and food drives. These same techniques have been used by Ivan Casanova and have shown excellent results.

5.4.2 – Upgrading Technology

A key concern of environmentalists pertains to the technology status of Puerto Rico's quarries. They believe much of the equipment used in the Island's aggregate industry does not make best use of natural resources. In addition, they argue that very few quarries invest in equipment specialized for the prevention of environmental impacts, like the pollution of water supplies and the release of dust emissions. AIPA members believe a longer permit will give them the opportunity to purchase environmental friendly equipment. We agree with the environmentalists that quarry owners need to make it a priority to invest in such technology in order to strengthen community relations. In the previous section we recommended techniques and equipment quarry owners can implement in order to reduce the environmental impacts of quarrying.

5.5 – Cost Reduction

Our analysis explains that the AIPA believes a longer permit would mean the gathering of scientific data/studies for renewal purposes would only need to be produced when permits expire. However, the DNER uses these studies to ensure that environmental regulations are being followed. If quarries were given a longer permit, the DNER and environmentalists would still expect these scientific studies to be conducted on a frequent basis.

Based on our data analysis, we believe **it is not possible for a longer permit to**

allow the AIPA to reduce its costs with respect to the collection and preparation of appropriate scientific data. We agree with the DNER and environmentalists that in order to ensure compliance of environmental regulations the appropriate environmental studies should be conducted and submitted on a frequent basis.

5.6 – Summary

This chapter has outlined multiple recommendations that could be beneficial to the AIPA, DNER and the environment. We suggested ways of improving the permit process by unifying organizations that issue permits, creating an electronic database, and basing the permit length on reserve size. We determined that monitoring quarries was a major issue for the DNER, which we recommend increasing fines for violators, training and hiring more technicians, and performing random quarry visits. To reduce the environmental impacts associated with quarrying operations we recommend the use of dust controlling systems, sedimentation and erosion control techniques, water recycling systems, and noise control techniques. Each of these recommendations could have a positive effect on both the environment and the permitting process.

Appendix

Appendix A1 – Ivan Casanova Interview Questionnaire

Aggregate Industry Producers Association (AIPA)
Ivan & Fernando Casanova
President and Lawyer for the AIPA
(787) 798-2234
Date: 3/18/03

1.) How long have you been associated with the AIPA?

2.) What are your responsibilities as President of the AIPA?

3.) Could you please explain the purpose and functions of the AIPA?
- Who else do you work with?
- What services do you provide them?
- What percent of the quarry/mine industry do you represent?
- What are the benefits of being represented by the AIPA?
- What role do you play in the quarry permitting process?

4.) Could you explain the quarry permitting process?
- How do you feel about the current process?
  - Does it adversely affect production?
- What are some common problems when applying for a permit for the first time or for a renewal?
- When assigning time durations for permits, which components (i.e.-size of reserve) should the DNER base their decisions on?
- Are the guidelines posed under these permits feasible to comply with?
  a) Environmental?
  b) Residential?
  c) Economical?

5.) What is your relationship with the government? How do you interact with it?
For example:
- Relationship with DNER and the permitting process
- Relationship with the PRHTA (Buyer/seller relationship)

6.) Are there any aggregate quality standards in PR that production facilities must abide by? If so, what are they?
- Do production facilities in PR produce aggregate that meets these standards?

- We were told that the majority of PR's fine aggregate contains 10-15% powder residue, when in fact, it should not exceed 5%. If this is true, would this not propose a major quality issue?
- Have aggregate buyers expressed an interest in obtaining higher quality aggregate?
- Is the current technology capable of producing higher quality aggregate?
- What can be introduced to improve the quality of PR's aggregate?

7.) What steps are involved with the aggregate production process that take mined/quarried rock and convert it into its final product?
- Are these steps practiced by all aggregate producing facilities on the Island?
- The scrubbing/washing stage is often overlooked in the production of aggregate; have you ever considered including this stage?
- What role does the quarry permitting process have in promoting technological innovation to the aggregate industry?

8.) Do you think the PR aggregate industry would benefit from technological innovation?
- What is the current condition of PR mining technology? How does this stand up to the states or other countries?
- Do you think an amended permitting process could help spur innovation?
    - What factors in particular would need to be satisfied?

9.) Are you aware of any quarry permitting processes in the United States or other countries?
- How does PR's process compare?

10.) What are the environmentalists up to?
- How do they engage the industry?
- What are their main issues with regard to aggregate mining in PR?
- How often do you engage with them?
- Who are they?

11.) Is there anything else you think we should know that we have not touched upon? Should we speak to anyone else?

Appendix A2 - Ivan Casanova Interview Notes

Aggregate Producers Industry (AIPA)
Ivan & Fernando Casanova
President and Lawyer for the AIPA
(787) 798-2234
Date: 3/18/03

- AIPA supplies 90 % of the construction use in PR - represents 32 quarries out of 120 quarries in PR.
- Ivan Casanova - Vice President of Operations, Director of AIPA; owns a quarry which we visited, cement block industry, and housing development company.
- Fernando Casanova - Lawyer for these companies
- Says that he has recently attended seminars in PR where members of the AIPA and DTOP attended. These seminars blamed the problem of road conditions on the poor quality aggregate.
- Ivan believes that there is no case of poor quality aggregate and that his quarry can definitely produce the specs that the DTOP require for road construction.
- He believes that the DTOP purchases poor quality aggregate because they are purchasing the lowest quality aggregate to reduce its costs.
- We brought up the case of the 10-15% contamination of impurities in the fine aggregate; in regards to this he says that his washed fine aggregate only contains 2% of these impurities. This aggregate is, of course, more expensive. Can the DTOP afford this aggregate? This washed aggregate is $14-16 /m^3
- 10-12 quarries wash their aggregates
- The standard for fine aggregates is 33 ASTM, which is what they meet. Ivan provided us with a study that they did on the quality of their aggregates.
- With regards to the washers, Ivan stated that they are not necessary. He once again said that his aggregate is capable of meeting the specs required. He said that quarries in the Southern region of PR can definitely produce quality aggregate without any washing or scrubbing.
- He believes that some quality issues can be directly related to some quarries not properly handling materials. When materials are mishandled some particles or even different grades of materials can be mixed together. This can add extra sediments to aggregate that are unwanted and ruin its quality.
- He also blames some of the poor quality issues on the cement that is used in the concrete mixtures. He says that the quality of the concrete is not good but it does the job.
- Permits- Both believe that a longer permit will in fact allow the industry to have the capability of upgrading its equipment, environmental protection methods, and community relations.
- They want a 5 or 10 yr permit, would desire a 20-25 year permit.

- He blames the smaller quarries in PR that do not operate according to the rules set by the DNER for giving the bad image the environmentalists and neighbors exploit. These operations basically setup operations without going through the permitting process, mine the material as fast as possible, do not follow environmental laws, and disrupt the community. Some of these operations also pay off inspectors and other officials in order to obtain false permits or simply manufacture false permits themselves.
- In order to obtain a permit you must first go the Planning Board and explain exactly how your operations will take place, how you will reclaim the land, what equipment you will have. This must be filed through a government agency under Law 9 sec 4c of Puerto Rico. You must follow all zoning, residential, commercial, etc. laws. Then it goes to the Environmental Quality Board (EQB), who ensures that the quarry is abiding by all rules set by the DNER and issues your permits for your ability for construction. However, the DNER is the last to issue the permit that allows operation. This permit is needed for the quarry to begin mining activities and usually takes the longest to receive. Without this no operations can begin and no equipment can be on site.
- AIPA believes that there is a serious structural problem in the DNER. They gave us an example of how the permitting process has prevented them from operating at a deposit site for the past 2 years. They believe the delay is due to the sec. who issues the permits. Apparently each time the paperwork reaches the sec. there is something wrong with the plans so it is sent back, then returned again not knowing the original problem so it is completely reviewed again. By time the permit is obtain operations from that point on will not make up for the investment in loans that they received from the bank ($200-250K).
- We received a document, which outlines the specific permits required to mine and flow in which they occur. We plan on making a flow chart of this after we get a better understanding of it from Veronica.
- They also believe that there is a serious lack in the funding for the enforcement of the laws set by the DNER (vigilantes corps which is the enforcement of the DNER that protects all the interests of the DNER not just in the mining industry). That is why these smaller operations are allowed to operate for so long. He thinks that if there was a stronger enforcement there would be a better image of the quarry industry and would eliminate the environmental lawbreakers and reduce the worries of the DNER.
- Popular environmentalists groups are usually comprised of the neighbors of the surrounding quarries and usually work at the site.
- Ivan Casanova Quarry Visit (See Pictures)

Appendix B1 - Jesus Burgos Interview Questionnaire

Aggregate Producers Association (AIPA)
Jesus Burgos
secretary for the AIPA
(787) 740-5252
Date: 3/18/03

1.) How long have you been associated with the AIPA?

2.) What are your responsibilities as secretary of the AIPA?

3.) Could you please explain the purpose and functions of the AIPA?
- Who else do you work with?
- What services do you provide them?
- What percent of the quarry industry do you represent?
- What are the benefits of being represented by the AIPA?
- What role do you play in the quarry permitting process?

4.) Could you explain the quarry permitting process?
- How do you feel about the current process?
  - Does it adversely affect production?

a. What are some common problems when applying for a permit for the first time or for a renewal?
b. When assigning time durations for permits, which components (i.e.-size of reserve) should the DNER base their decisions on?
c. Are the guidelines posed under these permits feasible to comply with?
   i. Environmental?
   ii. Residential?
   iii. Economical?

5.) What is your relationship with the government? How do you interact with it?
For example:
a. Relationship with DNER and the permitting process
b. Relationship with the PRHTA (Buyer/seller relationship)

6.) Are there any aggregate quality standards in PR that production facilities must abide by? If so, what are they?
- Do production facilities in PR produce aggregate that meets these standards?

- We were told that the majority of PR's fine aggregate contains 10-15% powder residue, when in fact, it should not exceed 5%. If this is true, would this not propose a major quality issue?
- Have aggregate buyers expressed an interest in obtaining higher quality aggregate?
- Is the current technology capable of producing higher quality aggregate?
- What can be introduced to improve the quality of PR's aggregate?

7.) What steps are involved with the aggregate production process that take mined/quarried rock and convert it into its final product?
- Are these steps practiced by all aggregate producing facilities on the Island?
- The scrubbing/washing stage is often overlooked in the production of aggregate; have you ever considered including this stage?
- What role does the mine permitting process have in promoting technological innovation to the aggregate industry?

8.) Do you think the PR aggregate industry would benefit from technological innovation?
- What is the current condition of PR mining technology? How does this stand up to states or other countries?
- Do you think an amended permitting process could help spur innovation?
    - What factors in particular would need to be satisfied?

9.) Are you aware of any mine permitting processes in the United States or other countries?
    a. How does PR's process compare?

10.) What are the environmentalists up to?
- How do they engage the industry?
- What are their main issues with regard to aggregate mining in PR?
- How often do you engage with them?
- Who are they?

11.) Is there anything else you think we should know that we have not touched upon? Should we speak to anyone else?

Appendix B2 - Jesus Burgos Interview Notes

Aggregate Producers Association (AIPA)
Jesus Burgos
secretary for the AIPA
(787) 740-5252
Date: 3/18/03

- Jesus Burgos – Project Manager, Secretary of the AIPA, EHS manager; worked for the DNER and EPA/EQB for a number of years.
- His company owns 5 quarries and 25 concrete plants
- Made many suggestions to the DNER to improve their operations and quicken the process flows.
- He is not concerned that smaller operations are taking a portion of their sales, only concerned that these quarries are setting a bad industry as well as not having to follow the same procedures they must follow.
- He believes that the DNER should have stronger enforcement and regulations on these quarries. He believes that these are the sites that environmentalists love to focus on as the prime examples of how the aggregate industry is effecting the environment.
- He worked with Veronica before and has suggests many new ways for the improvement of the aggregate industry. She, however, has rejected his proposals all the time. These rejections come with no valuable evidence supporting her claims.
- The AIPA is willing to unconditionally negotiate with the DNER, but they do not want to have anything to do with it.
- One slight reason for the DNER being so stubborn is the thought that they do not want the AIPA to become a monopoly. The AIPA should never be considered a monopoly because it is an association; each quarry is still its own business.
- Questions Burgos wishes of us to ask Veronica
  1.) How many permits are they processing each week?
  2.) How many complaints are they processing each week?
  3.) How many technicians do you have working?
  4.) How long does it take to process a permit?
- Environmental reference is Neftali Jarcia – (787) 292-0620.

Appendix C1 - Jose Cordero Interview Questionnaire

AIPA member
Jose Cordero
Quarry Owner
(787) 852-1418
Date: 3/19/03

1.) How long have you owned this quarry?

2.) What responsibilities do you have as the owner?

3.) Are you a member of the AIPA?

4.) What percent of the aggregate industry is made up of the AIPA?

5.) Are small quarries a problem for you? If so, why? If not, then who?

6.) What is your problem with the mine permitting process?

7.) Could you explain the mine permitting process?
- How do you feel about the current process?
- Does it adversely effect production?
- What are some common problems when applying for a permit for the first time or renewal?
- When assigning time durations for permits, which components (i.e.-size of reserve) should the DNER base their decisions on?
- Are the guidelines posed under these permits feasible to comply with?
    - Environmental/Residential/Economical

8.) What is your relationship with the government? How do you interact with it?
- Relationship with the DNER and the permitting process
- Relationship with the PRHTA (buyer/seller)

9.) Do you have to meet an aggregate quality standard?

10.) Is your current equipment producing the highest quality aggregate you are capable of?

11.) What steps are involved with the aggregate production process that takes mined/quarries rock and convert it into its final product?
- Do you have a washing and scrubbing stage?

12.) Is there anything else you think we should know that we have not touched upon? Should we speak to anyone else?

Appendix C2 - Jose Cordero Interview Notes

AIPA member
Jose Cordero
Quarry Owner
(787) 852-1418
Date: 3/19/03

- Was the AIPA president twice; AIPA consists of approximately 34 quarries;
- List of extraction sites on the island both producing and not producing; contact list of AIPA members
- He confirmed that 90% of the aggregate produced in PR is produced by the AIPA
- 34 permits are needed alone to operate his quarry.
- He has a list of mining extracting areas, which will be given to us later.
- We were given a list of all AIPA members.
- The smaller quarries don't follow the rules. They sometimes operate without a permit because it takes too long or cannot afford to get through the permitting process.
- In this region shutting down quarries does not happen often; the DNER divided PR into regions and vigilantes are in charge of enforcing the rules and regulations of the EQB and DNER. Vigilantes have the power to suspend operations.
- The problem with competition and public image does not stem from the smaller family owned quarries; instead the problem arises from contractors for development projects.
- Cordero said he would be willing to upgrade his equipment if a longer permit were issued.
- Problem is the contractors- go to a project and do not need to get a permit at all, mine material on their site and then sell the material in order dispose of it.
- For example when a mountain is removed, the contractor takes out the mountain and brings in aggregate producing equipment and sells the material. They don't need the permits to produce the aggregate.
- Cordero is more interested in contractors that take advantage of using mining equipment at the development site to produce the aggregate and sell it to outside consumers.
- If the government can reduce its costs by mining at the development site then it is ok but he thinks that it is wrong for them to have to sell the extra materials outside the operations to asphalt and concrete operations. Believes that they should have to follow all the same permitting processes and environmental regulations.
- Contractors don't have to follow the rules and regulations b/c they are contracted by the government.
- There are no laws regarding contractors using portable equipment or selling materials to outside consumers.
- His company, which has been in business since the 1950's, contains four small quarry operations here in Humacao. He believes that he has 10 more years left in his reserve and that there is no need for an upgrade in his equipment. However, when we visited

he should us that two of his operations were down. He explained to us that one of the operations is down once every week and that the other was an accident.

- There are approximately 34 permits required for quarry operations
- Believes that a longer permit would allow him to upgrade equipment. Believes that he doesn't need washing equipment because the aggregate that they produce here is good. EPA regulations would be too tough for them to implement the washing equipment. Can not get this type of aggregate in the Northern half of the island. This is granite. In the north it is limestone.
- Organizations that are involved with the permitting process
  -ARPE – Permitting saying where they are (location permit).
  -DNER – 3 year permit (max) – 4 different permits, ex. Water and extraction.
  -EQB – 5 year permit – recycling water, water waist, underground storage, above ground tanks, oil use, tire recycling, steel recycling, dust and water control.
- Puerto Rican Cement- 5 or 6 years ago had a housing development project that required the removal of mountain composed of limestone. So the PRC setup aggregate producing machinery on this site and turned it into basically a $2M quarry. This was the way in which the PRC got around the DNER. Since it was necessary to remove and dispose of this material they believed that there was need for them to obtain mining permits. The operation took 5 to 6 years to extract the material. There is a lawsuit in PR. The results were to that they could extract the rock but they could not have the aggregate producing equipment on site.
- Currently he is waiting for the renewal of his permit from the DNER.
- ARPE- location permit from the planning board
- 4 permits from the DNER- take water out of river, permit for extraction,
- Permit for recycling water (EQB), waste, underground tanks, underground storing, tire recycling, steel recycling, and permit of dust and water quality.
- EQB usually gives a permit for 5 years; DNER can give a permit for 3 years, but usually only gives it for 1 year, need to supply enough information to show that you need a longer permit.
- His permit expired in Sept, but if you apply for a renewal 90 days in advanced then the law says that you can still operate while your permit is in the renewal processes.
- Veronica- says she is tough-
  - Says that she says you must stick strictly to the rules. The reason the rules are not being changed is because the law is the law and there is not changing it.
  - Wants to see a change in the rules, especially the ones that the AIPA has suggested such as the blasting of .25 which causes the quarry to blast numerous times rather than a reduction in the number of blasts with a .3-.5 blast.
- EQB has information on who are the worst quarries, which is operating illegally.
- Feels that the AIPA and the big quarries do comply with the rules set by the DNER and EQB
- Environment- a longer permit 5-10 yr., since the DNER and EQB already have the capability to shut down quarries then a longer permit makes no difference.
- DIA- environmental impact statement- costs less than the complete evaluation.
- When the secretary changed they did not ask for an EIS anymore

- Has been trying to go through the senate to get a new bill passed. There was a law project to get the law changed to 5 years, but it did not pass the house. DNER did was in favor of changing it to 5 years
- The House (independent party member) was against changing it to 5 years, because many people here believe that if a permit given for 5 to 10 years then the industry will do more damage than what they are doing now.
- Ferdinand Perez- has the project as well b/c they are resubmitting it again.

Appendix D1 - Veronica Santa Rosa Interview Questionnaire

Department of Natural Resources (DNER)
Veronica Santa Rosa
Geologist of the Earth's Crust Division
Secretary: Elise Domingoe
(787) 723-3090, ext. 2215
Date: 3/20/03

1.) How long have you been associated with the DNER?

2.) What positions have you held during your tenure and what position are you currently holding?

3.) What are your current responsibilities?

4.) Could you please explain to us the mine permitting process?

- How is the process initiated? By whom? On average, how long does the permitting process take?
- What are the steps involved to obtain a permit? Who is responsible for each phase?
- What are the key elements (e.g., environmental assessment, reclamation, bonding)?
- Where is the permitting process codified in the law?
- What role if any do consultants play? Who are some local consulting firms involved in mining issues?
- What are some typical issues that arise during the process (e.g., environmental assessment, working with mining firms, consultants, environmentalists)?
- Who makes the final permitting decision? How many agencies must this decision go to?
- What factors guide the amount of time given to a permittee?
    - How long does a typical permit last?

5.) We've been talking about the permitting process for new mines, now let's talk about those already in existence—you know, those that need to renew their permits.

- Are these mining permits often renewed? If so, why?
- If not, why? What are some examples for denying a permit renewal?
- Let's talk about a real case: The largest quarry on the island has been closed for the last 4 years

- Are you aware of any proposals to change the mine permitting process? If yes, please explain.

- What are the proposed changes?
- Process to implement or approve changes?
- Agency's role in these changes? Pros? Cons?

6.) Have you examined any alternative permitting models? Do you know what US states do? Any state in particular?

7.) Is there any other information that you feel we should know regarding the mine permitting process?

8.) Is there anyone else on your staff we could talk to about these issues?

9.) What role do contractors play in the permitting process? How do they go about getting a permit? Do find you have many problems with these companies?

Appendix D2 - Veronica Santa Rosa Interview Notes

Department of Natural Resources (DNER)
Veronica Santa Rosa
Geologist of the Earth's Crust Division
Secretary: Elise Domingoe
(787) 723-3090, ext. 2215
Date: 3/20/03

- 15 years working here, is a technician, goes out into the field and test the soil and see how they are planning on using the land
- Requirements vary b/c of different extraction types: private property extractions, river extractions, underground extractions, water table extractions
- When they bring the application for a permit this is what they need: bring topographic map, calculate the reserve that they have, they ask for a plan for a measurement and topography of what they what to explode, 1:20,000 scale aerial shot of the site that they want to explode, cannot be any shot - must be from a certain organization and in the current year, 250 dollar payment for the application and certification of the material that they have, if they are going to use explosives they must say so and have the licenses from the police department, if they are not the owner of the property then they have to have a letter from the owner giving approval, the corporation must have the names and directions of all the people that represent that corporation, must have good standing, bring a resolution from the cooperation (the solution for the extraction), say where the material is going to be, areas and position of the mountain, methodology they are going to use
    - How are they going to break the rock, the DNER will suggest their own methodology, quarries do suggest their own methodology but the DNER suggests its own methodology based on their field tests. The DNER will take the quarry owners methodology and add to it what they feel necessary.
- Restoration- this is included in the permit, the DNER will specify how the topsoil will be stored and maintained, how the topography will be the same as the surrounding areas, have to restore vegetation
- Takes a long time to get a permit, does not just depend on the DNER, have to determine where to send the case, refer the cases to different parts of the dept. i.e. Planification – data on plants and animals, Archeologists- refer the environmental assessment to the EQB- supposed to take 30 days but it usually takes up to 6 months, also has to go the legal area, some cases where they are completed in 3 months sometimes a year.
- By law they are supposed to solve a case within 90 days but that does not happen, typically permit lasts 1 year, large quarries get 3 years
- Why wouldn't it be longer - extractors here are fine with taking the short permit and going; they go there and they don't have enough people to go out - 4

technicians for the whole island; they don't have enough man power to check up on everyone if permits are lengthened. They do not have the funding to employ anymore technicians.

- Unless the community brings any objection with that permit then they will investigate, dust emissions and noise , destruction of the roads
- The technicians don't have the ability to shut down the quarries, the vigilantes have the ability to paralyze the operation, and they can get a fine up to $50,000 max.
- Usually don't go straight out and close a place, only fine, only if they are mining without a permit then they close a place down
- The Environmental Police are not technicians so they are not knowledgeable about what is going wrong with the quarry so they won't know how to indicate a problem on the quarry. A longer permit would require more of these police and they don't have the funds to employ them.
- Technician visits are at random- look at the permit, they come with a copy and have a check list and make sure that everything is being followed.
- Sometimes give up to ten days to fix the deficiencies in the quarry
- Vigilantes check the areas regularly- almost every two or three weeks and make sure that they are following the permit
- Limitations on the technicians to handle permits longer than three years, b/c they would not have enough time to handle all the permits,
- A longer permit would be lengthy and too detailed and would not be understood by the vigilantes b/c they do not have the knowledge to understand and enforce these permits
- Usually the quarries that get a 3 year permit are the ones that have been in business for a long time with good reputation, the one years usually go to ones that have small mountains
- If you have a permit for 3 years, then the permit length is shortened but the time that it takes for you the get that permit takes a while
- If you get a one year permit, then you get a one year permit then it is added to the time it takes to get one.
- Contractors do need a permit- if you are going to remove, excavate, dredge any material then you are going to need a permit
    - Contractors usually have noise and dust emissions complaints, sometimes their methodologies just push materials down to creeks and rivers adding sedimentation
    - Sometimes they get problems with landsides b/c methodologies are not followed exactly
- Performance bond – they do have one to ensure restoration.
- Restoration- supposed to be implemented as you excavate, but a larger quarry you cannot restrict the areas, 25-30 acres possibly 30-40 years it makes no sense to go there and tell them that they have to restore this or that. So usually restoration occurs when the site is exhausted of all its resources.

- Other agencies- what problems to they face- same problems- not enough people and not enough equipment to process as fast a as possible - DNER is the only one that does fieldwork, other quarries just look at documents, EQB does have 2 technicians
- Other solutions- when a new regulation is made it are made as an environmental declaration and it goes to the EQB and then the DEPT of the State.
    - Changes the regulation plan that they have now b/c it is not clear
    - More elaborate
- New ways to speed the process- if you have all the permits then you can get an exception of permit "fast track way"- housing developer that has all the permits from other agencies already, then you can get exception of permit (or a farmer). About 4 ways to be issued from the secretary: housing developer, farmer, if the extraction is between 50 and 100 cubic meters, if there is a natural disaster. Can't sell or commercialize with this material, give it free to the municipalities, can do whatever you want with it but cannot sell. Permit can be received in one or two weeks. Need to write a letter specifying your plan, article 18 of the earths crust. Goes to the housing development agency where the DNER has an employee there who receives this and evaluates it.
- Usually every 3-4 years need a new topography map.

Appendix E1 - Juan Rosario Interview Questionnaire

Industrial Mission
Juan Rosario
Active Member
Date: 3/28/03

1.) What position do you hold in the Industrial Missions?

2.) What does the Industrial Mission do?

3.) What do you think about the mining situation currently in Puerto Rico?

4.) How would you assess the mine permitting process?

5.) What do you think a longer permit would do to the environment?

6.) Are alternative methods of extraction being investigated?

7.) Is there anything else you think we should know in developing our project?

Appendix E2 - Juan Rosario Interview Notes

Industrial Mission
Juan Rosario
Active Member
Date: 3/28/03

- Industrial Mission – Episcopal Church – Social Disruption – 1969 – Environmental agency – 3 fulltime workers – 30 to 40 part time workers – Members of the community – Only group like this on the island – Recycling and community are main concerns
- Construction is the "engine of the economy."
- Limits have been reached throughout the country, especially water. They are finding they have to import a lot of items.
- They call themselves the continent island. They sell this abroad so people believe in it. They do this to bring people to the country.
- Environmental Impact assessment – look at the process to make everyone happy – Not just for aggregate but for all industries.
- They are having a huge problem with the contractors who excavate the land and then houses are put out.
- They are trying to stop permits all together. They feel there are no more building places. There are so many permits right now.
- Already passed the amount of construction and people on the island. The island can not keep going forever.
- The island is consuming 20 to 30 times more resources than the island can produce.
- Even the United States are about 2 times the natural limits.
- Highest rate of square highway in the entire world. Highest car rate in the world.
- On the island they consume to no end.
- On the island people are looking for alternative mining solutions
- They feel they have to stop all quarry operations. They need to stop removing earth. They want to find a method of gathering aggregate that creates less damage to the land.
- A longer permit will not spark an upgrade in equipment. They feel that they won't upgrade because quarry owners have been doing the same process for the longest time. So they will not change their ways just because of a longer permit.
- He has heard about longer permits will stop quarry owners from cutting corners. He thinks this is not true; they will just keep doing the same thing.
- The government can not heavily fine construction operations because the island needs it.
- Problems - More money the easier it is to get a permit – Bribes are offered, most are not accepted but some of them are – Biggest pressure is construction – The island needs aggregate so the government is going to do anything to get it –

Governments have been disregarding the communities plea to stop quarry operations.

- The community feels they have been run over by the government.
- The permit issuers are not doing a very good job. It is not that they do not want too; it is the fact that they do not have enough people. They have very difficult jobs and it is hard to understand the law.
- 5000 cubic meters a year for extraction requires very little requirements and permits. They problem is that one group is putting together many of these.
- The island is running out of natural aggregate without hurting the people. They need aggregate though for building. So they are looking for alternative models for getting aggregate.
- Community concerns – Air pollution, dust, noise, hassle, they are most concerned about disasters happening. They are afraid that when the next big rain comes their homes might be wiped out.
- There is no machinery or processes on the island that can reduce these impacts.
- If quality aggregate is not produced, structures do not last as long, resources are depleted faster and everyone looses.
- The Limestone is in the northern part of the island. He says this rock should not be touched because this is where the aquifers are and they need to replenish themselves.
- Incentives need to be initiated or else people are going to keep doing the same thing.
- They feel the aggregate problem is a matter of survival for the environment.
- The government does not have the credibility for the community to trust them.

Appendix F1 – Roberto Lazaro Interview Questionnaire

Department of Natural Resources (DNER)
Roberto Lazaro
Sub-Secretary
(787) 724-8774
Date: 4/2/03

1.) What responsibilities do you hold as the Sub-Secretary?

2.) Where did a three-year permit come from?

3.) Are your major problems associated with Contractors and Developers? If so, why?

- What happens when Contractors are caught selling material?

5.) Could you please explain the bonding process?

6.) Is there anyway to cut down the paperwork associated with a permit application?

7.) Would a longer permit be more environmentally friendly?

8.) Could you give longer permits to certain quarries?

9.) What are the major fees and fines associated with quarry operations?

10.) Is it possible for funding to be increased?

11.) If quarry owners would to invest in new equipment, would the environment benefit?

12.) Would do you think would trigger quarry owners to buy new equipment?

- Is there anything else we should know in conducting our study?

Appendix F2 - Roberto Lazaro Interview Notes

Department of Natural Resources (DNER)
Roberto Lazaro
Sub-Secretary
(787) 724-8774
Date: 4/2/03

- DNER must strike a balance with extractors and environmentalists
- Most groups do not get involved with the permits. They have a view point and do not care what other agencies say.
- 3 year permit is a law not a regulation. It has been like this since the department was started. 1968 it was created. It says why the amendments were made.
- Problem with developers (Contractors). Selling of the material is prohibited unless they have a permit. You can get an exception from the permit by going to the ARPE and the CET. This allows contractors to sell the material. Contractors still need to present topographic maps, etc. They get these quick permits so they can make room for housing developments. So the government makes exceptions to these groups because PR needs more houses.
- What happens when Contractors are caught selling material? It is a whole legal thing. Usually they will end up with a 10,000 to 20,000 fine. By law the biggest fine that can be issued is 50,000 dollars, but they have never issued that before. To get a higher fine to be issued it has to go through law. The DNER can take away machinery and everything if they feel necessary. They lack in follow up. Contractors change their names all the time so they do not get caught again and again. Every department issues fines. Fines are tough to obtain because of companies fleeing and changing names. Million dollars in unpaid fines.
- 200,000 dollars for a bond. Can't include fines into the Bonding system.
- Until the DNER can prove they are capable of doing things right they are not going to get more funding.
- Number of employees is a problem also
- Cut down the paperwork – It is tough because the application process goes through many organizations. Environmental assessment (EQB) is required for permit to pass. If streams and rivers are present the permit needs to go through the hydraulic division which takes 20 to 30 days. Washing and scrubbing must go through the planning board. It is a whole other process.
- Planning board deals with zoning.
- Would a longer permit be more environmentally friendly? The DNER says no. It is short so the agencies can keep track of the quarries. The only time the DNER would hear from these quarries is every 10 years unless the community complains. So if the permit is short, the DNER can control quarries better. After evaluation they can shut down a quarry at anytime if they are not following the rules.
- 3 year permits do not give quarry owners a problem with bank loans. 1 year permits do. All the big quarries (AIPA members) have 3 year permits.

- Not a mater of negotiation with quarry owners. It is about taking care of the 4 million people on the island.
- If one quarry gets a longer permit, other quarries would try to get one, if they do not get it they would complain, then the DNER would be sued. You have to be fair to everyone. So they can not give out longer permit just to certain quarries.
- The DNER firmly feels that permits need to be issued every 3 years because they need to check up on the quarries.
- Big problem for the DNER is that they can not always collect the fines they issue to quarry owners.
- Zoning and operation of the plant goes through the Planning Board. Washing and scrubbing are included in the permit that the planning board issues.
- $250 dollars for the permit to be passed through the DNER. The EQB bases their price on the size of the quarry. The water place charges just over 1000 bucks. These are just filing fees.
- Funding can not be increased. The government has even been cutting funds.
- They are not sure if a longer permit would be better or worse for the environment. They would have to evaluate it case by case and the geology of the area.
- They agree that it would be more environmentally friendly if quarry owners purchased newer equipment. But they also say that quarry owners will not purchase new equipment because they are in it for the money and would not want to waist it on new equipment.
- They do not think that permit length will trigger quarry owners to buy new equipment. They think that new equipment will be bought when a higher quality aggregate is demanded.

Appendix G1 - Neftali Garcia Interview Questionnaire

Environmentalist
Neftali Garcia
Environmental Professor at UPR
(787) 292-0620
Date: 4/3/03

1.) What aspects of the environment do you teach at UPR?

2.) What are the main environmental concerns associated with quarry operations?

3.) What are the main reasons for these environmental factors getting out of control?

4.) What would a longer mine permit do to the environment?

5.) What permit length would you recommend and why?

6.) What regulations would you suggest the DNER undertakes?

7.) Is there anyway to decrease the amount of paper work required for a permit?

8.) Would quarry owners upgrade equipment with a longer permit?

9.) Is there anything else you think we should know in conducting our study?

Appendix G2 - Neftali Garcia Interview Notes

Environmentalist
Neftali Garcia
Environmental Professor at UPR
(787) 292-0620
Date: 4/3/03

- Quarry operations: Could take place in rivers or in quarries. If in rivers, sedimentation is a problem. This effects water quality, so aquatic life gets affected. If rocks are crushed, dust is an issue. Sand levels will be generated. This could affect the neighboring people. Transportation of the material – trucks pass through communities – Safety issues come up. Destruction of roads because of the weight of these trucks. Explosives in quarries – main effect is cracking of walls of structures.
- Not enough personnel to supervise these quarry operations. The only department that has enough coverage is explosives. Lacking personal means not adequate supervision and there is not good way to detect irregularities.
- Long term permits could lead to more problems. Not going to happen at every quarry. There will be a tendency that longer the permit the less presence there will be from the DNER people. For longer permits to be issued improvements in technical knowledge must be learned and more people employed. This means higher salaries need to be paid or else people will not take these jobs.
- Would not give a permit for longer than 5 years. He would increase the fines so the rules would not be broken. Use a portion of the fines to get more people and to train them. Increase the amount paid for a permit. Public properties are changed by the DNER. He would charge a fraction of how much aggregate is extracted from the sight. If the number of employees increases and they get trained, he would give a 5 year permit.
- With a longer permit, quarry owners will care about the rules at the beginning and at the end of the permit. So this would be a negative effect.
- It is a political decision to shut down quarry operations for not abiding by the rules.
- Given the high number of unemployment, given the slumping economy, PR is not going to shut down these operations.
- Would establish a time table of supervision. Every 3 months he would send someone to the quarries and give an inspection. These would be unannounced visits.
- The tendencies when they are given a permit they extract more than they are allowed. Spot check of trucks coming in and out of trucks to get an idea of how much they are actually extracting. These checks would be done randomly and they would not be seen.
- Mario Soriano is a geological engineer. We will give this guy a call.

- Why only a 5 not a 10 year permit: 5 years should be plenty of time to get a loan made.
- As of now he would not go past 3 years. They need to prepare environmental impact statements for the issuing of a permit. This is for any new quarry in PR. Would be required a submittal of a report on extraction and any environmental issues or problems and how they would be solved every 3 months.
- The paper work is a very good idea. This is an excuse for those who do not put enough thought into the environment. These loads of paperwork and their cost are microscopic to how much quarries make.
- Some quarries have paid people in the DNER to make paper work and fines easier. This gives all of them a bad name when this happens. AIPA should establish certain rules for people in their group.
- There are some illegal extractions. So why doesn't the AIPA bring these organizations to the DNER. This is another reason why the number of employees needs to be increased.
- It is a political decision not to increase the fines and permit costs.
- The EQB and Planning Board both have number and money issues. Planning Board deals with zoning permits. Only have to go here if you are going to be crushing the rock, not just blasting.
- Well done environmental assessment costs between 15 and 20 thousand dollars. Most people come in and say they will do it for half or third of the cost. So it is not nearly as good quality.
- Is technology good at quarry sites – Every quarry can make improvements to better the environment.
- Would low technology quarries upgrade equipment with a longer permit – Large ones would, but the smaller ones would have to keep using the hammer.
- These smaller quarries have contacts with political people. So they can move around all over the place without a problem.
- If you eliminate the small quarries, then more power is going to be given to the bigger ones.
- All quarries large and small play the political game.
- Serious doubts that any political changes would be made.

Appendix H1 – Jose Lopez Interview Questionnaire

Hormigonera
Jose Lopez
Concrete Technician
(787) 833-0630
Date: 4/9/03

1.) What are your responsibilities as a ready mix technician?

2.) What are the main differences in producing HPC?

3.) Why can only one ready mix plant produce HPC?

4.) What affects the quality of concrete more, the machinery being used or the raw material extracted from the ground?

5.) Are their any thoughts about importing HPC from the United States?

6.) Do you like holding a monopoly in the HPC market?

7.) If no, what could be done to bring in other HPC producers?

8.) Will a longer mine permit encourage quarry owners to purchase newer and better equipment?

9.) Currently, is their an impact law forced upon quarry owners?

10.) Is washing and scrubbing the aggregate necessary to produce HPC?

11.) What are some of the steps you do to produce HPC that other ready mix plants do not?

12.) What do you do if the aggregate you receive is not meeting spec?

13.) What do you feel are the environmental issues associated with a longer mine permit.

13.) Why do you keep trying to produce HPC if it is such a small fraction of your company.

14.) What steps are taken when making HPC?

15.) How do you think quarries should be regulated?

16.) Who can we contact to get more information about HPC?

17.) Is there anything else you feel might benefit our study?

Appendix H2 – Jose Lopez Interview Notes

Hormigonera
Jose Lopez
Concrete Technician
(787) 833-0630
Date: 4/9/03

- There is only one Charcoal plant in PR. It makes poor Fly Ash because there is too much sulfur in the charcoal.
- So for the most part, microsilica is used and that must be imported
- There are 3 or 4 HPC producers on the island. Only one actually makes spec.
- The reason they keep making spec is because they test their product over and over again until it is right.
- The reason it is tough to make HPC is because there is not enough good quality aggregate. Places like Carmello and Casanova do not produce quality aggregate because it is white limestone which is of poor quality.
- The best aggregate comes from blue limestone and granite. Even for these rocks to produce HPC, they need to be consistent.
- The demand for aggregate is high so all qualities end up being sold
- The major problem is the quality of the aggregate. This is why HPC is so hard to produce. The material is the problem, not the machinery.
- There is different material throughout the island. Granite is located in the upper right, gravel in the lower right, limestone in the upper left and upper middle, and crushed stone is located throughout the middle of the island. With this distribution, it makes it very tough to keep material consistent.
- It is very expensive to move material around the island
- To solve this problem a shift needs to be made to give opportunities to quarries. Closed ones should be opened. This would increase competition between quarries.
- He would sacrifice his monopoly and lower costs if HPC becomes easier to produce and more consistent. This will happen if competition is induced amongst quarries.
- He believes that the quality of aggregate being produced must be regulated. It must pass through a certain quality test.
- AIPA sells all the aggregate it produces because demand from contractors always exits.
- He believes that if a longer permit is issued, aggregate producers will purchase better equipment.
- There is no impact law right now and there should be.
- Washing and scrubbing of the aggregate is not necessary.
- Things they do that others do not – wash and monitor base material from other quarries.

- If the aggregate is not the best grade, they have to compensate by making the concrete paste better.
- Environmental issues with a longer permit: There will be better control over the environment, more efficient plans for water and better equipment will be purchased. Quarry owners will not purchase new equipment with a short permit. This must be regulated or quarries will just stay there longer.
- There are 2 people that supply low permeability concrete and both have potential problems producing it.
- He says that he does not have a strong grasp on the market because it is not very hard to start a concrete plant. He got to the top so he feels others can also.
- HPC is only a small portion of their production.
- If specs are not met, contractors fine them.
- He does not like the fact that he is the only HPC producer on the island. It is too difficult to produce. He would rather lower costs and have it easier to produce.
- You have to keep trying to get better quality concrete or you will become extinct.
- He KNOWS the market for HPC is going to grow. That is why they keep trying to perfect it. So this is why they do not import it.
- How to make HPC
    - Microsilica is in bags because this is the only way to import it
    - They have tries putting the microsilia in the front, middle and the end of a batch of concrete.
    - It takes a lot more energy to mix if the mixture is not even throughout.
    - Space needs to be left in the tank for mixing.
    - There is no difference in concrete and HPC production. The only thing different is raw materials have to be hard and clean. And microsilica is added in.
    - For low permeability, washing and scrubbing is greatly preferred.
- For methods of regulation – Should be based on what the quarry is capable of.
- AIPA wants a longer permit so they can upgrade their equipment. This will produce better aggregate. Washing stages would be added and newer crushers will be a lot more precise.
- There is a big concern with sand. It shines like gold and is bad for bonding with concrete.
- The DNER is not allowing river bank extractions
- The average weight of stone per mix is about 1600 to 1800 pounds
- There is not much room at sites so washers do not fit.
- Cemex – Puerto Rican cement – Call to find out how it is made. The quality control manager is Milton Rivera. 787-842-3000 ext. 4244
- San Juan Cement – Cartagena – 787-721-5878 ext. 242
- These are the only 2 on the island
- PR imports from Chine, Denmark and Venezuela.

Appendix I1 - Mario Soriano Interview Questionnaire

Geological Engineering and Environmental Services
Mario Soriano
Geological Engineer/Attorney at law
(787) 720-4831
Date: 4/15/03

1.) What organization do you work for?

2.) What position do you hold in your organization?

3.) What are your responsibilities?

4.) What environmental concerns do you have with quarry operations?

5.) Do you think a longer mine permit will increase or decrease these environmental impacts? Why or why not?

6.) How are the community relations between quarries and neighboring people?

7.) Is their any other information you feel would be beneficial to our project?

8.) Is their anybody else you think we should talk to?

Appendix I2 - Mario Soriano Interview Notes

Geological Engineering and Environmental Services
Mario Soriano
Geological Engineer/Attorney at law
(787) 720-4831
Date: 4/15/03

- 25 to 30 years dealing with this argument
- DNER is very prone to be keep Aggregate producers hostage. Do whatever is easiest for them. AIPA buy their way out of problems. They even pay off government officials and vigilantes.
- DNER is not doing a very good job of protecting the environment.
- All the Dunes in the north coast have been wiped away. Sand beaches have been destroyed. 33 beaches have been destroyed because of beach sand extractors. When they had to move away from the beaches they started to extract out of river beds. The permits we issued to only clean out the sand and gravel in the channels, but they extracted all over the place. So banks were being eroded and affecting the water supply. This greatly affected farms. When resources in the channels and rivers was exhausted they started seducing the DNER. They got it to the point, where they could extract below the aquifer. They extracted 30 to 40 feet below the river levels. These huge craters were filled with trash and waist. There is a great deal of suspicion to allow these people to continue quarry operations. They are doing all this with a one year permit. If they were to receive a longer permit it would be even worse. Toa valley in Toa Alta, Arecibo, Coamo valley – this is where this kind of activity is being done.
- There is currently no Impact law.
- In Terrazo sand extractors went to a farm and said they would extract material until it was good and then give the farm a fraction of the profits. The made a huge hole that went to water level. So any flood would cause great harm to the farm land.
- The Supreme Court just said that an Environmental Impact Statement should have been issued. This is for one of the cases where extractions from river beds cause some major damage.
- People are looking for the easy way out. Aggregate producers are looking for good money with little investment.
- The DNER messes up because they require the holes to be filled to the river level only. So they fill these holes with anything they can find including garbage.
- The DNER does not have the personal to control quarry operations.
- There are some aggregate producers that do follow the rules by the book. There are just too many people killing the environment.
- How can anyone have confidence giving a longer permit if this kind of destruction is done with a 1 to 3 year permit? The DNER can not supervise or shut them down because they are understaffed.

- 250,000 acres of farmland have been lost over the last 15 years. And there is only 650,000 acres of farmland on the entire island. The island is not going to be able to take these loses for much longer.
- Aggregate production is not a problem. Usually the areas are well confined.
- He does not think the sand from soft limestone is not of good quality. It is not strong and breaks down. It does not produce a competent concrete. Sand made from limestone acts more like clay than anything.
- There is plenty of rock so there is not a problem with these guys. A three year permit or longer could be granted to these people.
- The DNER has seen all these photographs and yet still allow it to proceed.
- PR is a sensitive island in accordance to the Environment. Lots or rain, small watershed, small farm land, oversized population. Land and resources have to be used only when needed or else the future of the island will be poor.
- Developers and Aggregate producers have taken the DNER hostage.
- Recommendations: DNER has done great things with Flora and Fauna. But there is not money involved. When you need money and a source of income such as sand they can not handle it.
- Sand is 36 dollars a cubic meter. This is enough to pay off government officials.
- Invented by the United States. It is a federal law. If you are going to make an action (build, dig, etc) and would effect the environment you must provide a statement saying how it will impact or not impact the environment, what are the benefits in the long run? Usually they are not evaluated properly. There is usually no sound scientific information. He does not believe in it because they are not done properly. They are not trust worthy. They can cost up to 70,000 to 100,000 dollars. Usually this is very untruthful information. DNER says it looks good and issues a permit. And the damage is done before they get stopped.
- Ex) Road – Cut trees, effect wetlands, substitute wetland, long run it will provide transportation.
- The island would be better off without the DNER. The Department of Publics work did look after quarry operations before the DNER and they closed down operations. So all the areas the DNER looks after should divide it up into different organizations and just shut themselves down. Beaches and other such areas should be given to organizations that can protect them.
- With an extraction – 45 – 50% is sand, 5% top soil, 40% is gravel. 4000 cubic meters of material per acre.

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