

CHAPTER I INTRODUCTION

1.1 General

1.1.1 Background

In response to the request of the Government of the Republic of the Philippines (hereinafter referred to as “the Government of the Philippines” or “GOP”), the Government of Japan has decided to carry out “the Study on Water Resources Development for Metro Manila in the Republic of the Philippines” (hereinafter referred to as “the Study”), in accordance with the relevant laws and regulations in force in Japan.

At the official request of GOP, Japan International Cooperation Agency (hereinafter referred to as “JICA”), responsible for the implementation of the technical cooperation of the Government of Japan, dispatched a Preparatory Study Team from November 28 to December 22, 2000 to discuss and determine the Implementing Arrangement for the Study. During the stay in the Philippines, the Preparatory Study Team had a series of discussions with the authorities concerned of GOP, in particular, with the National Water Resources Board (hereinafter referred to as “NWRB”), to conclude the Implementing Arrangement.

In March 2001, JICA determined to entrust the Study to a joint venture of Nippon Koei Co., Ltd. and NJS Consultants (hereinafter referred to as “JICA Study Team” or “the JICA Study Team”). The Study was commenced in the end of March 2001.

On the part of GOP, NWRB acts as a counterpart agency for the JICA Study Team and also as a coordinating body in relation with the relevant governmental and non-governmental organizations concerned for smooth implementation of the Study. For supervising the study activities, NWRB organized a Steering Committee and a Technical Committee, both of which are composed of representatives from the concerned agencies. NWRB also nominated counterpart personnel to coordinate closely with the JICA Study Team. Tables 1.1, 1.2 and 1.3 show the list of the Committees members, Technical Working Group members and Counterpart personnel, respectively.

1.1.2 Objectives of the Study

The objectives of the Study are:

- To formulate a master plan on water resources development in the Agos River Basin (including the Kanan and Kaliwa River Basins) to supply domestic, municipal and industrial water to Metro Manila (Phase 1 Study)
- To conduct a feasibility study on the priority project(s) which will be selected from the master plan (Phase 2 Study)
- To carry out technology transfer to the Philippine counterpart personnel in the course of the Study.

1.1.3 Study Area

The Study area covers the Agos River Basin including the Kanan and Kaliwa River Basins, as well as the MWSS water supply service areas in and around Metro Manila.

1.1.4 Overall Work Schedule of the Study

The Study was carried out dividing the work period into two phases, namely Phase 1: the Master Plan Study (M/P) spanning between March 2001 and November 2001, and Phase 2: the Feasibility Study (F/S) on the selected priority project spanning between January 2002 and March 2003.

Phase	1st Phase (Master Plan Study)												2nd Phase (Feasibility Study)																	
	1st Year												2nd Year						3rd Year											
Year/Month	Year 2001												Year 2002									2003								
	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3				
Study Stages	Preparatory Home Office Work in Japan			1st Home Office Work in Japan			2nd Home Office Work in Japan			3rd Home Office Work in Japan			1st Field Investigation									2nd Field Investigation						3rd Field Investigation		
Preparation/ Submission of Report	▲ IC/R			▲ P/R (1)						▲ IT/R			▲ P/R (2)						▲ DF/R/F/R											
Technology Transfer Seminar													Technology Transfer Seminar									●								

IC/R: Inception Report P/R: Progress Report IT/R: Interim Report
 DF/R: Draft Final Report F/R: Final Report

Overall Work Schedule of the Study

Originally, the Study was scheduled to terminate in November 2002. However, the completion had actually to be deferred by four (4) months to March 2003 due to a longer time requirement for the 2nd Field Investigation Work in the Phase 2 stage, which was obliged by security problem and adverse weather condition encountered at the site.

This Volume IV is the Main Report for the Feasibility Study describing the results of investigations and studies conducted in the Phase 2 of the Study.

1.2 Progress of the Study

1.2.1 Phase 1 Study (Master Plan)

(1) Explanation and Discussion of Inception Report

The JICA Study Team was assigned to the Philippines on March 31, 2001. The Study Team submitted the Inception Report to the National Water Resources Board (NWRB), the Counterpart Agency for the Study, on April 3, 2001. The Study Team had a preliminary discussion on the Inception Report with the Executive Director and Counterpart Staff of the NWRB on the same day.

The Steering Committee Meeting for the explanation of and discussion on the Inception Report was held on April 19, 2001. The Meeting discussed the Inception Report in sufficient detail. As a result, the approaches and methods for the Study proposed in the Inception Report were in principle accepted by the Steering Committee.

(2) First Field Investigation Work (April-August 2001)

The Study Team carried out the 1st Field Investigation Work for the period of about 4.5 months from April to August 22, 2001.

Initially, the Study Team carried out field reconnaissance surveys to acquire necessary information at the field with assistance of the NWRB Counterpart Personnel. A constraint encountered was the difficulty of access into the Kanan River upstream reaches due to security problem. This compelled the Study Team to gather the relevant information on the Kanan River Basin from map studies, interpretation of the existing aerial photographs and also from the previous survey reports. There was no major security problem in the access to the Agos River reaches and the Kaliwa River middle-lower reaches.

The Study Team also conducted the following two investigation works by subletting them to local survey firms:

(a) Hydrological Investigation

Hydrological investigation work at this stage consisted of four activities: i.e., (i) installation of three (3) new stream flow gauging stations, one each at Agos, Kaliwa and Kanan Rivers, (ii) discharge measurements at the three stations, (iii) river water sampling and laboratory tests for suspended sediment load analysis, and (iv) river water sampling and laboratory test for water quality analysis. The contract was signed on May 5, 2001 and the work continued up to August 2001.

(b) Initial Environmental Examination (IEE)

In view of the importance of environmental aspects to be examined in the Study, an IEE survey was carried out at the 1st Field Investigation stage. The contract for the work was concluded on May 31, 2001. The main objective of the survey was to delineate potential environmental problems and issues that may be relevant to dam development and water conveyance plans conceived at the initial stage of the 1st Field Investigation. The IEE attempted to define the screening and scoping of the potential environmental issues for each of the alternative development schemes.

The JICA Study Team visited various agencies to collect the necessary data and information relevant to the Study. Based on data and information collected, the Study Team carried out preliminary analytical and planning studies during the 1st Field Investigation. The activities covered socio-economic studies, water demand projection, hydrological analyses, geological assessment, plan formulation studies, preliminary design and cost estimate, and socio-environmental studies at a master plan study level.

As outcomes from the 1st Field Investigation Works, the Study Team submitted the Progress Report (1) to NWRB, which contained the findings of field investigations and also various study results including the preliminary formulation of alternative development plans. The Report was discussed at the Steering Committee Meeting held on August 20, 2002.

(3) First Home Office Work (September-November 2001)

The 1st Home Office Work in Japan continued for about 2 months from the middle of September to the middle of November 2001. The main study works undertaken during the 1st Home Office Work were as follows:

- Refinement of the findings presented in the Progress Report (1)
- Preparation of a master plan for the water resources development of the Agos River Basin
- Evaluation of the proposed master plan from the viewpoint of economic, technical and social aspects
- Selection of a priority project which will be taken up for the Feasibility Study

On the basis of the results of the study works performed in the 1st Home Office Work, an Interim Report was prepared at the middle of November as originally scheduled. The Interim Report presented a Master Development Plan of the Agos River Basin mainly focussing on the water resources development for water supply to Metro Manila. The Master Plan identified that, among eight (8) alternative development scenarios examined, a water supply development plan associated with Kaliwa Low Dam-Agos Dam (Scenario B) would be the most prospective one. The scheme was proposed as an alternative project comparable to or superceding the Laiban Dam Project which has been suspended due to social problem since 1984.

1.2.2 Phase 2 Study (Feasibility Study)

(1) Selection of Priority Project for Feasibility Study

After arrival of the JICA Study Team for the Phase 2 Study, a Steering Committee Meeting was held on January 16, 2002. The Meeting agreed to select the Kaliwa Low Dam-Agos Dam development scheme as a priority project and take it up for the subsequent feasibility study.

(2) Second Field Investigation Works (January-October 2002)

The first batch of the JICA Study Team was assigned to the field on January 9, 2002 and commenced the 2nd Field Investigation Works for the Feasibility Study.

The work comprised the following four items of investigations, which were conducted by subletting to four local investigation firms:

- (a) Topographic survey, covering Agos damsite, reservoir area, Agos lowermost plains (Infanta-General Nakar Plain) and waterway route from the Kaliwa River to Taytay area

- (b) Geological investigation, consisting of core drilling, seismic and electric prospecting surveys, test pitting and laboratory test, which cover main structure sites
- (c) Environmental Impact Assessment (EIA), including natural and socio-economic environmental surveys, covering all the Project area
- (d) Hydrological investigation, consisting of the installation of an additional manual-reading gauge on the Kaliwa River, discharge measurements at gauging stations and in limestone areas, and water sampling/laboratory tests for water quality and sediment analysis

As described above, the investigation work obliged a 4-month delay. The original schedule had contemplated to complete all works by June 2002, but actual completion was in October 2002. This delay was caused due to the following particular situations experienced at the investigation sites:

- (a) Activities of insurgents become active from the beginning of March 2002. Field investigation activities at the site had to be totally suspended for about 1.5 months up to the end part of April. The security condition thenceforward was not always stable, which gave influences on the progress of subsequent investigation works directly and indirectly.
- (b) Aerial photography for topographic mapping could not be accomplished during the dry season till June 2002. This obliged the change of the survey method and caused a 4-month delay in producing the final survey outputs.
- (c) The commencement of seismic refraction survey had been delayed due to the difficulty in acquiring the permission of dynamite use, since the authority concerned had a strict regulation for the use of dangerous articles such as dynamites, fire arms, etc. until the election of Barangay (village) captains was over in July 2002. Also, extra time was required for obtaining the local people's consent to blasting operation at the investigation sites. These caused the delay in the progress of seismic refraction survey.

As the outcome of the 2nd Field Investigation and the related studies, the JICA Study Team prepared the Progress Report (2) and submitted it to NWRB on October 5, 2002. The Report contains the essential findings from the investigation works and a conceptual framework plan of the proposed Kaliwa Low Dam- Agos water supply development project. The proposed plan remains almost identical to that presented in the Interim Report.

The Report was explained and discussed at the Steering Committee Meeting held on October 7, 2002. In principle, the Meeting conferred their general consent to the Report especially on the following items, provided that subsequent comments from the member agencies will be taken into consideration in the Final Report:

- Concept of the plan formulation and proposed layout plans of water resources development and conveyance facilities:

- Proposed implementation programs: including the implementation schedule, organizational set-up, work procurement packages (combination of the government project and BOT project);
- Consideration to major opinions raised at the public consultations and workshops as far as they are reasonably relevant to the Project;
- Implementation of resettlement programs in line with the methods presented in the Report: and,
- Transfer of four (4) gauging stations after the completion of the official procedures between NWRB and JICA and the request to NWRB and MWSS to program the continuation of hydrological measurements.

The 1st Workshop was conducted at Pililla on October 9, 2002, inviting the representatives of local governments and people in the affected area. The objective was to present advance information on the main features of the contemplated project to the officials and people and also to collect the general opinions of the participants about the project. A total of 94 persons attended the Workshop.

(3) Second Home Office Work (November 2002-February 2003)

At home office in Japan, the JICA Study Team conducted plan formulation and design studies at a feasibility study level by reviewing in further detail the results of the 2nd field investigation work and the preliminary planning studies presented in the Progress Report (2).

On November 5, 2002, the JICA Study Team received via NWRB supplemental comments on the Progress Report (2), which were submitted to NWRB by the member agencies of the Steering Committee. The JICA Study Team sent back the responses to the comments in the beginning of December stating the way of incorporation of the comments in the Final Report.

As the outcome of the home office work, the JICA Study Team prepared a draft version of Final Report compiling all the results of investigation works and studies so far conducted under this Study.

(4) Third Field Investigation (February 2003)

On arrival of the JICA Study Team at Manila on February 11, 2003 for the conduct of the 3rd Field Investigation, the JICA Study Team submitted the Draft Final Report to NWRB. On February 13, 2003, a Steering Committee Meeting was held to explain and discuss the Draft Final Report.

In the 3rd Field Investigation conducted for 9 days from February 11 to February 19, 2003, the 2nd Workshop was held in Manila with an aim of presenting the outline of the proposed Project to the representatives of local governments as well as the residents in the areas concerned with the Project, and of confirming the public opinions on implementation of the proposed Project. It was the final opportunity that the JICA Study Team could receive the public opinions on the proposed Project.

During 3rd Field Investigation, a Technical Seminar was also held in Manila as a

program for transfer of knowledge, which was attended by the staff of NWRB and other concerned government agencies. The Seminar took up the subjects relevant to the planning of water resources development and conveyance projects.

(5) Third Home Office Work (March 2003)

The JICA Study Team received additional comments on the Draft Final Report from the member agencies of the Steering Committee in one month after the Steering Committee Meeting. The JICA Study Team sent back the responses to the comments.

In the 3rd Home Office Work, the JICA Study Team has prepared this Final Report through reflecting the comments from the Steering Committee that were responded by the JICA Study Team to do so.

1.3 Reports

Final Report covers two (2) components; i.e., Master Plan Study (M/P) and Feasibility Study (F/S). The Report is presented in the following six (6) volumes:

Volume I	Executive Summary (covering both M/P and F/S)
Volume II	Phase 1: Master Plan Study – Main Report
Volume III	Phase 1: Master Plan Study – Supporting Report
Volume IV	Phase 2: Feasibility Study – Main Report
Volume V	Phase 2: Feasibility Study – Supporting Report
Volume VI	Phase 2: Feasibility Study – Data Book

F/S Report consists of three (3) volumes: Volumes IV to VI listed above. This Report, Volume IV, presents the essential findings in the F/S, while the other two volumes contain the details of respective investigation works and study subjects.

The F/S has refined and updated various figures earlier presented in the M/P, based on new findings from the 2nd Field Investigation conducted after the Master Plan Study. Hence, there are some differences in the presented figures between M/P and F/S. The refinement and updating were made especially for the following aspects:

- (a) Assessment of in-situ field conditions based on the results of field investigations
- (b) Layout plans of the waterway facilities based on the findings from (a) above
- (c) Assessment of socio-environmental conditions based on EIA
- (d) Construction cost estimate based on changes in (b) and (c) above
- (e) Economic and financial evaluations of the project incorporating the revision in (d) above

It is noted that the concept of plan formulation has been kept consistent throughout the course of the studies. The revision of plans and figures made in the F/S is not of such a major extent as affecting the logic and results of comparative studies presented in the M/P. Hence, the conclusion and recommendation in the M/P and F/S are consistent each other.

Table 1.1 Members of Steering Committee

No.	Agency	Position	Name
1	National Water Resources Board (NWRB)	Chairman	Mr. Rodolfo D. Mateo (Executive Director of NWRB) <i>Alternate:</i> <i>Jesus G. De Leon</i> <i>(Deputy Executive Director of NWRB)</i>
2	National Economic and Development Authority (NEDA)	Member	Mr. Ruben S. Reinoso, JR (Director of NEDA, Infrastructure Staff) <i>Alternate:</i> <i>Librado Quitarano</i> <i>(OIC, Assistant Director of NEDA, Infrastructure Staff)</i>
3	Metropolitan Waterworks and Sewerage System (MWSS)	Member	Ms. Macra A. Cruz (Deputy Administrator of MWSS)
4	Department of Public Works and Highways (DPWH)	Member	Mr. Erlinda Templo (Director of DPWH, Planning Services)
5	National Power Corporation (NPC)	Member	Rodolfo German (Department Manager of NPC, Angat Reservoir HEP, GENCO 2)
6	Department of Environment and Natural Resources (DENR)	Member	Romeo T. Acosta (Director of DENR, Forest Management Bureau (FMB))
7	Department of Interior and Local Government (DILG)	Member	Serafin M. Benaldo (Regional Director, National Capital Region)
8	Department of Agriculture (DA)	Member	(not specifically nominated)

Table 1.2 Members of Technical Working Group

No.	Agency	Position	Name
1	National Water Resources Board (NWRB)	Chairman	Mr. Lope R. Villenas (Chief, Policy and Program Division of NWRB) <i>Alternate:</i> Ms. Isidra D. Penaranda (Planning Officer of NWRB)
2	National Economic and Development Authority (NEDA)	Member	Mr. Rufino C. Guinto Supervising Eco. Dev. Specialist Infrastructure Staff <i>Alternate :</i> Mr. Dennis Von Custodio (Supervising Eco. Dev. Specialist, Infrastructure Staff of NEDA)
3	Metropolitan Waterworks and Sewerage System (MWSS)	Member	Mr. Jose M. Dimatulac (Acting Manager, PMO, MWSS)
4	Metropolitan Waterworks and Sewerage System (MWSS)	Member	Mr. Arsenio N. Macaspac (In-House Consultant of MWSS)
5	National Power Corporation (NPC)	Member	Mr. Romualdo Ma. T. Beltran (Acting Principal A, Planning and Development Dept., PMES, NPC)
6	Department of Environment and Natural Resources (DENR)	Member	Mr. Jesus A. Javier (Chief, Forest Mgt. Specialist Forest Management Bureau (FMB), DENR)
7	National Irrigation Administration (NIA)	Member	Mr. Milo M. Landicho (Chief, Water Resources Utilization Division, Project Dev. Dept., NIA)
8	Manilad Water Services, Inc. (MWSI)	Member	Mr. Philip E. Cases (SAVP, Regulatory Affairs, MWSI)
9	Manila Water Company, Inc. (MWCI)	Member	Mr. Roberto A. Santiago (Strategic Planning Specialist, Asset Management Dept., MWCI)

Table 1.3 Counterpart Personnel of NWRB

No.	Designation	Name of Counterpart Personnel
1	Team Leader of Counterpart Personnel	Pacita F. Barba
2	Dam Planner	Dolores S. D. Cleofas
3	Hydrologist	Joey C. Castro
4	Design Engineer	Emmanuel Abalain
5	Water Conveyance Planner	Panfilo Manalastas
6	Geologist / Geophysist	Ricarte Olarte
8	Sociologist/Resttlement Planner	Francis Hilarie
9	Construction Planner	Josephine Billones
10	Economist and Insitutional Planner	Cristina Arellano
11	Environmentalist	Joey Beltran
12	Water Supply Planner	Ma. Victoria Astraquillo
13	Surveyor/Coastal Engineer	Melchor Abril

CHAPTER II FIELD INVESTIGATION WORKS

2.1 General

A series of field investigations were carried out in order to acquire in-situ information and data relevant to the actual field conditions. The investigations covered the following items:

- (a) Topographic Survey
- (b) Geological Investigation Works
- (c) Hydrological Observation and Measurement
- (d) Environmental Impact Assessment (EIA)

This Chapter describes the outline of investigation works carried out at the field. The findings therefrom are described in the respective Chapters hereinafter.

2.2 Topographic Survey

2.2.1 Surveys Originally Programmed

The purpose of the topographic survey is to produce the topographic data and products covering the sites of Kaliwa Low Dam, Agos Dam and its reservoir, water conveyance facilities connecting the Kaliwa River and the proposed Taytay Service Reservoir, and also Agos River downstream reaches up to the Infanta-General Nakar Plain. The topographic survey program originally intended consisted of the following works:

- (a) Ground control survey for photogrammetric mapping
- (b) Aerial photography
- (d) Photogrammetric mapping at scales of 1:2,000 and 1:5,000
- (e) River cross section survey in the lower reach of the Agos River

As stated above, the original program contemplated to produce the necessary topographic information mainly by aerial photographic survey method.

The topographic survey conducted for the Feasibility Study is explained in detail in Annex A of Volume V.

2.2.2 Modification of Survey Method

Aerial photography was attempted from the beginning of February 2002, but there were very few occurrences of bright and clear weather or good conditions to take aerial photographs. The weather condition was cloudy or rainy around the Project area. Although the attempts for the aerial photography were carried on up to June 15, 2002, there were not enough bright and clear days to complete the aerial photography. Since the rainy season had already started and there is no more possibility of accomplishing aerial photography as originally scheduled, the JICA Study Team had to give up further attempts of the aerial photography. The areas

covered with the new photography (photo scale 1,10,000) accomplished this time are shown in Figure 2.1.

The new aerial photographs cover a large portion of waterway route up to the Taytay Service Reservoir except for a small area at the eastern end of the Tunnel No.1 route. Photo shooting for the Agos River Basin was entirely failed, while the photos for the Agos Dam and Afterbay Weir sites were taken.

In order to make up for the deficiency of new aerial photographs, the JICA Study Team was obliged to modify the technical specification for the topographic survey and to work out the alternative methods for acquiring the topographic maps that were required for the subsequent study work for the Feasibility Study.

The following alternative methods for acquiring the topographic maps and other topographic information were introduced and some new work items were added to the original technical specification for the topographic survey.

(1) Change of Method for Acquiring Topographic Information:

(a) Mapping by Using Existing Aerial Photos:

Existing aerial photographs available from NAMRIA (scale 1:25,000, taken in 1995) covering the Infanta-General Nakar Plain and from CERTEZA (scale 1/10,000, taken in 2000) covering Antipolo area were used for mapping of the areas where new photos are lacking.

(b) Use of Earlier Prepared Maps:

For areas not covered by both the new and existing photographs, the existing maps (scale 1:5,000) prepared by NPC in earlier studies in 1980 for the Kaliwa River Basin and in 1992 for the Kanan River Basin, were used for re-preparing the topographic maps. New maps were produced by digitizing the contour lines and other topographic features indicated on the existing maps. The coordinates and heights were adjusted to the NAMRIA datum adopted for the topographic survey.

(c) Use of Existing 1:50,000 Maps

For the area at the eastern end of the Kaliwa-Taytay Waterway route (7 km long section of Tunnel No.1), the Study had to rely on the existing NAMRIA 1:50,000 scale maps.

(2) Additional Survey Items:

Lack of latest information on the old aerial photographs and existing maps necessitated to carry out the following additional works:

(a) Photo Shooting Using Helicopter and Ordinary Camera

This work was carried out for the purpose of grasping the distribution of houses in the Agos Reservoir area. In view of time constraint and rainy weather condition prevailed during the work period (July to August 2001), this was only the possible alternative method of acquiring the objective

information. The location of houses was delineated by GPS equipment mounted on the helicopter.

(b) Land Classification Mapping by SPOT Satellite Data

This work is to grasp the latest condition of land uses in the Agos Reservoir area. The land use was classified into 11 different categories.

2.2.3 Outputs from Topographic Survey

As a result of topographic survey, the following outputs were produced:

- 1:5,000 scale topographic map: 50 sheets, covering Agos River Basin and Kaliwa-Taytay Waterway route
- 1:2,000 scale topographic map: 44 sheets, covering the Agos Dam site, Afterbay Weir site, Kaliwa Low Dam site, Morong Water Treatment Plant site, No.1 and No.2 Pipeline routes, and Taytay and Antipolo Service Reservoir sites
- Aerial photographs at 1:10,000 scale: 1 set, taken along flight courses shown in Figure 2.1.
- River cross sections: 35 sections along the Agos River
- 1:10,000 scale map showing the distribution of houses in the Agos Reservoir area: 1 sheet with photographs of the identified housing areas
- 1:50,000 scale land classification map covering the Agos Reservoir area

2.3 Geological Investigation

2.3.1 Geological Investigation Works Conducted

The following geotechnical investigations were carried out on local contract basis in this Study:

- i) Core drilling : 1,700m in total
- ii) Geophysical exploration
 - Seismic Refraction Prospecting : 11.5 km in total
 - Electric Prospecting : 5.0 km in total
- iii) Laboratory test : 1 set
- iv) Geomorphological analysis : 1 set

The geological investigation works performed for the Feasibility Study are explained in detail in Annex B of Volume V.

2.3.2 Core Drilling

Core drilling was carried out at 32 sites in total to clarify the geological conditions of the Agos damsite, Agos Afterbay Weir site, Kaliwa Low Dam site, Daraitan limestone area, No.1 Tunnel route and other Kaliwa-Taytay Waterway facilities'

sites. The standard penetration tests (SPT), water pressure test (WPT), and temperature logging were also performed inside the selected boreholes. The following table shows the work quantities of core drilling at each of the main structure sites:

Work Quantities of Core Drilling

Site/Location	Hole No	Number of Holes	Total Length (m)
Agos Dam Site	AD-1~8	8	400
Agos Afterbay Weir Site	BD-1~3	3	100
Kaliwa Low Dam Site	KD-1~5	5	120
Daraitan limestone area	LD-1~2	2	350
Tunnel No.1 Route	TD-1~6	6	550
Other Kaliwa-Taytay Waterway Facilities	WD-1~8	8	180
Total		32	1700

2.3.3 Geophysical Prospecting

(1) Seismic Refraction Prospecting

A total of seven (7) seismic prospecting was conducted along the Agos dam axes, Agos spillway, Kaliwa low dam axis and No.1 Tunnel route, and at the proposed Morong water treatment plant (WTP) site in order to clarify the geological conditions as summarized below:

Quantities of Seismic Prospecting

Site/Location	Line No.	Number of Lines	Total Length (m)
Agos Dam Site	AS-1~3	3	4,500
Kaliwa Low Dam Site	KS-1	1	600
Tunnel No.1 Route	TS-1~2	2	5,000
Morong Water Treatment Plant	WS-1	1	1,400
Total		7	11,500

(2) Electric Prospecting

One (1) electric prospecting of 5 km in total length was carried out to confirm the continuity of Daraitan limestone mass toward south applying the two-dimensional resistivity profiling method.

2.3.4 Laboratory Tests

Laboratory tests were conducted to clarify physical and engineering properties of construction materials, i.e. rockfill material and concrete aggregates and filter materials, and earth materials that will be used for construction of the Agos Dam, Kaliwa Low Dam and Kaliwa-Taytay Waterway structures. The rock samples for the laboratory tests were obtained from drilled cores and outcrops, while soil, sand and gravel were sampled from a total of 35 test pits. The results of the laboratory tests are also utilized to assess the geological conditions of foundations at the aforesaid main structure sites.

2.4 Hydrological Observation and Measurement

2.4.1 Installation of New Streamflow Gauges

The hydrological investigations performed in the Master Plan Stage and Feasibility Study Stage are explained in detail in Part-C of Volume III and Annex C of Volume V, respectively.

During the course of the field investigations in 2001 and 2002, the following 4 new streamflow gauging stations (SGS) were installed:

Outline of New Streamflow Gauging Stations

Station Name	Agos SGS	Kanan SGS	Daraitan SGS	Pagsangahan SGS
River	Agos Mainstream	Kanan	Kaliwa	Kaliwa
Location	N 14°41'92" E 121°34'56"	N 14°42'07" E 121°31'76"	N 14°36'02" E 121°26'03"	N 14°41'32" E 121°31'69"
Start Date of Measurement	May 2001	May 2001	May 2001	February 2002
Height of Staff Gauges	8 m (Right Bank)	7 m (Left Bank)	8 m (Left Bank)	5 m (Left Bank)
Automatic Water Level Recorder	Installed (Right Bank)	Installed (Left Bank)	None	None
Cable System	Installed	Installed	None	None

Out of the above 4 new SGSs, the Agos, Kanan and Daraitan SGSs were installed in May 2001 to start the water level observation in the early part of the Master Plan Study stage. While, the Pagsangahan SGS was installed in February 2002 when the hydrological field investigation for the Feasibility Study was commenced.

The locations of the above 4 new SGSs are shown in Figure 2.2. The Agos SGS and Kanan SGS were equipped with an automatic water Level recorder (AWLR) and a cableway system for the discharge measurement during high flow seasons, while that installed at the Daraitan SGS and Pagsangahan SGS are of manual type.

At the end of the Study, these gauges are going to be transferred to NWRB for continuation of the water level recording henceforward.

2.4.2 Discharge Measurement and Sediment Sampling

(1) Discharge Measurement

Discharge measurement at each of the 4 new SGS was carried out for 4 months from May to August 2001 (minimum 25 times each) and 5 months from February to June 2002 (minimum 24 times each). The number of times of the discharge measurements is as follows:

Number of Discharge Measurements Conducted at Each of New SGSs

Station	No. of Measurements	Period Covered
Agos SGS	55	May 2001 - June 2002
Kanan SGS	50	June 2001 - June 2002
Daraitan SGS	55	May 2001 - June 2002
Pagasangahan SGS	24	February 2002 - June 2002

Based on the results of measurement, a stage-discharge rating curve (H-Q curve) was constructed for each station to convert the water level records to discharges. Due mainly to the period of field investigation works, the measurement above could not collect sufficient data for high flow period, which should be made up by the subsequent measurements.

(2) Sediment Sampling and Analysis

The river water samples were taken at each of the aforesaid 4 new SGSs to be used for the suspended load analysis. The sediment sampling was carried out for 4 months from May to August 2001 (minimum 30 times each) and 4 months from January to April 2002 (minimum 10 times each). The number of water samples collected is as follows:

**Number of Water Samples for Suspended Sediment Load Analysis,
Collected at Each SGS**

Station	No. of Samples	Period Covered
Agos SGS	45	May 2001 - May 2002
Kanan SGS	39	June 2001 - April 2002
Daraitan SGS	41	May 2001 - May 2002
Pagasangahan SGS	16	February 2002 - May 2002

The suspended loads contained in the river water were analyzed in a laboratory. Based on the results of laboratory tests, a discharge-sediment rating curve was constructed for each of Agos, Kanan and Daraitan SGSs. The same for the Pagasangahan SGS could not be drawn due to insufficiency of the data collected to date.

2.4.3 Spot Discharge Measurement in Kaliwa Limestone Area

Spot discharge measurement was carried out at eight (8) points on the Kaliwa River in the Feasibility Study stage. The main objective was to investigate the distribution of flows in the limestone areas along the Kaliwa River, through which the Study intended to assess the potential water loss at the limestone areas. The measurements at 8 locations were made on a same day to compare the discharges at each place under a constant runoff condition. The measurement was carried out on 5 days during low flow period in May to June 2002. Location of the spot discharge measurements is shown in Figure 2.3.

2.5 Surveys and Investigations for Environmental Impact Assessment

This Environmental Impact Assessment (EIA) study was carried out to further examine the environmental and social and resettlement issues relative to the Agos River development and provision of the Kaliwa-Taytay Waterway facilities that were identified in the Initial Environmental Examination carried out during the Phase 1 (2001). It is noted that the EIA has to basically conform to the regulatory requirements of the Philippine Environmental Impact Statement (EIS) System. Hence, the EIA survey and study were also conducted as required by the System. A local environmental firm was contracted to carry out the EIA under the

supervision of the Environmental Expert and Resettlement Planner of the JICA Study Team.

There were two stages in the conduct of the EIA, namely the Basic Study Stage and Detailed Study Stage. The Basic Study Stage involves the collection of secondary data and conduct of site reconnaissance for the data validation. The Detailed Study Stage involves field survey and investigation for both natural and social environment.

The following Subsections summarize the field investigation and survey works conducted in relation to the EIA and their methodologies and procedures are explained in detail in Annex D of Volume V.

2.5.1 Surveys and Investigations for Natural Environment

(1) Biological Environment

1) Terrestrial Ecology/Watershed Study

Maps were prepared to show the boundaries of each ecosystem and watershed to include the forest, savannah, grassland, riparian, riverine area (floodplain), agroforestry (agroecosystem), and the coastal zone. From these maps, the area and number of plots and transects for assessing the floral and faunal attributes of each ecosystem were determined. Specifically, for floral assessment, a line was drawn on the map parallel to the longest stretch of the watershed area that serves as the baseline.

Transect lines perpendicular to the baseline were drawn at regular interval to use as a guide to determine the placing of quadrants. Ten by 10 meter quadrants were established at regular interval adopting the stratified random sampling where both random and systematic placement of quadrants were employed. All trees in the 100 m² quadrant were listed together with the undergrowth up to 3 m height within 4 x 4 meter and herbs and grasses inside 1 x 1 meter.

For faunal population, the time area count method was used to list down the animal species encountered in the entire watershed including the vast mangrove forest. The species lists prepared in the previous study were also utilized in the verification of existing and newly found animals.

2) Aquatic Ecology

A total of ten sampling stations was established in the Kaliwa-Kanan-Agos River system to represent the aquatic profile of the river system: three in the Kaliwa River; two in the Kanan River; and five in the Agos River. Figure 2.4 provides the sampling location map. Collection of plankton and benthos, and interviews with the locals regarding the fishery resources and fishing gear they commonly use were conducted at each station. To verify fish species, which are present in the river system, samples were collected in Barangay Pagsangahan.

(2) Physical Environment

1) Geology and Geohazard Study

The study on the geology and geohazard of the Project site is a part of the Engineering, Geological and Geo-hazard Assessment (EGGA) report required by DENR-DAO 2000-28. Field survey in the Project Area was conducted in order to validate information from the maps and reports and observe the surface features and details that could not be determined from other data sources.

Final analysis of the photographs and results of the geotechnical survey were performed based on the results of the field validation. The necessary additional information that would fully define and design the requirements of the Project were also solicited.

The aerial photographs at scales of 1:10,000 and 25,000 and Stereo SPT (XS) images of 1998 were obtained, where the limited data on the Project site were plotted. The photographs, maps and other coverage were analyzed as to the rock patterns and landforms and examined for geologically vulnerable locations. Existing and potential hazard/risk sites were delineated and plotted.

2) Coastal Sedimentation Survey

The siltation and sedimentation study was done primarily on the watersheds and rivers and along the coast of Infanta fronting the Pacific Ocean. Within the watershed along the reach of each river, soil samples were obtained from within 100 to 150 m from the riverbanks. During the survey/fieldwork, significant results were noted as collapsible or unstable soil features and denuded areas.

For coastal sedimentation, the study was done from areas in the vicinity of the mouth of the Agos River to the edge of the peninsula at Dinahican fish port. Soil-sand sediment samples were taken at strategic locations from Barangay Pamplona in General Nakar to Barangay Dinahican in Infanta as shown in Figure 2.5. Formation and location of sandbars were assessed. Water samples were also taken in the vicinity of these soil and sand sampling sites immediately after a significant storm.

Also after a significant storm when the murky or cloudy flow is still apparent, water samples were taken. Three water samples were obtained from the Agos River and two water samples were obtained from the coastal area of Infanta.

Soil Sampling and Analysis

A total of 12 soil samples were obtained from the Kaliwa-Kanan-Agos River system, constituting 4 samples from each river. In addition, sand-soil samples were also obtained at the 5 strategic locations along the coast. Locations were selected and spaced within the reach of the rivers concerned as shown in Figure 2.6.

Soil samples were brought to a geotechnical laboratory for gradation analysis using a standard mechanical sieve. The percent fines were further analyzed for silt and clay content using hydrometer test. Laboratory soil analyses used for the study are: i) sieve analysis; ii) hydrometer analysis; iii) particle distribution curve; and iv) soil classification

Water Sampling and Analysis

Two sets of water samples were obtained for the study. The first set constitutes 5 coastal water samples. These samples were obtained along the coast where breaking waves occurred to take advantage of the turbulent and mixing processes. The second set constitutes 5 river coastal water samples obtained 1 day after a significant storm where the water is still brown with sediments.

The Total Suspended Solid (TSS) test for the water samples obtained from the rivers and coastal areas were performed at the laboratory using the photometric method. The method is used to describe the actual silt and clay loading where they were obtained. The results served as the base to analyze the sedimentation along the coast.

3) River Use Survey

Information on river water use and peoples' dependence on rivers in the proposed Agos Reservoir area and along the river reaches downstream from the Agos Dam was obtained through the focus group discussions (FGD), observations and interviews. The survey results showed the different river water uses by Sitio and Barangay. All significant activities were indicated on the map. Such activities included:

- Domestic (laundry, bathing, drinking water source, sewage disposal, etc.).
- Agricultural (irrigation, washing/bathing of carabaos, fishing, canals, etc.).
- Recreation (swimming, etc.)
- Transport (people, forest and agricultural products, goods and services)
- Commercial (sand and gravel quarrying, etc.)

During the FGD, the perceived problems affecting the rivers and their livelihood were also investigated.

4) Air and Noise Quality

Ambient air and noise quality survey was undertaken to provide baseline information on the present condition of the air and noise levels in the proposed project area as required by the Philippine EIS system as basis for future monitoring.

The survey was conducted through actual on-site one-hour grab sampling over a 24-hour period. The ambient air quality assessment process consists of air sampling and testing for the level of concentration of 3 common air contaminants, Sulfur Dioxide (SO₂), Nitrogen Dioxide (NO₂)

and Total Suspended Particulates (TSP). During sampling, the prevailing meteorological conditions, e.g., wind direction and velocity, air temperature and relative humidity were recorded. The results of the ambient air quality and noise determination were compared to the DENR standard limits.

Noise level determination was conducted using a portable Extech Sound Level Meter for ten minutes at each site. The noise intensity is measured in decibels. Six (6) sampling stations in close proximity to sensitive receptors in the Project site were chosen as shown in Figure 2.7 (1) and (2).

2.5.2 Surveys and Investigations for Social Environment

The study of the social environment conditions of the potentially affected population was carried out through extensive consultation and participation programs utilizing a combination of methodologies. First was the conduct of socio-economic inventory and household surveys (SES) using structured questionnaires, which were carried out on all those who would be directly affected as well as those indirectly affected by the proposed Project. Second was the Barangay meetings held together with the officials in the three directly affected Barangays. Third was the holding of focus group discussions (FGD) in several Sitios in the affected and indirectly affected Barangays where a total of 424 individuals participated. Fourth were key informant interviews with selected representatives of eight active Peoples Organizations (POs) in the directly and indirectly affected areas. The indirectly affected areas were those areas located downstream of the proposed Agos Dam including the coastal area of Infanta, as well as Barangay Daraitan located at the tail end of the proposed reservoir.

The secondary data were also used to obtain the scope of activities in the communities. The combined use of these methodologies provided not only socio-economic data but also those on the major perceptions, issues and concerns on the impact of the Project on the primary affected persons and communities in the Project Area.

The findings of the various surveys and consultations provide a deeper understanding of the social conditions of the people to be affected by the implementation of the Project. The information also provides vital input into the resettlement plan that will be required to be drawn up for the potentially affected people.

(1) The Socio-Economic Inventory and Household Survey (SES)

The socio-economic inventory and household survey was conducted to ascertain the socio-economic and environmental conditions of the people and communities in four primary impact areas, namely the Kanan River area, the Kaliwa River area, the Agos River area and the mangrove area. The SES endeavored to provide a 100% level of coverage in the directly affected area and a 10% sampling for the households in the indirectly affected area. The SES also described the traditions, beliefs and lifestyles of the PAF/PAPs with particular emphasis on the indigenous members of the community.

The surveys for inventory of losses (IOL) were carried out simultaneously with the social surveys. The EIA survey team worked closely with the officials from the respective Barangays and also attempted to have the presence of the Barangay officials during the said activities. In addition, a replacement cost study was also undertaken in order to calculate all losses such as land, structures in order to reflect the replacement cost or current market values.

(a) Framework of the SES and IOL

The SES/IOL questionnaire was divided into seven parts, each providing inputs for resettlement and compensation planning. As previously mentioned, 100% coverage was necessary for two reasons, (a) to have a complete profile of socio-economic items such as household size, income levels, livelihood, access to social services and infrastructures, among others; and (b) to have a complete census, inventory of losses (IOL) and preliminary measurement surveys for all types of physical losses for the affected persons, such as land, house and structure, land improvements, and other properties that would have an effect on resettlement and compensation.

Framework of the Socio-Economic and Household Inventory Survey

Part	Title	Information Provided
Part 1	Background Information	Detailed profiles of project affected persons' economic and social situation
Part 2	Demographic Profile	
Part 3	Household Income	
Part 4	House and Lot	Parameters for determining and/or computing both resettlement and compensation packages
Part 5	Characteristics of Living Conditions	
Part 6	Awareness of the Study	The level of awareness, and perception on the project; issues and concerns on relocation.
Part 7	Perception towards Relocation	

(b) Total Number of Respondents for the SES

The surveys in the directly affected area involved a total of 186 respondents, including the 12 households in the planned Afterbay Weir site as shown below:

Number of Families (Households) in the Directly Affected Area as per the SES ^{1/}

Barangay	Affected /Surveyed Families ^{2/}
Magsaysay	83
Mahabang Lalim	10
Pagsangahan ^{3/}	93
Total	186

1/ Number of households affected as per actual count in the Socio-Economic Household and Inventory Survey, 2002.

2/ Of the total number of 186 affected families/households, only 170 were surveyed. Sixteen households were not covered since they were only identified during the IOL.

3/ IP communities in Sitio Yokyok were not included in the survey due to the stiff opposition of Fr. Pete Montellana of Tribal Community Development (TCD-NGO).

Surveys were also undertaken in the designated indirectly-affected areas traversing 28 Barangays within the 3 municipalities of General Nakar, Infanta and Tanay. The total number of respondents was 871 households, representing 10% of the total number of households.

(2) Barangay Meetings

Barangay meetings were conducted in three Barangays primarily affected by the Project, namely Magsaysay (Infanta) and Pagsangahan and Mahabang Lalim (General Nakar). Representatives of the Barangay councils and the people's organizations attended the meetings. Its purpose was to inform the local officials and key leaders of the data gathering methodologies that will be conducted by the different components of study in addition to seeking their active participation and support.

The meeting in Magsaysay was attended by 30 key leaders-officials and members of SAPANG BALITI and KANLUNGAN, both being a farmers' organization. Out of about 30 participants who attended the meeting in Pagsangahan, 50% were women. The key leaders were the Barangay chairman and selected councilors and the president and members of SAMAKABAY, a people's organization. In Mahabang Lalim, the Barangay chairman brought up the matter of the SES activity in the regular meeting of the council.

(3) Focus Group Discussions (FGD)

The FGD is considered as the most comprehensive approach used in gathering the community perceptions through presentation of the Project and discussions of major issues and concerns that were perceived by the group. The FGDs were held in 33 Sitios located in four Barangays, namely Magsaysay, Pesa, Mahabang Lalim and Pagsangahan. Although not originally included, Barangay Pesa was added to the list because it is located between Mahabang Lalim and Pagsangahan. The number of participants ranged from 3 to 25 depending on the size of the community or village.

The FGDs followed a discussion framework to ensure that biases were minimized by avoiding factors that might have a significant influence in both process and outcome. Nevertheless, flexibility was also observed owing to the unique setting and composition of the group in each of the Sitios

Documentation of the responses/opinions of the different sectors especially the indigenous groups, was carefully noted. Both common and distinct opinions were documented. In addition, observation of the setting, flow of discussion and other significant factors not captured by the specified questions were documented.

(4) Key Informant Interview

Key informant interviews were conducted with representatives of eight out of 15 people's organizations. The FGD instrument was utilized as the discussion guide during the said interviews.

(5) Resettlement Site Development (RSD)

The relocation of PAPs entails that suitable resettlement sites be identified, and planned and developed. The methodologies used were: (1) review of resettlement planning team's survey reports; (2) reconnaissance surveys; (3) site selection and evaluation; (4) conduct of space programming; and (5) development of conceptual and schematic site plan.

The RSD also took into careful consideration the desires and perceptions of the potential PAFs as expressed in the various fora. It also took note of the number of PAFs to be resettled and the preliminary inventory of losses.

(6) Strategic Communications Plan (SCP)

The strategic communications analysis was conducted to identify the strategic audiences through interest group analysis in order to identify the strategic messages that will have to be developed and communicated. This was done through the employment of the Strategic Impact and Assumptions Identification Method (SIAM).

The directly affected communities as well as the IP communities have been identified as those needing special strategic communications attention. The SCP considered the type of message, media and provided for a budget for a specific implementation period that runs in parallel to the activities in the Project.

2.5.3 Public Consultation and Workshop

There were 3 formal public consultations, where key representatives and officials from the local government units (LGUs), Barangays and Sitios as well as NGO/PO representatives were present.

Schedule of Public Consultations

Place	Date	Number of Participants
General Nakar	September 16, 2002	71
Infanta	September 17, 2002	42
Daraitan	September 18, 2002	35
	Total	148

The general objectives of the public consultations were broadly categorized into information, communication and education. The specific objectives are: (a) to present information on the project; its goals, major components and different activities; (b) to educate the participants on the project development cycle, so as to provide them with the basic background on how projects of this nature are developed; and (c) to have the communications with the participants conveying issues and concerns for resolution.

The 1st Workshop was conducted last 09 October 2002, which was attended by 94 participants from the principal LGU stakeholders, the concerned national/regional government officials, the representatives of the private sector and the NGOs. Its objectives were (a) to present the interim result of the Study including advance information on the main features of the contemplated Project at the stage and (b) to elicit the general opinions of the participants about the Study.

While, the aim of the 2nd Workshop held on 19 February 2003 in Manila was to explain the proposed features of the Project and to collect extensively the participants' opinions on the Project that should be reflected in the subsequent proceeding of the Project implementation. The 2nd Workshop was attended by representatives from the LGUs, the government agencies, the academe, the private sector and the NGOs/POs.

In the two Workshops, the general consent was given by the participants in regard to the two basic matters presented in the workshop, provided that all issues and concerns are properly and justly considered and the principles of the implementation of relocation plans, need of income restoration and livelihood supporting programs are strictly adhered. The issues and questions raised by the participants in the two Workshops as well as the recommendations and countermeasures of the Study Team thereon are shown in Table 13.2 in the succeeding Chapter XIII.

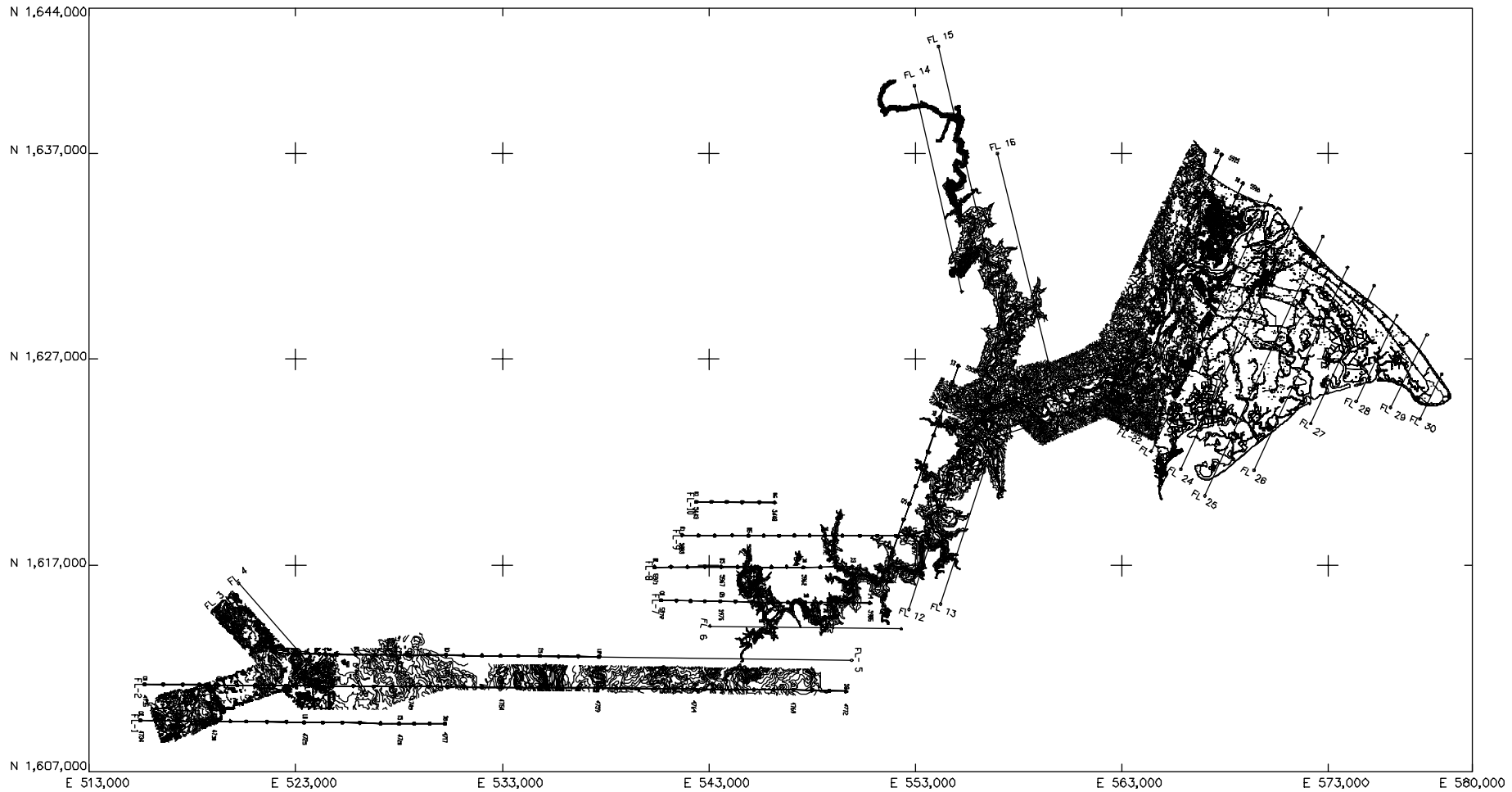


Figure 2.1 Coverage of New Photography and Other Photography Used in Photogrammetric Mapping

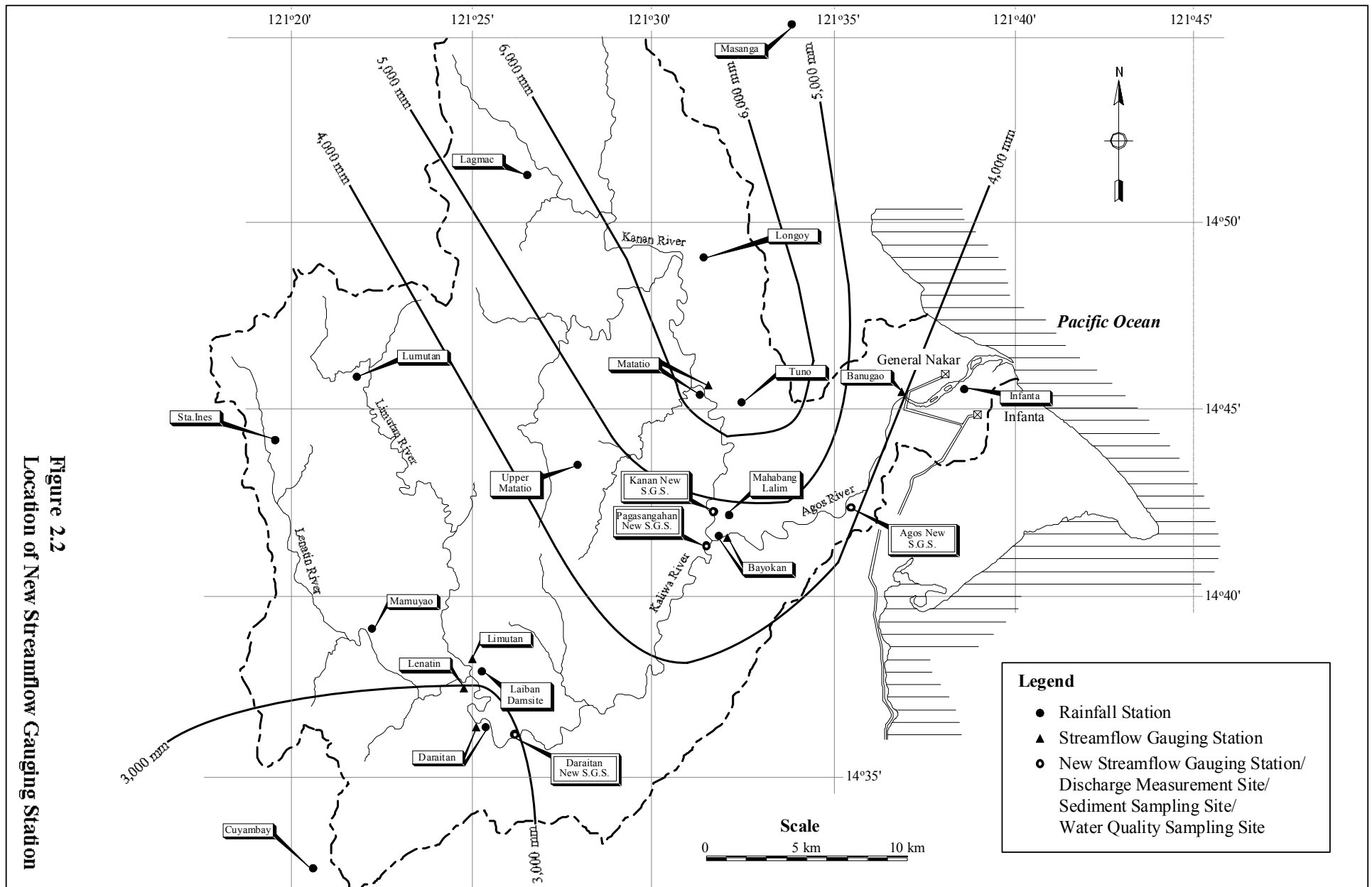


Figure 2.2
Location of New Streamflow Gauging Station

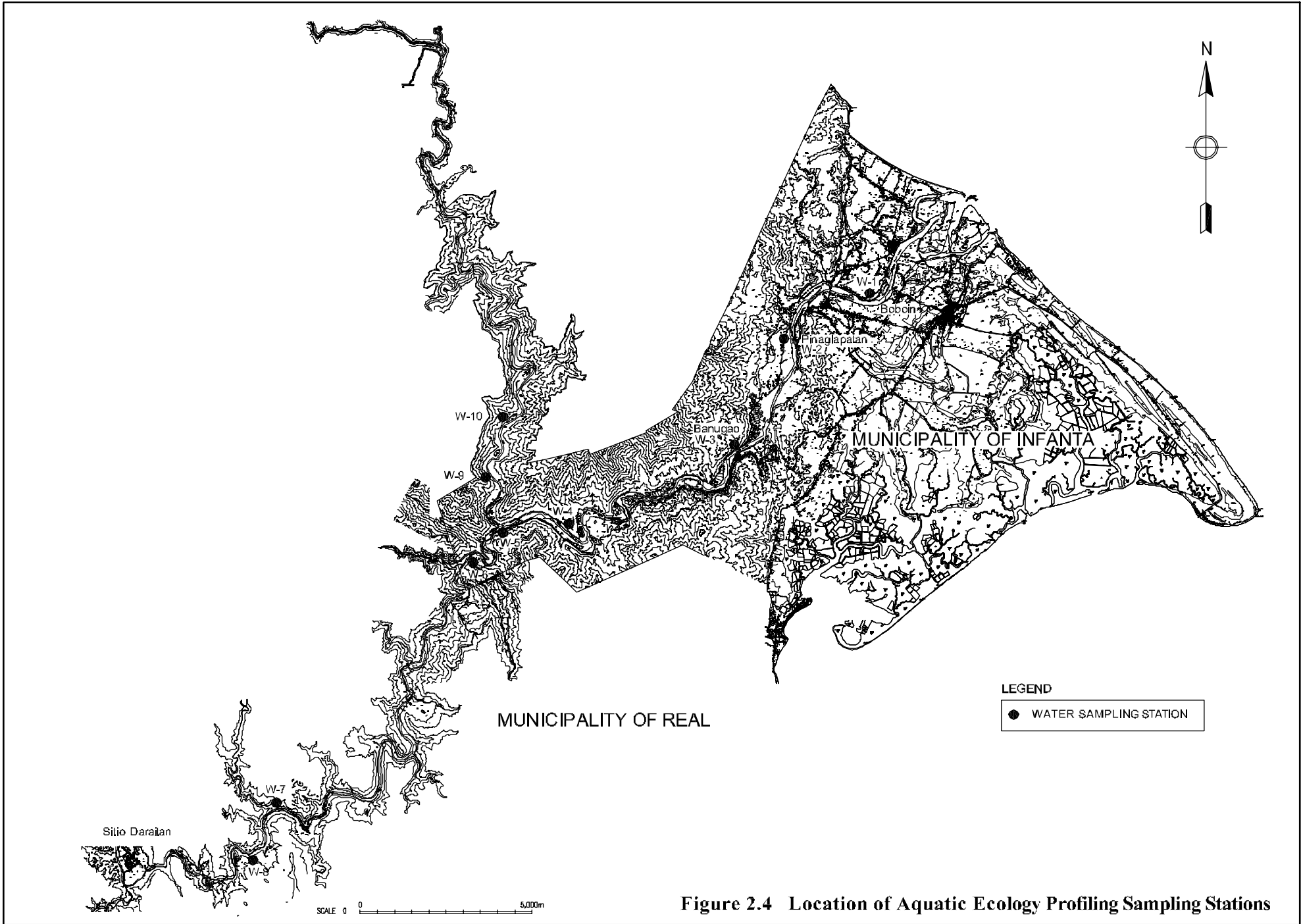


Figure 2.4 Location of Aquatic Ecology Profiling Sampling Stations

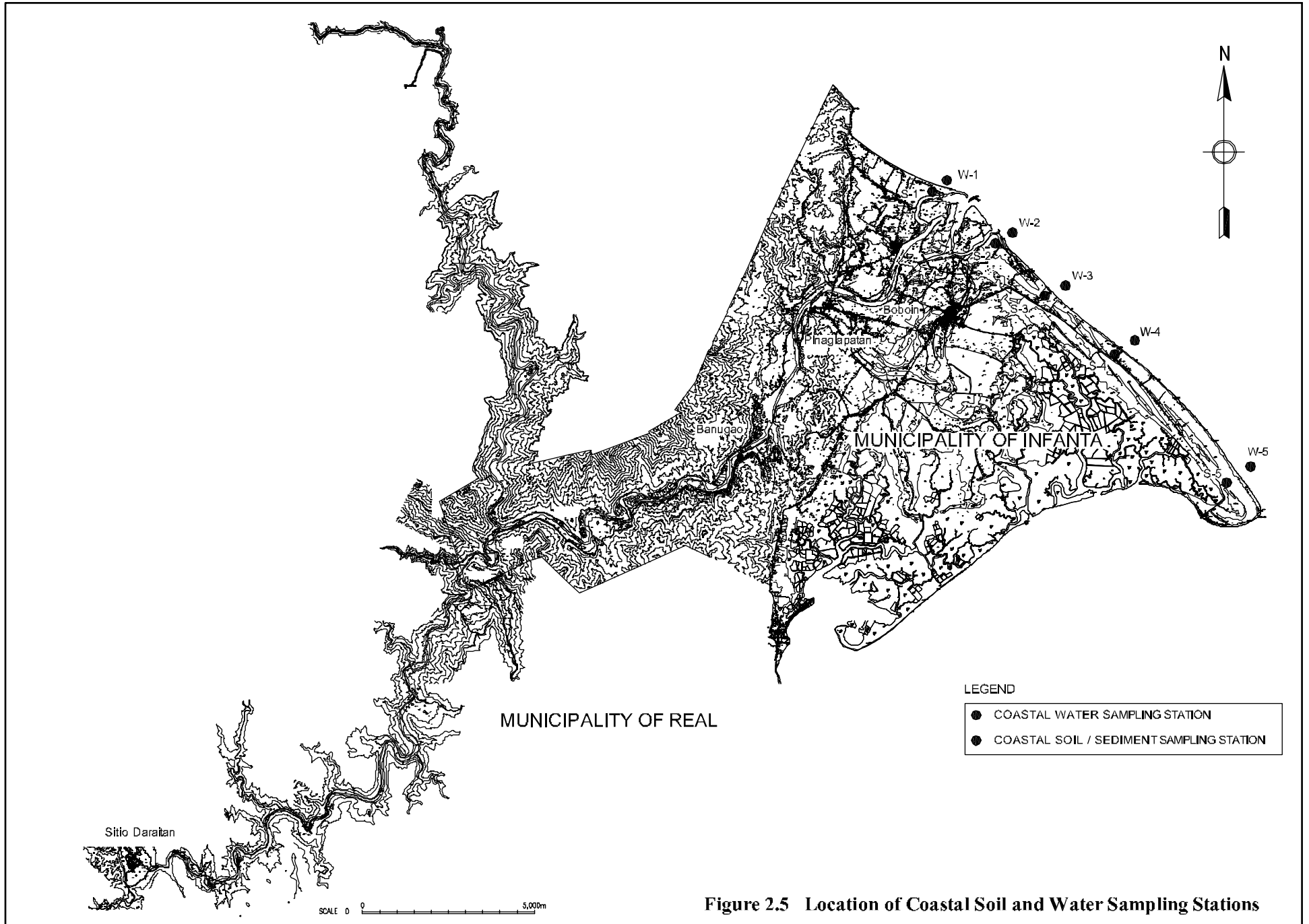


Figure 2.5 Location of Coastal Soil and Water Sampling Stations