The Mangrove Forests of the City of Colón: A Situation Analysis, Socio-Economic, and Environmental Impact Assessment of Development Initiatives

Punta Galeta Marine Laboratory and Reserve
McGill University Internship Report

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Los Manglares de la Ciudad de Colón:
Un Análisis de la Situación y Un Estudio de Impacto Socio-Económico y Ambiental
Sobre Iniciativas de Desarrollo

Sumario Ejecutivo - Español

En años recientes el potencial dañino que ha traído el desarrollo son evidentes en la República de Panamá, y la preocupación sobre las implicaciones sociales y medioambientales de este fenómeno para el futuro de esta nación está en aumento. Desde 1969 aproximadamente el 71% de los manglares del Caribe Panameño se han perdido, dicha cifra representa el 56% de la cobertura total nacional de las costas. Estos cambios son muy importantes porque los manglares tienen una función ecológica vital y un valor incalculable para el hombre. Cuando los manglares desaparezcan de Panamá sus servicios ecológicos incluyendo una guardería para los peces de importancia comercial y artesanal, protección de las tormentas y los terremotos a las costas, filtración de agua y aire, biodiversidad propia de ellos y otros ecosistemas que protegen, estabilización litoral y erosión, estética, turismo, y valores culturales, habrán desaparecido con ellos.

La ciudad de Colón, por su acelerado desarrollo, también atraviesa por una gran pérdida de manglares. Actualmente los manglares de Bahía Las Minas (norte-este de Colón) han sido deforestados para la expansión de la Zona Libre de Colón, las instalaciones de puertos asociado (Colón Container Terminal [CCT] y Manzanillo International Terminal [MIT]), y elementos del proyecto difunto Multi-Modal (incluir la yarda de ferrocarril por Panamá Railway y áreas para la expansión del aeropuerto France Field). A pesar de preocupaciones medioambientales y sociales muy serias y consecuencias negativas evidentes (por ejemplo: la inundación de Colón), la destrucción de los manglares de Bahía Las Minas está continuando. Por ahora, CCT (Evergreen Marine Corporation) y MIT (Stevendoring Services of America) están planificando una expansión de puertos en los que involucran la deforestación de 18.2 ha y 12 ha de manglares vírgenes respectivamente. También, están hablando sobre más grande Panamá Railway expansión y aeropuerto France Field expansión proyectos.

En el presente estudio realizamos un análisis de la situación actual de los manglares de Bahía Las Minas, los proyectos de desarrollo, y sus estudios de impacto ambiental. También, creamos un estudio detallado de los impactos ambientales y sociales que examina los proyectos
de CCT y MIT, y creamos varias alternativas de desarrollo, las cuales son presentadas como recomendaciones para ambas compañías.

Los autores de este reporte descubrimos que los estudios de impactos ambientales hecho por CCT y MIT no son comprensivos, le falta credibilidad científica, profesionalismo, son poco objetivos y a veces llenos de mentiras. Nuestro estudio escogió como blanco los numerosos y diversos impactos ambientales y sociales asociados con estos desarrollos. Estos incluyen las pérdidas de funciones del ecosistema, ya mencionado, como también los impactos específicos en la región. Entre lo más perjudicial podemos mencionar la gran cantidad de sedimentos tóxicos dentro de los manglares en estas áreas producto de los dos derrames de petróleo ocurrido muy cerca de estos sitios representan un enorme potencial toxico, ya que al ser talados los manglares estas sustancias químicas pasaran del suelo a el ambiente marino, también la destrucción de estos maravillosos ecosistemas traerá consigo una disminución del valor científico y educativo que están realizando en el Laboratorio Marino de Punta Galeta, como también los impactos socio-económicos aumentaran en comunidades cercanas como por ejemplo: el pueblo pobre de Coco Solo Norte.

Debido a estos hallazgos, los autores de este reporte recomiendan que:

- Todos los permisos de desarrollo ya aprobados por la ANAM para la desarrollo de los manglares de la región de Bahías Las Minas deberían ser revocados hasta que profesionales imparciales realicen los estudios de manera adecuada.
- Los estudios de impactos ambientales deberían realizarse de forma más rigurosa y científica.
- Deberían evaluar el sitio como una forma de desarrollo turística y educativa.
- Los evaluadores de uso de suelo, zonificacion del sitio y conservación de la región deberán recalcar que los diferentes servicios ambientales brindados por estos ecosistema y al mismo tiempo desarrollar un mejor plan de desarrollo en armonía con la naturaleza.
- Los evaluadores deberían incluir la participación pública, tal cual como fue hecha en el proyecto “Millennium Ecosystem Assessment Framework.”

Todos estos puntos serán discutidos de manera detallada de principio a fin en el presente documento. Con la expansión inminente de la canal de Panamá y la desarrollo rápido de la república de Panamá, la nación esta en un punto crítico de su historia. Por primera vez Panamá está en una posición para determinar independientemente su propio futuro económico, social y
ecológico. Los panameños deberán decidir si su país va a ser mucho más que una canal y sus industrias asociadas. Entrando en el próximo siglo, nos preguntamos, ¿Panamá será un país naturalmente bello, con justicia y con una mezcla ricas de culturas o será consumido por sus propias y estrechas aspiraciones? Las decisiones que elijan hoy, moldeará el país en la cual vivirán.
The Mangrove Forests of the City of Colón: 
A Situation Analysis, Socio-Economic, and Environmental Impact Assessment of Development Initiatives

Executive Summary - English

In recent years the potentially harmful effects of economic development have become apparent in the Republic of Panama and concern is growing over the long term social and environmental implications of the nation’s development policies. Since 1969 almost 71% of Panama’s Caribbean mangrove forest cover has been lost, with a corresponding loss of approximately 56% nationally. This is of great concern given the vital ecological role that mangrove forests play and their high value in terms of ecosystem services. As mangroves disappear from Panama, so too do the ecosystem services that they provide. These include such things as spawning grounds for commercial fish, storm and flood barriers, water and air filtration, habitat for biodiversity, erosion stabilization and coastline control, aesthetics, tourism, and cultural values.

Rapid deforestation has occurred in the mangroves of Bahía Las Minas (north east of Colón) in order to make room for the expansion of la Zona Libre de Colón, its associated port facilities (Colón Container Terminal and Manzanillo International Terminal), and elements of the now defunct Multi-Modal Project (including Panama Railway yard and France Field Airport expansions). Despite very serious environmental and social concerns, and evident negative consequences (such as flooding in the city of Colón), deforestation in the Bahía Las Minas mangroves continues. At present both Colón Container Terminal (Evergreen Marine Corporation) and Manzanillo International Terminal (Stevedoring Services of America) plan port expansions that will result in the clearing of 18.2 ha and 12 ha of virgin mangrove respectively. In addition, much larger Panama Railway expansion and France Field Airport expansion projects are being discussed.

The authors of this report have generated a situation analysis examining the Bahía Las Minas mangroves, the development projects, and their environmental impact studies. In addition, the researchers have conducted their own environmental and social impact assessments and generated several alternative development options and recommendations.

Over the course of this research, it was found that the environmental impact assessments filed by Colón Container Terminal and Manzanillo International Terminal were far from
comprehensive, they lacked scientific credibility and professionalism, they were highly biased, and at times blatantly dishonest. Our report highlights the numerous and widespread environmental and social impacts associated with these development projects, including losses in the ecosystem services discussed above, as well as impacts specific to this region. Regional impacts include the potential for the release of toxic sediments sequestered in the mangroves, diminishing value for the scientific and educational activities of Punta Galeta, and severe socio-economic impacts for the adjacent impoverished community of Coco Solo Norte.

As a result of these findings, the authors of this report have recommended that:

- All construction permits for projects in the Bahía Las Minas mangroves be revoked until proper assessments have been filed and the projects has been adequately reevaluated by a non biased third party.
- The impact assessments be redone in a more rigorous and scientific fashion.
- Consideration be given to development alternatives (alternate sites/ecotourism).
- Planners reassess and develop a land use and conservation plan for the region emphasizing ecosystem services, conservation in the mangroves, and rezoning of land.
- Governmental and project planners make use of a public participatory approach to development planning such as the Millennium Ecosystem Assessment Framework.

All of these points are discussed in more detail throughout the report. With the impending expansion of the Panama Canal and the rapid development of the Republic of Panama, the nation is at a critical point in its history. For the first time Panama is in a position to independent determine its own economic, social, and ecological future. The people of Panama must decide whether their country will be more than a canal and its associated industries. Going into the next century, will Panama be a nation of beauty, cultural diversity, and justice or will it become consumed by its own narrow developmental aspirations? The choices that are made today will shape the country in the years to come.
1.0 Context

1.1 Introduction

In recent years the potentially harmful effects of economic development on poverty, inequality, culture, and the environment has become an area of great concern. These deleterious effects are expected to increase with growing global inequality and populations, placing more stress on already strained ecosystems. Currently more than one third of the world’s population lives within 100 kilometers of the ocean and it is expected that by 2050 nearly half of the world’s population will live within the coastal zone (Hunt et al. 2005). As a result of this, anthropogenic pressure on coastal ecosystems is high and continues to intensify.

In much of the tropics mangrove forests form the juncture between the marine and terrestrial environment. These ecosystems are characterized by plant species which are adapted to both terrestrial and marine conditions and are able to survive within the changing environmental conditions of the coastal zone. This entails adaptations to periodic water-logging, high salinity, variability in ground level temperatures, and periodically intense weather conditions (Hogarth 1999). Mangrove forests are environments of global ecological significance providing many critical environmental services. Due to their transitional position mangroves impact both the terrestrial and marine environment substantially by providing spawning grounds and nurseries for fish and shellfish, preventing coastal erosion, providing protection against regular and cataclysmic weather events, and by providing habitat and food for both marine and terrestrial organisms. In addition, mangroves contain significant biodiversity, are critical for commercial fishing stocks, and protect human habitations (Quarto 1997). In the 2004 South-East Asian tsunami, for example, communities that were protected by intact mangroves suffered substantially less damage and far fewer fatalities than those which were unprotected (Danielsen et al. 2005). Despite their critical ecological and economic value mangroves are among the world’s most endangered ecosystems. Since 1980 mangroves have decreased from 18.8 million ha worldwide to 15 million ha, a loss of approximately 20% (Wilkie & Fortuna 2003).

The mangrove forests of Panama have fared far worse than the terrestrial forests of the nation. It is estimated that since 1969 the mangrove forest of Panama have shrunk from 360,000 ha to approximately 158,000 ha in 2000 (FAO 1969; WRI 2000). In recent years the Caribbean
mangroves around the city of Colón have been significantly reduced and those which remain are threatened by several port and industrial expansion projects.

In anticipation of the widening of the Panama Canal and increasing canal traffic major port expansions continue in the Colón area. Currently both the Manzanillo International Terminal (Stevedoring Services of America) and the Colón Container Terminal (Evergreen International Corporation) are undergoing major expansion programs while expansions of the Frances Field Airport and the rail yards of the Panama Canal Railway Company have also been proposed in the Colón area (Business Panama 2007). Despite their large scale the socio-economic and environmental impacts of these development projects have not been substantially studied. In particular, questions regarding the impacts of these developments on the mangrove ecosystems and the impoverished people of Colón have not been answered.

1.2 Host Institution

The Smithsonian Institute was established in 1846 by the United States Congress based on the bequeathed legacy of British Scientist James Smithson who willed his estate to the growing country as a charitable trust. The Smithsonian Tropical Research Institution (STRI) is an extension of the American institution and was first established in Panama in 1923 in the form of a modest research station on the newly created Barro Colorado Island. STRI’s mission continues to be the collection and dissemination of knowledge for the good of mankind through the understanding of biodiversity and ecology. STRI hosts some 900 visiting researchers annually and provides important training to tropical ecologists as well as singular opportunities to study dynamic ecosystems. STRI’s research program emphasizes public education, long term research, and the exchange of information and personnel without geographical limitations (Smithsonian Institute 2007; STRI 2007).

1.3 Research Site

The Punta Galeta Marine Research Laboratory is located on Panama’s Caribbean coast east of Colón. Galeta Point has a long history as a pivotal strategic stronghold for the United States navy and has housed anti-aircraft and anti-cruiser batteries during WWI, while it also
served as a frogman deployment zone during WW2 and an important satellite monitoring center during the Cold War. Isla Galeta and Punta Galeta are riddled with the concrete ghosts of its military history. The visitor center was constructed for US naval use during the 1950s and in 1964 this site was given over to the Smithsonian Tropical Research Institute. Punta Galeta is the location of one of the Caribbean ocean’s oldest marine research sites with the longest running Caribbean Sea monitoring data in the world. As a result, Punta Galeta has been and remains one of the most important marine research centers in the world. The Punta Galeta marine laboratory prioritizes research activities, though the facility has recently incorporated a progressive outreach and public education program which has received thousands of visitors since the year 2000. The research station sits within a small protected area which researchers and visitors are attracted to in order to experience the old growth mangrove stands, rich sea grass beds, and extensive coral reefs which surround the site (STRI 2006).

The city of Colón and the development initiatives in this region have been intimately linked to the Punta Galeta Marine Laboratory. The majority of the staff and volunteers from Punta Galeta come from Colón and, when the mangroves around the research center have been threatened in the past, the community has rallied around the research center and assisted in defending the area’s critical environments. The city of Colón is the second largest city in the Republic of Panama boasting a population of over 204 000 inhabitants (2000 census). Colón was founded under the name Aspinwall and is located at the Caribbean mouth of the Panama Canal. The city was originally established by Americans working on the Panama Railroad Project. Urban development since its inception in 1850 has been driven by Canal traffic and shipping interests continue to dominate the city’s economy. Currently Colón is home to three modern free ports and is the location of the second largest free zone in the world; the Colón free zone or la Zona Libre de Colón. Despite its considerable economic activity, Colón has very high poverty and unemployment rates with prevalent inequality (Green 1996; Geocities 2007).
1.4 The Punta Galeta Internship Program

Punta Galeta has hosted interns from McGill University for several years. Previous McGill interns have completed reports examining fishing activities and the viability of ecotourism, both involving the nearby artisanal fishing community of La Playita. Originally the 2007 McGill internship group had planned to continue work with the fishermen of La Playita with the intention of implementing an ecotourism project by the end of the internship period. However, news of impending developments in the mangrove forests around Punta Galeta have brought into question the future of the region’s ecology and the viability of ecotourism in a potentially degraded environment. At the request of the internship supervisor (Dr. Heckadon-Moreno) the 2007 internship has been re-oriented towards the fulfillment of three research priorities:

- The compilation of an accurate situation analysis that identifies current and proposed threats to the remaining mangrove forests in the area surrounding Punta Galeta.
- The completion of an impact study. This study examines the anticipated environmental, socio-economic, cultural, and scientific impacts of proposed development projects in the mangroves surrounding Punta Galeta.
- Identification of alternative development possibilities and construction sites.

Each of these research objectives is addressed in the course of this report.
### 1.5 Days Spent on Project

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<th>Punta Galeta</th>
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1.6 Theoretical Background

Following the creation of Law 41 in 1998, the republic of Panama has incorporated Environmental Impact Assessments (EIA) into its standard evaluation procedures for public and private works. With the creation of Law 41 la Comision National de Ambiente (ANAM) was also created- the official governmental body overseeing issues of environmental protection and management. Under the guidance of ANAM Panama is now nearing the end of its first decade of institutionalized environmental impact assessment and mediation procedures. The EIA is a standard tool employed in assessing the social and environmental impacts of development projects and provides a means of understanding potential project impacts affecting human well-being and the environment. This report constitutes a review, response, and re-evaluation of a series of impact assessments filed with ANAM for port expansion projects in the Zona Libre area near Colón. This evaluation follows the principles and guidelines that are commonly employed and accepted for environmental situation analysis and EIA implementation (Government of Panama 2006).

1.7 Methodology

Each element of this report necessitated a different methodology. The methodology that was employed is discussed in more detail in the relevant sections. For the situation analysis information was gathered by retrieving and evaluating environmental impact assessments filed with ANAM, by visiting various government offices (at The Maritime Authority, ANAM, and the zoning registry), through a literature review, and through informal discussions with various officials. The environmental impact assessment was primarily completed through a literature review that focused on examining scientific literature generated at Punta Galeta and nearby Caribbean mangroves. Lastly, the socio-economic impact assessment was conducted through informal interviews, formal interviews with the Coco Solo Norte Community, and literature review. The methodology for the socio-economic impact assessment interviews are discussed in more detail in that section of the report.
1.8 Ethical Considerations

Following the McGill Code of Ethics for researchers there are several aspects of this research project which required ethical consideration. Primarily, the researchers needed to consider the ethics involved in conducting formal and informal interviews of government officials and members of the Coco Solo Norte community. To ensure compliance with the McGill Code of Ethics the nature of the research project and the identity of the researchers was explained to all interviewees prior to questioning. All interviewees were informed that their consent was required for the interview process and no interviews were conducted without the consent of the interviewees. To assure anonymity, names were not collected or printed in the document for any interviewees other than officials and experts who work for the Smithsonian. The names of officials and experts that were published in this report were included with the formal consent of the interviewees.
2.0 Situation Analysis

Before a comprehensive impact study could be conducted the proposed developments needed to be systematically identified and described. The situation analysis was completed by consulting the zoning registry, relevant conservation laws, environmental impact studies filed at the ANAM offices in Colón and Panama City, and through a review of relevant literature.

2.1 Mangrove Forests – A Highly Threatened Ecosystem

Mangrove ecosystems are among the most threatened of the world’s major biomes, historically receiving far less attention from environmental managers and conservationist than their stature within the global environment warrants. As mentioned earlier, approximately 20% of the world’s mangroves have been lost since 1980 (Wilkie & Fortuna 2003). In total, approximately 35% of the world’s mangrove forests have been severally degraded or deforested. In the last two decades the extent and rate of habitat loss in mangrove forests has exceeded the much higher profile destruction of tropical rainforests and coral reefs (Valiela et al. 2001).

Panama has faired particularly badly in terms of mangrove losses as a nation; while it has conserved large amounts of its terrestrial forests, mangrove habitat has been lost rapidly. As a whole, Panama has lost approximately 56% of its mangroves since 1969 with mangrove cover shrinking from 360,000 ha to approximately 158,000 ha. The majority of these losses have occurred in the nation’s Pacific mangroves, which have accounted for the majority of Panama’s historic mangrove cover (FAO 1969; D’Croz 1993; WRI 2000). However, the rate of mangrove destruction has been highest on the Caribbean coast with mangrove cover dropping from 20,400 ha in 1980 to 5,900 ha by the mid 1990s, a loss of approximately 71% of the total Panamanian mangrove cover for the Caribbean coast (Ellison & Farnsworth 1996). Though specific measurements of mangrove loss in the Colón area are not available, it is known that large tracts of mangrove have been reclaimed around the city for port development and mangrove loss has been devastating and extensive.
In the early 1990s Duke et al. (1994) published an inventory of the mangroves that were present in the Punta Galeta reserve and the coastal area east of the city of Colón (and Northeast of the Colón Free-Zone), known collectively as Bahía Las Minas. At this time Duke et al. (1994) identified a total of 1232 ha of mangroves in the Bahía Las Minas area. At the time of his publication, Duke states that only approximately 73 ha of the Coco Solo portion of the Bahía Las Minas stand remained. The Coco Solo portion of the stand represents the area upon which the Zona Libre, Colón city housing developments, and port facilities now stand. It is important to note that 73 ha represents only a small fraction of the historic mangrove cover in this area as large amounts of mangroves were cleared in the area prior to 1994 for the construction of France Field Airport, the former US Navy Base at Coco Solo, and the Colón Free-Zone. Since 1994 mangrove deforestation in the Bahía Las Minas area has continued and the proposed Colón Container Terminal and Manzanillo International Terminal developments threaten to eliminate the last of the mangroves in the Coco Solo stand.
2.2 Legislative Situation- Law 41 of the 1st of July 1998

The Autoridad Nacional del Ambiente (ANAM) was created under Title 3, Chapter 1, Article 5 of Law 41 of the 1st of July 1998. According to its initial charter, this newly created ministry was to be charged with the protection, conservation, and management of natural resources in the Republic of Panama. Under Chapter 2, Article 23 of Law 41 ANAM is charged with the implementation of environmental impact assessments that are to be conducted as part of the approval process for new development projects. Under Chapter 2, Articles 24-26 of Law 41, all development projects must be clearly outlined and the impacts examined by an impartial third party as part of the environmental impact procedure. Once this is completed a report must be generated and submitted to ANAM for review and potential approval (Article 29). In addition, Law 41, Chapter 2, Article 27, mandates that environmental impact assessment must be open for public review and consultation and that information concerning developments must be freely accessible (ANAM 2005).

2.3 Legislative Situation - Zoning Legislation and Law 21

On July 2nd 1997 the Panamanian government, as part of the canal transfer negotiations, created Law 21, which delineated the zoning for land use of all land that was formerly part of the American controlled Canal Zone. Under this legislation a regional plan for the development of the inter-oceanic region and a general land use plan were created. While many areas of the Panama Canal watershed were reforested or fell into conservation land status, the mangroves of Bahía Las Minas were primarily zoned for development, as shown in Figure 2 (MMLC 2002).

In accordance with the zoning plan, the mangroves of Bahía Las Minas were subdivided and parceled into concessions that were made available to port developers and housing projects. The majority of the remaining mangroves (outside of Punta Galeta) reside within concessions owned by the Zona Libre and its associated businesses (MMLC 2002).
2.4 Legislative Situation - Punta Galeta’s Protected Landscape Classification

The mangrove stand surrounding Punta Galeta has been listed as a protected landscape according to Category V of the IUCN classification system. Under this definition, the mangrove areas present in the Punta Galeta Protected Landscape are said to be “…protected areas managed mainly for landscape-seascape conservation and recreation; an area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity…” Though the legal ramifications of this designation are unclear, it is important to recognize that the area has been designated by the Panamanian authorities as an area of special conservation concern and status (Earth Trends 2003).

2.5 Zoning Laws and Future Projects

Under the Panamanian Canal Area Zoning Law (Law 21, last modified in 1994) all the mangroves that remain in the Coco Solo mangrove stand are zoned for industrial and office development. This land area has been divided into various concessions that have been granted exclusively to the Zona Libre de Colón and its associated businesses.

In recent years the management of the Zona Libre de Colón and associated businesses have promoted a large scale multi-modal project that would include the expansions of the MIT (Manzanillo International Terminal) and CCT (Colón Container Terminal) container terminals (discussed subsequently), the expansion of the Panama Railway Company facilities in Colón, and the expansion of the France Field Airport (MMLC 2002). Ultimately the goal of these expansion projects is to create an international multi-purpose logistics center. When originally tabled, the development plan required the clearing of 451 hectares of mangrove forest for the creation of 7 industrial zones, as shown in Figure 2 (Jackson 2002; MMLC 2002). However, when proposed in 2002 as a single multi-billion dollar mega-project under the abbreviated title CEMIS, the Colón multi-modal project was undermined by accusations of corruption as well as political, environmental and social opposition. As a result, the project was ultimately discarded.

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1 The information presented in this report was gathered through informal conversations with ANAM personnel and management officials at the Zona Libre de Colón. Currently definitive information on these development proposals is not available.
and is remembered as one of the great political scandals in Panama’s recent history. For the time being, the Bahía Las Minas mangroves were allowed to persist, though the zoning laws remained unchanged (Jackson 2002).

Since their initial failure, the Zona Libre de Colón and its associates have chosen to promote the CEMIS project in several smaller sections. This has made the project more politically feasible but has not reduced the potential environmental and social impacts. At this time only the CCT and MIT port expansions have been officially approved (as discussed subsequently), while the railway and airport construction projects are still at the planning/rhetorical stage. If approved, these projects threaten to eliminate large sections of mangrove forest as their proposed development sites include large areas of mangrove forest. It is estimated that the France Field Airport expansion, planned to accommodate Bowing 747 and 737 cargo traffic and perhaps smaller tourist charters arriving daily, would consume more than 100 ha of pristine mangroves. It is estimated that the Panama Railway Company rail-yard expansion would consume a similar amount (MMLC 2002). Because the details of these proposals have not been released publicly and have not been reviewed by ANAM, exact construction details are not available. However, it is likely that these projects would have similar environmental impacts as the port expansions, though on a much larger scale.

At present only the CCT and MIT port expansions are official projects that are scheduled for construction. The sections of these projects which will directly affect the mangroves of Bahía Las Minas are now discussed.
Grey Areas are “Industrial and Office Zones,” Black areas are “Protected Forest Zones,” and Red areas are “Medium Density Housing Zones.”
2.6 Colón Container Terminal

Colón Container Terminal is a subsidiary of Evergreen Marine Corps, an international Taiwanese shipping firm. Established in 1968 by Dr. Yung-Fa Chang, the firm achieved international importance in 1984 when it pioneered full east-west container shipment services, growing thereafter until it became the second largest cargo shipping firm in the world. The company’s head office is in Taipei and it is from this location that the firm coordinates subsidiaries and port operations in more than 240 locations in 80 countries worldwide. Evergreen dominates five of the world’s major shipping lanes and commands a fleet of 150 vessels worldwide (Granitsas 2002). The company is dedicated to a credo of efficiency and low cost
operations, specializing in the management of large vessels with small highly trained crews. Evergreen’s operational motto is: “Evergreen gives earth a green name.” Nevertheless, Evergreen has had a checkered environmental past. In 2005, for example, The United States Justice Department ordered Evergreen to pay one of the largest fines ever issued against a private corporation as a result of a case involving deliberate vessel pollution. After pleading guilty to the charge of intentionally discharging 500 gallons of oil into the Columbia River near Kalama, Washington the company agreed to pay $25 million in fines. The investigation, which began in 2001, found that seven ships regularly and routinely discharged oily waste and sludge oil when in the Washington port (The Wall Street Journal 2005).

Paradoxically, the Evergreen S-type Greenship, designed especially for Evergreen, has received numerous environmental awards such as the Lloyds Register Environmental Protection award as well as awards from the American Bureau of Shipping. These tankers possess a double skinned hull with special placement of oil tanks on board to minimize the risk of oil spillage. In addition, the company systematically uses low sulfur fuels and has designed a special tin-free non-corrosive coating for their vessels which minimizes tin and chemical leaching into the environment (Evergreen Marine Corporation 2006).

2.7 Colón Container Terminal – Development Plans

Currently the Colón Container Terminal (CCT) is undertaking a large multi-phase expansion project at an estimated cost of $110,000,000 US. As an auxiliary to the portside development, CCT plans to construct two container storage yards in areas which are currently mangrove forest. The first of these is a 12.2 ha storage yard to be built at a development cost of $20,000,000 US and the second is a smaller 6 ha storage yard to be constructed at a cost of $5,000,000 US. In total the CCT expansion project will result in the conversion of 18.2 ha of land from mangrove forest to concrete container platforms. The two yards will be built side by side along Randolph road and will touch the boundary of the Punta Galeta Protected Landscape (Galeta road) on the northern side of the development. The small Coco Solo Norte Community is directly beside the proposed development zone on the opposite side of Randolph road (L.L & O. Company 2005; L.L. & O. Company 2006). See Figure 3 and Appendix I for Development Maps.
2.8 Colón Container Terminal – Environmental Impact Statement

The two CCT environmental impact statements are nearly identical with only a few changes when describing the specific construction plans of each project. Thus, these documents are considered together and differentiation between the two documents is necessary only for a few points. Key points and areas of dispute are the focus of this examination and the entirety of the CCT Environmental Impact Statements will not be discussed. The CCT Environmental Impact Statements were filed at the Colón ANAM office under the names:

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3 La Zona Libre refers to *La Zona Libre de Colón*, CCT refers to *Colón Container Terminal (Evergreen)*, MIT refers to *Manzanillo International Terminal*. Development sites (shown in red boxes) are approximations of the size and shape of the development sites and should not be considered exact. Dark green areas are mangrove forest cover.


The CCT projects’ anticipated positive impacts are exclusively economic. As mentioned, the two CCT container storage projects will be constructed at a combined cost of approximately $25,000,000 US. This investment will create 50 temporary construction jobs during the eight month construction period. Once construction is completed 10 permanent jobs will be available in the CCT container storage yards, though the details of these positions were only vaguely stated. CCT believes that this project will benefit the Panamanian economy by bringing in foreign currency, by creating jobs, and by helping to maintain ‘international competitiveness’ through upgraded port facilities (L.L & O. Company 2005; L.L. & O. Company 2006).

The CCT environmental impact statement discusses several anticipated negative impacts. These include:

- A negligible (and monitored) impact on water and air quality
- Noise Impact from construction and trucks; The CCT report argues that the impact on the nearby Coco Solo Norte community will be minor because truck activity will be confined to regular working hours. They believe this impact can be reduced by maintaining equipment regularly. They argue that noise will not impact wildlife because few noise susceptible species occur in the area.
- All garbage and cuttings will be removed and so there will not be an impact from refuse.
- They believe there will be ‘no affect’ on the adjacent Punta Galeta Marine Reserve, which the development will border.
- Deforestation of mangroves; The CCT report states that approximately 29.2 ha of mangrove will be indirectly affected by the development (300 m radius from the development) while 18.2 ha will be completely deforested. Furthermore, they argue that since this area is part of the humid tropical rainforest that covers 32% of Panama it cannot be considered a unique ecosystem.
- Biodiversity; The CCT report acknowledges the presence of 10 endangered vertebrate species within the development zone and one endangered species of tree (*Rhizophora sp*).
Endangered vertebrates include the Central American agouti - Ñeque (*Dasyprocta punctata*), Raccoon (*Procyon lotor*), White Faced Capuchin Monkey (*Cebus capucinus*), Mantled Howler Monkey (*Alouatta palliate*), White Faced Coati (*Nasua narica*), the Green Iguana (*Iguana iguana*), Boa Constrictor (*Boa constrictor*), Spectacled Caiman (*Caiman crocodilus*) and two species of pigeons.

- In addition, they estimate the following diversity values for the development area:
  - Invertebrates: They do no examine invertebrate diversity
  - Mammals: They argue that 8 mammal species can be found in the area.
  - Reptiles: They identify 9 reptile species that can be found in the area.
  - Amphibians: They identify only one amphibian species; The Giant Toad (*Bufo Marinus*). They argue other frogs cannot live in the area due to high salinity.
  - Birds: They argue that only 32 species of birds inhabit the area.
- According to the CCT reports these diversity numbers were determined through consultation with ANAM staff, through field observation, and by consulting the staff at the Punta Galeta Marine Laboratory.
- The CCT report argues that this development will actually increase diversity by creating a new roadside habitat for many species (ie. Palms) which are not native to the nearby mangroves. By creating a habitat for new species the development will increase the biodiversity of the area.
- Remediation measures include planting 1500 trees along the road for aesthetics, monitoring air and water quality, and erosion prevention through the use of a drainage ditch. In addition, CCT stated its intention to move endangered vertebrate species to ‘acceptable’ habitats the day before construction. How this will be done, which species will be moved, and where they will be relocated to is not discussed.
- In the report it is stated that consultations with the people of the Coco Solo Norte community were conducted and that these people were found to generally support the project. Concerns expressed by the community include worries over the impact of the development on the environment and who would be employed by the newly created positions. CCT states in the reports that they intend to maintain constant communication with the Coco Solo Norte Community, which lies across the street from the development site.
2.9 Summary of Refutation – CCT

There are several important points where the findings of these authors differ from the opinions express in the CCT Environmental Impact Statements. Points of contention are summarized below and will be discussed in more detail subsequently. The authors of this report believe that:

- The mangroves in the cut area are not heavily degraded and act as an essential buffer protecting the mangroves within the Punta Galeta Reserve. Sufficient marine water reaches these mangroves for the ecosystem to be maintained. This area has considerable natural value and is not equivalent to the much more common Humid Tropical Forest. This mangrove ecosystem is fundamentally different, far less common, and rapidly disappearing when compared to the Humid Tropical Forest of Panama (as discussed above).

- There are considerable biodiversity values not identified in the CCT reports. The species counts presented in the CCT report are far lower than those which have been documented by the scientists of the Punta Galeta Marine Laboratory, who have monitored the area for over 40 years. For example, while the CCT report indicates that 32 species of birds live in the development area, the scientists of Punta Galeta have documented more than 200 species. Furthermore, despite their high ecological importance within mangroves, invertebrates are neglected by the CCT report.

- Endangered species: Many of the ‘endangered’ species listed in the CCT report are either not listed as endangered (ie. The Northern Raccoon) or have never been previously documented in the development area (ie. Howler monkeys). This may result from a misuse of terminology by the CCT authors, though this is unclear. Furthermore, several officially endangered species that do frequent the area (ie. The American Crocodile) are not discussed in the CCT report.

- Numerous potential environmental impacts are not studied, addressed, or discussed by the CCT reports. These include:
  - Noise impacts: The impact of noise cannot be considered negligible simply because human settlements are unaffected. Noise may have a substantial unidentified impact on wildlife.
The impact of erosion and sedimentation on nearby ecosystems.

The impact of the development on the Punta Galeta Protected Landscape and the considerable scientific activity of the Punta Galeta Marine Laboratory. The CCT report dismisses the possibility that the development will impact this protected area.

The presence and impact on several endangered species.

The impact on connected ecosystems, particularly sea grass beds and coral reefs.

The potential for this development to destabilize toxic sediments sequestered in the mangroves during the Galeta oil spills.

Potential economic and environmental losses associated with degraded ecosystem services. These include losses in the ability of the mangroves to function as fisheries nurseries, storm protection, and erosion control.

The non-economic impacts on the nearby Coco Solo Norte community.

Alternative options for development and alternative development sites are not identified, studied, or discussed.

- We do not dispute the statement that the impact on water and air pollution will be negligible. However, water quality is dismissed as simply meaning the level of pollutants present in the water. Suspended sediments and nutrient loading associated with erosion is likely to impact water quality. There is no discussion of the potential salinization of inland waters and land as a result of mangrove removal.

- The environmental management funds identified are not sufficient to protect the integrity of nearby ecosystems. In particular, erosion control measures are not adequately discussed and the impacts on local hydrology are ignored.

- The CCT reports’ claim that the development will create a new ‘roadside’ ecosystem is highly erroneous. The roadside ecosystem represents a highly degraded environment characterized by invasive species, low productivity, low diversity, and low value in terms of ecosystem services.

- The CCT reports lack scientific merit: Virtually no relevant scientific literature is reviewed, the methodology of the study is not discussed, and the findings of the report are drastically different than those of the Punta Galeta Marine Laboratory researchers and conventional wisdom in the field of study. Several examples of this exist. As discussed,
species are identified in the development zone which have never been previously documented in the area, tree allometric data is presented that is inconsistent with the mangroves of Panama, and species are identified as being ‘endangered’ which are not recognized as endangered by any known regulatory body.

- There are serious questions regarding the honesty of data presented in the reports. In the reports it is stated that staff and researchers at the Punta Galeta Marine Laboratory were consulted regarding the biological diversity of the area, however, none of the staff or scientists of the laboratory have any recollection of being consulted in this manner. Furthermore, when conducting surveys in the Coco Solo Norte community the authors of this report found no evidence to indicate that the CCT researchers had actually informed the community of the development plans and interviewed them regarding their opinions. Of the 30 adults interviewed in the ~250 person Coco Solo Norte community, none of them acknowledged being interviewed or otherwise consulted by staff from the CCT and none of them had any recollection or knowledge of visits by CCT researchers. Furthermore, the vast majority of adults in the community were not aware of the impending development even though it is being built across the road from their community. These results suggest very strongly that the ‘Coco Solo interview’ data presented in the CCT environmental impact statement was entirely fabricated. (***Please note: The results and methodology of the survey conducted by the authors of this paper are discussed in more detail in the Socio-Economic Analysis)

Each of these points is discussed in more detail throughout this report. For the reasons identified above, a more detailed and objective study of the environmental impacts of the CCT development project is required.

### 2.10 Manzanillo International Terminal

MIT began operations in 1995 and offers port services to ships transiting the Panama Canal and shipping line servicing for the Caribbean and South America. Manzanillo does not operate its own shipping division and operates the Manzanillo International Terminal near Colón as its primary activity. With 800 employees MIT is the largest and most productive transshipment hub in Latin America. The terminal was built on the old Coco Solo Sur US Navy
Sea plane base by the Manzanillo corporation, a partnership between Carrix Inc. and the Motta and Heilbron families (MIT 2007).

Because MIT was built on the site of the old Coco Solo Sur Navy Base, the construction of their port-side facilities did not damage the mangroves directly, although this area was historically mangrove (Heckadon-Moreno, personal communication, January 12, 2007). However, container storage, warehousing, and maintenance yards associated with MIT have been built over mangrove forest resulting in the deforestation of 82 ha (Vargas 2005).

### 2.11 Manzanillo International Terminal – Development Plans

Currently the Manzanillo International Terminal (MIT) is undertaking a large expansion project involving the construction of several pieces of infrastructure on cleared lots (former mangrove) and in the portside area. In total the MIT expansion is a $210,000,000 US project that will span several years and five development sites (Zones A to E). Only the container storage area in Zone C (as labeled in Vargas 2005) will involve the clearing of new areas of mangrove forest though several other buildings will be placed in areas that were formerly mangrove but are already cleared. MIT intends to clear an additional 12 ha of mangrove forests in Zone C for the construction of a concrete container storage platform. Zone C will neighbor the CCT developments already discussed and will be built along the south side of the planned CCT container yard (Vargas 2005). See Figure 3 (above - Section 2.7) and Appendix I for Development Maps.

### 2.12 Manzanillo International Terminal – Zone C - Environmental Impact Statement

Because Zone C is the only area of the MIT expansion that is planned in existing mangroves, this analysis will focus on this area specifically. Key points and areas of dispute are the focus of this examination and the entirety of the MIT Environmental Impact Statement will not be discussed. The MIT Environmental Impact Statement was filed at the Colón ANAM office under the name:
The MIT project’s anticipated positive impacts are exclusively economic. As mentioned, the entire MIT expansion project will cost approximately $210,000,000 US and is expected to create 120 construction jobs followed by 75 permanent positions when construction is completed. MIT believes that this project will benefit the Panamanian economy by bringing in large cash investment, by creating jobs, and by increasing the local tax base through increased economic activity. While this may be true, the MIT statement neglected to discuss where money will be spent and in which of the five development zones job creation will occur. Thus, the economic benefits of the relatively small Zone C development is not specifically stated (Vargas 2005). Given that a similarly sized area providing a similar function is expected to generate 10 permanent positions at a development cost of $5,000,000 in the nearby CCT container yards, it can be expected that the Zone C development will generate a similar number of positions (L.L. and O Company 2006).

The MIT environmental impact statement discusses several anticipated negative impacts. These include:

- A negligible (and monitored) impact on water and air quality
- Noise Impact from construction and trucks; The MIT report argues that since their development is not near human habitation the noise impact will be negligible.
- Deforestation of mangroves; The MIT report argues that the mangroves in this area are already heavily degraded and surrounded by industrial developments. Furthermore, they argue that very little marine water reaches this area due to other development projects and that this forest is part of the humid tropical rainforest that covers 32% of Panama. For these reasons this area cannot be considered a unique ecosystem.
- Biodiversity; The MIT report does not highlight the presence of any endangered species within Zone C. In addition, they do not provide species number estimates for any group. Identified biodiversity is as follows:
  - Invertebrates: They identify several taxonomic orders of insects that occur in the area.
Mammals: They argue that mammals are rare in the area other than four species which occasionally frequent Zone C. These are Geoffroy’s Tamarin (Saguinus geoffroyi), Mantled Howler (Alouatta palliata), and two species of rabbits.

Reptiles: They identify only Ameiva ameiva, Iguana iguana, and several species of anoles in the development area.

Amphibians: They identify only The Giant Toad (Bufo marinus) as a species that occurs in the development area. However, they speculate that species of Ranidae and Hylidae frog also occur in the area.

Birds: The only bird species which are identified in the development area are two species of vulture, Brotogeris jugularis (a parakeet species) and Tachycineta albilinea (a species of swallow).

- The MIT report argues that invertebrates are the main group to be affected by the development as other species will simply move to nearby forest.
- They acknowledge that mangroves are important for cleaning air, water, for accumulating sediments, and for preventing erosion.
- Remediation measures include $2000/year for noise monitoring, $1500/year for garbage clean-up and aesthetic tree planting, water quality checks 3 times per year, and regular maintenance of equipment and trucks to minimize noise and pollution.

2.13 Summary of Refutation – MIT

There are several important points where the findings of these authors differ from the opinions express in the MIT Environmental Impact Statement. Points of contention are summarized below and will be discussed in more detail subsequently. The authors of this report believe that:

- The mangroves in the cut area are not heavily degraded and act as an essential buffer protecting the mangroves within the Punta Galeta Reserve. Sufficient marine water reaches these mangroves for the ecosystem to be maintained. This area has considerable natural value and is not equivalent to the much more common Humid Tropical Forest. This mangrove ecosystem is fundamentally different, far less common, and rapidly
disappearing when compared to the Humid Tropical Forest of Panama (as discussed above).

- There are considerable biodiversity values not identified in the MIT report. Species counts reveal high biodiversity, particularly for bird species. Furthermore, in depth analysis reveals the presence of several endangered species of plants and animals. Mammals are not ‘virtually non-existent’ in this area and numerous mammal species use this habitat.

- Invertebrates are not the only group that will be affected. Birds and other vertebrates cannot simply ‘move’ to nearby habitat.

- The report acknowledges the importance of the mangroves for cleaning air and water, for accumulating sediments, and for preventing erosion. However, the impacts on these ecosystem services are not discussed.

- Numerous potential environmental impacts are not studied, addressed, or discussed by the MIT report. These include:
  - Noise impacts: The impact of noise cannot be considered negligible simply because human settlements are unaffected. Noise may have a substantial unidentified impact on wildlife.
  - The impact of erosion on nearby ecosystems.
  - The impact of the development on the Punta Galeta Protected Landscape and the considerable scientific activity of the Punta Galeta Marine Laboratory.
  - The presence and impact on several endangered species.
  - The impact on connected ecosystems, particularly sea grass beds and coral reefs.
  - The potential for this development to destabilize toxic sediments sequestered in the mangroves during the Galeta oil spills.
  - Potential economic and environmental losses associated with degraded ecosystem services. These include losses in the ability of the mangroves to function as fisheries nurseries, storm protection, and erosion control.
  - The non-economic impacts on the nearby Coco Solo Norte community.
  - Alternative options for development and alternative development sites are not identified, studied, or discussed.
• We do not dispute the statement that the impact on water and air pollution will be negligible. However, water quality is dismissed as simply meaning the level of pollutants present in the water. Suspended sediments and nutrient loading associated with erosion is likely to impact water quality.

• The environmental management funds identified are not sufficient to protect the integrity of nearby ecosystems. In particular, erosion control measures are not adequately discussed and the impacts on local hydrology are ignored.

Each of these points is discussed in more detail throughout this report. For the reasons identified above, a more detailed and objective study of the environmental impacts of the MIT development project is required.

2.14 Conclusion

In summation, this situation analysis has found that the zoning laws in the Bahia Las Minas mangroves allow for considerable development space with no land conservation outside of the small Punta Galeta protected landscape. Currently two port expansion projects are scheduled for construction, both of which plan to build part of their infrastructure (specifically container yards) in old growth mangroves. As discussed, the environmental impact assessments submitted for these studies are shockingly incomplete and in some areas dishonest (particularly CCT). Lastly, two much larger development projects (the airport and rail-yard expansions) are also being discussed in the Bahia Las Minas area. Now that the development situation has been outlined, environmental values that will be impacted by the development projects are identified and discussed through a literature review.
3.0 Environmental Impact Assessment

In this section of the report scientific literature is reviewed that is relevant to the points of refutation discussed in the ‘Summary of Refutation’ sections. Through this review it will be shown that the findings of the MIT and CCT environmental impact statements underestimate the importance of Colón’s mangrove forests. Furthermore, it will be shown that this ecosystem is critically important for the region’s ecology, that it holds significant scientific and educational values, and that conservation measures are necessary to preserve the integrity of the local and regional environment.

3.1 The Mangrove Ecosystem – Basic Ecology

In much of the tropics mangroves form the juncture between the terrestrial and marine environments. Typically mangrove forests occupy the dynamic inter-tidal zone where they are periodically inundated with sea water. As a result, mangrove forest are defined by species of trees that are adapted to periodic desiccation, high salinity, variable soil level temperature, and periodically severe weather conditions (Hogarth 1999).

The mangrove trees which create and sustain the mangrove forest ecosystem represent a wide variety of taxa that are related by ecosystem function rather than through genetic heritage. Thus, while mangrove trees are not closely related to one another genetically, they grow under similar conditions, are subject to similar ecological stresses, and display similar adaptive features (Duke 1992).

The distribution of mangrove species within a mangrove forest is related to the level of seasonal seawater inundation. In the mangroves surrounding Punta Galeta red mangrove (*Rhizophora mangle*) lives in nearly pure stands at 10-20 m from the water’s edge. In the low inter-tidal zone white mangroves (*Laguncularia racemosa*) also become common and share the habitat with the red mangrove. In the mid-inter-tidal zone black mangroves (*Avicennia germinans*) begin to grow alongside the white mangrove while the red mangrove becomes rarer. Finally, in the upper inter-tidal zone black mangroves form almost pure stands with trees of up to 30 meters. Thus, there is a gradual transition in species dominance from red, to white, to black mangrove trees as one moves further inland (Sousa *in press*; Duke *et al.* 1994; Sousa 1998). In
the mangroves around Punta Galeta the red mangrove (*Rhizophora mangle*), the white mangrove (*Laguncularia racemosa*), and the black mangrove (*Avicennia germinans*) are the three most common species, however, 6-8 species⁴ of mangrove trees occur in the Caribbean mangroves of Panama (Duke *et al*. 1994; Sousa 1998).

### 3.2 Mangrove Ecosystem Services and Economic Values

Ecosystem services are those services and products created by natural ecosystems which directly benefit humankind. These services have measurable economic value and include such things as clean water, clean air, raw materials, food, habitat, etc. (Eamus *et al*. 2005). In traditional economic analyses ecosystem services have largely been neglected and, as a result, the true value of ecosystems is often understated in cost benefit analyses. In the MIT and CCT environmental impact statements ecosystem services are not discussed and the economic value of mangrove ecosystem services is ignored. However, mangroves provide a wide variety of ecosystem services which have both direct and indirect economic value (Harborne *et al*. 2006).

First and foremost, mangroves are vital for the breeding, growth, and maintenance of a variety of commercially important fish species. As discussed earlier, mangroves host a great diversity of fish and invertebrate fauna. Because mangroves provide a salt water environment that is sheltered from most large predators, many fish and shark species breed near mangroves and use mangrove ecosystems worldwide as a nursery for their young (Nagelkerken *et al*. 2000; Feldheim & Edren 2002). The Caribbean mangroves of *Bahía Las Minas* are known to function as a nursery and refuge for the young of commercially important crabs, spiny lobster (Marx & Herrnkind 1986), penaeid shrimp (Stoner 1988), and over 200 species of fish, many of which are commercially harvested species (Austin 1971; Philips 1981; Louis & Guyard 1982). When mangroves are destroyed or degraded their function as fisheries nurseries, water filters, and food sources for marine species are also removed. As a result, it has been found that both fisheries and aquaculture activities are heavily dependant on nearby mangroves, and where mangrove ecosystems have been degraded or removed in the Caribbean, these industries have suffered (Ronnback *et al*. 2003). In addition, recent studies have found that the long term sustainability of

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⁴ The number of species depends on the definition of what is and is not a mangrove species. There is considerable debate over whether or not some species should be considered ‘mangrove’ trees (Duke 1992; Duke *et al*. 1994).
coastal aquaculture projects is heavily dependant on the health of surrounding mangrove ecosystems. Where mangroves have been removed, coastal fisheries and aquaculture production have historically suffered (Gunawardena & Rowan 2005).

The fisheries sector is vital to the Panamanian economy and currently fisheries products are the nation’s second largest export. In total, the Panamanian fisheries industry has an annual productivity worth approximately $250.8 M USD and it employs ~1500 industrial fishermen, ~13,000 individual and artisanal fishermen, and ~37,500 people in processing activities. In addition, tens of thousands of other jobs are created by this industry through indirect employment and aquaculture activities (FAO 2007). Clearly the fisheries resources that are maintained by healthy mangrove ecosystems have major economic value and are essential for the Panamanian fishing industry and for employment. In particular, these resources are vitally important for thousands of poor subsistence fishermen, including the impoverished artisanal fishermen of Colón’s La Playita community (Chirchikova et al. 2006).

Another important ecosystem service provided by mangroves is flood and storm protection. A wealth of scientific literature exists examining this ecosystem function and it has been found repeatedly that mangrove ecosystems are among the most valuable biomes in the world in terms of providing storm protection and flood control. The value of mangrove ecosystems at reducing property damage and loss of human life caused by storm events is well documented (Mazda et al. 1997; Massel et al. 1999; Chong 2005). Mangroves are extremely effective at protecting coastal communities from cataclysmic weather events. In the aftermath of the 2004 Asian tsunami, for example, it was found that communities which were protected by healthy mangrove forests suffered far fewer casualties and far less severe property damage than those areas which had highly degraded or converted their coastal forests (Badola & Hussain 2005; Dahdouh-Guebas et al. 2005; Danielsen et al. 2005; Kathiresan and Rajendran 2005; UNEP 2005). As a result of this realization, many of the East Asian governments affected by the Tsunami are now investing heavily in mangrove reforestation and conservation projects (Barbier 2006). The high rate of mangrove deforestation around the city of Colón has already caused major storm related environmental impacts and parts of the city, including the Zona Libre and Cuatro Altos areas, have flooded several times in the last decade. Wet season flooding in Colón is expected to intensify as mangrove deforestation continues (SINAPROC 2006). Given climate change related transformations to world weather patterns, the expected intensification of
worldwide storm activity, and rising sea levels, the importance of mangrove ecosystems for their flood control and storm protection functions should not be ignored.

In addition to the paramount ecosystem services already discussed, mangroves provide a variety of other valuable services. Mangroves are known to reduce coastal erosion and siltation, while also contributing to the long term stabilization of the coast and the process of coast building (Fondo & Martens 1998; Mazda et al. 2002). These services are particularly important when linkages to surrounding ecosystems are considered as sediment stabilization is vital for the health of sea grass beds and coral reef communities. This is discussed in more detail in the ecosystem linkages section. Also, mangroves are highly effective at water purification and are particularly useful for absorbing excess nitrates and phosphates that result from agricultural activities as well as effluents that would otherwise contaminate inshore waters (Nagelkerken et al. 2000). For example, as discussed in more detail in the Toxic Sediments section (section 3.5), the mangroves of Bahía Las Minas were effective at controlling and sequestering oil during the 1986 oil spill (Levings et al. 1994).

As discussed, mangrove ecosystems provide a variety of direct economic benefits (aka ecosystem services) that have been entirely overlooked in the cost benefit analysis of the development projects. It should be noted that the list of ecosystem services discussed thus far is not complete and the economic value of mangroves expands exponentially when linkages with other ecosystems and less easily defined values, such as biodiversity, the spiritual and aesthetic value of nature, and subsistence utilization, are also discussed (Gunawardena & Rowan 2005). In order to simplify the argumentation of this analysis, the value of mangrove ecosystems for biodiversity, as a source of subsistence income, as a source of aesthetic and cultural values, and in terms of ecosystem linkages is discussed in other sections of the report. However, it should be noted that these services also have well recognized, albeit indirect, economic value. Tables 1 and 2 (below) summarize the trends and anticipated impact on ecosystem services discussed in this document.

While quantifying the economic value of mangrove ecosystems is inherently difficult, total ecosystem valuation estimates have been conducted in the past. In Sri Lanka, for example, it was estimated that mangrove ecosystems were worth $493/ha/year locally and $1088/ha/year
when economic values associated with outside ecosystems\(^5\) were also considered (Gunawardena & Rowan 2005). However, values associated with storm and flood protection, biodiversity, aesthetics, and culture were not incorporated into this analysis and these values are highly variable geographically and much more difficult to quantify.

**Table 1: Trend Symbol Legend**

<table>
<thead>
<tr>
<th>Trend Prior to Development*</th>
<th>Anticipated Effect of Development**</th>
<th>Impact Level***</th>
<th>Remediation****</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral ⇒</td>
<td>Neutral ⇒</td>
<td>1 Small Degradation with cumulative relevance at regional scales only</td>
<td>☺ Reversible without remediation</td>
</tr>
<tr>
<td>Increasing ↑</td>
<td>Increasing ↑</td>
<td>2 Degradation of Ecosystem Function with no replacement required</td>
<td>☺ Reversible with remediation</td>
</tr>
<tr>
<td>Increasing Rapidly ‥ ‥</td>
<td>Increasing Rapidly ‥ ‥</td>
<td>3 Severe Degradation of Ecosystem Function with partial replacement required</td>
<td>☹ Irreversible despite remediation</td>
</tr>
<tr>
<td>Decreasing ↓</td>
<td>Decreasing ↓</td>
<td>4 Cessation of Ecosystem Function with full replacement required</td>
<td></td>
</tr>
<tr>
<td>Decreasing Rapidly ‥ ‥</td>
<td>Decreasing Rapidly ‥ ‥</td>
<td>5 Severe Degradation or Cessation of Ecosystem Function with no replacement possible</td>
<td></td>
</tr>
<tr>
<td>Unknown ?</td>
<td>Unknown ?</td>
<td></td>
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</table>

*Pre-development trends* refer to the trend in the ecosystem service in the last 20 years. These trends were driven primarily by the conversion of mangrove forest into industrial space for la Zona Libre de Colón, CCT, MIT, and the Colón multi-modal project.

**Post development trends** refer to trends in the ecosystem services that are expected to occur as a result of the current CCT and MIT expansion plans.

***Impact level** refers to the scale of the impact (resulting from the proposed developments) and the consequential need for ecosystem service substitution or replacement through artificial means.

****Remediation/Reversibility refers to the ability to remediate or reverse the environmental impact at a reasonable cost.

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\(^5\) Values are in $USD. Examples of values associated without outside ecosystem include commercial fish species that are harvested outside the mangrove but which feed on mangrove species, the maintenance of healthy coral reefs through erosion control, etc. These types of linkages are discussed in more detail in the ecosystem linkages section.
<table>
<thead>
<tr>
<th>Ecosystem Services</th>
<th>Pre-Development Trend</th>
<th>Post-Development Trend</th>
<th>Impact Level</th>
<th>Reversibility/Remediation</th>
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<tr>
<td>Aesthetic Values</td>
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<td>Erosion Regulation</td>
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<td>Wild Foods</td>
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</tbody>
</table>

*Economic Development and Employment were added to highlight the benefits of the developments. These are not ‘ecosystem services.’
From this analysis it should be abundantly clear that the mangrove ecosystems of Bahía Las Minas have a very high economic value and provide a variety of services that are important for the greater environment as well as human communities. These values have not been adequately addressed by the environmental impact statements submitted by CCT and MIT.

3.3 Biodiversity and the Mangroves of Bahía Las Minas

As mentioned earlier, the species diversity estimates provided in the CCT and MIT environmental impact assessments greatly underestimate the biodiversity value of the mangrove ecosystem. While a comprehensive assessment of terrestrial species biodiversity has not been conducted in the mangrove forests of Bahía Las Minas, exploratory analysis suggests that the area has considerable biodiversity value. For example, on May 17-18, 2003 the Punta Galeta Marine Laboratory hosted an international biodiversity day. As part of this event, 221 volunteers, researchers, and students conducted a species inventory of the terrestrial environment surrounding the laboratory, documenting all of the species encountered in the 24 hour period. During this time 316 species of plants, 32 macro-fungi, 10 amphibians, 13 reptiles, 30 mammals, and 150 birds were documented in the mangroves surrounding Punta Galeta (Punta Galeta Marine Laboratory 2003). These numbers represent a baseline diversity value, as many taxonomic groups were not comprehensively examined (ie. terrestrial invertebrates) and many rare or migratory species were likely missed. In the case of birds, for example, it is estimated that 200-250 species frequent the mangroves of Bahía Las Minas but that many migratory or rare species were missed during the exploratory 24 hour investigation. This is supported by recent field experience where the authors of this report, during casual observation, identified several species that were not documented during the biodiversity day. These includes three species of unlisted birds (Black Bellied Plover – *Pluvialis squatarola*, Ruddy Turnstone – *Aernaria interpres morinella*, and American Pygmy Kingfisher – *Chloroceryle aenea*) as well as two species of unlisted mammals (Common Opossum – *Didelphis marsupialis* and White Nosed Coati – *Nasua narica*). Thus, the actual species numbers are likely much higher than those observed during the biodiversity day, even for those groups which were studied thoroughly (Punta Galeta Marine Laboratory 2003). In addition, there are many groups that were not studied during the biodiversity day which have high biodiversity values. It is known, for example, that
the mangrove forests of *Bahia Las Minas* and the Caribbean of Panama have the highest mangrove associated invertebrate fauna in the world, with over 90 species of crabs in the Punta Galeta area alone (Farnsworth and Ellison *in press*).

When ecosystem linkages are considered it becomes clear that the biodiversity value of mangrove forests is staggering. In addition to the diversity of animal and plant life that is found in the mangrove itself, there are considerable linkages between the mangrove, sea grass, and coral reef communities and many studies have suggested that the even greater biodiversity values of the offshore reefs are strongly dependant on the mangrove ecosystem. For example, Heck (1977) found that the invertebrates in the waters of *Bahia Las Minas* regularly move between the mangrove, sea grass, and reef environments during different parts of their life cycle. If the biodiversity value of connected ecosystems (sea grass beds and coral reef) are also considered then the biological diversity value of the mangrove forest is considerable. The linkages between the mangroves and surrounding ecosystems are discussed in more detail subsequently and the interdependence of these ecological systems will be shown in the *Ecosystem Linkages* section (section 3.4).

Finally, the mangrove ecosystem provides critical habitat for the endangered American Crocodile – *Crocodylus acutus*, a species which retains an abundant and actively breeding population in the mangroves of *Bahia Las Minas* (Punta Galeta Marine Laboratory 2003; IUCN 2007). Again, if ecosystem linkages are considered then a wide variety of endangered animals that live in the offshore environment are supported by the mangrove ecosystem. These include many endangered species of sharks, rays, sea turtles, and reef fish such as *Lachnolaimus maximus*, an endangered hogfish (IUCN 2007).

It is clear from this analysis that the biodiversity value of the mangrove forest is far greater than expressed in the CCT and MIT environmental impact assessments. It is highly likely that continued habitat destruction in the *Bahia Las Minas* mangroves will have harmful effects on biodiversity and species will be lost as suitable habitat disappears.
3.4 Mangrove Ecosystem Linkages

Mangroves, owing to their unique ecology as terrestrial pioneers fringing on marine systems, occupy the transitional zone between aquatic and terrestrial habitats. From this unique location they form important linkages between terrestrial and marine ecosystems. Mangroves are essential to the productivity of near shore habitats and the fallen leaves and branches of mangroves are an important part of the aquatic nutrient cycle, supporting a large biomass of detritus feeders that are an essential part of the intricate food webs of shallow marine communities (Gonneea et al. 2004). However, the importance of energy and biomass flows emerging from mangroves varies greatly between sites.

Beyond the input of detritus, the mangroves of Colón affect the productivity of sea grass beds and coral reefs in another important way. Unlike most terrestrial habitats few species that occupy the mangroves are permanent residents of the ecosystem, other than the mangrove trees and associated epiphytes themselves. Nearly all other species which inhabit the mangrove ecosystem use this environment during part of their life cycle only and they occupy other habitats, such as tropical forest, sea grass beds, coral reefs, or open ocean for the remainder of their lives. As a result, energy (in the form of biomass) flows in and out of the mangrove ecosystems almost constantly. The movement of fish between mangroves and adjacent sea grass beds, for example, has long been documented. At low tide when fish cannot physically occupy certain areas of the mangroves, they retreat to the sea grass beds surrounding the mangroves (Jelbart et al. 2007) from which they can still retreat into the shallow creeks linked to the mangrove ecosystem when threatened (Robertson & Duke 1990a). As discussed, mangrove habitats are recognized as important nursery habitats for many species of fish and invertebrates that are commercially important (Monterossa 1991; Pinto & Punchichewa 1996; Kieckbusch et al. 2004). As a result, destruction of mangroves can result in the loss of marine species that spend the majority of their lives many kilometers away. Because of their function as nurseries and the energy that they provide to surrounding ecosystems, mangrove have been found to increase fish abundance and diversity in adjacent sea grass beds and coral reefs (Jelbart et al. 2007).

In addition to providing habitat for migratory species and nursery grounds, the mangroves of Colón support diversity in surrounding ecosystems by sheltering them from
anthropogenic changes. Through the stabilization of coastlines mangroves prevent erosion and siltation; a process that can be particularly damaging to sea grass and coral reef communities (Fondo & Martens 1998). In a Thai study, for example, the disappearance of mangrove cover along coasts was correlated to the loss of coastal terrain. The only areas in the study where the coastlines were found to expand were at the edge of mangrove forests. Upstream deforestation or river blockage associated with damming or port development was linked to increased siltation levels, erosion, and the degradation of downstream mangroves (Thampanya et al. 2006). Where mangroves are removed siltation increases which causes water clarity to decline. This causes less light to reach the sea grasses and the corals, significantly reducing photosynthesis. When sustained over long periods siltation can eventually result in the extirpation of species and may favor the persistence of species best adapted to the new conditions, thus reducing structural complexity and biodiversity (Molles 2005). As the mangroves of Bahía Las Minas continue to disappear, the flora and fauna of associated ecosystems will also suffer.

From this analysis it should be clear that the removal of mangrove forests affects the ecosystems that are linked to them in a variety of ways. As mangroves continue to be deforested the loss of habitat for migratory species, the loss of the mangroves as a nursery, the loss of energy flows to other ecosystems, and the loss of erosion/siltation protection will affect adjacent ecosystems adversely, particularly sea grass beds and coral reefs.

3.5 Toxic Sediments

In 1986 a major oil spill occurred in the Bahía Las Minas area that involved the accidental release of 50,000 barrels of medium weight crude oil, resulting in the oiling of the coral reefs, sea grass beds, and mangrove forest along the coast east of Colón (Burns et al. 1993). After causing massive ecological damage in the coastal ecosystems, large amounts of oil from the Bahía Las Minas spill became trapped in mangrove sediments, penetrating as deep as 20 cm due to the presence of open crab holes (Burns et al. 1994). While somewhat effective at sequestering oil within their sediments, numerous studies in the Galeta mangroves have indicated that the anoxic conditions in mangrove sediments maintain the toxicity of oil for 20 years or longer (Corredor et al. 1990; Burns et al. 1994; Levings et al. 1994). While repeated re-oiling events occurred following rains and mangrove die-offs in the years after the initial spill, the re-
release of oil into the environment has gradually declined (Levings et al. 1994). This has occurred as the coastal mangroves, which experienced massive die-offs immediately after the spill, have re-grown and re-established mature root systems capable of stabilizing sediments and preventing continual re-oiling (Guzman & Holst 1993; Burns et al. 1994; Garrity et al. 1994). While the highly toxic sediments created by the 1986 oil spill are a major ecological concern in the Bahía Las Minas mangroves, this ecological hazard was not addressed by the CCT or MIT environmental impact statements. There is a definite danger that mangrove deforestation will directly destabilize toxic sediments resulting in the release of oil into the coastal ecosystem. Indirectly, mangrove deforestation inland is known to cause erosion in down slope mangroves (Burns et al. 1994). Because this type of erosion can cause toxic sediments to be released from mangroves surrounding the development areas, even if toxic sediments are not directly present in the development sites there is a real danger that deforestation will cause oil to be released from contaminated sediments in surrounding areas (Levings et al. 1994). The re-release of toxic sediments following the 1986 oil spill was extensively studied and it was found that even in very small quantities the toxic substances stored in the sediments can impact the health of the mangroves, sea grass beds, and coral reef communities as well as their associated flora and fauna (Duke & Pinzon 1993; Guzman & Holst 1993; Guzman et al. 1993; Marshall et al. 1993). Whether direct or indirect, the risk of releasing toxic sediments has not been addressed by the development proposals and no assessment of the current toxicity of sediments in the development site or surrounding areas has been conducted.

3.6 The Impacts of Noise Pollution

In the MIT and CCT environmental impact reports the effect of noise pollution on wildlife is discussed only briefly and in both cases it is stated that the impact of noise will be negligible, despite the fact that a high noise burden is expected as a result of construction and regular trucking traffic to and from the container storage yards. Numerous studies have found that anthropogenic noise can substantially impact wildlife by driving animals away from suitable habitats and by interfering with the ability of wildlife to communicate, forage for food, and breed. Such research has lead to the ‘sound niche theory’ which states that “…the sounds of each of these zones (habitats) are so unique and important to creature life in a given location... that
disturbance to this soundscape could be detrimental to the future of the individuals, populations or entire species…” (Krasse 1993).

Examples of the impact of noise on animal species abound and it has been found that loud anthropogenic noises, such as those created by trucking traffic, can have a wide range of negative impacts on animal species. Noise related panic responses, for example, disrupt the energy budgets of animals and can cause adult animals to become separated from their young (Radle 2007). This phenomenon is especially common among birds and ‘sound pollution’ has decimated bird populations in many areas (Kavaler 1975). Loud noises can cause animals that rely on sound for feeding, such as bats, to starve and can even deafen animals which have particularly sensitive hearing (Kavaler 1975; Immel 1995). In the desert of the southwest United States, for example, the sound caused by dune buggy motors has been found to cause both temporary and permanent deafness in small rodents, making these animals more susceptible to predation by snakes (Immel 1995). Clearly, there is considerable evidence to support the conclusion that the sound pollution created by container trucking traffic will negatively impact wildlife in surrounding areas, including in the adjacent Punta Galeta protected landscape.

### 3.7 Impacts for Punta Galeta

All of the environmental impacts discussed so far will be felt, at varying degrees, in the Punta Galeta Protected Landscape and Marine Laboratory which is adjacent to the construction sites. This is of great concern given the high natural, scientific, and educational value of the Punta Galeta Protected Landscape. As discussed earlier, Punta Galeta is administered by a Smithsonian Tropical Research Institute team for research, conservation, and educational purposes. In addition to the ecological values of this area (as discussed), the Punta Galeta Marine Laboratory serves as one of the world’s premier marine research labs. As the oldest functioning marine lab in the Caribbean, the researchers of Punta Galeta have made many important contributions to the marine, climatic, ecological, and biological sciences. During its 43 years of operation Punta Galeta has produced over 400 peer reviewed publications, it has hosted some of the world’s imminent marine and mangrove ecologists, and it has provided a site to study such important events as a major oil spill and climate change. Because Punta Galeta contains the world’s oldest continual Caribbean atmospheric and oceanic monitoring data the site is
particularly important for climate change studies (STRI 2006; Heckadon-Moreno, personal communication, January 12, 2007). In addition, Galeta has also hosted an innovative and popular children’s education program that has been growing steadily since it was founded in 2000. This program seeks to teach Panamanian elementary school children about ecology, science, and their environment. In the few years since its inception the education program has been highly successful and currently it incorporates over a dozen full time guides who collectively received over 8000 students in 2006 alone. In addition, Punta Galeta provides a research site and support facilities for dozens of graduate and undergraduate students every year (Heckadon-Moreno, personal communication, January 12, 2007). Clearly, the Punta Galeta Protected Landscape and Marine Laboratory has considerable scientific and educational value, in addition to the ecological values discussed earlier.

However, just as the CCT and MIT developments threaten the ecology of Punta Galeta, they also threaten the scientific and educational activities of the marine laboratory. The current director of the Marine Laboratory, Dr. Stanley Heckadon-Moreno (personal communication, January 12, 2007) has expressed deep concerns about the development projects and is worried that further degradation of the ecosystems surrounding Punta Galeta will interfere with the scientific activities of the Smithsonian and its associated researchers. If mangrove deforestation continues in the Colón area the Bahía Las Minas coastal ecosystem will be so thoroughly degraded that ecological and biological research projects may no longer be tenable. In particular, the long term Caribbean monitoring dataset will be disturbed by anthropogenic environmental changes that will render it useless as a source of baseline data. As Dr. Heckadon-Moreno explained, the purpose of Punta Galeta is to measure and study the natural state of coastal ecosystems, in part, so that anthropogenic changes can be put into context. Simply put, if Punta Galeta becomes a highly degraded ecosystem then it will no longer be useful as a research institution. Furthermore, because the educational program is an offshoot of the research center, it too will disappear if the Punta Galeta area is allowed to ecologically degrade any further. It should be abundantly clear from this analysis that significant scientific and educational values are also being threatened by the proposed development projects, and with them, our ability to understand our natural environment is also being jeopardized.
In this literature review a variety of potential environmental impacts and environmental risks have been identified and discussed, none of which were adequately addressed in the CCT and MIT environmental impact statements. As discussed, the mangroves of Bahía Las Minas have considerable ecological, biodiversity, and ecosystem service values which are threatened directly by the habitat destruction associated with the proposed development projects. In addition, the proposed development projects will create several other environmental impacts that threaten the ecological integrity of the mangroves, sea grass beds, and coral reefs surrounding the development area. These include potential impacts associated with noise pollution, erosion, and the release of toxic sediments that were sequestered after the 1986 oil spill. In addition to the damage that the development projects will create in the surrounding ecosystems, and the consequential loss of ecological services, these development projects will severally jeopardize the scientific and educational activities of the Punta Galeta Marine Laboratory. Because the forest will be completely converted to paved industrial areas, most of these impacts cannot be remediated or reversed at a reasonable cost. If the people of Colón and the nation of Panama wish to prevent the environmental impacts described and preserve the natural, scientific, and educational values of the Bahía Las Minas coastal ecosystems, then immediate conservation is necessary in the small fraction of the region’s mangroves that still exist.
4.0 Socio-Economic Impact Assessment

4.1 Introduction

In addition to the environmental, scientific, and educational impacts of the proposed development projects, there are several potential social and economic impacts which have not been addressed by the MIT and CCT impact assessments. In this section impacts which are primarily social or economic are discussed, though the authors acknowledge that many linkages exist between the socio-economic and environmental impact sections and we believe that these impacts should not be viewed dichotomously. For example, as discussed earlier, the majority of environmental impacts associated with the development also have significant economic costs. In this section the social and economic dimensions of the development projects that have not yet been addressed are discussed. Potential impacts for the community of Coco Solo Norte, impacts related to fisheries decline in the community of La Playita, and impacts related to flooding in the city of Colón are examined. In addition, the social and economic impacts related to the Punta Galeta Laboratory and their education programs are discussed. In the course of this analysis it will be shown that the development projects will have significant negative social and economic impacts that need to be addressed prior to continued development.

4.2 The Coco Solo Norte Community

Coco Solo Norte is a small community with ~250 to 300 members living in the abandoned barracks and housing facilities of the old United States Coco Solo Naval base. Since the closure of the naval base the area has been occupied by squatters living in the old navy buildings and people who were relocated to the area by the Panamanian government following fires in the slums of Colón. Coco Solo is a very poor community with most of its inhabitants surviving on less than $1/day. The majority of people living in Coco Solo are unemployed and survive through various informal activities, though a few have part time jobs in construction or as wage laborers (Interview results; Thomas, personal interview, March 1, 2007). The Coco Solo

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6 The information presented in this section was obtained by talking with members of the Coco Solo Norte community, through formal surveys, and through discussion with a nature guide at Punta Galeta, Gabriel Thomas, who lives in Coco Solo Norte with his family.
Norte community is located directly across the road from the proposed site of the CCT container patio, an area which is currently occupied by old growth mangrove forest. Coco Solo Norte is the only community located within several kilometers of the MIT and CCT development sites. Due to the location and economic vulnerability of the Coco Solo Norte community it seemed likely that the development projects would adversely affect the community. As a result the authors of this study decided it was necessary to conducted opinion and data collection surveys in the Coco Solo community.

4.3 Objectives

The objective of the Coco Solo Norte interviews was to determine the potential socio-economic impacts of the development projects within this community. The authors of this report were primarily interested in:

- The level of employment for community members as workers of CCT, MIT, or the Zona Libre.
- The awareness and opinions of community members regarding the mangroves and the proposed development projects.
- The ways in which community members utilize the mangroves.

4.4 Methodology

In order to gather this information a short and clear survey was administered to 32 members of the Coco Solo Norte community who were selected randomly simply by walking through the community and interviewing any adults that were encountered who were willing to participate. Surveying was conducted on a Sunday after 3:00 pm when the majority of the community was neither working nor in Church. The researchers were advised that at this time of the week most of the community can be found in the streets of Coco Solo where they socialize and participate in leisure activities. The surveys were administered in Spanish by the two authors of the report with the help of Gabriel Thomas, who lives in the community. Surveys were handed out with writing utensils and the researchers remained nearby in case any questions were found
to be unclear or ambiguous. A copy of the survey has been included in Appendix III. Survey data was compiled using *Excel* and analyzed using standard statistical methodology.

Because interviews were carried out on the street level with individuals encountered in an informal manner, it is possible that this biased the results as elderly, infirm, or reclusive individuals may not have been present on the street at the time of sampling. Nevertheless, this style of interviewing was implemented as the researchers believed it was the most casual and least intrusive way to interview the respondents.

### 4.5 Coco Solo Survey Results: Basic Demographics

A total of 33 surveys were completed by respondents and returned to the interviewers. Of these surveys one was forfeited by the respondent. In this interview process, 16 men, 15 women, and one individual who did not select a gender were interviewed. The average age of respondents was 33.2 and 30 years for women and men respectively.

### 4.6 Coco Solo Survey Results: Consultancy and Stakeholder Participation

In this environmental impact assessment the members of the Coco Solo Norte community have been identified as a key stakeholder group who’s input and participation is important when accessing the impacts of the development project and when devising plans for ecological management. In the CCT environmental impact statement it was repeatedly stated that members of the Coco Solo Norte Community were consulted about the development and that they were generally in favor of it and involved in development planning. However, our analysis strongly suggests that the data presented in the CCT report is entirely fabricated. While 13% of the community was surveyed in the course of this investigation, not a single person indicated that they, or anyone that they knew of, had been consulted in any way about the development project. Manzanillo also failed to consult the Coco Solo Norte community, though they did not make any false claims in this regard. The absence of consultancy and the failure to involve the Coco Solo Norte community represents a major failure in the CCT and MIT developmental plans and is enough, in itself, to justify a reexamination of the development projects.
The survey results indicate very strongly that the people of Coco Solo do not understand the nature of the development project and that they were unclear about the future of their community. The majority of Coco Solo residents were moved to this location temporarily (after fires in Colón) and have no idea if or when they will be relocated to more permanent housing. After living in the area for several years many individuals now consider Coco Solo to be their permanent home. However, only three members of the community indicated that they were aware of CCT’s plans to demolish their homes as part of the fourth phase of their expansion plan (cutting of the mangroves is phase two of the project). It is undeniably scandalous that members of the community were almost completely unaware that CCT and Manzanillo plan to cut the mangroves across the street from them and that CCT plans to demolish the community of Coco Solo in the near future.

In addition to the complete disregard for stakeholder involvement and the dissemination of information concerning the project, CCT and MIT have not adequately presented development alternatives and education about alternative development possibilities is lacking. The possibility that these developments could be carried out in another less ecologically sensitive location or that other forms of employment such as ecotourism could be implemented by keeping the mangroves intact has not been formally presented to the community in an organized manner by an outside party. Only three respondents indicated that they had received information concerning alternative uses of the mangroves.

### 4.7 Coco Solo Survey Results: Developmental Concerns

A significant portion of the population expressed concerns over the development of the mangroves adjacent to their community (81% of respondents). When asked what specific aspects of development concerned them, 28% expressed concern over the destruction of local flora and fauna, 19% said they were uncertain of the consequences of the development for the community, 15% said they were worried about dangerous displaced animals, and 9% said they were worried about the loss of important ecosystem functions such as erosion control and a reduction in air quality as a result of dust and smoke from the road. As shown in Figure 1, overall 59% of the respondents stated that they believed the projects would be ‘bad’ or ‘disastrous,’ 20% were ‘neutral’ or non-responsive, and 21% said the projects were ‘good’ or ‘excellent.’
The majority of those who indicated that the development projects would be ‘good’ or ‘excellent’ also stated that they believed these projects would generate much needed employment for the community. To put this in perspective, 53% of respondents indicated that they were currently unemployed. Among the employed, 12% were employed within the Zona Libre and 35% were supported by other forms of employment. This strongly indicates that the desire for employment is the main source of support for the project among community members.

As mentioned briefly earlier, several issues have been raised in the discussion and survey session carried out within the community that were not addressed in the environmental impact assessments submitted by MIT and CCT. Primary amongst them was a sincere concern over the safety of residents, especially children, during the construction of the development projects. Numerous parents stated that they believed the machinery and areas around the development were not secured in any way and were hazardous to the children who may play around them. Additionally, during previous episodes of mangrove clearing there were numerous incidents where dangerous displaced animals (crocodiles and venomous snakes) wandered into the community. In a particularly notorious incident, two large adult crocodiles were discovered in the flooded streets of Coco Solo. Residents were unable to move the animals and on one occasion a child was attacked by one of the crocodiles though not seriously harmed. Residents also told us that whenever mangroves have been cut they have observed a large increase in the presence of venomous snakes within the community. The mangroves surrounding Coco Solo house some of the most dangerous snakes in the world such as the Eyelash Pit Viper and the notorious Fer de Lance. Given that this particular mangrove stand is directly across the street from the community, the displacement of highly dangerous animals such as crocodiles and
vipers, without any special assistance to deal with these creatures, is a large and unaddressed concern for the community. While impacts such as these are hard to quantify, they indicate the possibility of unanticipated and unexplored impacts on the day-to-day lives of community members and the existence of numerous unaddressed concerns.

4.8 Coco Solo Survey Results: Mangrove Utilization

The mangroves and their associated resources are used in the subsistence practices of the community of Coco Solo. Of those interviewed, ~81% of respondents used the mangroves for some kind of subsistence utilization, as shown in Table 3.

Table 3: Frequency of Uses of Different Mangrove Resources by Inhabitants of Coco Solo

<table>
<thead>
<tr>
<th>Use</th>
<th># of Individuals</th>
<th>Percentage of Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metal</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td>Food</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td>Recreation</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td>Work</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>No Use</td>
<td>6</td>
<td>19</td>
</tr>
</tbody>
</table>

Several interesting issues were raised when discussing mangrove use in the community. First, though mangroves are well documented as providing an excellent source of timber for construction as well as firewood, none of the residents admitted to using the mangrove trees in this manner. Second, residents stated on numerous occasions with great pride that they harvested high quality crabs from the mangroves during the rainy season for food and cultural reasons. The women of the community in particular were very excited about this resource and look forward to the yearly crab harvests as a major social and cultural event. Because the majority of the community has a very low income, food is neither variable nor highly nutritious. Every year the rainy season brings with it an abundant supply of crab meat, a cherished delicacy in a place which otherwise has so little.
The collection of scrap metal was also cited as an unlikely, yet significant, resource located in the mangroves that is used by a significant number of the interviewees. Informal interviewing revealed that the United States Galeta Point Naval base used a site within the mangroves as a dumping ground for waste products, including metal sheeting and metal equipment. Since the closure of the naval base trees and vegetation have reclaimed this area and members of the community now enter the mangroves to retrieve this metal in order to sell it as scrap. This form of recycling provides a critical income source in a community that is extremely poor. Of the 12 individuals who were unemployed, 5 indicated that they were involved in metal harvesting as a source of income. On numerous occasions the researchers have observed a team of 6 to 12 Coco Solo men harvesting scrap metal from within the mangroves.

4.9 Discussion: Developments and the Coco Solo Norte Community

As indicated by the survey results, there are several ways in which the development projects could impact the Coco Solo Norte community. As discussed, the sole benefit for the community that is anticipated in relation to the development projects is employment. On the negative side, the development project will eliminate an important source of subsistence income (metal scrapping), food (crab and other wild foods), and recreation. In addition, there is a risk that the developments will create dangerous conditions through the displacement of animals and the use of unsecured machinery. Once these development projects are completed the Coco Solo Norte Community will be completely surrounded by heavy industrial activity without any direct link to nature or other communities. Numerous studies have highlighted both the psychological benefits of having natural areas nearby residential neighborhoods and the negative psychological impacts that high intensity transportation noise can have on the mental health of individuals (Singer 1976; Kaplan 2001). The psychological effects of living in this industrial wasteland, and the increased noise level due to trucking traffic, could be profound and have been completely disregarded.

Lastly, the survey results reveal that the majority of community members know nearly nothing about the development projects, they have nearly no knowledge of other developmental possibilities, they are very wary of the project, and 59% have very negative feelings towards the development. Perhaps more troubling than this is the fact that the development projects have
been designed and will be implemented without any serious consultation with, or considered of, the Coco Solo Norte community. CCT and MIT have been able to conduct their expansion plans in a way that shows no regard for the vulnerable Coco Solo community, its members, and their psychological and physical health.

4.10 Socio-Economic Impacts of Fisheries Declines

In addition to the anticipated impacts on the Coco Solo Norte community, continued mangrove deforestation in the Bahía Las Minas area will result in the loss of fish breeding habitats and hence a reduction in fish stocks for a variety of species. In addition to the impact that this will have on biodiversity and the natural environment, socio-economic impacts will also be felt in the fishing communities that depend on these natural resources. As mentioned earlier, approximately 13,000 artisanal fishermen in Panama generate income for themselves and the nation by working in the fishing industry (FAO 2007). The majority of these fishermen rely on near shore fisheries where they hunt for species with high cash values (ie. lobster and octopus) or those with high subsistence and nutritional values. Colón’s La Playita community is highly dependent on artisanal fisheries activities and the fishermen from this community regularly fish in and around the mangroves of Bahía Las Minas (Chirchikova et al. 2006). Approximately half the population of La Playita relies on fishing for subsistence and cash income; an activity that brings them an average of only $168/household/month. La Playita is an extremely poor community that was founded by squatters and continues to have extreme problems with infrastructure and land ownership. As a pressure tactic, land owners in the La Playita area have repeatedly cut electricity and water to the community in an effort to expel the squatters from the land (Chirchikova et al. 2006). Given low education levels, low employability, and the dependence on local fisheries, declines in fish stocks as a result of over-fishing and habitat destruction (primarily mangrove deforestation) have conspired to squeeze this highly marginalized community even tighter. In particular, declines in two commercially important species, spiny lobster and octopus⁷, have coincided with falling income levels. As a result, living standards in an already impoverished community have declined and members of the community

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⁷ Recall that spiny lobsters require mangroves as a nursery habitat. Octopus also feed on a variety of young fish, which may be declining with mangrove deforestation.
have been forced to illegally fish in the protected waters of the Punta Galeta reserve (Chirchikova et al. 2006). It is abundantly clear that as mangroves continue to be cleared for development projects in Colón, fish stocks will continue to decline in the Bahía Las Minas area, catches will decline, and the people of La Playita will become increasingly unemployed, marginalized, and impoverished.

4.11 The Socio-Economic Impacts of Flooding

As discussed earlier, mangroves provide essential flood and storm protection and where mangroves have been removed flooding incidents have become more frequent. This pattern has been observed in numerous places internationally. As discussed earlier, in recent years incidents of flooding have become increasingly frequent and severe in the Colón area, culminating in a large flood in 2006 that inundated the Cuatro Altos and Zona Libre areas as well as the eastern part of the city (SINAPROC 2006).

Figure 6: 2006 Flooding on Randolf Road (Adjacent to Mangrove Development Sites and Zona Libre) (SINAPROC 2006)
Although the socio-economic impacts of these floods have not been extensively examined or studied it is certain that they have had high economic and social costs. In the 2006 flood, for example, approximately 1,750 people were affected, most of whom suffered as a result of property damage. The vast majority of these people were poor or lower middle class individuals without insurance or the means to cope with the economic losses associated with flooding (Reliefweb 2006; SINAPROC 2006). As a result, the flooding in Colón has caused widespread suffering and has had significant unstudied social impacts. While the blame for any natural disaster cannot be entirely placed on anthropogenic changes, it seems obvious that in a city that is mostly below or just above sea level, with a semi-functional drainage infrastructure, in one of the rainiest regions of the world, that the removal of natural storm management systems without any prior study is dangerous. There is no doubt that the deforestation of mangroves east of the city is at least partially responsible for the flooding of the last decade. As deforestation continues (accompanied by erosion) it is very likely that flooding in Colón will intensify and the poor will continue to bear the burden of ecological mismanagement. This is especially likely given that large sections of the city and la Zona Libre are only 1 meter above sea level, as shown in Figure 7 and Appendix I.
4.12 Punta Galeta, Aesthetics, and Spiritual Impacts

As discussed earlier, the development projects will have a detrimental impact on the Punta Galeta Protected Landscape and its scientific and educational programs. The existence of this research center directly contributes to the education of thousands of elementary aged school children, university students, researchers, and professional scientists. While it is clear that the educational and scientific activities of the Punta Galeta Protected Landscape have definite socio-economic value in terms of the creation and dissemination of knowledge, the integrity of this protected area also has significant aesthetic and spiritual values. Thousands of people visit this protected area every year as tourists, for recreation, and for spiritual reasons. This, in itself, implies that the protected area has a high use value in terms of aesthetics, recreation, and
spirituality. As revealed by the Coco Solo surveys (discussed earlier), the people who live closest to the mangroves highly value the aesthetic and spiritual qualities of the area. While these values are difficult to quantify due to their particular nature, they are none-the-less important and have been completely disregarded by the environmental impact statements submitted by CCT and MIT.

4.13 Conclusion: Socio-Economic Impacts

From this analysis it should be clear that the development projects will have a variety of direct and indirect socio-economic impacts, nearly none of which have been addressed by the CCT and MIT environmental impact statements. As revealed by the survey results of this study, the people of Coco Solo Norte have not been consulted about the development projects and the majority of the community is very worried about how the development will impact their precarious social condition. In particular, these projects threaten to remove significant cultural, economic, and psychological resources from the Coco Solo Norte community without any guarantee of compensation or employment. The results of this study indicate that the people of Coco Solo Norte are very concerned about the development projects while simultaneously being completely excluded from any planning or consultation.

The results of this analysis reveal that there is a strong chance that indirect socio-economic impacts will be felt outside of the development area. In particular, the decline in fisheries that result from mangrove deforestation is likely to negatively impact the poor fishing community of La Playita while the continued flooding of Colón disproportionately affects the poor, causing significant social and economic damage. Lastly, the degradation of the aesthetic, spiritual, scientific, and educational values associated with the Punta Galeta Protected Landscape is disconcerting and completely ignored.

In conclusion, it is clear that significant socio-economic impacts will be created by the development projects and that nearly none of these have been considered in the CCT and MIT environmental impact statements. These impacts are very serious and the development projects should not be allowed to continue until the full range of socio-economic impacts is considered in an honest and transparent manner.
5.0 Development Alternatives

Given the potentially high environmental and social impacts of the development projects, alternative development sites, modes of development, and methods of development planning should be examined. In this section alternative development sites, modes of development (ecotourism), and alternative methods of development planning (the MA Framework) are discussed.

5.1 Alternative Development Sites

There are several potentially feasible sites in the vicinity of MIT and CCT which could be used for port expansion projects and specifically the construction of the planned container storage yards. As shown in Appendix I, Figure 4, there are several large sections of cleared land east of La Zona Libre de Colón and the Manzanillo International Terminal which are not currently being utilized. Because these lands are already cleared and are now occupied by anthropogenic grasslands without human habitations, they could potentially be used for container storage yard development, greatly reducing the social and environmental impact of the developments.

5.2 Ecotourism

In an effort to alleviate unemployment and stimulate economic development in the Colón region, considerable effort and investment has been directed towards the development of the city’s tourism industry, including the cruise ship oriented Colón 2000 project. The development of Colón’s tourism industry is a major part of the current government’s national development plan (Fenix Panama 2004). However, tourism development projects have had mixed success in the city and it remains primarily a retail stopover point for tourist transiting the canal. The city’s reputation for crime, poverty, and the lack of cultural and environmental attractions limits the development of tourism in the area.

The potential for ecotourism in the Bahía Las Minas mangroves was explored in detail by a 2006 McGill University internship researcher group. The conclusion of their analysis was that
significant potential for ecotourism exists in the Bahía Las Minas mangroves due to high aesthetic and biodiversity values, the diversity of the landscape, its proximity to the area’s major attraction - Isla Grande, as well as the support capabilities of Punta Galeta. Furthermore, their investigation revealed that ecotourism in the Bahía Las Minas area has the potential to protect the environment while simultaneously having significant social and employment related benefits for La Playita and Colón. Lastly, the 2006 investigation found that investment costs (training and capital investment) to establish preliminary tourism activities (boat tours) would be relatively low with a high developmental payoff. Consultations with ANAM, IPAT, and regional tour operators revealed significant interest in the project (Chirchikova 2006).

While it is clear from the 2006 McGill report that there is significant potential for ecotourism development in the Bahía Las Minas area, no ecotourism developments have yet been proposed in the area, despite the central government’s Colón tourism development initiative. Prior to the continuation of the port expansion other development initiatives with a high developmental and sustainability potential, such as ecotourism, should be considered.

5.3 Alternative Methods of Development Planning

The CCT and MIT development projects were planned without any input or consultation from many of the key stakeholders affected by the projects, including the people of Coco Solo Norte, the staff of Punta Galeta, and various relevant sections of the government. During any future rounds of development planning or negotiations concerning the MIT and CCT projects, a fully democratic, inclusive, and social justice planning process should be employed. This is necessary to ensure that the citizens and institutions affected by development projects are consulted during the planning process in order to guarantee that the true impacts of the development are properly assessed. In the case of the CCT and MIT developments important stakeholders in the development area, including members of relevant government departments, staff from Punta Galeta, community members from Coco Solo Norte, and representatives from CCT and MIT should meet and discuss the development plans in a participatory and inclusive manner. This will help identify the true costs and benefits of the development projects, avoid long term conflict, and ensure that the development projects serve the broader interest of Panamanian society. Many frameworks and processes exist that allow for inclusive and
participatory negotiation processes. One way of creating a participatory, socially just, and democratic negotiation and planning process is through the implementation of a Millennium Ecosystem Assessment Framework. This framework is discussed in detail in Appendix IV and applied to the Bahia Las Minas situation theoretically.
6.0 Recommendations

When undertaking large scale development ventures in populated zones bordering ecologically sensitive areas, special care and attention must be accorded to ensure the project is planned in an environmentally sound and socially just manner. While this report is by no means exhaustive, several serious socio-economic and ecological impacts have been identified which need to be addressed.

Owing to the anticipated social and ecological impacts, the undemocratic nature of the planning process, and the many failings of the environmental impact statements filed at ANAM the authors of this report recommend the following actions:

- Revoke all construction permits within the Bahía Las Minas mangroves until proper assessments have been filed and the projects have been adequately reevaluated by a non-biased third party. This would include:
  - A resubmission of the environmental impact studies conducted in a more rigorous, honest, and scientific fashion.

- Alternatives must be considered fully including:
  - Alternative development sites
  - Alternative modes of development (i.e. capitalizing on tourist influx in the Zona Libre to promote mangrove ecotourism)

- Planners need to reassess and develop a land use and conservation plan for the region prior to continued construction. Such a plan would need to emphasize ecosystem services, conservation in the mangroves, and rezoning of land.
  - To this end, a reevaluation of current zoning laws is required as there is currently no provisioning for the protection of mangroves, ecosystem services, and conservation. Land use plans must emphasize the conservation of remaining mangroves.

- Planning approaches that incorporate public participation and highlight the importance of ecosystem services for the human populations are essential when assessing the value of habitats threatened by construction. For this reason, the authors recommend the use of an inclusive and progressive planning framework, such as the Millennium Ecosystem Assessment (MA) framework (see Appendix IV).
7.0 Conclusion

In recent years the potentially harmful effects of economic development have become apparent in the Republic of Panama and concern is growing over the long term social and environmental implications of the nation’s development policies. Since 1969 almost 71% of Panama’s Caribbean mangrove forest cover has been lost, with a corresponding loss of approximately 56% nationally. This is of great concern given the vital ecological role that mangrove forests play and their high value in terms of ecosystem services. As mangroves disappear from Panama, so too do the ecosystem services that they provide. These include such things as spawning grounds for commercial fish, storm and flood barriers, water and air filtration, habitat for biodiversity, erosion stabilization and coastline control, aesthetics, tourism, and cultural values.

Rapid deforestation has occurred in the mangroves of Bahía Las Minas (north east of Colón) in order to make room for the expansion of la Zona Libre de Colón, its associated port facilities (Colón Container Terminal and Manzanillo International Terminal), and elements of the now defunct Multi-Modal Project (including Panama Railway yard and France Field Airport expansions). Despite very serious environmental and social concerns, and evident negative consequences (such as flooding in the city of Colón), deforestation in the Bahía Las Minas mangroves continues. At present both Colón Container Terminal (Evergreen Marine Corporation) and Manzanillo International Terminal (Stevedoring Services of America) plan port expansions that will result in the clearing of 18.2 ha and 12 ha of virgin mangrove respectively. In addition, much larger Panama Railway expansion and France Field Airport expansion projects are being discussed.

The authors of this report have generated a situation analysis examining the Bahía Las Minas mangroves, the development projects, and their environmental impact studies. In addition, the researchers have conducted their own environmental and social impact assessments and generated several alternative development options and recommendations.

In our research we have found that the environmental impact assessments filed by Colón Container Terminal and Manzanillo International Terminal were far from comprehensive, they lacked scientific credibility and professionalism, they were highly biased, and at times blatantly dishonest. Our report highlights the numerous and widespread environmental and social impacts
associated with these development projects, including losses in the ecosystem services discussed above, as well as impacts specific to this region. Regional impacts include the potential for the release of toxic sediments sequestered in the mangroves, diminishing value for the scientific and educational activities of Punta Galeta, and severe socio-economic impacts for the adjacent impoverished community of Coco Solo Norte.

As a result of these findings, the authors of this report have recommended that:

- All construction permits for projects in the Bahía Las Minas mangroves be revoked until proper assessments have been filed and the projects has been adequately reevaluated by a non biased third party.
- The impact assessments be redone in a more rigorous and scientific fashion.
- Consideration be given to development alternatives (alternate sites/ecotourism).
- Planners reassess and develop a land use and conservation plan for the region emphasizing ecosystem services, conservation in the mangroves, and rezoning of land.
- Governmental agents and project planners make use of a public participatory approach to development planning such as the Millennium Ecosystem Assessment Framework.

All of these points are discussed in more detail throughout the report. With the impending expansion of the Panama Canal and the rapid development of the Republic of Panama, the nation is at a critical point in its history. For the first time Panama is in a position to independent determine its own economic, social, and ecological future. The people of Panama must decide whether their country will be more than a canal and its associated industries. Going into the next century, will Panama be a nation of beauty, cultural diversity, and justice or will it become consumed by its own narrow developmental aspirations? The choices that are made today will shape the country in the years to come.
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La Zona Libre refers to La Zona Libre de Colón, CCT refers to Colón Container Terminal (Evergreen), MIT refers to Manzanillo International Terminal. Development sites (shown in red boxes) are approximations of the size and shape of the development sites and should not be considered exact. Dark green areas are mangrove forest cover.
Figure 9: Zoning in the Bahía Las Minas Area (Ministry de Vivienda 1996)\textsuperscript{9}

\textsuperscript{9} Grey areas are “Industrial and Office Zones,” Black areas are “Protected Forest Zones,” and Red areas are “Medium Density Housing Zones.”
Figure 10: Multi-Modal Project Master Plan (MMLC 2002)
Figure 11: Areas with Elevation of 0 to 1 meter (Red Dots)
Appendix II – Personal Interviews

- Dr. Stanley Heckadon-Moreno; Dr. Heckadon-Moreno is an expert in Panamanian history, environmental issues, and agriculture. He has worked for a variety of Panamanian environmental and agricultural organization for over 30 years and is currently the Director of the Punta Galeta Marine Laboratory and manager of the Punta Galeta Reserve. Dr. Heckadon-Moreno was consulted regarding various issues related to the Punta Galeta Reserve.

- Gabriel Thomas is a nature guide working in the Punta Galeta Laboratories education program and is currently in a biology program at the University in Colón. Gabriel is from the nearby Coco Solo Norte community and was interviewed informally about his community.
Appendix III – Coco Solo Survey

ENCUESTA

Colón Container Terminal está haciendo un proyecto de desarrollo para hacer un patio de contenedores en frente de la comunidad de Coco Solo. Este cuestionario se trata de eso.

1) Edad _____   Sexo_____

2) Hizo Colón Container Terminal alguna consulta a ti o a tu familia acerca de este proyecto?
   Sí____  No____

3) Te preocupa el desarrollo de este proyecto? Porque?
   Sí____  No____
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

4) Visitas o utilizas los manglares de Coco Solo para algo?
   _____ para madera
   _____metal, chatarra
   _____para comida ñ otros productos del bosque
   _____para recreación
   _____para trabajo
   Otro:_______________________________________________________
   __________________________________________________________
   __________________________________________________________

5) Crees que la tala de los manglares va a beneficiar a la comunidad de Coco Solo Norte?
   Si su respuesta es sí: como?
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   Si su respuesta es no, porque?
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
6) Estás trabajando con Colón Container Terminal, Manzanillo Internacional Terminal u otra empresa relacionado a la Zona Libre de Colón?

_______Sí    Nombre de la empresa: ___________________
_______No
_______Esta desempleado

Colón Container Terminal propuso dos obras a ANAM que fueron aprobados recientemente. En total la compañía va a cortar 18.2 hectáreas de manglares para la creación de dos grandes patios de contenedores. CCT estima que un área de 47.2 hectáreas van a ser afectadas. Colón Container Terminal estima que este desarrollo va a producir 50 trabajos durante la construcción de manera no permanente y 10 trabajos después de la construcción. También, Manzanillo Internacional Terminal va a cortar unas otras 12 hectáreas de manglares para la construcción de otro patio de contenedores, al lado del patio de contenedores de CCT.

Porque los Manglares son Importantes:

- Son una guardería por gamba, langosta y pequeños peces
- Funciona como barrera natural contra las tormentas, vientos fuertes y maremotos
- Limpia el aire y purifica las aguas
- Sirve como casa para muchas especies de animales amenazadas
- Prevén la erosión de la costa y el levantamiento del nivel del mar

7) Antes de conocer esta información usted pensaba que lo que estaba realizando la empresa CCT era:

_______Excelente
_______Bueno
_______Neutral
_______Malo
_______Desastreoso

8) Sabía usted de lo que estas empresas estaban haciendo o alguna persona había discutido con usted acerca de otras alternativas para la utilización de los manglares?

Sí____  No____

9) Esta información cambia tu opinión sobre el desarrollo del proyecto?

Sí____  No____

En una manera positiva_______ o negativa?_________

Otro Comentarios?

________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

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Appendix IV – The Millennium Ecosystem Assessment

Introduction

In anticipation of the widening of the Panama Canal and increased canal traffic, major port expansions continue in the Colón area. Currently both the Manzanillo International Terminal (Stevedoring Services of America) and the Colón Container Terminal (Evergreen International Corporation) are undergoing major expansion programs while expanded airport facilities at Frances Field Airport and rail yard developments for the Panama Canal Railway have also been proposed in the Colón area (Business Panama 2007). Despite their large scale, the socio-economic and environmental impacts of these development projects have not been substantially studied. In particular, questions regarding the impacts of these developments on the mangrove ecosystems and the impoverished people of Colón have not been answered.

In the environmental and socio-economic impact study conducted by internship researchers at the Punta Galeta Marine Laboratory it was found that the environmental impact statements submitted by Colón Container Terminal (CCT) and Manzanillo International Terminal (MIT) had many scientific flaws, that they failed to address the full range of social and environmental issues associated with the project, that they were very dishonest in their assessment and project planning, and that the development plans were created without consulting the local community. As a result, the researchers have recommended that all construction in the Bahía Las Minas mangroves be suspended and re-evaluated. The internship researchers believe that this action must be taken to ensure the environmental sustainability and social justice of the project, and in order to alleviate mounting tension between the Coco Solo Norte Community, environmental groups, MIT, CCT, the Smithsonian Punta Galeta research site, and the Panamanian government. In order to avoid confrontation and resolve these issues justly and equitably, a consultative and transparent planning process must be implemented prior to the resumption of construction in the ecologically and socially sensitive areas. Therefore, the internship researchers have recommended that a socially and environmentally comprehensive assessment framework be implemented in order to evaluate the development projects.

The Millennium Ecosystem Assessment framework provides a structure for open public participation and discussion which can be implemented to address these controversial issues. In
this section the potential implications of a Millennium Ecosystem Assessment are discussed as an example of a consultative planning process which could be implemented in the mangroves of 
Bahía Las Minas.

The Millennium Ecosystem Assessment

Given the controversial and highly political nature of the proposed development projects, a comprehensive and collaborative ecological and social assessment is needed which is mindful of its own legitimacy and credibility. The Millennium Ecosystem Assessment framework, which was developed in order to conduct the international Millennium Ecosystem Assessment, is a framework that is capable of meeting these goals by following principles of transparency, inclusiveness, consensus building, and objectivity. In essence, implementing an MA framework assessment would involve meetings with all of the relevant stakeholders to discuss the controversial issues surrounding the project, to identify our current state of knowledge regarding the projects and their impacts, and to agree on a consensus based solution to the problems associated with the project. This section provides some of the background information that would be needed to conduct a full ecosystem assessment addressing the MIT and CCT expansion projects that affect the mangroves of Bahía Las Minas and the community of Coco Solo Norte. For ease of presentation, the major elements of the MA framework have been divided into six distinct steps.

Step 1: Organization and Identifying Assessment Goals

In Step 1, the assessment facilitators need to outline their organizational goals, core principles, identify who should be involved in the assessment, and assess the availability of resources and limits of the assessment. While the facilitators initiate these preliminary decisions, goals and participants can be changed at a later date once stakeholder participation is initiated.

- **Core Principles:** The core principles of our assessment are to maintain credibility, legitimacy, and relevance.
- **Who To Involve:** The facilitators believe it is important to involve a variety of stakeholders in the consultation process. Each party should be consulted equally and
suggestions for the inclusion of other stakeholders can be tabled during the consultation process. In this way stakeholder involvement can be equitable and comprehensive. The initial group of stakeholders should include:

- The Community of Coco Solo Norte
- The Punta Galeta Research Staff
- A representative from ANAM
- Representatives from the Evergreen (CCT) and Manzanillo (MIT) corporations
- Representatives from la Zona Libre de Colón
- Representatives from the Maritime Authority of Panama
- Relevant governmental representatives (ex. Urban Planning, ANAM)

**Available Resources:** The facilitators can identify a variety of resources that are immediately available for the consultation and assessment process. These include:

- The ecology, biology, and climatology research of the nearby Smithsonian Punta Galeta research site. Through the Smithsonian this consultative process has access to very high quality scientific expertise, monitoring data, and research.
- Contacts in the Coco Solo Norte Community, the Smithsonian, ANAM, the Manzanillo corporation, at the Maritime Authority of Panama, and other governmental offices.
- What is lacking: Contacts at the Evergreen corporation and clear economic valuations for the mangroves. Up to date information concerning current mangrove coverage in the area is also lacking.

**The Limits of the Project:** The geographic limits of this examination are:

- The *Bahía Las Minas Mangroves* (including its historic range, ie. la Zona Libre)
- Areas impacted by those mangroves including surrounding coral reefs, sea grass beds, la Zona Libre de Colón, and the community of Coco Solo Norte. The zone of indirect influence must be extended as well to include areas inhabited by species such as crabs, shrimp, lobster, and fish which use these mangrove ecosystems as nursery habitats and later disperse.

**Potential Conflicts:** From the outset it is possible to identify several potential conflicts among stakeholders. First and foremost, it is likely that the community of Coco Solo Norte, environmental groups, and many of the scientists of Punta Galeta will feel
animosity towards Evergreen, Manzanillo, and members of the Panamanian government (and vice versa). This arises from the fact that these groups have been in conflict over the development issue. In addition, it is possible that power disparities will exist between the highly educated and experienced representatives of Punta Galeta and the corporations, as they compare to the people of Coco Solo Norte (for example). Both of these issues can be addressed by promoting a non-confrontational consultation process and by enforcing a consultation process that values the opinions of all stakeholders. This will require careful management by the facilitators.

**Step 2: Identifying Needs and Goals**

In Step 2 the stakeholders are assembled and consultations begin. The first step of this, by necessity, involves the sharing of knowledge. Stakeholder groups present their knowledge of the development project and express their individual goals for the development process. It is expected that this process will produce the following results:

- The goal of Evergreen and Manzanillo is economic expansion achieved through port development. They would like to build container storage patios in the mangroves.

- The goal of governmental representatives: To provide the greatest good to the populous while working within national initiatives and policies. They would like to achieve this by balancing developmental and environmental needs.

- The goal of Coco Solo Norte: To protect the mangroves of Bahía Las Minas and the ecosystem services that they rely on while also finding ways to relieve rampant unemployment and poverty.

- The goal of Punta Galeta scientists: To protect the natural environment and maintain their research activities.

Once the individual goals of group participants are known the group can work towards defining more fundamental common goals such as human wellbeing, environmental health, and economic development.
Step 3: Identifying Ecosystem Service Dependencies and Impacts

Once knowledge sharing is complete, the goals of the individual stakeholders are known, and some common goals have been agreed to, the ecosystem services that the proposed development projects are dependent on, and those that they will impact, can be identified. Ecosystem services are those services and products created by natural ecosystems which directly benefit humankind. These services have measurable economic value and include such things as clean water, clean air, raw materials, food, habitat, etc. (Eamus et al. 2005). The MA assessment framework is designed to address ecological problems from the ecosystem services approach and so it is very applicable in this case. Mangroves are known to have very high ecosystem services values providing such essential and valuable ecosystem functions as spawning grounds and habitat for commercially important fish species (Nagelkerken et al. 2000; Feldheim & Edren 2002), flood and storm protection (Mazda et al. 1997; Massel et al. 1999; Chong 2005), erosion control and coastal stabilization (Fondo & Martens 1998; Mazda et al. 2002), and water filtration (Nagelkerken et al. 2000). In addition, the mangroves of Bahía Las Minas contain significant biodiversity (Punta Galeta Marine Laboratory 2003), they have considerable scientific, aesthetic and educational value (STRI 2006; Heckadon-Moreno, personal communication, January 12, 2007), and they provide a source of subsistence income, food, and resources for the people of Coco Solo Norte (see survey results). Lastly, the mangroves of Bahía Las Minas have sequestered large amounts of toxic chemicals that were released into the area as a result of an oil spill in 1986. These substances have been safely sequestered by mangrove sediments but will be re-released into the environment as a result of deforestation with very severe environmental consequences (Duke & Pinzon 1993; Guzman & Holst 1993; Marshall et al. 1993; Burns et al. 1994; Garrity et al. 1994; Levings et al. 1994). It is clear that the mangroves have considerable value in terms of ecosystem services; this value expands exponentially when associated ecosystems are also considered, particularly sea grass beds and coral reefs (Gunawardena & Rowan 2005).

Knowing this, it is the expectation of the facilitators that the consultation process will reveal the following ecosystem service dependencies:

- The Evergreen and Manzanillo development projects will be dependent on erosion control, drainage control (water regulation), and storm protection.
• The Coco Solo Norte Community is dependent on a wide variety of ecosystem services provided by the mangrove forests including aesthetic values, air quality, desalination, natural hazard regulation, spiritual and religious values, water provisioning, water regulation, and wild foods.

• The Punta Galeta Marine Laboratory is also dependent on a wide variety of ecosystem services provided by the mangroves including aesthetic values, air quality, biodiversity, climate regulation, education, erosion regulation, genetic resources, natural hazard regulation, nutrient cycling, photosynthesis, primary production, scientific values, soil formation, tourism, toxic sediment sequestration, water cycling, water provisioning, and water regulation.

Furthermore, it is expected that the consultation process will find that the development projects have the potential to impact a variety of ecosystem services which are currently provided by the mangrove forests. These include aesthetic values, air quality, biodiversity, capture fisheries, climate regulation, desalination, education, erosion regulation, genetic resources, natural hazard regulation, nutrient cycling, photosynthesis, primary productivity, scientific value, soil formation, spiritual and religious value, timber, tourism, toxic sediment sequestration, water cycling, water provisioning, water regulation, and wild foods. Each of these ecosystem services will need to be addressed during the assessment. In this case trade-offs between different ecosystem services do not exist as the development projects seek to eliminate all ecosystem services by completely clearing and paving over the mangrove forests. If the development projects remain in their original form then economic resources and employment would completely replace the ecosystem services listed here. While this trade off is tangible, the distribution of benefits from this development must be addressed. The foreign interests of CCT and MIT will control the profits collected from the proposed projects with little foreseen redistribution of benefits to surrounding communities. However, the majority of the cost of ecosystem alteration (erosion, degradation of fisheries, coastal oiling, flooding, reduction in water quality, etc) will be borne by the people of the Caribbean coast of Panama, specifically in the Colón area. The long term economic benefit to this community is expected to consist of 20 manual labor positions. Clearly, significant issues of equity surround this project and its benefits are expected to be concentrated in the hands of a few wealthy and foreign individuals.
Step 4: Identifying Drivers of Change and Trends

In Step 4 the stakeholder group will attempt to identify the drivers of change affecting the ecosystem services provided by the Bahía Las Minas mangroves. It is the expectation of the facilitators that several drivers of change will be discussed by the stakeholder group. These include:

- Economic Development: Economic Development in the Bahía Las Minas mangroves is the principle driver of change. Specifically, expansions of la Zona Libre de Colón, the CCT and MIT port facilities, and the expansion of the Colón multi-modal project are the main causes of ecosystem alteration in the region. These projects are driven by the desire to promote economic development, to alleviate unemployment, and to prepare for the canal expansion. **Trends:** It is likely that economic development in the region will slow once the canal related expansion projects are completed.

- Several secondary and less significant drivers of change affect the Bahía Las Minas mangroves. These include population growth in the city of Colón, climate change (perhaps more relevant in the future), and the building of the Panama City –to- Colón highway. **Trends:** It is likely that population growth will continue in Colón and its nearby communities with the completion of the highway and that the impact of climate change will intensify. Population growth may result in further deforestation.

With the drivers of change identified, trends in specific ecosystem services can be evaluated. It is expected that consultations with the stakeholder group and the scientists of Punta Galeta will highlight trends in the availability of ecosystem services. As discussed in Stage 3, mangrove ecosystems provide a variety of ecosystem services and the conversion of mangrove forest into industrial activities over the last century in the Bahía Las Minas mangroves has resulted in a steep decline in the provisioning of ecosystem services. Scientists working at the Punta Galeta Marine Laboratory believe that while ecosystem services have declined in the area, sufficient mangrove cover has survived to maintain ecosystem services in a functional state. However, there is considerable concern that deforestation in the region is reaching a critical threshold and that the ability of the remaining mangroves to maintain ecosystem services and harbor biodiversity is becoming increasingly threatened (Duke *et al.* 1994; Heckadon-Moreno, personal communication, January 12, 2007). Based on the work of the internship researchers,
which included an extensive literature review of the scientific work conducted at Punta Galeta (as discussed earlier), it is expected that the stakeholder group will articulate the trends in ecosystem services shown in Tables 4 and 5.

Table 4: Trend Symbol Legend

<table>
<thead>
<tr>
<th>Trend Prior to Development*</th>
<th>Anticipated Effect of Development**</th>
<th>Impact Level***</th>
<th>Remediation****</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral ⇒</td>
<td>Neutral ⇒</td>
<td>1 Small Degradation with cumulative relevance at regional scales only</td>
<td>Reversible without remediation</td>
</tr>
<tr>
<td>Increasing ↑</td>
<td>Increasing ↑</td>
<td>2 Degradation of Ecosystem Function with no replacement required</td>
<td>Reversible with remediation</td>
</tr>
<tr>
<td>Increasing Rapidly ↑↑</td>
<td>Increasing Rapidly ↑↑</td>
<td>3 Severe Degradation of Ecosystem Function with partial replacement required</td>
<td>Irreversible despite remediation</td>
</tr>
<tr>
<td>Decreasing ↓</td>
<td>Decreasing ↓</td>
<td>4 Cessation of Ecosystem Function with full replacement required</td>
<td></td>
</tr>
<tr>
<td>Decreasing Rapidly ↓↓</td>
<td>Decreasing Rapidly ↓↓</td>
<td>5 Severe Degradation or Cessation of Ecosystem Function with no replacement possible</td>
<td></td>
</tr>
<tr>
<td>Unknown ?</td>
<td>Unknown ?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Pre-development trends refer to the trend in the ecosystem service in the last 20 years. These trends were driven primarily by the conversion of mangrove forest into industrial space for la Zona Libre de Colón, CCT, MIT, and the Colón multi-modal project.

**Post development trends refer to trends in the ecosystem services that are expected to occur as a result of the current CCT and MIT expansion plans.

***Impact level refers to the scale of the impact (resulting from the proposed developments) and the consequential need for ecosystem service substitution or replacement through artificial means.

****Remediation/Reversibility refers to the ability to remediate or reverse the environmental impact at a reasonable cost.
Table 5: Ecosystem Services Trend Summary

<table>
<thead>
<tr>
<th>Ecosystem Services</th>
<th>Pre-Development Trend</th>
<th>Post-Development Trend</th>
<th>Impact Level</th>
<th>Reversibility/Remediation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetic Values</td>
<td>↓</td>
<td>↓↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Air Quality</td>
<td>↓</td>
<td>↓↓</td>
<td>1</td>
<td>☹</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>⇧</td>
<td>↓</td>
<td>5</td>
<td>☹</td>
</tr>
<tr>
<td>Capture Fisheries</td>
<td>↓</td>
<td>↓↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Climate Regulation</td>
<td>⇧</td>
<td>↓</td>
<td>1</td>
<td>☺</td>
</tr>
<tr>
<td>Desalination</td>
<td>?</td>
<td>↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Economic Development*</td>
<td>↑</td>
<td>↑↑</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Education</td>
<td>↑</td>
<td>↓</td>
<td>2</td>
<td>☺</td>
</tr>
<tr>
<td>Employment*</td>
<td>↑</td>
<td>↑</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Erosion Regulation</td>
<td>↓</td>
<td>↓↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Genetic Resources</td>
<td>⇧</td>
<td>↓</td>
<td>5</td>
<td>☹</td>
</tr>
<tr>
<td>Natural Hazard Regulation</td>
<td>↓</td>
<td>↓↓</td>
<td>3</td>
<td>☺</td>
</tr>
<tr>
<td>Nutrient Cycling</td>
<td>↓</td>
<td>↓↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Photosynthesis</td>
<td>↓</td>
<td>↓↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Primary Productivity</td>
<td>↓</td>
<td>↓↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Scientific Value</td>
<td>↑</td>
<td>↓</td>
<td>2</td>
<td>☹</td>
</tr>
<tr>
<td>Soil Formation</td>
<td>⇧</td>
<td>↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Spiritual and Religious Value</td>
<td>↓</td>
<td>↓↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Timber</td>
<td>⇧</td>
<td>↓</td>
<td>4</td>
<td>☹</td>
</tr>
<tr>
<td>Tourism</td>
<td>↑</td>
<td>↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Toxic Sediment Sequestration</td>
<td>↓</td>
<td>↓↓</td>
<td>5</td>
<td>☹</td>
</tr>
<tr>
<td>Water Cycling</td>
<td>↓</td>
<td>↓↓</td>
<td>3</td>
<td>☺</td>
</tr>
<tr>
<td>Water Provisioning</td>
<td>?</td>
<td>↓</td>
<td>3</td>
<td>☹</td>
</tr>
<tr>
<td>Water Regulation</td>
<td>?</td>
<td>↓</td>
<td>3</td>
<td>☺</td>
</tr>
<tr>
<td>Wild Foods</td>
<td>⇧</td>
<td>↓</td>
<td>4</td>
<td>☹</td>
</tr>
</tbody>
</table>

*Economic Development and Employment were added to highlight the benefits of the developments. These are not ‘ecosystem services.’
Step 5: Detailed Ecosystem Service Assessment and Related Topics

Following the identification of trends in ecosystem services, it is expected that it will become clear that significant issues exist with certain ecosystem services and that more detailed evaluations will be required in some areas. It is the expectation of the facilitators that Stage 5 of the consultation will produce the following results:

- **Services Needing Detailed Assessment:** The services most in need of detailed assessment are those which are likely to have the greatest social and environmental impact and/or those which have not been extensively studied in the Bahía Las Minas area. Capture fisheries declines have already been observed in the Colón area and so the effect that continued deforestation will have on this critical industry is of paramount importance and needs to be examined in detail (Chirchikova et al. 2006). Furthermore, the occurrence and severity of flooding events in the city of Colón has been increasing for at least 10 years and so erosion regulation, natural hazard regulation, and water regulation all need to be examined in greater detail (Reliefweb 2006; SINAPROC 2006).

- **Substitution and Remediation:** As shown in Table 5, it is expected that the focus group will find that most ecosystem services can be substituted but that nearly none can be remediated or reversed at reasonable costs. This is due to the complete nature of the habitat alteration, as the forest is being completely converted into paved industrial areas. In essence, this project represents a complete trade-off between natural values and industrial economic development. As such, remediation and reversibility in the future is highly unlikely and would be prohibitively expensive for most services. The most difficult services to substitute are biodiversity (especially important for the scientific, education, and tourism activities of Punta Galeta), capture fisheries, genetic resources, natural hazard regulation, toxic sediment sequestration, and water regulation. In addition, the cultural services offered by the mangroves will be impossible to replace. Because development projects have been degrading these services in the Bahía Las Minas area without any replacement plans, the decline in these services has already had significant impacts.

- **Future Trends:** While it is difficult to evaluate the future trends in the area it is expected that continued economic development and unemployment will maintain political pressure
for the conversion of mangroves to other economic uses. However, as the population of Colón increases it is also highly likely that the need for ecosystem services will continue to increase and that the rationale for conservation and sustainable management will become salient. A major unknown factor in the future is the impact of climate change in the mangroves as this has not been extensively studied in the region. Furthermore, if attempts to promote ecotourism in the mangroves are successful then this could significantly alter the economic situation of the area. Unanticipated synergistic effects may also hamper the adequacy of future visions. For example, the creation of jobs in the Zona Libre is likely to attract far more people to the area in search of employment than the region will actually employ or be able to support. It is unknown how they will use ecosystem services or how this additional stress may affect resources.

**Step 6: Risks and Information Gaps**

There are several risks and information gaps associated with the proposed development projects that the facilitators expect the stakeholder group will identify in Step 6. These include:

- **Risks:** Loss of natural hazard protection, erosion regulation, and water regulation increase the risk of disasters such as storm damage, flooding, and landslides. The loss of mangroves also increases the risks of the release of sequestered toxic sediments and the disappearance of biodiversity. As the effects of climate change intensify, it is likely that these risks will amplify.

- **Regime Shifts:** The potential for sudden and possibly irreversible regime shifts exists in the mangrove ecosystems and its associated habitats. There is a real risk that continued deforestation will limit habitat size below what is required by many of the resident species, thus reducing biodiversity ( Heckadon-Moreno, personal communication, January 12, 2007). A similar phenomenon could be experienced in the fisheries which are supported by the mangrove forests. Again, it is possible that if breeding habitat is reduced below a threshold level that commercially important fish stocks will suddenly crash.

- **Information Gaps:** Due to the high scientific capacity of the Punta Galeta Marine Laboratory most of the information that is needed for the assessment already exists or can be quickly assembled. However, there are major information gaps that could be addressed
by Smithsonian scientists. It would be useful to know the impact that deforestation has had on the fisheries of Colón and recent flooding events in the city, the impact of climate change in the future, and the economic feasibility of alternative development projects (i.e. ecotourism).

**Conclusions**

Once the six steps of the assessment are completed the stakeholders will have the background information that they require to negotiate an equitable, socially just, efficient, and sustainable solution to the development controversy. In reality, this type of assessment and planning process can only be implemented if the stakeholders are willing to step beyond the politics of confrontation and find compromises that respect the needs of other stakeholders and the natural environment. In the case of the *Bahía Las Minas* mangroves the biggest obstacle to finding a sustainable and equitable solution to the developmental conflict is the stakeholders themselves. If the people of Colón, the Panamanian government, and the stakeholders in the *Bahía Las Minas* area are truly committed to achieving sustainability and social justice, then a considerable change in management practices and managerial attitudes is necessary. The successful implementation of an MA ecosystem assessment would be a step in the right direction.