TABLE OF CONTENTS

1.0 INTRODUCTION

This document is the Environmental Impact Study (EIS) of the Panama Canal Expansion Project – Third Set of Locks, drafted by URS Holdings, Inc., in collaboration with *Fundación Universidad de Panamá* (FUDEP) and *Universidad Nacional Autónoma de Chiriquí* (UNACHI), hereinafter the consulting team, in compliance with the regulatory requirements defined in Executive Decree Nº 209 of September 5, 2006, the Terms of Reference drafted by the Panama Canal Authority (ACP), and the Proposal submitted by the consulting team for the compilation, synthesis and complementation of the environmental, social and economic studies performed to date for this Project.

This chapter describes the general aspects of the Project that will contribute to the reader's review and understanding of the document. These aspects include the background and objectives of the expansion proposed, as well as the objectives, categorization and structure of the EIS.

1.1 Background and Justification

Ever since its discovery, the Isthmus of Panama has been an important trade and transportation center. Initially used as a colonial route for land transportation through the Cruces Trail and the Royal Highway, its role gained new momentum at the beginning of the Republican Period with the construction of the Transisthmian Railroad, inaugurated in 1855, which was later consolidated with the opening of the Panama Canal in 1914, and more recently, with the construction of the Transisthmian Pipeline in the 1980s.

It is evident that other economic activities not related to the Canal operation were being developed in Panama. These activities thrived because of the comparative advantages derived from the geographic location of the country as well as from the legal, fiscal and monetary conditions it offers. This economic diversification, unrelated to the transit of vessels, fostered the growth of parallel activities, among which are the merchant marine, the shipping registry and air cargo and passenger hub.

Nevertheless, from the very moment of its inauguration, the Canal became the socioeconomic axis of the country, to the point that over time it emerged as the most important port hub and navigation route of Central and South America. The service rendered by the Canal to international maritime transportation favors the development of multiple economic activities related to the transit business. Over the past years, these opportunities have combined into an interdependent axis of economic activities such as trade, commerce, finance, logistics, insurance and services, known as the Canal Economic System (CES). This is defined as the sum of the direct contributions generated by the operation of the Canal, indirect contributions generated by services to vessels in transit, and the contributions spawned by logistics services, ports, cruise ship tourism, among others. Specifically, during the last decade, Panama has increasingly become a connection and air-cargo hub, with important private investments in capacity, infrastructure and airport equipment and its telecommunications infrastructure has been modernized by the use of transcontinental fiber optic cables. To summarize, the service cluster that operates around the Canal has been renewing and expanding to take great advantage of the opportunities offered by its geographic location.

In this context, we can affirm that Panama benefits from the production of goods and services not related to Canal activities, as well as from the export of other goods and ancillary services. Therefore, the CES generates income with a very large multiplier effect, which means that once received they generate demand for other goods and services throughout the Republic. To illustrate this, it is worth noting that in 1999 this system made a contribution of US$1,859.8 million to the local economy (ACP, 2006).

Even before this economic juncture, expanding the capacity of the Panama Canal by constructing a third set of locks had already been conceived and partially executed between 1939 and 1942. However, when the United States entered the World War II in December 1942, it stopped the construction works, which were not continued afterwards because of a change in their post-conflict naval strategy, giving priority from that moment to the permanent deployment of separate fleets in the Atlantic and the Pacific, instead of the deployment of one large naval fleet from one ocean to the other.

Various efforts were made over the years to increase the operational throughput of the Canal, as well as its water system and navigational safety. Among the most important works accomplished in this regard are the following: (i) construction of Madden Dam and creation of Alhajuela Lake for flood control in the Chagres River watershed (1931-1935); (ii) widening of a section of the Canal, known as Gaillard Cut, measuring 91.5 m (300') to 152 m (500'), in response to an increase in Panamax vessel transits (1957 and 1971); (iii) deepening of Gatun Lake navigational channel (1970); (iv) replacement of the locomotive fleet (1964); (v) installation of a high-mast lighting system at the locks, aimed at providing better lighting and safety to vessels transiting at night (1964 and 1979); (vi) a new Gaillard Cut widening from 152 m (500') to 192 m (631.5') (1992-2001); (vii) replacement of all lock locomotive tracks (1990-2000); (viii) replacement and increase of the locomotives fleet with modern and powerful units (1990-2000); and (ix) increase and modernization of the tugboat fleet (1990-2000).

The decision to expand the Canal was delayed, then in 1993 the Tripartite Committee study done by the United States, Japan and Panama reactivated the possibility by recommending the construction of a third set of locks with capacity for vessels up to 150,000 DWT (Dead Weight Tons) that would operate together with the current Canal and share navigational channels and resources.

However, a few years later, the assessment of Canal facilities performed by the US Army Corps of Engineers (USACE) to evaluate the conditions prior to its transfer to Panama, included some recommendations that served as an input to prepare the Canal Modernization Program, which execution over the past ten years required an investment of more than US$1.5 billion.

Every improvement undertaken made it more evident that the Canal was reaching its maximum locks utilization capacity. Current estimates show that the Canal handles an annual maximum traffic of 14,000 vessels and operates at 85% of its capacity. This current level limits its capacity to match the sustained growth experienced by the world's most important current trade routes.

With regard to the traditional Canal users, it is worth highlighting that until 2002, bulk commodities represented the main source of revenues of the Panama Canal. This type of cargo

includes dry goods (corn, soy beans, wheat, minerals, fertilizers and coal), as well as liquid bulk (crude oil, petroleum by-products, chemical products, etc.). However, as of that date, the transit of containerized cargo replaced the transportation of dry and liquid commodities as the main source of income. Among the main reasons for this shift are: the traditionally steady transit of bulk cargo, which is served by a broad range of carriers of multiple routes, origins and destinations, meanwhile, containerized cargo transit has tended to consolidate in a relatively small number of carriers and a few relevant routes such as the Panama Canal, by the increasing trend of containerizing a large variety of commodities because of the transportation advantages it represents for world trade routes. This has not only transformed the traditional base of Canal routes and clients, but has also brought about irreversible changes in its competitive environment.

To illustrate, it may be said that actually 25% of the carrying capacity of the world containerized fleet is in Post-Panamax vessels. These vessels are too large to transit through the Canal and consequently use alternative routes; and so, it is estimated that by 2008, thirty-seven percent of the carrying capacity of the worldwide fleet of container ships will consist of this type of vessels.

In this regard, and as stated before, Panama is not the only country that provides options to meet the increasing demand of interoceanic cargo traffic. There are alternatives such as the U.S. Intermodal System, which is complemented by the use of Post-Panamax container vessels on the Trans-Pacific route; the Suez Canal, from Asia to U.S. East Coast, which permit the use of Post Panamax container ships; the prospect of the North-South intermodal system from Mexico to the U.S.; and the prospect of transshipment systems across the Central American Isthmus, among others. Of the alternatives cited, only the Intermodal System and the Suez Canal currently may be regarded as serious competitors of the Panamanian route. Therefore, the maritime route through Panama is subject to a strong competition in its most important markets, precisely those that will contribute significantly to its future revenues.

In addition, it is important to note that the Canal is not an isolated component of the routes it serves. While it is an inseparable part of the cluster of services to traffic and Panamanian trade, it is also a vital link of the trade routes of which it is a part. This chain includes other components

such as the shipping companies, ports, railroads, and distribution centers. If the Canal does not maintain its capacity level, technology and service of these other components, is at risk of becoming bottlenecked, affecting the long-term sustainability of the entire system utilizing it.

In response to this and other trends perceived, and with the purpose of securing the strategic share and competitiveness of the Canal as a key route in world maritime trade, while increasing the long-term contributions to the Panamanian State and the related benefits and income it generates to the population, ACP conducted an intensive outreach with leaders and experts of the maritime industry, as well as Canal clients and users in a search for possible alternatives. As a result, from the year 2000, ACP began a study, review, analysis or identification process of more than 30 alternatives for the expansion, modernization and future viability of the Canal.

In the final analysis of the water supply options for the Canal with a third set of locks, the ACP used two main principles as a guide: (1) the system should be environmentally sound, while using the most efficient water-saving technology; and (2) should make the best use of the Canal watershed water supply to avoid building new reservoirs.

Meeting the following objectives was also used as assessment parameters for the alternatives: (1) increase the profitability of the Canal; (2) generate increasing and sustainable long-term contributions from the Canal to the State; (3) maintain both Canal competitiveness, as well as the value of the maritime route through Panama; (4) capture the increasing demand with adequate levels of service for each market segment; and (5) make the Canal more productive, safe, and efficient.

Once the expansion alternative for the construction of a third set of locks was selected and defined, a national referendum was required by law to consult the Panamanian population on the alternative selected. The referendum result would finally determine whether the proposed expansion would be carried out or not. The date established for the referendum was October 22, 2006, and ACP organized and conducted an intense disclosure and communication program, which provided the population a broader knowledge of the main characteristics of the Project.

The referendum result, which had a turnout of slightly over 40% of the population legally entitled to vote, showed that 78% of participants voted in favor of the Canal Expansion Proposal. This result gave the Project approval for its execution.

1.2 Scope, Objectives, Methodology, Duration, and Implementation of the Study

1.2.1 Scope

The Terms of Reference and Executive Decree N° 209 of September 5, 2006, define the scope of this study. In this regard, a thorough review of the literature was conducted of all the environmental, social and economic studies and assessments conducted in the Project area and its adjacent areas, which contributed to draft the baseline. Subsequently, the information obtained was compared and field samples were taken in those cases where it was deemed necessary. This was done to guarantee a complete analysis of the possible impacts the Project could have and to propose appropriate mitigation and/or compensation measures. Finally, the required activities were carried out aimed at proposing the corresponding management plan, which integrates and complements the information contained in the Project description, the baseline and the impacts identification.

Regarding the scope of this Environmental Impact Study, it is important to mention that the Panama Canal Authority has undertaken the execution of the corresponding environmental assessments of some partial components of the Panama Canal Expansion Project, through independent environmental impact studies that have been submitted to the National Environmental Authority (ANAM). The studies submitted to ANAM which complement this EIS are the following:

- Category II Environmental Impact Study - Earthmoving and Leveling of Cartagena Hill.
- Category II Environmental Impact Study - Pacific Entrance Channel Widening and Deepening
- Category I Environmental Impact Study - Site T6 Preparation Project.

1.2.2 Objective

According to the Terms of Reference drafted by the ACP, the objective of this study is to ensure that the social and environmental impacts of the Panama Canal Expansion Project – Third Set of Locks, are identified, assessed and where it is necessary, mitigated and compensated in a proper, effective and pragmatic manner. To this end, the following elements constitute a important part of this study:

1. Geographic features that may be affected by the Project.
2. Assessment of supply and vulnerability of the natural and social systems.
3. Recognition and assessment of the impacts that could affect the quality of resources and the environment of the area.
4. An Environmental Management Plan that will contribute to prevent the impacts that can be prevented; mitigate or minimize those that cannot be prevented; and compensate those that cannot be mitigated or minimized.

1.2.3 Methodology

The methodology used by the URS Team to draft the Study was in accordance with the provisions established in the proposal for conducting an Environmental Impact Study of the Panama Canal Expansion Project, which consisted mainly in making the best use of the existing information on topics such as Project description, environmental baseline, and social baseline.

An Environmental Study Area (ESA) and a Socioeconomic Study Area (SESA) were defined in order to have the necessary information that would allow an analysis of the socioenvironmental impacts in a context that was suitable to the scope of the works that will be performed as part of this Project.

Within the ESA it was also deemed worthwhile to define a General Study Area (GSA), a Specific Study Area (SSA), subdivided into 6 zones, and the Project Direct Impact Area (DIA).

The SSA groups the areas that could be affected, both positively as well as negatively, in the socioeconomic context and comprises a broader geographic region than the one used in the environmental structure. The SSA was in turn subdivided into six zones that respond to criteria such as population density, proximity to Gatun Lake, and proximity to the Transisthmian Corridor.

Chapter 3 - Project Description - presentes more details on the way in which these areas were defined and what each of them comprises.

Physical Environment

Even though the existing information on this subject was quite complete, it was necessary to discuss topics such as air quality, odors and noise.

In order to measure air quality it was necessary to use gravimetric methods to monitor particles smaller than 10 microns (PM_{10}) to complete the information for some communities near to the Project development sites.

The previous studies or those conducted simultaneously to the execution of this EIA which are related to air quality, evaluated the environmental concentrations of Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), and Ozone (O_3). To measure sulfur dioxide, methods such as fluorescent spectroscopy and the glycerine passive tube / ρ-Rosaniline UV were used, as well as spectroscopy tests and the Griess/Saltzmann method for Nitrogen Dioxide; and the Chemiluminescence and the passive tube sampler for ozone measurements. The method used for particle sampling was the Andersen High Volume PM_{10} Sampler.

The noise measurements performed as part of this EIA were conducted with a calibrated Quest sonometer, Soundpro model, with a type-2 microphone with wind shield. The calibration of the equipment was verified before and after each measurement with a QC-10 calibrator. Measurements were made for 20-minute periods during the day. The studies previously

conducted that were used as a noise reference, also used a similar methodology and included night measurements.

A Nasal Ranger Field Olfactometer was used for field ambient measurements. This instrument provides measurements based on a calibrated series of dilutions obtained by mixing the odorous ambient air with odor-free carbon filtered air. The application of this methodology helps to define the number of dilutions necessary to make the odorous ambient air non-detectable. Two measurements were recorded at each point and as a control measure, these were made by two different technicians. Field work was complemented with several interviews performed by officials from the Health Ministry to obtain a general view of the potential odor sources within the study area.

The water quality and sediment information was mainly based on previous analysis reports and data generated directly by the Panama Canal Authority or by sub-contractors, in addition to information compiled for other environmental impact studies conducted at the Project development site.

Likewise, different studies conducted by government authorities, research organizations and the consulting firm URS Holdings, Inc., were used as a reference on soils.

Biological Environment

The methodology used for flora and fauna sampling was the one developed by CEREB – UP 2005, since the information contained in the studies provided by the Panama Canal Authority was used in the description of the biological environment. Data for the forested habitats were obtained according to the distribution of trees in the forest. The description of the forest structure was evaluated based on the mix coefficient, relative abundance of arboreous species, frequency, horizontal expansion of each tree species and the importance value index of the arboreous species.

The sampled plots were geo-referenced with GPS technology. Transect of one kilometer long by 10 meters wide were marked off in the forested areas; each of these strips had a surface of one hectare. The strips were subdivided into 10 tracts, each measuring 100 x 10 meters. Measurements were taken in each one of them at diameter at breast height (DBH) and at the full height of all trees with a diameter greater than 10 cm. In areas covered by shrubs and grass, one-hectare plots were used and routes followed on parallel plots, based on the topography and landscape.

For the flora inventory, lists of angiosperms, gymnosperms, ferns, and fern allies were prepared, representing the types of vegetation and these were used in the field works. Preliminary field identifications were made and the species that were not identified were collected for their identification at the University of Panama herbarium. To preserve the sample, a record was made of the place where the plant was collected and the collection date. The samples were put in plastic bags and were later pressed and dried in the herbarium.

Regarding the mastofauna, sample sites were selected according to bat habitats and linear transects was the main method used for identifying and monitoring other mammal species. The transects were worked on day and night schedules and different samples were collected depending on the hour of the day. The open trails, roads and narrow paths in the forest were covered during the night and demanded a greater effort. During the day, the works focused on the survey of sample sites, searching for traces, tracks and any other signs of the presence of mammals in the area.

Among the methods used by CEREB – UP 2005 for bird sampling were: overall search and capture with mist nets. For the overall search sites such as trails, roads and paths considered ideal for this activity were identified, and the birds were located and visually identified with the help of binoculars and the **Panama's Birds Guide**. The general searches were complemented with the recording of vocalizations of birds, and these were compared with the songs identified and recorded by G. Angehr. The mist nets were placed in the forested and non-forested habitats (shrubs) for trapping hidden birds or those that were difficult to identify at a distance. This Guide

was used in their identification. It is worth mentioning that the captured birds were released at the same site.

Herpetofauna was sampled by using the general search method described in the previous paragraph, as well as the selected transects for flora sampling. During field work, the animals observed were recorded, as well as the number of individuals and their gender, in those cases where this was possible. The findings were analyzed according to Pisan's methodology (1994).

In obtaining samples of aquatic fauna, collection stations were established and geo-referenced at the water bodies on both slopes. The samples were placed in labeled plastic bags, which were placed in 5-10% formalin and stored in covered plastic buckets for their transportation and process in the Ichthyology Laboratory of the Exact Natural Sciences and Technology Faculty of the University of Panama.

Socioeconomic Environment

For the description of this component, information related to the population characteristics and their quality of life was compiled through the use of demographic, social, economic, mortality, morbidity and labor occupation indexes, among others. The information main source was the 2000 National Population and Housing Census, as well as other news bulletins published by the Comptroller General of the Republic and complementary information provided by the same institution.

Additional information was also obtained from previous studies, institutional publications and government offices on topics such as the conditions of the existing services and infrastructures in the area and economic activities in the zone.

The population perception was revealed in the information gathered from the citizen´s participation process carried out as a part of this study. To this end, the population was consulted through a series of standardized interviews at the homes in the communities of the

Socioeconomic Study Area (SSA)[1], as well as direct individual interviews and some group in-depth interviews to local and regional leaders were conducted.

With the purpose of collecting the largest amount of information on the archaeological, historical and cultural resources, published literature on colonial, modern and contemporary history, ethnohistory, archaeology and paleobotany studies were used. The original archaeological and historical data were placed on base maps containing topographic, hydrographic and aerial and satellite photography information, knowing there is a lot of information that can be inferred taking into consideration the physiographic variable location of archaelogical sites. The use of this system was helpful to identify, in some cases, towns geographic coordinates and other ancient settlements, both pre-hispanic, as well as colonial and historic settlements related to the Canal construction.

In addition, a systematic pedestrian survey was performed in six sites to properly identify, describe and assess the archeological sites on the Atlantic Side construction zone of the third set of locks. For that reason, eight transects were established and distributed in the following manner: six at the 1939 excavations (two to the East, two to the West, and two at the bottom) and two at the earth dam that isolates the excavation from the sea.

Impacts Identification and Management Plan

The methodology used to identify the impacts is based on a modification of the Leopold matrix (Garmendia et al., 2005), in which the activities carried out in the Project influence area are correlated to the existing biophysical, socioeconomic and cultural elements of the area. To valuate the impacts, the method applied is an adaptation of the Relevant Criteria Method (Buroz, 1994; SWECO-INGENSA-CALI, 1997; Walsh Peru, S.A. 2005; Garmendia et al., 2005), in which a series of impact indicators are calculated and extrapolated with a function that provides a unique index called Significance Index (S).

[1] Please refer to Chapter 2 for the definition of the SSA.

The Management Plan is a summary of the recommendations presented by the professionals who worked in the Project impacts identification. These recommendations are aimed to propose adequate mitigation measures and their corresponding mechanisms of execution.

1.2.4 Duration and Instrumentation

The drafting works to elaborate the Environmental Impact Study and their corresponding quality control revisions were carried out in a five-month period. This period include bibliographic reviews and required field work.

The following instruments were used to collect the field information: GPS, maps, binoculars, photographic camera, Nasal Ranger Field Olfactometer, Soundpro sonometer model, QC-10 calibrator, gravimetric sampler, and collection inputs. Also available were a large number of studies done in the Project area and they are listed in detail in the bibliography.

1.3 Categorization

Pursuant to regulations established in Article N° 15 of Title II (Projects included in the Environmental Impact Assessment Process) of Executive Decree Nº 209 of September 5, 2006, which governs the Environmental Impact Assessment Process, the following essential requirement has been identified as a result of the activity proposed in this study:

- The new projects, works, activities, or **modifications to the existing ones** that will be part of the Environmental Impact Assessment Process or will adhere to the **Good Environmental Practices Guide** during the planning, execution, sitting, installation, construction, fitting, assembly, maintenance, operation, modification, dismantling, abandonment and termination phases, are those specifically listed in Article 16 of this Regulation.

Based on the above information and because this is a modification to an existing project, its inclusion in the Environmental Impact Assessment Process is subject to the specific list of the cited regulation. The list review described in Article 16 of the cited regulation, determined that this Project can be classified at least in the following two categories: **(i) Construction of channels, navigation channels and**; **(ii) Movement and/or leveling and/or landfill to develop infrastructures**. Therefore, it must be subject to the Environmental Assessment Process.

To establish the EIA category, the provisions of Article 22 of Chapter I, Title III of Executive Decree N° 209 of September 5, 2006, was taken into account. This Article defines five Environmental Protection Criteria to assign the category under which a specific Project will be classified in the environmental impact studies.

Pursuant to the criteria defined in the regulation and the content of Article 24 of Chapter II, Title III of Executive Decree N° 209, which determines three EIS categories according to the significance degree given to the negative impacts generated by the Project and bearing in mind that the Panama Canal Expansion Project – Third Set of Locks could cause qualitative and quantitative negative impacts to forests, soils and water quality, this EIS is classified as a Category III and therefore, it requires a more thorough analysis to evaluate the impacts and to propose its Environmental Management Plan.

1.4 Structure

Based on the preceding, the information presented in this document is in line with what is established for Category III Environmental Impact Studies, according to Article 27 of Executive Decree N° 209 of September 5, 2006 requirements. The information is organized as follows:

Table of Contents. This section contains an ordered list of the chapters included in the Environmental Impact Study and indicates the page on which each one begins.

Executive Summary. An overall view of the study is presented in this section based on information regarding the company´s general data, a brief Project description, influence

area characteristics, relevant information on the critical environmental problems caused by the Project, description of all positive and negative impacts, mitigation measures, follow-up, monitoring and control and a brief description of the citizen´s participation plan.

Chapter 1 – Introduction. This section describes an overall background of the project, objectives, justification, categorization and proposed structure for the document.

Chapter 2 – General Information. This section contains information related to the developer, type of company, location and legal representation.

Chapter 3 – Project Description. This section contains the Project objective and its justification, a geographic location map, the legal basis that justifies the execution of the Project, such as the requirements and international applicable good practices. It also describes the processes and logistics during the different stages of design, construction and operation, including any actions that could impact the environment. This chapter concludes by indicating that the Project is compatible with the land use guidelines and gives a financial study and analysis and the investment total amount.

Chapter 4 – Description of the Physical Environment. This section contains the information related to the physical components of the study area. It also analyzes potential natural threats and the flood hazards, erosion and landslides that the Project could contend.

Chapter 5 - Description of the Biological Environment. This section depicts the various biological components within the study area and determines the fragility and a representational portrayal of ecosystems.

Chapter 6 – Description of the Socioeconomic Environment. This section lays out the different social, economic and historical/cultural components present in the study area.

Chapter 7 – Identification of Specific Environmental Impacts. This section analyzes the existing environmental conditions; identifies, evaluates and prioritizes the Project impacts; and describes the used methodologies.

Chapter 8 – Environmental Management Plan (EMP). This section specifies the identification and recommendation of specific mitigation measures, the agency responsible for implementing these measures; the establishment of monitoring measures, and the execution schedule. Likewise, the EMP includes the citizen participation plans, risk prevention, fauna rescue and relocation, environmental education, contingency, post-construction environmental recovery and abandonment plans. Also, other requirements defined by the international financing institutions pertaining to report accountability and community relations, among others, are included as part of the EMP. This plan includes a summary of the estimated environmental management costs.

Chapter 9 – Economic Adjustment for Social and Environmental Issues and Final Cost-Benefit Analysis. This section includes the environmental impact and social issues monetary valuation . In addition, the NPV estimates are shown.

Chapter 10 – List of Professionals that Participated in the Drafting of the Environmental Impact Study and the Responsible Signatures. This section contains the duly notarized signatures and registry number of the consultants that prepared the Study.

Chapter 11 - Conclusions and Recommendations. This chapter presents the conclusions and recommendations concerning the Project environmental feasibility and its implementation success.

Bibliography. This section presents a summary of the bibliographic references that were consulted for the preparation of this document.

Annexes. Ancillary information such as charts, photos, etc., are attached in support of the analysis conducted.