5.2 Economic Development Plans and Strategy

5.2.1 National and Regional Economic Development Plans

(1) National Economic Development Plan

Medium-Term Philippine Development Plan (MTPDP) spells out policies and strategy concerned with national economic development.

The Medium-Term Philippine Development Plan (MTPDP), 1993-1998, was approved by NEDA on December 15, 1992. NEDA shall coordinate the preparation of the Updated MTPDP, 1996-1998. The NEDA Board Committees and the Cluster system shall be tapped as the plan updating committees. The updated MTPDP, 1996-1998, was to be submitted to the NEDA Board by December1995.

1) Vision

Philippines 2000 is the main guide to the Updated MTDP for 1996-98. Philippines 2000 seeks an improved quality of life for all Filipinos. Policies and strategies continue to be anchored on the twin strategies of international competitiveness and people empowerment within the framework of sustainable development. Principal objective of realizing this development is poverty reduction. Poverty incidence of 35.5% estimated in 1994 is targeted to go down to 30% by 1998.

The Updated Plan serves as a comprehensive guide to the economic and social policy reform in 1996-1998. It consists of two parts:

①An assessment of the country's socioeconomic performance over 1993-1995 vis-a-vis the goals, targets, policies and strategies contained in the MTPDP for 1993-1998.

②The policy reform for implementation in 1993-1995 of the Plan.

The objectives, policies and strategies are organized around the following:

①Macroeconomic policies for stability
②Long-term policies for industrial restructuring
③Social policy reforms directed toward poverty alleviation and human development
④Policies for infrastructure development
⑤ Policies on development administration

2) Policies and Strategies in Trade and Industry

In the drive towards achieving global competitiveness and economic growth that is fueled by investments, there is no doubt that the pursuit of an outward looking strategy via the adoption of investment liberalization and deregulation among others, has indeed started to pay off. Foreign investments have continuously poured into the country since 1993 and lately to special economic zones (SEZs) being promoted by government through incentive packages claimed by foreign investors to be better than that offered by the Board of Investment (BOI). While this may not really be unfavorable as foreign investments are in a way being diverted to the regions, caution preference of foreign investors to register with the Philippine Economic Zone Authority (PEZA) indicates a possible competition among incentive-giving agencies government.

(a) Closer coordination of macroeconomic and trade and industry policies

Continuing efforts to liberalize the trade environment will be pursued to encourage the development of efficient and competitive domestic industries. These efforts will include the elimination of the remaining quantitative restrictions that are subject to administrative discretion and the sustained implementation of the tariff reform program, alongside the implementation of a market-determined exchange rate.

(b) Strengthen linkages among sectors and intensify dispersal of industries

Linkages between the agriculture and industry sectors will be intensified. In the same manner, networks and linkages with local government units (LGUs) will be strengthened to boost their capabilities and investment promotion efforts. The dispersal of industries will also be intensify fasttracking the operationalization of the priority regional growth centers, i.e., the Regional Agri-Industrial Growth Centers (RGCs), and the development of identified special ECOZONES.

(c) Promotion of export

Measures toward strengthening the international competitiveness of Philippine exports will continue to be pursued, with the private sector taking the lead. These include: (a) the continued strengthening of export winners and identification and promotion of new products that have comparative advantage and high value added; (b) diversifying export markets and strengthening footholds in existing markets; (c) nurturing the growth of more entrepreneurs and would-be-exporters, particularly small and medium enterprises through business assistance such as market exposure through trade fairs; and (d) the implementation of the Export Development Act.

(d) Investment liberalization

Existing laws will continuously be reviewed with the objective of further easing up the investment environment. This will be complemented by the introduction of reforms in the issuance and use of business visas and other investment-enhancing measure.

(e) Promotion of environment-friendly industrial policies

Consistent with the government's commitment to pursue sustainable development, measures to address industry and environment issues, which are increasingly demanding attention, will be formulated and implemented. These measures will focus on three key areas of industrial operations, namely: pollution control, energy efficiency and waste minimization. Clean production will also be encouraged through the continuous search for new and more efficient technologies; development of local expertise and capacity on environmental assessment; implementation of appropriate environmental standards/policies/rules and regulations; and regular dialogues/consultations with business and industry sectors.

(f) Promotion of SMEs

To assist small and medium enterprises (SMEs) in improving their production and marketing capabilities, efforts will be exerted toward the promotion of subcontracting between large firms and SMEs. Subcontracting arrangements such as the Center-Satellite Factory System (C-S System) have been designed to integrate larger firms (center factory) and SMEs (satellite factories) in production and marketing activities. SME productivity improvement programs will also be intensified.

(2) Regional Economic Development Plans

Regional economic development plans are spelled out in Central Luzon Regional Medium-Term Development Plan. Its spatial development strategy is summarized below.

As an immediate requirement, development initiatives shall be geared towards addressing the negative impact of the Mt. Pinatubo calamity. The reconstruction strategies shall be an opportunity to make situations better than their pre-eruption capacities and move forward towards supporting the long-term development being espoused for the region. Major projects include the revitalization of affected built-up communities, pursuing efforts to make resettlements sustainable, restoration and protection of drainage systems and key transport links, and enhancing the irrigation efficiency of farmlands to increase productivity.

Parallel with the reconstruction efforts is the enhancement of the region's infrastructure base particularly in support of the operationalization of the "Triad Growth Corridor". This includes the initial implementation of highway links between key urban areas particularly the Subic-Clark connection, the requirements of Clark International Aviation Complex, telecommunications and other utilities for economic zones, and the urban environment renewal and improvement in the identified major growth centers.

1) Spatial Development Strategy (The Triad Growth Corridor)

It is anchored on the aggressive development of a "Triad Growth Corridor" having nodes envisioned to experience accelerated urbanization and more intense economic activities triggering the upsurge of economic activities in the region. Areas outside shall complement activities within the corridor and shall advance based on the their comparative endowments and potentials. Agri-industrial development zones have been identified comprising the largest economic areas of the region that shall showcase modern, sustainable and highly productive agriculture. Agro-forestry and forestry protection zones are also pinpointed as well as aquamarine development areas and key tourism areas.

2) Urban Centers

In Central Luzon, three broad areas are identified for accelerated urbanization based on the existing distribution of urban population and infrastructure facilities. They are called the National Triad Growth Centers. In relations to these, more important urban centers are identified and hierarchical structure of urban centers proposed to provide various urban services effectively throughout the region. In line with the proposed urban hierarchy, a network of transportation arteries is conceived linking those urban centers in higher tiers.

(a) National Triad Growth Centers

The urbanization pattern in Central Luzon is more concentrated. The three broad areas of urban population concentration are defined as follows.

① Subic Bay Metropolitan Area

This area covers Olongapo City, Zambales where the Subic Bay Metropolitan Authority has its headquarters and its neighboring areas. Special economic zones may be expanded to Dinalupihan, Hermosa and Morong, Bataan as well as Subic, Zambales.

② San Fernando – Angeles Metropolitan Area

This area extends along the Manila North road and Northern Luzon expressway from San Fernando, through Angeles City to Mabalacat. The neighboring municipalities of St. Thomas, Mexico and Bacolor may also be included.

③ Bulacan Conurbation

This is the area in Bulacan directly affected by the spill-over from Metro Manila. It includes 15 municipalities along main highways radiating from Metro Manila, but those in the eastern mountainous area and the fishery municipality of Hagonoy are not included.

(b) Hierarchical structure of urban centers

Urban centers are classified with respect to delivery capacity and effectiveness of various urban services. Determining factors include(1)existing accumulation of urban population, (2)existing accumulation of various economic activities, (3)present and expected administrative and other specialized functions, (4)resource potentials and constraints, and (5)location in relation to arteries, other urban centers and other specialized facilities.

A hierarchical structure of urban centers in Central Luzon has been analyzed based on the present distribution of population and urban centers, distribution of manufacturing and service establishments, land capability, existing infrastructure and urban facilities.

① Regional Center

San Fernando is the Regional Center strategically located in relation to other provincial capitals and within the National Triad Growth centers. In addition to administrative functions with regional and provincial offices, a variety of industrial and service activities are accumulating.

② Sub-Regional Centers

Considering the spatial extent of Central Luzon, three Sub-Regional Centers may be designated. Malolos has been selected due to its dominant commercial and administrative functions, at present and expected. Olongapo City is expected to serve the western part of Central Luzon as an industrial, trade and tourism center. Cabanatuan City may be a primary trade center situated at a strategic point between the Northern Luzon and Metro Manila, and serve the northeastern part of Central Luzon with multiple functions. In addition Cabanatuan City includes higher education as the City has two universities, five colleges and 12 high schools.

③ Major Urban Centers

Eleven Major Urban Centers may be designated to extend main urban services coverage to the entire region. These centers are Palayan City, San Jose City and Gapan in Nueva Ecija, Tarlac in Tarlac, Meycauayan and Baliuag in Bulacan, Angeles City in Pampanga, Dinalupihan, Balanga, and Mariveles in Bataan, and Iba in Zambales.

These are medium sized multi-functional urban centers with functions of sub-regional business/service center, sub-regional education center and industrial area. These centers are also equipped with some specialized functions, depending on locational and resource characteristics.

④ Service Urban Centers

Under the Major urban Centers, 23 Service Urban Centers may be designated: six in Nueva Ecija, five in Tarlac, one in Bulacan, four in Zambales. These centers serve rural hinterlands with distribution functions of agricultural input and output, agricultural support facilities, agro-processing and social services delivery functions.

⑤ Rural Centers

Further down the tier are Rural Centers, which provide basic urban services to their rural neighborhood with a town hall, schools and local markets. All the remaining municipality capitals fall in this category.

3) The W Growth Corridor

The Growth Corridor evolved from a 'Triade' to a 'W'.

In 1995, the JICA Study Team responsible for drafting the Central Luzon Development Program Masterplan Study presented the 'Triad concept' of urbanization in the report. This concept integrated the concentric urbanization pattern from three rapidly expanding areas, namely; Metro Subic, Metro Angeles (Clark and its environs) and the Bulacan Conurbation Area (towns contiguous to Metro Manila).

The triad concept was patterned from the successful 'Ranstad triad' in the Netherlands, where the interdependence of the airport city (Amsterdam), seaport city (Rotterdam) and seat of government (The Hague) brought about a balanced and dynamic triad area of growth.

On the other hand a hierarcal structure of urban centers in Central Luzon has been expanded. While the triad concept was seen to be advantageous, it was also noted to be too limiting. Strategic areas of industrial growth in Bataan and Tarlac were observed to be outside this triad area.

There was a need to expand the concept of a 'growth corridor' that not only would encompass other industrial areas but likewise integrate the growth potentials that would be derived from other sectors such as tourism and high-value agriculture. Then the Department of Trade and Industry evolved the triad concept and proposed the 'W growth corridor' concept.

In 1997, the Regional Office of the Department of Trade and Industry sought the inputs of the 6 Governors of Central Luzon on their expectations of what the region's growth corridor should include. The output of the consultations made with the governors was a listing of 49 municipalities and 3 cities out of the region's 117 municipalities and 5 cities.

These area were perceived by the governors as having a high potential for rapid growth. When these were plotted on a map, the shape of the letter 'W' emerged. The map is shown in Figure 5.2.1-1

(a) The Tourism Belt (The First Line)

The 'W' starts from the northernmost towns to Sta. Cruz and Masinloc in Zambales. These two towns are presently working on the development of their industrial estates to optimize the benifits of being included in the PEZA Law as economic zones. The line continues through San Antonio, where Southern Zambales Ecozone/tourism estate is taking shape, then the line continues to link Subic town and SBF area, through Morong where the Bataan Technology Park is also being pursued as a 'knowledge center'. The area from Morong to Mariveles in the western coast of Bataan, while seemingly undeveloped, eyed to be a viable, world-class tourism belt in the future.

(b) The Industrial Belt (The Inner Peak)

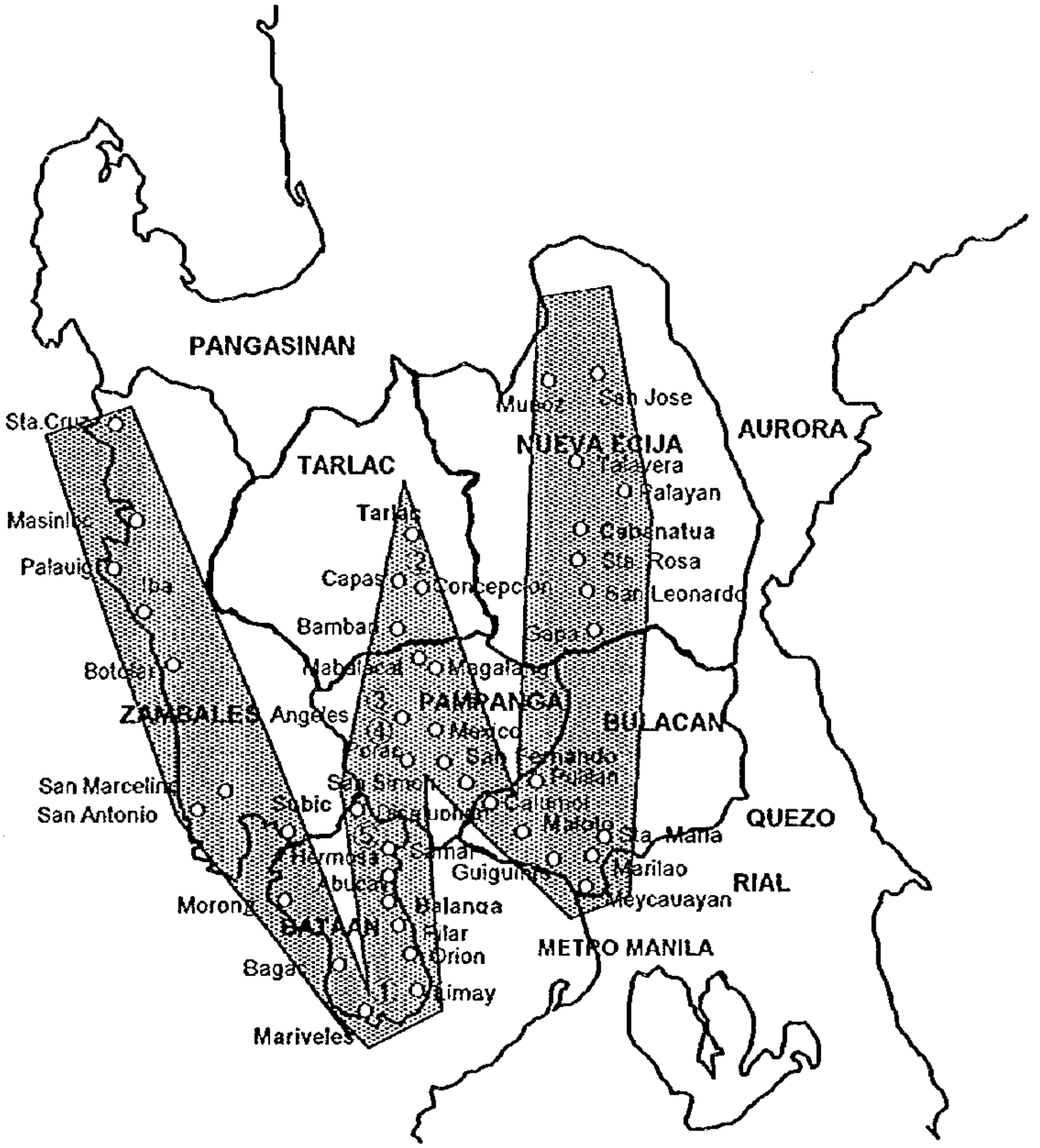
The second ascending line from Mariveles, through Limay, and Hermosa are definitely areas that will be the hub of industrial activity on account of the industrial estates in these areas. In fact, Hermosa, which lies in the corner of Bataan, Zambales and Pampanga will be pushed as the next Regional Industrial Center (RIC), previously designated for Mariveles.

The line pushes northward through Floridablanca, Porac and Angeles City which hosts the Clark Special Economic Zone. It rises further to Capas (Sacobia area is also now part of Clark) and ends up with Tarlac and the Luisita Industrial Park on top of the crown of the 'W'.

The third line of the corridor then descends, cutting through from Tarlac to Mabalacat, Magalang, San Simon and through the referred to in the CLDP masterplan study as the Bulacan Conurbation Area. The second leg 'W' then rests on the point of Meycauayan in the map.

(c) The Green Belt (The Rightmost Line)

The last leg of the 'W' is the area that will showcase successful farms devoted to high value crops, agro-forestry. The is situated in the fertile western part of Bulacan and through the areas near Cabanatuan City. The 'W' ends at the Mnoz area, site of the research and development 'city' that aims to anchor the agricultural agenda for the region.



LEGEND

① : Bataan Export Processing Zone

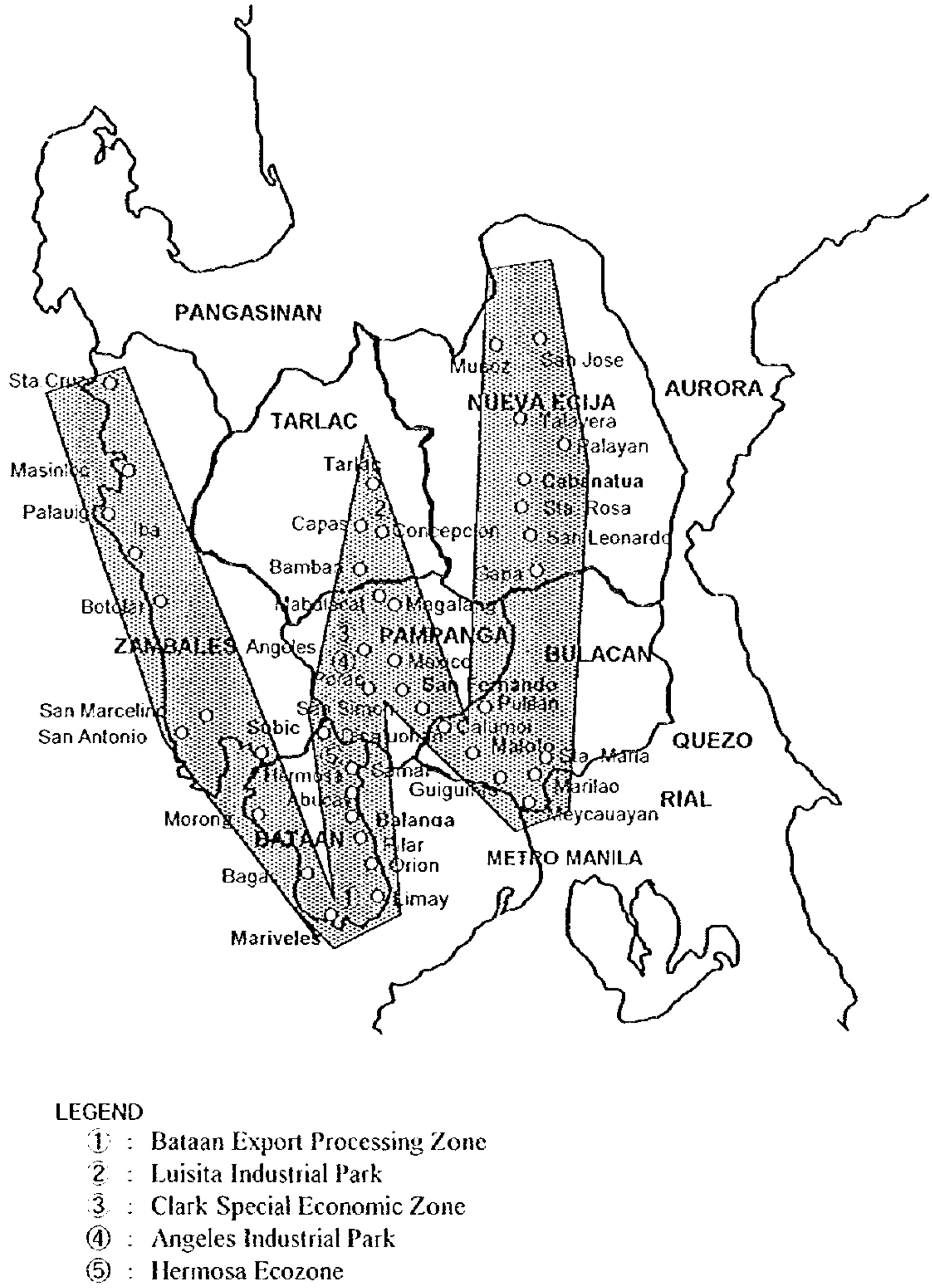
② : Luisita Industrial Park

③ : Clark Special Economic Zone

④ : Angeles Industrial Park

⑤ : Hermosa Ecozone

Figure5.2.1-1 Map of the W Growth Corridor



LEGEND
① : Bataan Export Processing Zone
② : Luisita Industrial Park
③ : Clark Special Economic Zone
④ : Angeles Industrial Park
⑤ : Hermosa Ecozone

Figure5.2.1-1 Map of the W Growth Corridor

5.2.2 Economic Zones and Industrial Estates

(1) Establishment of Economic Zones

Main EPZs and SPZs in and around Region3 are as follows (see Figure 5.2.2-1).

1) Bataan Export Processing Zone

Bataan Export Processing Zone is located in Mariveles, Bataan, Central Luzon and developed/operated by Philippine Economic Zone Authority (PEZA).

- **Site Accessibility** : Manila and Malila Port 160 km.
  Ninoy Aquino International Airport 160 km.
  Subic Port 60 km.
- **Area**
  Total Area of EPZ : 1,742 hectares
  Occupied Area : Phase I , II & III-103 hectares
  Unoccupied Area : Phase I , II & III-64 hectares
  Undeveloped Area : PhaseIV-50hectares: Phase V-147hectares: PhaseVI-57hectares
- **Services and Amenities**
  Within the EPZ : Bank, shipping, housing, tennis and basketball court, twin cinema, golf course, clubhouse hotel, 3 schools, chapel, wet market, and bowling alley, 1 hospital, park, fire station, restaurant, staff house.
- **Preferred Industries** : Light, medium and heavy industries.

2) Luisita Industrial Park

Luisita Industrial Park is located in San Miguel, Tarlac, Central Luzon and developed/operated by Luisita Industrial Park Corporation.

- **Site Accessibility** : Manila, Manila Port 100 km.
  Subic Port 90 km.
  Clark International Airport 35 km.
- **Area**
  Total Area : Phase I -120 hectares (Available Area- 1.4 hectares)
  Phase II -300 hectares (in the planning stage)
  Area of EPZ : 29 hectares
- **Services and Amenities** : Shipping, housing, hotel, golf course, schools, chapel, hospital, park, fire station, restaurant.
- **Preferred Industries** : Light and medium non-pollutant industries.

3) Angeles Industrial Park (Special Economic Zone)

Angeles Industrial Park is located in Bacolor, Pampanga, Central Luzon and developed/operated by Angeles Industrial Park Inc.

- **Site Accessibility** : Manila and Manila Port 80km.
  Clark International Airport 5km.
  Subic Port 70 km.
- **Area**
  Total Area : 32 hectares
  Available Area : 30 hectares
- **Services and Amenities** : Training center, banks, medical facilities, leisure facilities, educational facilities, commercial establishments, housing facilities.
- **Preferred Industries** : Light and medium industries, non-pollutant, labor intensive and export oriented.

4) Baguio City Export Processing Zone

Baguio City Export Processing Zone is located in Baguio City, Benguet, Cordillera Administrative Region (CAR) and developed/operated by PEZA.

- **Site Accessibility** : Manila 250km.
  Session Road 6 km.
  Loakan Airport -Adjacent
  Poro Point, San Fernando and La Union Port 60 km.
  Subic Port 240 km.
- **Area**
  Total Area of EPZ : 62 hectares
  Available Area : 22 hectares
- **Preferred Industries** : Electronics and other high technology operations requiring cool temperature.

5) Hermosa Ecozone

Hermosa Ecozone is located in Hermosa, Bataan, Central Luzon and developed/ operated by Hermosa Ecozone Development Corporation (HEDC). The commencement of site development is scheduled by late 1998 or 1999.

- **Site Accessibility** : Manila 96km.
  Clark Field 35km.

Subic Port 12 km.
Bataan EPZ 55km.

- **Area**

Total Area	:	600 hectares
Industrial Area	:	400 hectares
Residential Area	:	110 hectares
Golf Course	:	90 hectares

(2) Clark Special Economic Zone

The Clark Special Economic Zone (CSEZ) used to be American's largest US military installation outside of its mainland.

Following the pull-out of American troops, the Zone is now being developed into a world-class aviation-led metropolis and economic center contributing to a globally competitive Philippines.

The CSEZ spans a total land area of 33,653 hectares. It is located in Pampanga and Tarlac, Central Luzon, and developed/operated by Clark Development Corporation. And it is 80 kilometers north of Manila, and 70 kilometers northeast of Subic.

The initial phase of development is focused on the Main Zone (former Clark Air Base) which comprises 4,440 hectares. It is being transformed into a new townsite characterized by modern industrial estate, tourism and trade centers, residential complexes, and the Philippines' future premier international airport.

The second area, the Sub Zone, comprises a total land area of around 29,213 hectares. It is earmarked as the site of agro-industries, ecological and eco-tourism projects, modern industrial estates, research and development centers, leisure parks, financial centers and corporate headquarters. Other characteristics are as follows;

- **Aviation Area** : Clark Field's aviation complex- 1,620 hectares
  Take-off and landing infrastructure- 490 hectares
  : 2 runways of 3,200 m. ,each capable of accommodating the largest aircraft in the world.
- **Preferred Industries** : Light and medium industries.

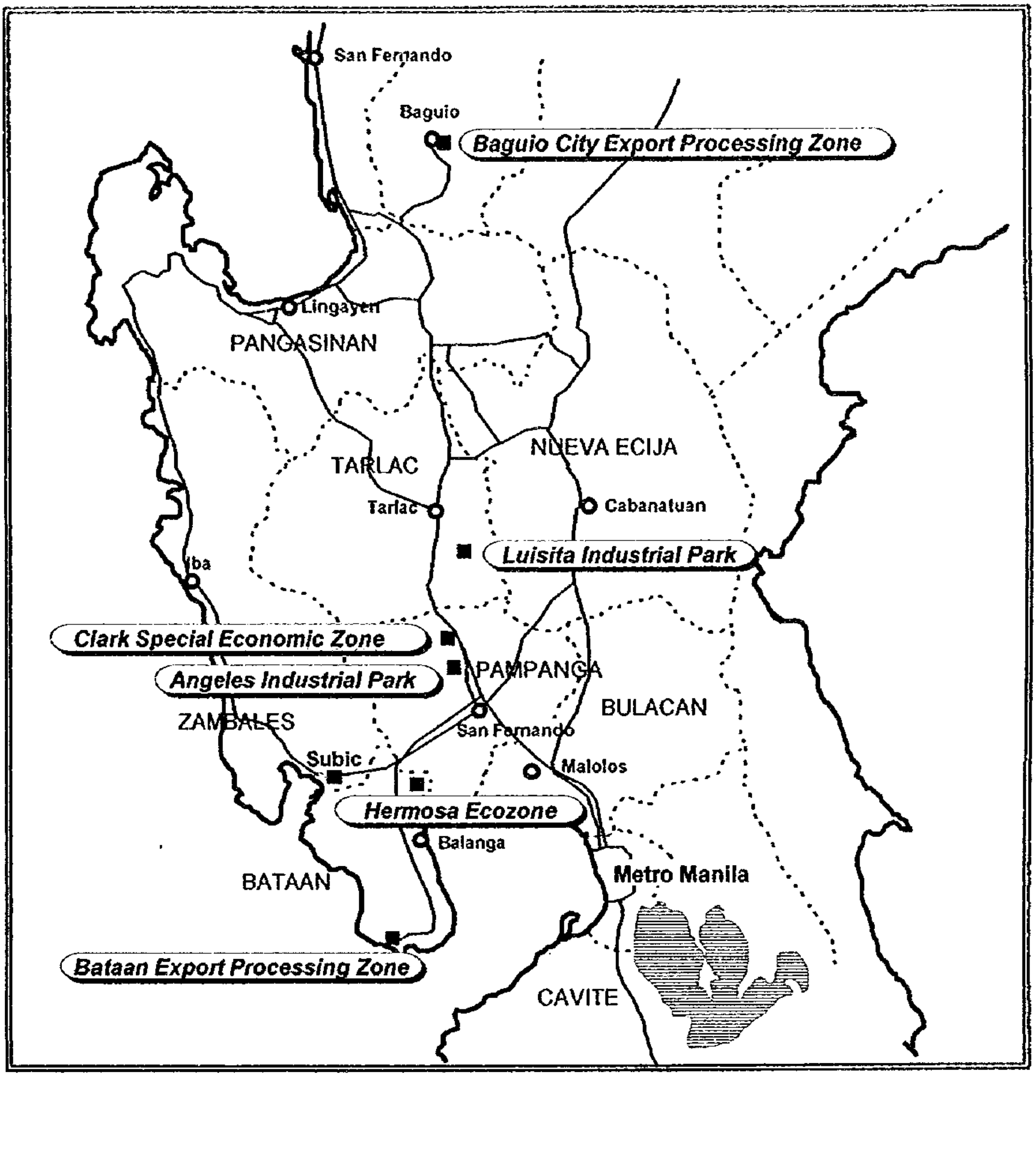


Figure 5.2.2-1 Location Map

5.3 Transportation Sector

5.3.1 Existing Situation of Transport Sector

(1) Roads

Much the largest mode is road transport, in terms of traffic volume and expenditure. Some 80% of domestic passenger traffic currently goes by road, and 75% of government capital expenditure on transport infrastructure goes into the road system. Although the road network is still sparse and generally of low quality, it has already captured much of the potential traffic from air and sea (and also rail).

1) Present Infrastructure

In 1996, the length of the whole road network was estimated as 160,970 kms, which was divided into administrative categories as follows:

national roads (national government)	26,720 kms
provincial roads	29,117 kms
city roads	3,949 kms
municipal roads	12,820 kms
barangay roads	88,364 kms

2) Situation of Region 3

Based on the 1995 inventory, the total road length in Region 3 was 14,632 kms where only about 4,171 kms representing 29 percent are paved with either asphalt or concrete surfacing. According to Central Luzon Region Medium-Term Development Plan Update(1996-1998) Region3 needs to improve road quality in some critical sections of inter/intra roads that are perennially subjected to inundation. Despite having relatively better road network in quantity as indicated by a road density of 0.80 as of end 1995, much is still needed to be done to improve road quality particularly the critical sections of trunk line roads perennially subjected to inundation during calamities, e.g., earthquakes, typhoon induced flooding, erosions, mudflows. Among the trunk line roads where this problem is regularly experienced are: Pampanga section of the Gapan-San Fernando-Olongapo Road (GSO); Bamban section of the Manila North Road (MNR); and Dalton Pass section of the Philippine-Japan Highway (PJH).

Although substantial investments were spent to improve the situation during the past three years, the Bamban section of the MNR remains inaccessible while the Dalton Pass section of the PJH always gets closed due to landslides whenever typhoons hit this part of the region. Studies have been conducted to identify viable alternatives to address these problems but the recommended options have remained in the conceptual stage. On the other hand, the Pampanga section of the GSO has been upgraded and some critical intersections were widened to accommodate increasing traffic.

(2) Railways

1) Present Infrastructure

Philippine National Railways (PNR)'s assets consist of its right of way, structures, rolling stock, signaling a telecommunications system, and additional land. Its route network, as shown in Figure 5.4.2-2 measures 1,296 km but only 494 km are operational, namely the main line south from Manila to Legaspi (479 km) and the short section north from Manila to Meycauayan (15 km). Owing to typhoon damage in 1995, services on the main line south currently stop at Naga. The track gauge is 1,067 mm.

2) Situation of Region 3

In contrast to the extensive road network in the region, the railway system has been inoperable in the past years. The railway facilities, which are part of the main north line of the PNR, run from the Tutuban Central Station in Manila towards La Union in Region 1 passing through the provinces of Bulacan, Pampanga and Tarlac with a branch line from Tarlac going to San Jose City in Nueva Ecija. The total length of railway tracks in the region is 184 km. Considering that the railway system is an economical mode of transport for bulk cargo, the feasibility of reviving it should be looked into.

According to Central Luzon Region Medium-Term Development Plan Update(1996-1998) Region3 needs to revitalize and expand usage of railway system. Although the Philippine National Railway system has had its role as a critical mode of transport within the Luzon Island, demand has diminished in favor of other modes of land transport, e.g., jeepneys and buses. However, there are problems attendant to the current mode of transport such as congestion in existing routes which result in longer traveling time and, therefore, lower productivity. In addition, worsening pollution as indicated by alarming levels of carbon monoxide emissions from public utility vehicles need to be attended.

Despite efforts of the government in addressing the problem of congestion through physical (road widening, fly-over and new route development) and structural (odd-even scheme) measures, these problems continue to plague key growth areas.

(3) Shipping

1) Present Infrastructure

There are said to be about 1,250 ports in the country but many of them are extremely small. There are 220 private ports, mostly ports belonging to private enterprises for their own exclusive use. These ports handle 65%, in tonnes, of all cargo traffic, which consists largely of minerals, petroleum, cement and bulk agricultural produce. There are 179 fishing ports (which come under the Philippine Fisheries Development Authority). The Philippine Ports Authority (PPA) operates 123 public ports, including most of the largest ones. In addition there are four other important authorities involved in operations:

- the Cebu Port Authority, which operates Cebu Port and several small neighboring ports on Cebu Island;
- Subic Bay Metropolitan Authority, which operates Subic Bay Port;
- the Bases Conversion Development Authority (BCDA), which now has jurisdiction over San Fernando Port; and
- the Cagayan Economic Zone Authority (CEZA), which is designated to operate the Port Irene freeport.

The remaining ports are very small and serve mainly as feeder ports. Investment in feeder ports is the direct responsibility of the DOTC, and some ports are owned by municipalities. However, all these ports remain under the jurisdiction of the PPA.

2) Situation of Region 3

Central Luzon has a long coastline where an alternative to land transport system could be developed. The importance of sea transport was exemplified during and after the Mt. Pinatubo eruptions when land-based transport system failed due to closure of critical road links as a result of mudflow deposition/inundation. Relatedly, port developments need to be pursued more vigorously.

As of 1995, 5 of the region's 26 existing ports are classified as national ports, namely: the Ports of Limay, Mariveles and Zambales. Previously, these ports catered only to the shipping requirements of industries and companies operating within the municipalities where they are situated. However, with the recurring closure of the Gapan-San Fernando-Olongapo (GSO) Road due to lahar inundation, these ports now offer regular ferry services between Central

Luzon and Metro Manila. The 23 existing tertiary ports, on the other hand, cater mostly to the fish landing requirements of coastal municipalities. Although passenger and commodity movement are also serviced, these are minimal and are usually ferried by motorized or manually propelled boats. The facilities in the tertiary ports need improvement to support the development of the fishing industry.

(4) Air Transportation

1) Present Infrastructure

There are 87 operational public airports in the Philippines, of which 47 provided commercial services in 1995. The largest are Manila, Cebu and Davao. Control over Manila airport is vested by charter in the Manila International Airport Authority (MIAA), and control over Cebu is similarly vested in the Mactan International Airport Authority (MCIAA). Separate authorities control Clark and Subic Bay, and one airport is operated by the Department of Tourism (DOT). The remaining 82 public airports are run by the Air Transportation Office (ATO). At present the ATO classifies the airports into five categories:

- international
- alternate international
- trunk-line
- secondary
- feeder

2) Situation of Region 3

The three national airports in the region are the Plaridel Airport in Bulacan, and the Iba and Castillejos Airports in Zambales. The first is classified as a secondary airport while the other two are feeder airports all of which cater only to general aviation. The Philippine Air Force utilizes the Basa Air Base in Floridablanca, Pampanga. The former military airports formerly under US control were converted into civilian use, namely: the Subic Bay International Airport (SBIA) and the Clark International Airport (CIA) which serves as an alternate airport to decongest the Ninoy Aquino International Airport (NAIA). Eventually, the CIA will be the country's premier airport while the NAIA will serve domestic flights.

5.3.2 Freight Transportation in Central Luzon

(1) Current movement of cargoes

In this chapter, the generated cargo volume such as materials and products from the following industrial estates will be determined as the cargo flow from/to the Subic Bay Freeport Zone (SBFZ). Based on a questionnaire survey, potentiality of cargo volume handled at SBF in the future will be determined.

1) Locators in Subic Bay Freeport Zone (SBFZ)

a) Existing Industrial Area

There are about forty-three (43) manufacturing companies in the existing industrial area located in Cubi point, Boton Area, Canal Road, SRF Area and Naval Magazine etc. In 1997, the cargo generated from SBFZ handled at SBF is mostly from the factories located at these areas:

b) Subic Bay Industrial Park

c) Subic Technopark

2) Bataan EPZ
3) Clark Special Economic Zone
4) Angeles Industrial Park
5) Luisita Industrial Park
6) Baguio City Economic Zone
7) Hermosa Ecozone

(2) Current Movement of Industrial Cargo

1) Industrial Cargo movement of the SBFZ

a) Import / Inbound

The data is not sufficient to determine the import/inbound cargo volume for factories located in SBFZ. However, the cargo volume can be estimated by using the data on exports which is given in the next section. This information was obtained through a questionnaire survey (see Chapter 7.3.4 for results).

In some cases, the weight of the incoming material will be equal to that of the outgoing product, but for heavier cargoes, the imported materials will usually weigh slightly more than the exported products. This is especially true in the case of containerized cargo.

For the time being, materials coming in to the SBFZ will tentatively be assumed to weigh 10% more that products going out.

b) Export / Outbound

The exports of containerized and non-containerized cargo generated at the SBFZ in 1997 are 2,101 TEU and 5,470 metric tons. This includes other than locator's cargo through the Subic Bay Freeport/Manila Port: 199 TEU/14 TEU, 40 metric tons/32 metric tons respectively (see Table 4.3.1-1).

The share of containerized and non-containerized cargo volume through SBF generated at SBFZ is 20% and 48% of total containerized and non-containerized cargo volume.

The ratio of mode usage between seaport and airport at SBF is 45 : 55.

Nearly 70% of the containerized cargo generated at SBFZ is transported to the Manila Port for exports. However, 50 % of non-containerized cargo volume generated at SBFZ is transported to the Manila Port and NAIA, though the ratio of mode usage is almost the same as in the case of non-containerized cargo (see Table 4.3.1-6).

2) Industrial Cargo movement of Other EPZ and Special Economic Zone

The cargo movement to the other industrial estate has been described already in Chapter 4.3.1 as outbound cargo from the SBFZ. The cargo movement to the other industrial estate, located in Central Luzon, is shown in Table 4.3.1-12.

Based on this Study, the cargo volume and commodities transported by road from the SBF to other EPZ and SEZ described in preceding chapter are mainly consumable goods for the Duty Free Shop located in Clark Special Economic Zone and the materials for manufacturing of semi-conductor and integrated circuits in Baguio City Economic Zone.

On other hand, the cargo volume and commodities transported by road for export from other EPZ and SEZ to SBF came only from Bataan EPZ as shown in Table 4.3.1-6.

3) Current Movement of Non-industrial Cargo

Other cargo through the SBF is mechanical equipment and steel materials for the construction of the power plant of NAPCO, located at Sual, Pangasinan and at Masinloc, Zambales.

The power station project at Masinloc is going to be completed at the end of 1998. Another power plant, Sual power station project, is expected to be completed by 1999.

Accordingly, the construction materials and equipment needed for that huge project and factory construction at Region Ⅲ(Central Luzon) will be expected in the near future. The location and facilities of the SBF are ideally suited to handle these cargoes because of the heavy traffic in Manila and Manila port congestion.

(3) Port Activities and Development Plans

As mentioned in Chapter 4.4, the following ports which are assumed to be in the hinterland are considered as adjacent ports. Hereinafter, the present condition of adjacent ports is examined to determine whether some commodities handled at adjacent ports presently can shift to the SBF in future or not.

1) Present Condition of Adjacent Ports

a) Port of Manila

The Port of Manila consists of three (3) ports, namely North Harbor, South Harbor and MICT, and is the biggest port in the Philippines. This port is located at the northeast shoulder of Manila Bay, southeast of Luzon Island in the City of Manila.

The North harbor, the country's leading domestic port is located along the shores of Tondo District in Manila. The South Harbor, the country's gateway to international shipping and trade is located just south of the mouth of Pasig River. Manila International Container Terminal (MICT) is located just north of the mouth of Pasig River.

i) North Harbor

North Harbor is the most important domestic port in the Philippines. This port has eight (8) piers (No. 2, 4, 6, 8, 10, 12, 14 and 16). These piers are protected by the north breakwater with a length of 1,900 meters. The depth of the channel is approximately 8.0 meters. All piers are used for general cargo, containerized cargo and extensively for passengers.

The port facilities service the Metro Manila area and the immediate provinces of Bulacan, Pampanga, Tarlac, Nueva Ecija and Nueva Vizcaya in the north, Rizal in the east and Laguna and ports of Quezon and Batangas in the south.

ii) South Harbor

South Harbor has five (5) finger piers (No. 3, 5, 9, 13 and 15). These piers are protected by the west breakwater of 2,300 meters in length and the offshore south breakwater of 880 meters in length. The navigation channel of South Harbor is about 200m wide between the south and west breakwater. The depth of the channel is approximately 10.5m below mean below mean lower low water (MLLW)

The port facilities service the whole Metro Manila area, including the port's hinterland such as Pampanga, Zambales, Nueva Ecija, Nueva Vizcaya, and the Calabarzon areas, namely Cavite, Laguna, Batangas, Rizal and Quezon provinces.

iii) MICT

MICT has a usable quay length of 900 meters with a minimum water depth alongside of about 12 meters. It currently has four (4) berths.

This terminal has a container yard of 29 hectares, three (3) container freight stations, cargo handling equipment with nine (9) gantry cranes and other supporting facilities.

b) Port of Batangas

Port of Batangas is located south of Metro Manila facing Batangas Bay. The port of Batangas is poised as a gateway of shipping and trade from the Region of the Southern Philippines where activities are growing rapidly. In Batangas Bay, many private jetties with attached refinery are handling a large volume of petroleum products.

Currently, port development project phase I is on going under an OECF loan. Furthermore, the port expansion project phase II will soon be initiated as a National Project. In the so called Calabarzon area, namely Cavite, Laguna, Batangas, Rizal and Quezon provinces, many industrial estate projects are in progress or being planned.

Due to the above demand, the port expansion project is a most important subject now.

c) Port of San Fernando

The port of San Fernando(usually referred to as Polo Port), is located in northwestern Luzon in Region I facing the East China Sea. Polo Port consists of two public piers and two private piers at present. The main commodity of cargo handled at Polo Port is fertilizer, petroleum product and cement, which are imported/inbound as bulk cargo from foreign/domestic source and distributed to the provinces of West-northern Luzon and Central Luzon.

2) Port development plan of adjacent ports

During the first five years (1992-1996) of the Ramos Administration, cargo traffic through the ports registered a growth rate of 5.8%, from 110.84 million metric tons in 1992 to 138.91 million metric tons in 1996. While Manila went down in 1996 to No.18 in the world in container throughput from No.16 in 1995, Manila was one of only 4 international ports with double digit growth, registering a 13% rate in 1996 over 1995. This continuing upward trend of the country's maritime trade has to be supported by the necessary infrastructure.

Cognizant of this need, the Philippine Ports Authority (PPA) came out with a 25-Year Master Plan which was approved in principle by the President on 10 July 1995. The Plan was updated in 1996.

a) Port District of Manila

The following is a presentation of the updated list of projects covered in the 25-Year Master Plan.

The Port District Office of Manila, which covers the Manila Bay and Bataan/Zambales Coastline, has the following twelve (12) port development plans.

i) Manila South Harbor Port Expansion Project

ii) Manila North Harbor Port Expansion Project
iii) Manila North Harbor Passenger Terminal Project
iv) MICT Expansion Project
v) Manila Cruise Center Project
vi) Bataan-Cavite Ferry Terminal
vii) Manila Grains Terminal Project
viii) North Manila Bay (Bataan - Pampanga) Port Project
ix) South Manila Bay (Rosario) Port Project
x) South Harbor Expanded Port Zone Development Project
xi) Manila Fast Ferry Terminal
xii) Real Port Development Project

b) Port District of Luzon

At present, for the Port District Office of Luzon, which covers the entire island of Luzon and the Southern Tagalog Region less the area covered by PDO Manila, a total of twenty-seven (27) development plans have been authorized by the Philippine Ports Authority (PPA).

The following two(2) projects are related directly to the hinterland of SBF.

i) Batangas Port Expansion Project (Phase II, III and IV)
ii) Sual Port Development Project

3) Cargo Volume Handled at Five Adjacent Ports

The PPA's administrative and operational arm stretches to every port district of the Philippines. There are twenty-one (21) Port Management Offices (PMO) and one Field Office (MICT: Manila International Container Terminal) in the country each of which maintains a baseport and all or any of the following: terminal, municipal and private ports under its territorial jurisdiction.

In Luzon Island, there are four (4) PMO (North Harbor, South Harbor, Batangas and San Fernando) and MICT Field Office.

The aforesaid Port Management Office is organized with base port, terminal ports, municipal ports and private ports. Each of PMO's ports consists of four kinds of port as shown in the following Table 5.3.2-1.

The Subic Bay Freeport is one of the municipal ports under the supervision of PMO's North Harbor of Manila.

Table 5.3.2-1 Details of each of PMO's five ports are as follows

Unit: Number of Port

Type of Port \ PMO	North Harbor	South Harbor	Batangas	San Fernando	MICT
Base Port	1	1	1	1	1
Terminal Port	0	1	6	2	0
Municipal Port	3	0	7	4	0
Private Port	16	0	24	12	0
Total	20	2	38	19	1

Source: Annual Statistical Report, PPA,1996

The total cargo volume, based on the Annual Statistical Report(1996-Volume 2) published by PPA, in the Philippines in 1996 was 129.04 million tons, of which 62.29 million tons was domestic and 66.75 million tons foreign.

The cargo volume handled at above mentioned five PMO's ports during five years from 1992 to 1996 is shown in Table 5.3.2-2 and Figure 5.3.2-1, -2, -3 & -4. The total cargo, domestic cargo and foreign cargo volume, at the PMO's five ports in 1996 had respective shares of 64%, 59% and 69% of the total cargo volume in the Philippines as shown in the following Table 5.3.2-3.

Table 5.3.2-2 Cargo Volume from 1992 to 1996 (1/2)

All Cargo

Unit: Metric Tons

Port Management Office \ Year	1992	1993	1994	1995	1996
Batangas	17,605,642	16,409,079	17,342,106	21,033,177	21,872,808
Manila (North Harbor)	22,825,034	23,868,301	26,708,045	27,592,076	31,037,638
Manila (South Harbor)	10,439,638	11,266,242	12,167,856	14,236,918	18,512,104
Manila - M.I.C.T.	5,121,876	5,797,720	5,769,201	5,642,509	9,157,696
San Fernando	1,283,154	1,343,858	1,677,416	2,147,788	2,179,688
Total	57,275,344	58,685,200	63,664,624	70,652,468	82,759,934

Domestic & Foreign Cargo

Port Management Office \ Year		1992	1993	1994	1995	1996
Batangas	Domestic	6,726,639	5,848,552	6,163,716	7,785,619	6,702,802
	Foreign	10,879,003	10,560,527	11,178,390	13,247,558	15,170,006
Manila (North Harbor)	Domestic	15,086,572	16,104,311	18,972,000	20,461,432	21,396,368
	Foreign	7,738,462	7,763,990	7,736,045	7,130,644	9,641,270
Manila (South Harbor)	Domestic	4,139,012	4,603,935	4,459,386	5,294,728	7,300,427
	Foreign	6,300,626	6,662,307	7,708,470	8,942,190	11,211,677
Manila - M.I.C.T.	Domestic	295,122	592,704	268,736	30,423	0
	Foreign	4,826,754	5,205,016	5,500,465	5,612,086	9,157,696
San Fernando	Domestic	734,030	725,093	951,538	1,210,377	1,144,079
	Foreign	549,124	618,765	725,878	937,411	1,035,609
Total (A)		57,275,344	58,685,200	63,664,624	70,652,468	82,759,934

Table 5.3.2-2 Cargo Volume from 1992 to 1996 (2/2)

Domestic Cargo

Port Management Office / Year		1992	1993	1994	1995	1996
Batangas	Inward	1,987,305	2,033,095	2,459,803	2,657,428	2,206,659
	Outward	4,739,334	3,815,457	3,703,913	5,128,191	4,496,143
Manila (North Harbor)	Inward	5,991,807	6,050,203	7,280,240	7,750,101	8,000,612
	Outward	9,094,765	10,054,108	11,691,760	12,711,331	13,395,756
Manila (South Harbor)	Inward	4,086,559	4,536,290	4,353,118	5,123,575	7,097,102
	Outward	52,453	67,645	106,268	171,153	203,325
Manila - M.I.C.T.	Inward	173,206	291,919	153,322	30,423	0
	Outward	121,916	300,785	115,414	0	0
San Fernando	Inward	617,499	630,561	761,187	1,026,100	1,063,681
	Outward	116,531	94,532	190,351	184,277	80,398
Total (B)		26,981,375	27,874,595	30,815,376	34,782,579	36,543,676
(B) / (A)		47.1%	47.5%	48.4%	49.2%	44.2%

Foreign Cargo

Port Management Office / Year		1992	1993	1994	1995	1996
Batangas	Import	10,103,242	9,576,787	9,780,737	11,527,196	13,917,293
	Export	775,761	983,740	1,397,653	1,720,362	1,252,713
Manila (North Harbor)	Import	6,472,784	6,979,120	7,197,545	6,371,375	8,719,615
	Export	1,265,678	784,870	538,500	759,269	921,655
Manila (South Harbor)	Import	5,948,484	6,313,954	7,090,517	8,564,243	10,737,209
	Export	352,142	348,353	617,953	377,947	474,468
Manila - M.I.C.T.	Import	3,224,084	3,505,719	3,759,828	3,636,291	6,102,410
	Export	1,602,670	1,699,297	1,740,637	1,975,795	3,055,286
San Fernando	Import	362,391	474,302	579,197	798,667	933,742
	Export	186,733	144,463	146,681	138,744	101,867
Total (C)		30,293,969	30,810,605	32,849,248	35,869,889	46,216,258
(C) / (A)		52.9%	52.5%	51.6%	50.8%	55.8%

Source: Annual Statistical Report, 1992 to 1996, PPA

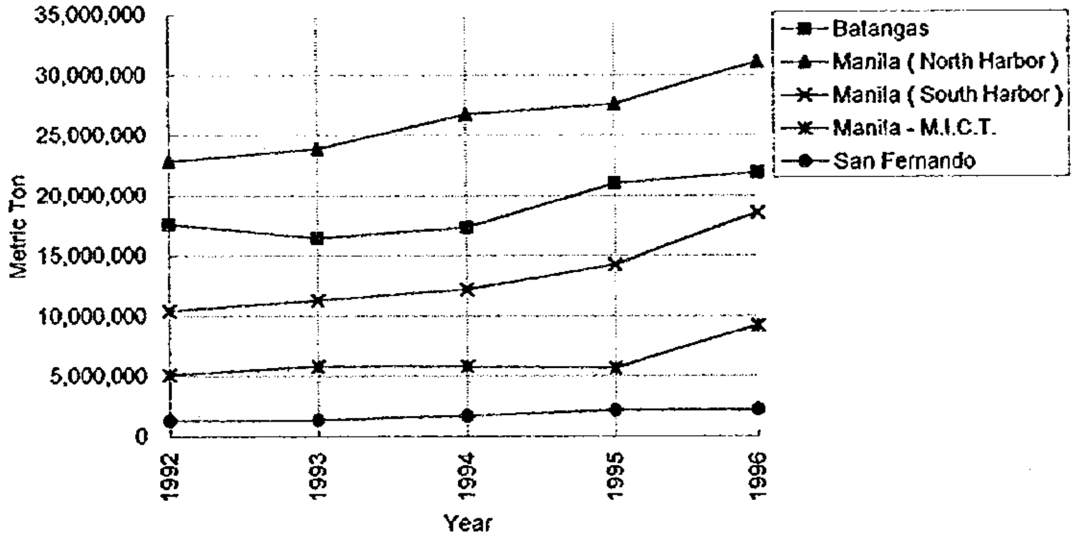


Figure 5.3.2-1 Cargo Handling Volume at Five Ports

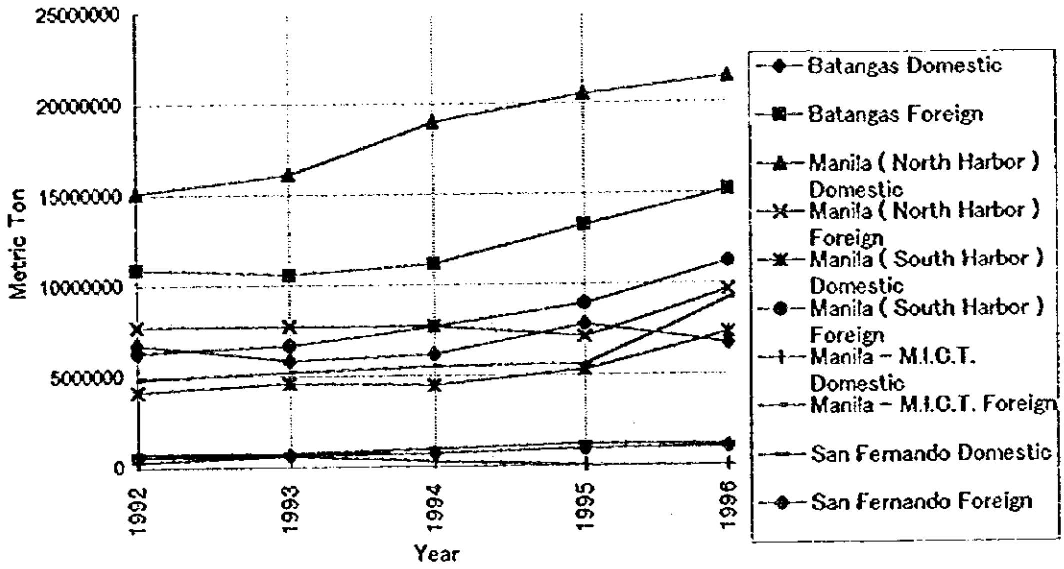


Figure 5.3.2-2 Domestic & Foreign Cargo at Five Ports

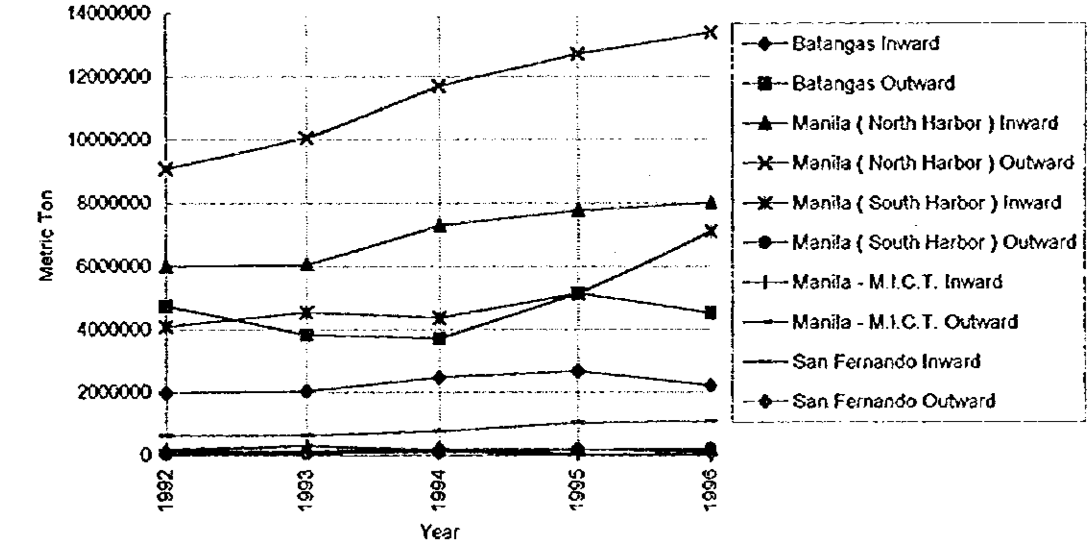


Figure 5.3.2-3 Domestic Cargo Volume Handling at Five Ports

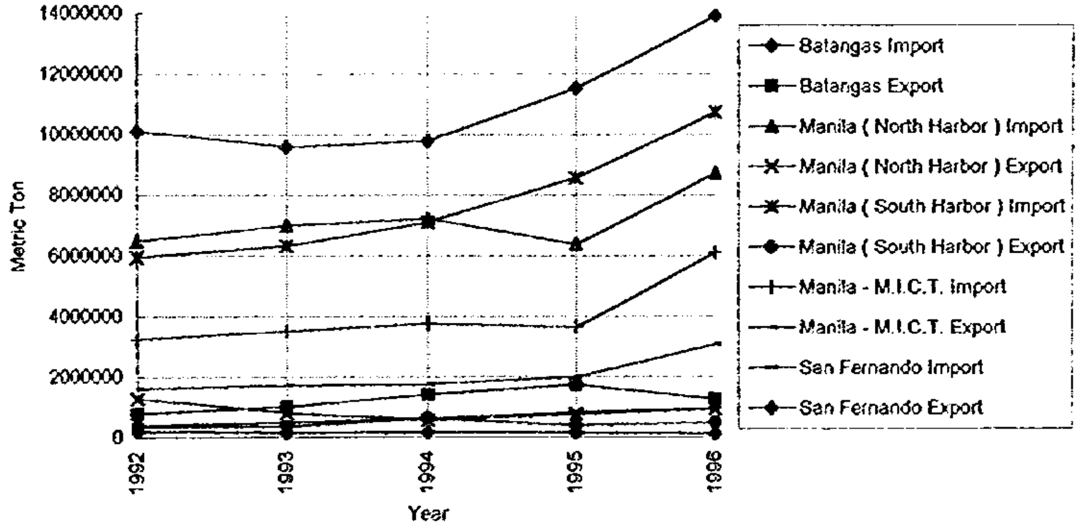


Figure 5.3.2-4 Foreign Cargo Handling Volume at Five Ports

Table 5.3.2-3 Five PMO's ports in 1996

Unit: 1000 Ton

	(A) In the Philippines	(B) Five PMO's port	(B)/(A)
Domestic Trade Cargo	62,290	36,540	59%
Foreign Trade Cargo	66,750	46,220	69%
Total Cargo	129,040	82,760	64%

The cargo volume handled at the PMO's five ports has been growing constantly, reflecting the growth of the Philippine and Pacific Asian economy.

Annual growth rate of cargo volume handled at PMO's five ports are as following Table 5.3.2-4.

Table 5.3.2-4 Annual growth rate at PMO's five ports

Year / Port Management Office	1992 - 1996 Annual Growth Rate
Batangas	5.58%
Manila (North Harbor)	7.99%
Manila (South Harbor)	15.40%
Manila - M.I.C.T.	15.63%
San Fernando	14.16%

Source: Annual Statistical Report, PPA, 1992 - 1996

4) Ship Calls at Five Adjacent Ports

Ship calls at the five ports in the past 5 years (1992 - 1996) are shown in Table 5.3.2-5.. The growth of ship calls at the five ports was recognized clearly, especially the number of domestic ship calls at Batangas Port and Manila Port (North & South). (see Figure 5.3.2-5)

In terms of ship size, foreign cargo volume has grown each year though the number of ship calls has remained the same. This indicates that the average ship size of foreign vessel is becoming larger each year. (see Table 5.3.2-6 and -7)

Table 5.3.2-5 Ship Call at Five Ports from 1992 to 1996

Unit: Ships Nos.

Year / Port Management Office		1992	1993	1994	1995	1996
Batangas	Domestic	15,919	16,644	19,613	30,309	35,844
	Foreign	908	1,032	1,045	1,023	974
Manila (North Harbor)	Domestic	11,596	12,503	13,247	13,530	16,419
	Foreign	299	267	290	245	238
Manila (South Harbor)	Domestic	6,403	6,619	6,549	7,333	9,813
	Foreign	1,937	2,170	2,508	2,533	3,157
Manila - M.I.C.T.	Domestic	133	129	63	34	0
	Foreign	1,156	1,113	1,232	1,324	1,348
San Fernando	Domestic	474	509	654	685	747
	Foreign	208	151	269	510	747

Source: Annual Statistical Report, 1992 to 1996, PPA

Table 5.3.2-6 Average Gross Tonnage of Ship Call from 1992 to 1996

Unit: Gross Tons

Port management Office	Year	1992	1993	1994	1995	1996
Batangas	Domestic	516	549	484	439	401
	Foreign	13,049	11,769	12,071	12,463	13,509
Manila (North Harbor)	Domestic	1,423	1,452	1,703	2,010	1,969
	Foreign	18,935	22,228	19,709	22,245	25,956
Manila (South Harbor)	Domestic	371	379	365	380	401
	Foreign	7,058	7,064	7,753	8,846	9,237
Manila - M.I.C.T.	Domestic	5,392	6,294	6,367	4,319	4,319
	Foreign	12,796	12,269	12,621	13,150	14,861
San Fernando	Domestic	1,081	1,083	1,086	1,317	1,282
	Foreign	4,071	4,886	3,462	2,380	1,826

Source: Annual Statistical Report, 1992 to 1996, PPA

Table 5.3.2-7 Average Length of Ship from 1992 to 1996

Unit: Metre

Port Management Office	Year	1992	1993	1994	1995	1996
Batangas	Domestic	45	48	45	41	38
	Foreign	130	126	129	122	120
Manila (North Harbor)	Domestic	62	62	65	70	67
	Foreign	141	144	129	137	148
Manila (South Harbor)	Domestic	39	39	39	40	41
	Foreign	118	116	122	124	127
Manila - M.I.C.T.	Domestic	118	124	125	111	111
	Foreign	163	156	157	156	162
San Fernando	Domestic	58	55	55	67	66
	Foreign	80	100	80	61	49

Source: Annual Statistical Report, 1992 to 1996, PPA

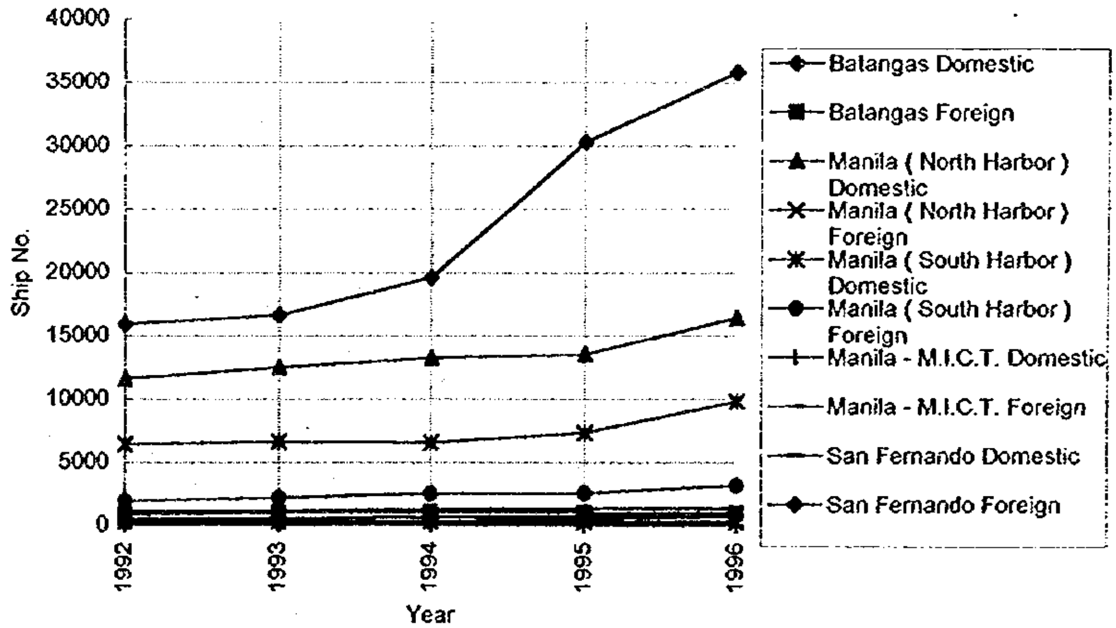


Figure 5.3.2-5 Ship Call at Adjacent Five Ports

5.4 Strategic Transport Plans

5.4.1 Strategic Transport Planning Study

(1) Philippine Transport Strategy Study (PTSS)

The output from PTSS differs from past plans. The imperative is to re-engineer the government bureaucracy, and to introduce policy reform. This is essential to support national goals, and to promote private sector participation.

According to PTSS the conclusions from it should be translated into a Statement of Transport Policy, and incorporated in the new Development Plan 1999-2004, to guide the implementation of the transport strategy.

1) The Objectives of PTSS

PTSS was commissioned to develop the Transport Agenda for the next 6-Year Plan period (1999-2004). It was specifically required to identify the role of the private sector in implementing the Agenda. The Study was funded by the Asian Development Bank, carried out within NEDA, and reported to the Inter-Agency Technical Committee for Transport Planning (IATCTP).

2) The Framework of Government Policy

Government is proactive in achieving the national development goals. Deregulation, decentralization, democratization and privatization are the central thrusts of policy. Re-engineering the government bureaucracy is recognised as necessary to achieve this. A new medium-term national development plan is to be produced in 1998.

3) Key Issues Facing the Transport Sector

It is important to start from a position of realism. Nine factors identify the dimensions of this, and point to the challenge that must be faced:

① Politics intrudes extensively in the sector - too intrusively. The result is that just about everywhere is a development priority, and little attention is paid to economic efficiency.
② The institutions of Government are now ill-suited to the task ahead - change is needed.
③ There is inadequate funding to meet the sector's needs.
④ The private sector is, incorrectly, seen as the (easy) answer to this funding problem.
⑤ There is no transport policy and strategy that is owned by the agencies of government.
⑥ In many areas there is inadequate understanding of the potential of transport strategy.

⑦ Attention focuses on projects, not institutions or policies - which are now more important.
⑧ There are few prepared good projects that are implementable - surprisingly few.
⑨ Many projects are simply unrealistic or unaffordable.

4) A Realistic Strategy

PTSS should determine a realistic (implementable, fundable) strategy that the main agencies of government will sign up to. This should:

- set the priorities for action
- identify the necessary institutional reforms
- recommend future policy
- recommend priority investments in the roads, rail, maritime and aviation sectors, and
- determine how the private sector can be involved in implementation.

(2) Artery network in the Central Luzon Development Program Masterplan Study

Spatial development of any region is affected by a network of transportation arteries and distribution of urban centers as well as resources potentials and constraints. A future artery network for Central Luzon is proposed in line with the National Triad Growth Centers and the proposed hierarchical structure of urban centers. It consists of inter-regional arteries and intra-regional asteries linking those urban centers in the upper tiers. Artery network in Central Luzon is shown in Figure 5.4.1-1

1) Inter-regional arteries

Inter-regional arteries for Central Luzon are basically north-south roads linking the northern regions to Metro Manila through Central Luzon. The main artery will continue to be the Manila north Road passing through Bulacan, Pampanga and Tarlac and the North Luzon Expressway with its extension. It has a secondary artery branching off at Tarlac and leading to the Lingayen gulf area in Pangasinan.

The alternative artery is provided by the Maharlika highway leading from Metro Manila, through Bulacan and Nueva Ecija, to the Cagayan Valley. In view of limited capacity and right-of-way acquisition problems associated with this highway, a new inter-regional artery is conceived with the alignment to the east of the Maharlika highway as a medium to long term option. This alignment has two potential advantages. It may contribute to opening up the Cagayan Valley and Aurora province, and provide an alternative link with the Metro Manila urban transport system. Other inter-regional links are from Nueva Ecija to the Dingalan bay area in Aurora and from Zambales to Pangasinan along the coast.

2) Intra-regional arteries

Intra-regional arteries for Central Luzon are main roads connecting those urban centers in the upper tiers of the proposed hierarchy. They are mostly existing roads to be improved or upgraded such as Olongapo City-Iba, Gapan-San Fernando-Dinalupihan, and Dinalupihan-Balanga-Mariveles links. The Iba-Tarlac link is new.

A new structure of intra-regional arteries is proposed to strengthen links between key urban centers to support the Central Luzon Development Program paradigm. It consists of a new highway leading from the Subic bay area, through Angeles City, Capaz and La Paz in Tarlac and Cabanatuan City, to Palayan City in Nueva Ecija, a more direct link between Malolos in Bulacan and Olongapo City, and strengthened link from Malolos through San Fernando to Angeles City.

This structure should be fully established in the medium term. In view of high costs involved in extensive viaduct sections of the Malolos-Dinalupihan and the Dinalupihan-Angeles City links, however, improvement of the San Fernando-Dinalupihan road may provide a short-term alternative to both of the links.

The new intra-regional highway called here the Rainbow highway links effectively five provinces except Bulacan and four cities except San Jose City directly. This highway would help to direct flow of goods and movement of people away from Metro Manila by creating self-sustaining and evolving sphere of economic development within Central Luzon.

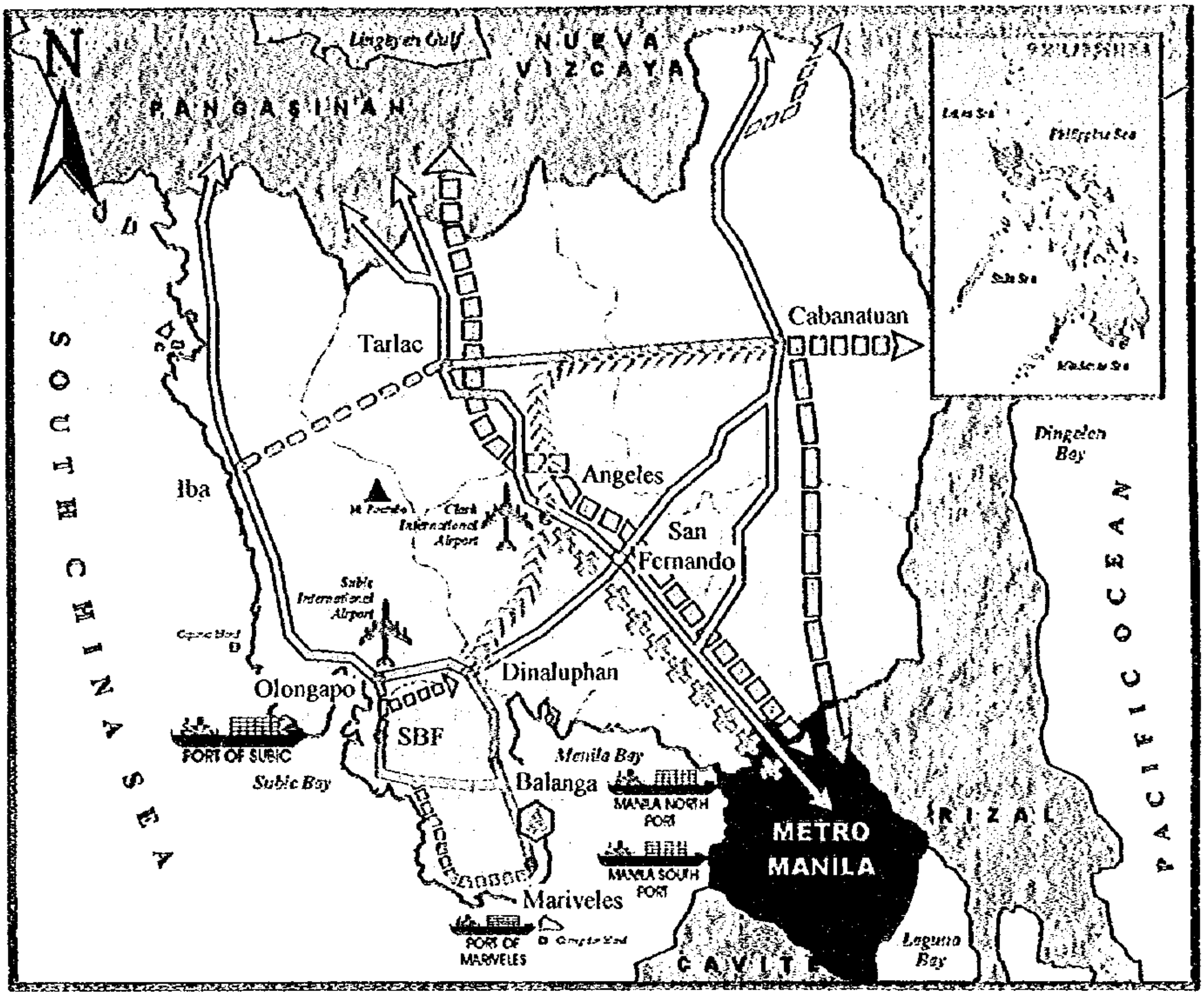


Figure 5.4.1-1 Artery Network in Central Luzon

Source: The Central Luzon Investment Coordinating Council

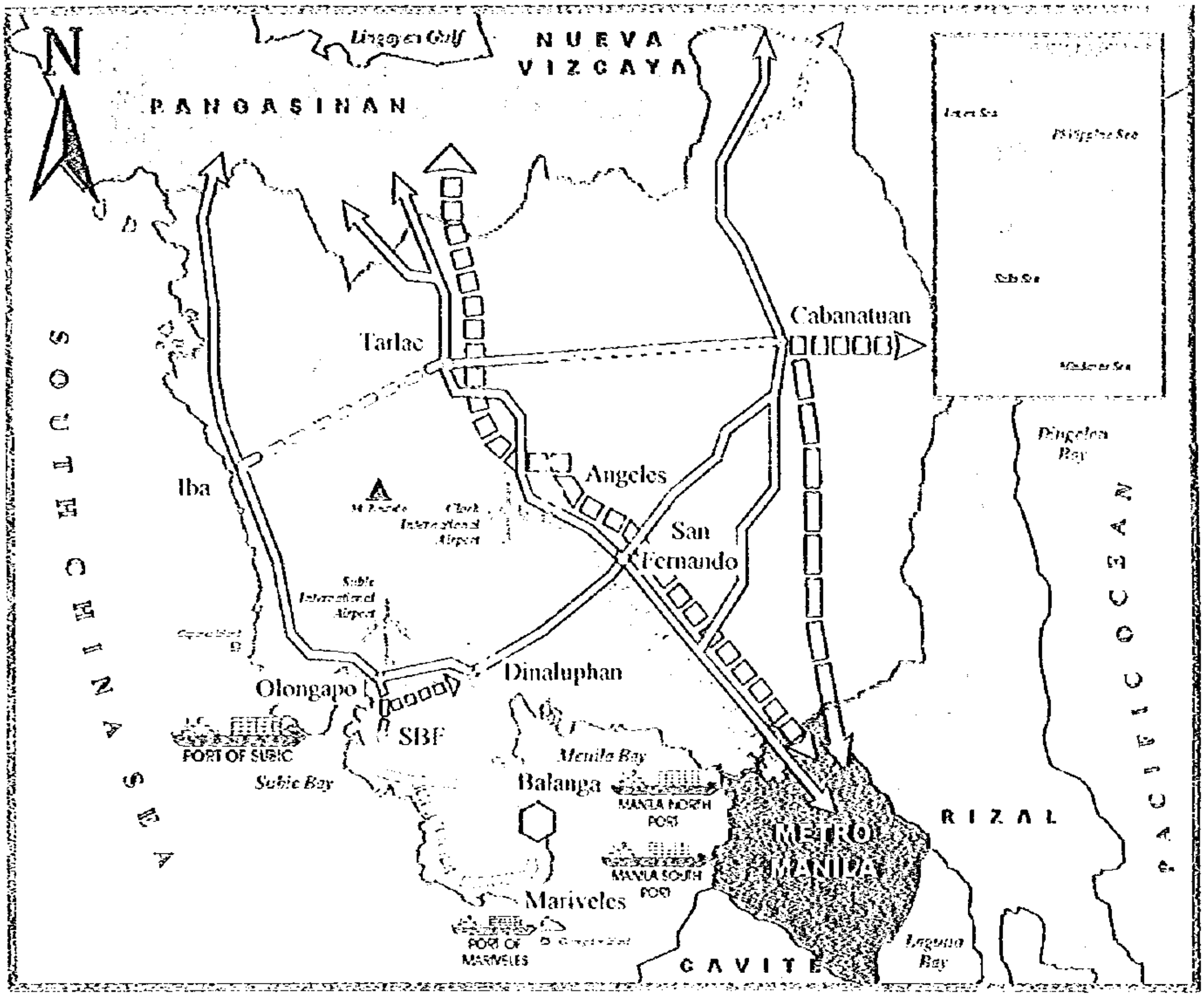
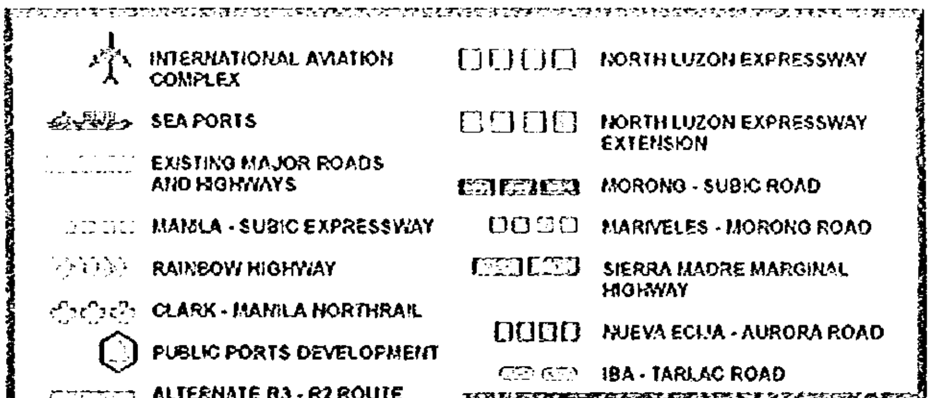


Figure 5.4.1-1 Artery Network in Central Luzon



Source: The Central Luzon Investment Coordinating Council

5.4.2 Public Investment Projects for Transport Sub-sector

The PTSS recommendations concerned with the institutions and the public investment projects are summarized as follows;

(1) Roads

1) Reform the government institutions:

① Implement a revised Roads Classification

② Establish National Roads and Bridges Agency (NRBA), and a Road Fund for maintenance of the national hightways

③ Reform DPWH, privatize some DPWH function

④ Reform and preferably abandon the system of 'block allocations' to regions

2) National Roads Projects (excludes urban projects)

(a) General

a) Adopt the following priorities for the road network:

① Maintenance (existing roads) ② Rehabilitation (existing roads) ③ Improvement (existing roads) ④ New penetrator roads ⑤ Missing links

b) Adopt the following strategy to keep the national road system in good condition:

① all roads to be asphalt, or concrete ② concrete to be used where the existing asphalt pavement is 'poor' and EIRR of improvement > 15% ③ otherwise asphalt to be used

	Cost(P billion)
(b) Committed	(n.a.)
① Carry over from existing Plan ② ADB sixth Road Improvement Project ③ twenty-second OECF Yen package (under negotiation)	
(c) Priority 1	100
Maintenance(17), Rehabilitation(20), Improvement(59), New Roads(4)	
(d) Priority 2	72
Improvement(64), New Roads(8)	
(e) Total Cost	172

National road/ferry network (Luzon) is shown in Figure 5.4.2-1

(2) Railways

1) Reform the government institutions:

① Undertake PNR Privatization Implementation Action Plan Study

② Implementation the recommendations (probably letting franchises for commuter and inter-city services on Main Line South)

2) Projects (excludes urban projects)

(a) General

Determine rail strategy at the core of the network in Metro Manila

Cost(P billion)

(b) Committed 5

① Ongoing subsidy to PNR operation(5) ② North Rail (Clark-Valenzuela)(n.a.)

③ Main Line South rehabilitation (almost complete)(-)

(c) Priority 1 5

① Implementation of PNR Privatization and Implementation Action Plan(5)

② No new rail projects pending reform of PNR(other than those committed)(-)

(d) Priority 2 (n.a.)

(e) Total Cost 10

PNR route network is shown in Figure 5.4.2-2

(3) Ports

1) Reform the government institutions:

① Re-structure PPA: • Remove its regulatory powers

• PPA to decentralize activities (e.g. to District Offices and PMO's)

② Independent Economic Regulator(s) to: • Reform(increase) port tariffs

• Fully deregulate domestic shipping

③ PPA to: • Prepare priority projects for implementation

• Commission review of Ports Strategy for the Greater Capital Region (GCR)

④ PPA to market selected ports to the private sector.

2) Projects

Cost(P billion)

(a) Committed 8

① Manila South Harbor Expansion, MICT, Batangas Phase1 and 2

② Nationwide Feeder Ports Program (36 ports) 23

(b) Priority1

① Major Ports - Cebu, Iloilo, Manila Grains(4) ② Ro-Ro Programme(4)

③ Safety-related projects(5) ④ GCR Programme (provisional)(10)

(c) Priority2 13

① Major Ports - Tacloban, Davao, Cagayan de Oro, Tagbilaran, General Santos(3)

② GCR Programme (provisional)(10)

(d) Total Cost 44

Domestic shipping routes are shown in Figure 5.4.2-3

(3) Airports

1) Reform the government institutions:

① Re-structure ATO:
- Corporatize ATO
- Remove its regulatory powers
- ATO to decentralize its activities

② An independent Economic Regulator reform (increase) airport/ air navigation tariffs

③ Adopt a revised airports classification

④ Develop Philippine standards for airports, and enforce compliance

⑤ ATO to prepare priority projects for implementation

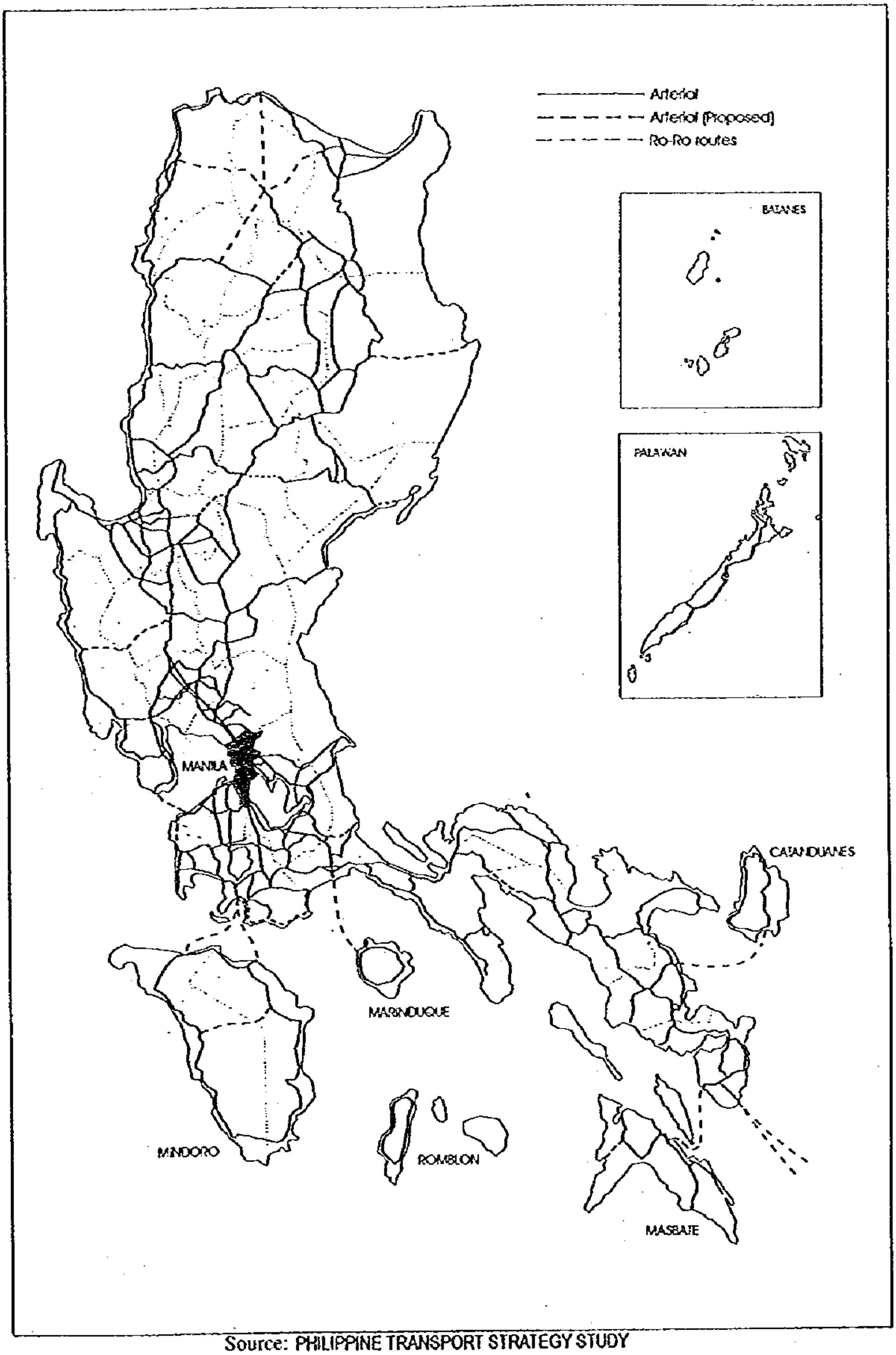
⑥ Government to commission an Airports Strategy Study for the Greater Capital Region (GCR)

⑦ ATO to market selected airports to the private sector

2) Projects

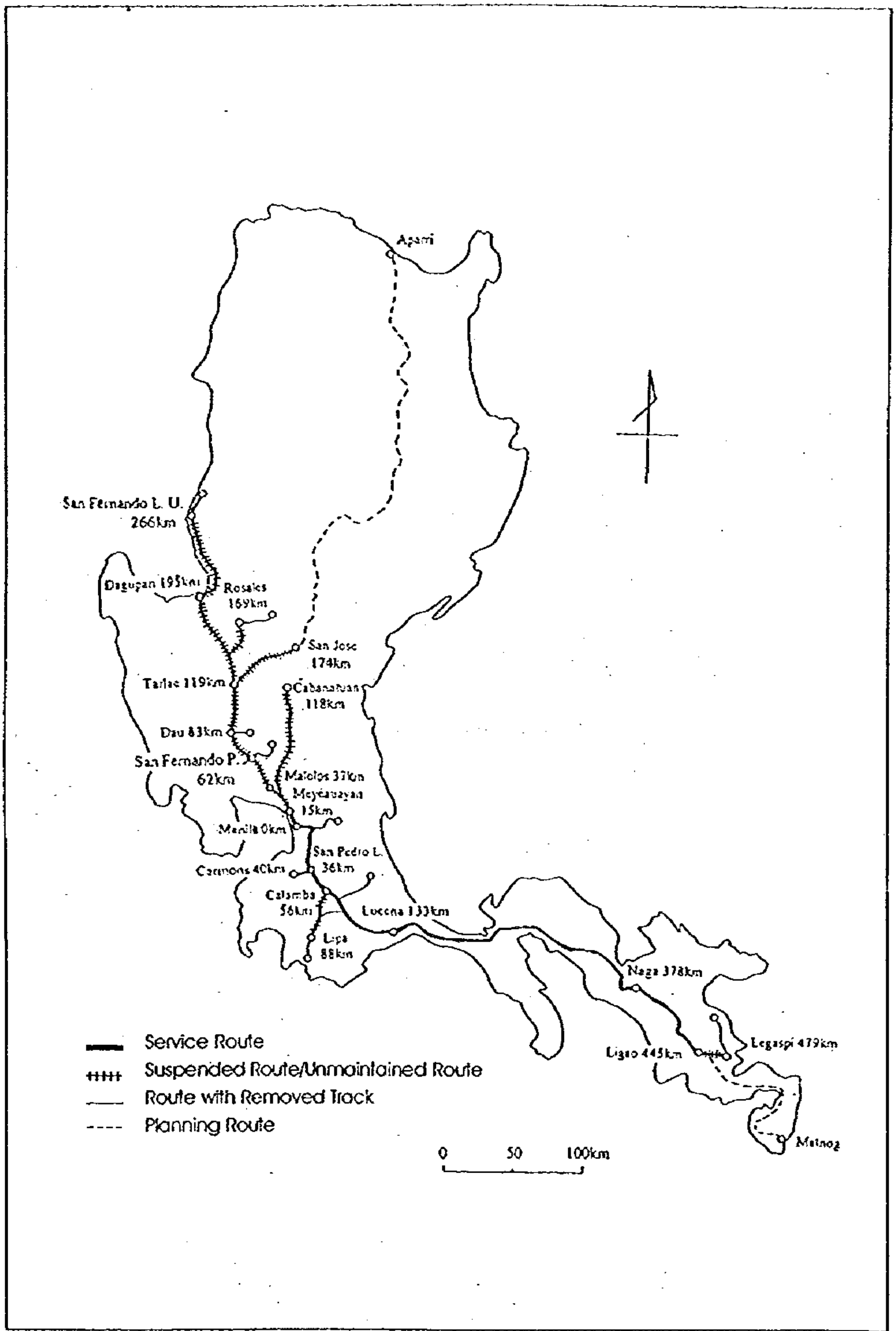
	Cost(P billion)
(a) Committed	11
① NAIA Terminal 3 (n.a.)	
② Airports in the forthcoming ADB First and Second Airport Development Projects: Davao, Zamboanga, Laoag, Puerto Princesa, Cotobato, Dipolog, Pagadian, Jolo, Tuguegarao, Butuan, Sanga Sanga; and those for possible OECF funding: Cebu-Mactan, Bacolod.(11)	
(b) Priority1	4
① Major Airports - Kalibo, Roxas, Tagbilaran, Masbate, Virac, Dumaguete, Laguindingan(2)	
② Safety-related projects(2)	
(c) Priority2	4
• Major Airports - Basco, Busuanga, Naga, Tacloban, Baguio, Iloilo, San Jose (Mind. Occ.), Catarman, Malabang(4)	
(d) Total Cost	19

Domestic air network is shown in Figure 5.4.2-4



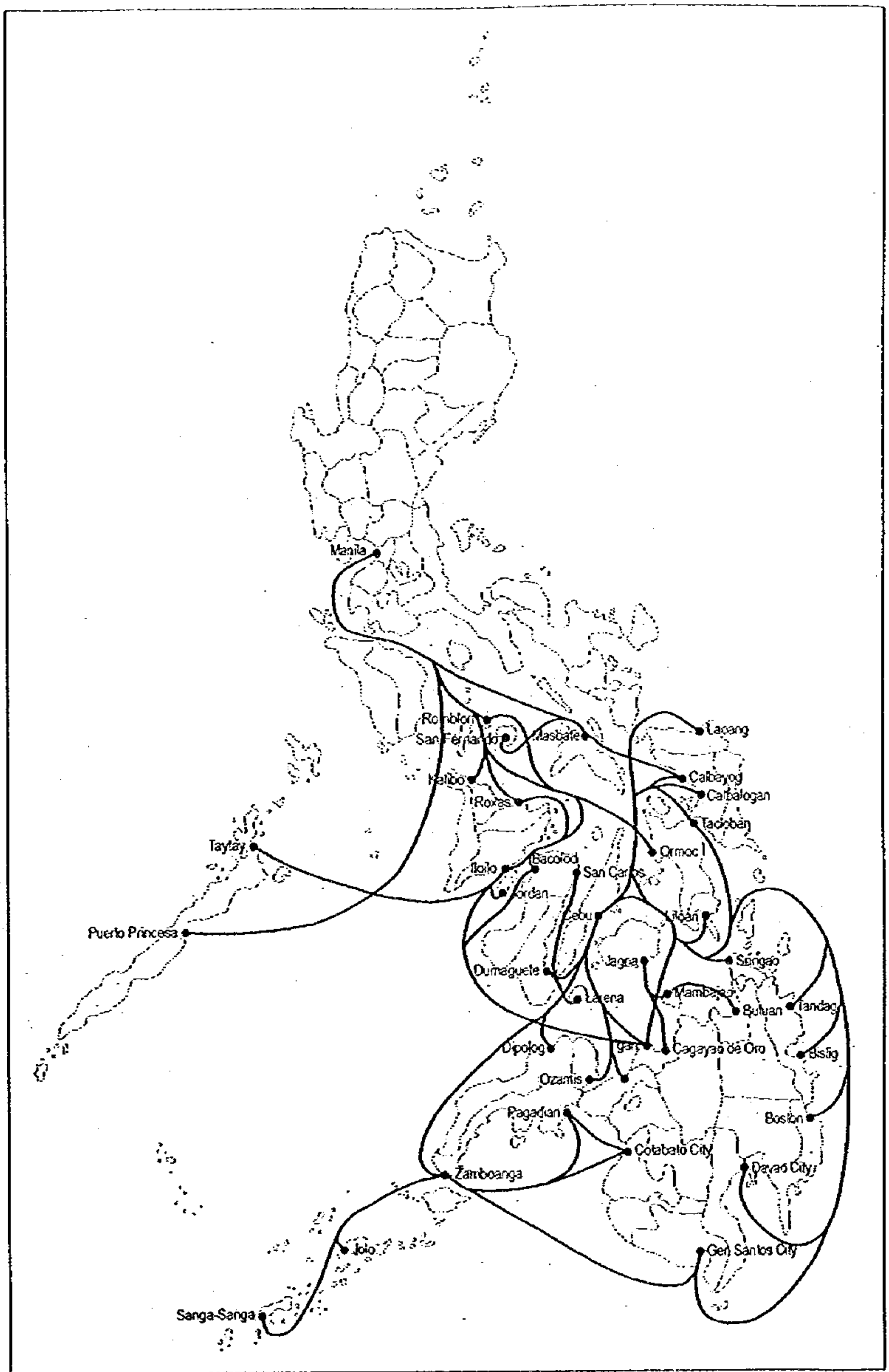
Source: PHILIPPINE TRANSPORT STRATEGY STUDY

Figure 5.4.2-1 National Road/Ferry Network (Luzon)



Source: PHILIPPINE TRANSPORT STRATEGY STUDY

Figure 5.4.2-2 PNR Route Network



Source: PHILIPPINE TRANSPORT STRATEGY STUDY

Figure 5.4.2-3 Domestic Shipping Routes

6.1 Natural Conditions at Subic Bay

The Study Team conducted a series of data collection and field surveys/investigations for the natural conditions of Subic Bay in 1998. Locations of these field surveys/investigations are shown in Figure 6.1.1-1.

6.1.1 Meteorology

The meteorological information in the Subic Bay area was recorded by the US Navy from 1955 to 1989. After the conversion of the Naval Base, PAGASA weather station at SBIA have resumed the observation and have been providing their meteorological services on 24 hour basis since 1994.

Throughout the Philippine Islands, the southwest monsoon winds from June to mid-October bring warm, moist and unstable tropical air producing mostly cloudy to cloudy skies with intermittent showers and scattered thunderstorms. During this period, tropical storms/typhoons pass over or within close proximity of Luzon Island twice a month on average.

During the southwest monsoon season, 2,641 mm of the rainfall is recorded in the 5 months at Cubi Pt., where the average annual rainfall is 3,386 mm. Monthly rainfall sometimes reaches over 1,000 mm in July or August, which is the wettest month in a year. An extreme monthly maximum of 2,461 mm was recorded once in the past. The average daily maximum and minimum temperature during this season are 34 and 22 ℃, respectively.

During October, the transition from the southwest monsoon (wet) season gradually changes to the northeast monsoon (dry) season. The transition of the climate generally completes over the Luzon Island by November. The dry season prevails until May when the other transition occurs vice versa.

In the northeast monsoon season, the average rainfall is 745 mm in total. In May 1997, a monthly rainfall of 964 mm was unusually recorded. January is the coolest month with a daily average maximum and minimum temperature of 33 and 19℃, respectively. May is the hottest month of the year, when the average daily maximum temperature reaches 37℃.

Some meteorological data from January 1995 to December 1997, recorded at the weather station in SBIA are shown in Figure 6.1.1-2. From the same data, an windrose for three years, i.e. from February 1995 to January 1998, has been created as shown in Figure 6.1.1-3.

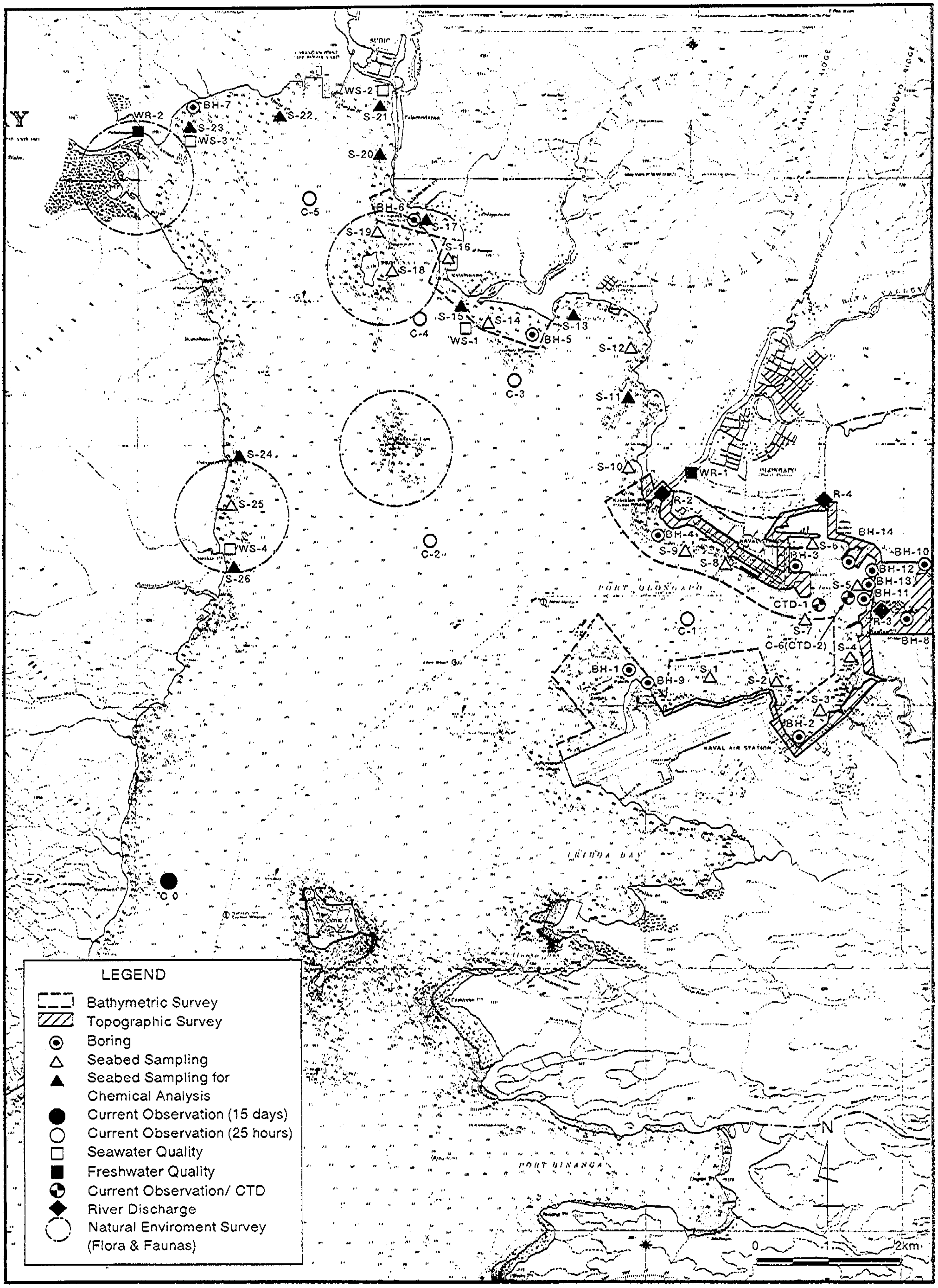


Figure 6.1.1-1 Location of Field Survey/ Investigations

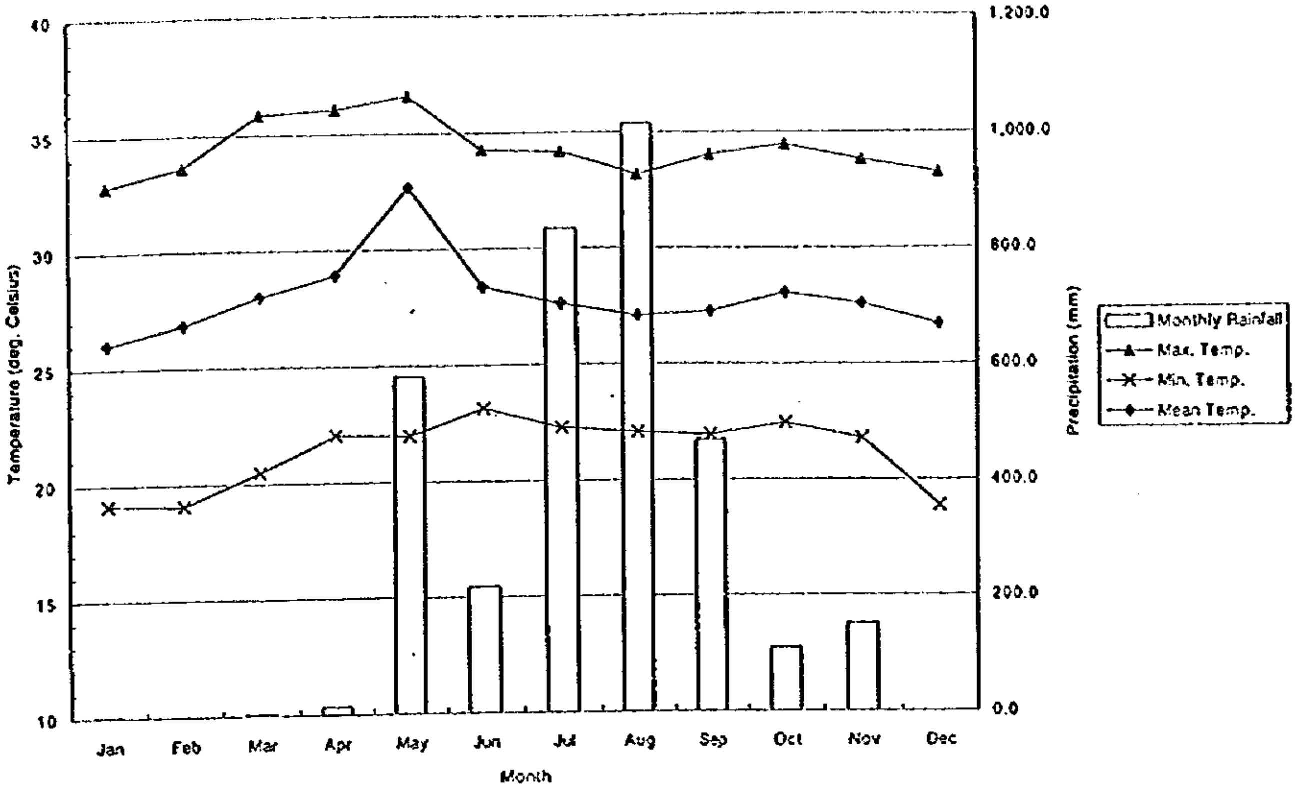


Figure 6.1.1-2 Meteorological Information at the SBIA

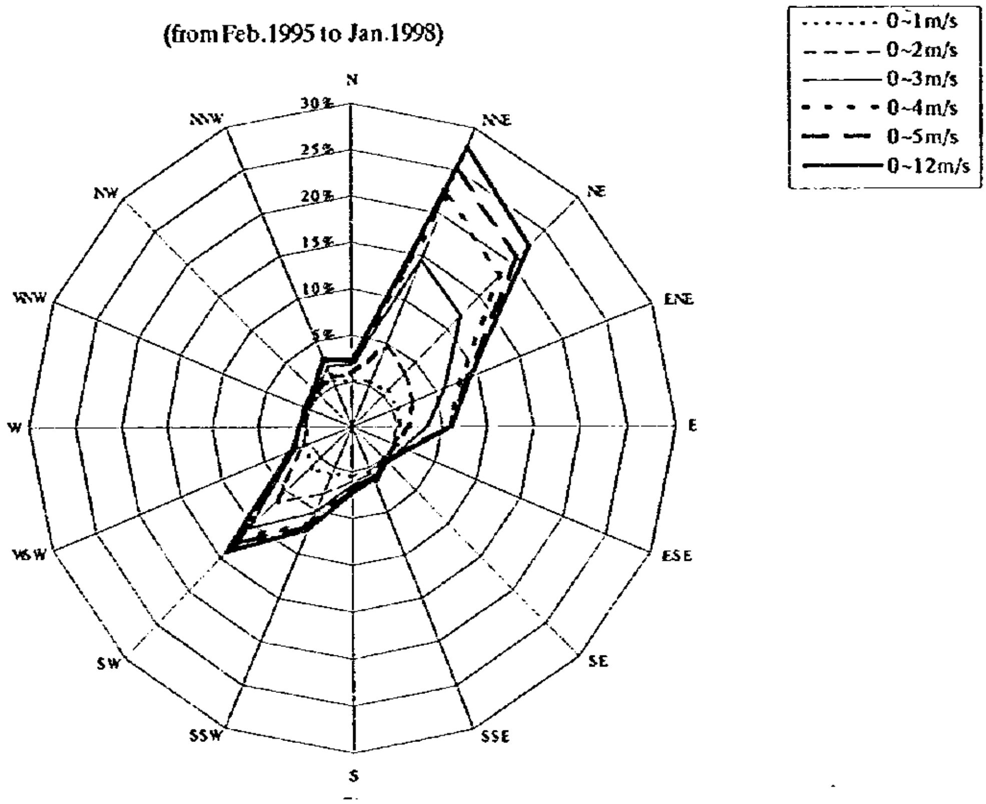


Figure 6.1.1-3 Annual Windrose at SBIA

6.1.2 Oceanography

(1) Tide

A continuous tide observation for 36 hours was conducted in July 1998. It has been observed that the tide in Subic Bay is 20 to 30 cm higher than that of Manila South Harbour predicted from the tide table. All levels to be used for the Study are based on Mean Lower Low Water (M.L.L.W.) as SBMA Chart Datum. The following tide levels have been established:

- Highest High Water Level (H.H.W.L.)	: E.L. + 1.70 m
- Extreme High Water Level (E.H.W.)	: E.L. + 1.37 m
- Mean Higher High Water Level (M.H.H.W.)	: E.L. + 1.20 m
- High Water Level (H.W.L.)	: E.L. + 0.91 m
- Mean High Water Level (M.H.W.)	: E.L. + 0.87 m
- Mean Sea Water Level (M.S.L.)	: E.L. + 0.46 m
- Mean Low Water Level (M.L.W.)	: E.L. + 0.10 m
- Mean Lower Low Water Level (M.L.L.W.)	: E.L. ± 0.00 m
- Low Water Level (L.L.W.)	: E.L. - 0.20 m
- Design Low Tide Level (D.L.T.)	: E.L. - 0.35 m
- Extreme Low Water (E.L.W.)	: E.L. - 0.46 m
- Lowest Low Water Level (L.L.W.L.)	: E.L. - 0.52 m

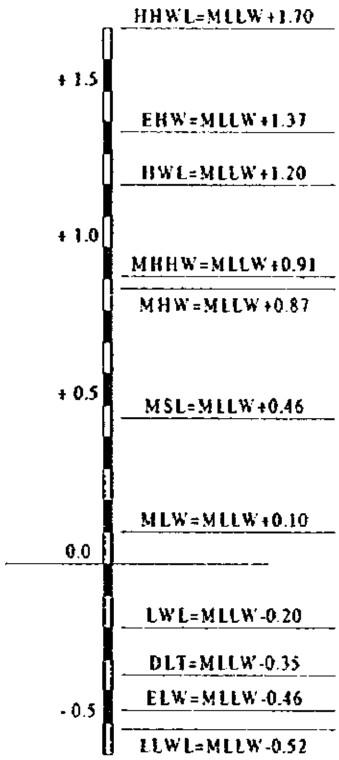
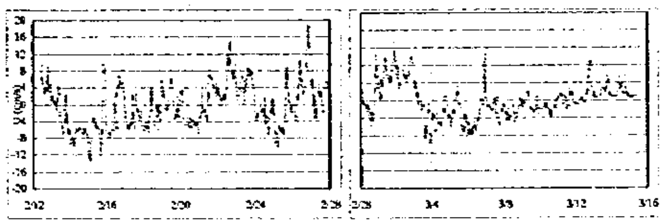


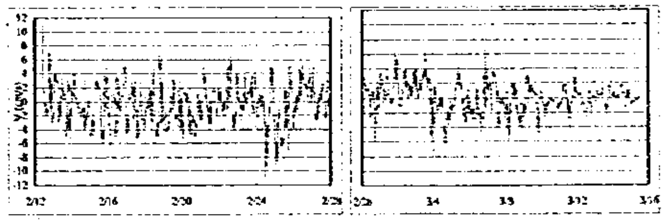
Figure 6.1.2-1 Tidal References

(2) Current

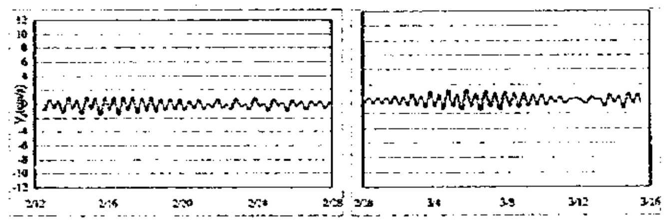
The JICA Study Team conducted a series of current observations in Subic Bay. The continuous observation for 15-day period was recorded at two (2) locations. At the other three locations, shorter records for 25-hour period were obtained. The longer records at two locations were subjected to the harmonic analysis. The results of the analysis are summarised in Figure 6.1.2-2 and also introduced in the later section on EIA for Change in Costal Currents. Through these observations and analyses, it has been confirmed that the tidal current in Subic Bay is generally less than 0.1 m/s and the residual current inflows at the east side of the mouth and outflows at the west side.



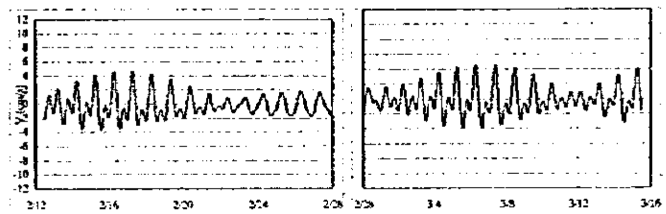
(a) Observed Current Record (EW component, U)



(b) Observed Current Record (NS component, V)



(c) Harmonic Curve (EW component, U)



(d) Harmonic Curve (NS component, V)

	ω (rad/hr)	U (m/s)	μ (rad)	V (m/s)	ν (rad)
O1	0.24335158	0.00055174	-1.2101115	0.00639004	3.53353977
K1	0.26251617	0.00222831	1.01259947	0.01217409	3.26244090
M2	0.50586804	0.00357801	1.13425696	0.01132539	0.99079259
S2	0.52359877	0.00523311	-1.23945725	0.00649472	4.57629061
N2	0.49636691	0.00288756	3.82549191	0.00603206	3.54044008
K2	0.52503233	0.00027857	-0.8616243	0.00042210	3.07144332
P1	0.2610826	0.00016474	1.12303483	0.00255821	0.42836761
Q1	0.23385074	0.00196304	-1.22152197	0.00940874	-0.5180306
T2	0.52288198	0.00057537	3.45315808	0.00027444	2.04674864
L2	0.51465239	0.00053277	-0.38016143	0.00184104	4.33098078
Regular Current (Uo,Vo)		-0.159683		-0.221584	

Figure 6.1.2.-2 Results of Harmonic Analysis of Current at C0

(3) Waves

Wave hind-cast was conducted based on the wind and typhoon data collected both in Subic and Japan. For normal condition, daily wind data observed and recorded at Subic Bay International Airport by PAGASA were analysed and used for the hind-cast, while for extreme condition the hind-cast was conducted based on past typhoon records, which are available at the Meteorological Authority in Japan.

Figure 6.1.2-3 shows schematic analysis flow of the wave hind-cast adopted in this master planning study for zoning purpose. It should be noted that wave generation was evaluated both inside and outside the Bay, reflecting rather large water surface inside, where former wave generation is no longer negligible.

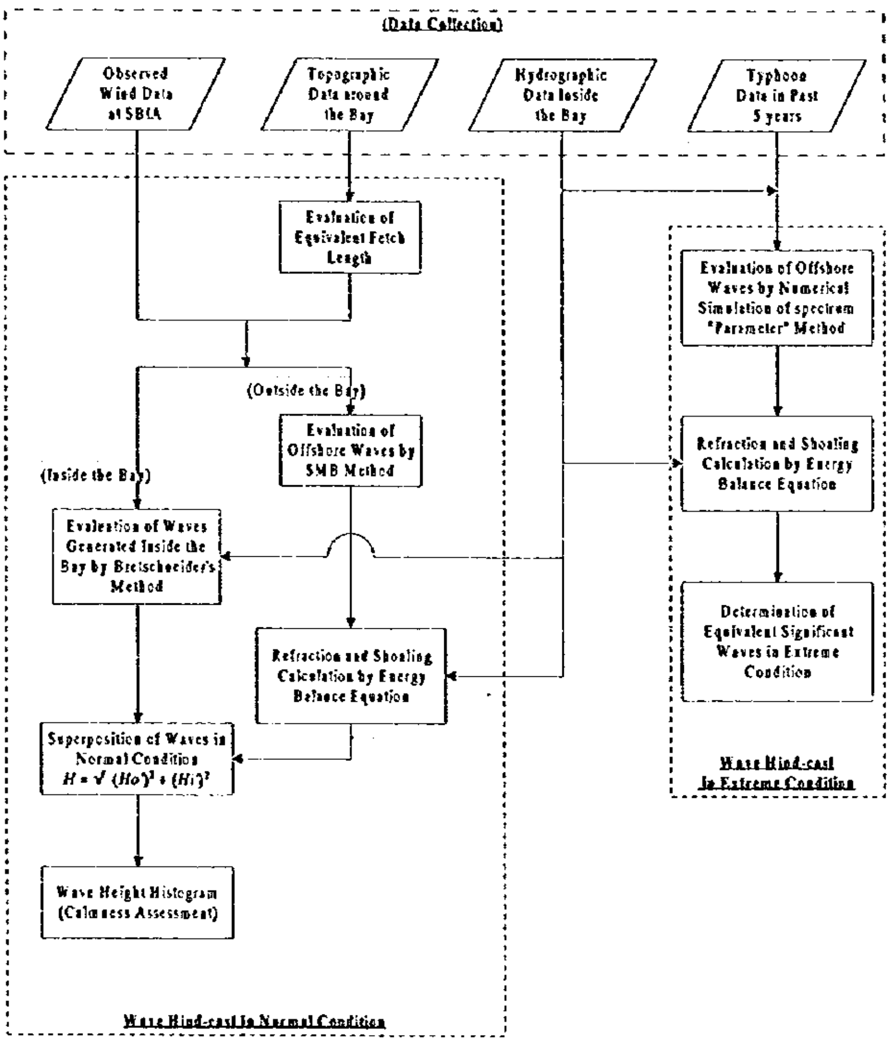


Figure 6.1.2-3 Schematic Flow Diagram of Wave Hind-casting in This Study

1) Waves in Extreme Condition

a) Offshore (Deep Water) Waves

Past typhoon traces in the latest five years were gathered and analysed in Japan. From those records, three largest typhoons, which are expected to have affected wave conditions in Subic Bay, were selected and subjected to detailed numerical simulation by so-called "Parameter Method", which is able to estimate waves generated by typhoon from its trace and pressure changes in time series at any points inside the analysis area.

From the simulation, the expected wave height is not so large at the entrance of Subic Bay, say two to three meters, although the largest typhoons in the latest five years were selected. A virtual typhoon was, artificially, created for the simulation that has the same pressure change as the actual record, but moves northward along a different route from the actual trace.

The maximum wave height thus obtained reaches 5.34 m with its period of 7.8 second at a point sufficiently offshore in the area. Particulars of this wave are then used as of an offshore significant wave for further analyses.

b) Refraction and Shoaling of Offshore Waves

Propagation of the offshore wave towards the shoreline inside Subic Bay was also simulated by solving Karlsson's energy equilibrium equation, which incorporates refraction and shoaling effects of irregular waves considering spectrum nature of its principal direction. A finite difference scheme is used to solve the basic differential equation, of which analysis area of 43 by 38 km wide was discretised in 173 by 153 meshes at 250 m.

Numerical computation was conducted for offshore waves in three directions, including its principal direction of SSW.

2) Waves in Normal Condition

a) Offshore (Deep Water) Waves generated outside the Bay

Offshore (Deep Water) waves generated outside the Bay, were evaluated from observed wind data at Subic Bay International Airport, by "SMB" method widely used for the purpose. The estimation was conducted in five directions, ESE, SE, SSE, S, SSW, SW and WSW.

With these results, wind data obtained in this study can be directly related to corresponding wave height and period in each direction. The relation is used for wave calmness study in later stage by transforming occurrence of winds to that of waves.

b) Shoaling and Refraction of Offshore Waves generated outside the Bay

The same procedure in extreme condition is also adopted in normal condition. The period of the wave used is 4 seconds, which represents all the estimated offshore waves in practical use.

Waves in shallow water can be evaluated by multiplying the above ratios by the corresponding offshore deep waves previously obtained.

c) Waves generated inside the Bay

Subic Bay is characterised by relatively wide water surface enclosed by narrow entrance and quite deeper water to its heart. Considering such topographic and bathymetric natures, waves can be generated not only outside the Bay, but inside. In particular, longer distance from the south entrance to the north heart, more than 10 km, is a sufficient effective fetch length for wave generation, which is no longer negligible. These wave generation inside the bay was also evaluated by a method originally proposed by Bretshneider for shallow water waves.

The following eight points in the Bay are selected as possible development sites in this Study as shown in Figure 6.1.2-4.

① Cubi Pt. West
② Boton Area
③ SRF Area
④ Pequena Is. at north, east, south and west sides
⑤ Apalit Pt.
⑥ Panibasco Pt.
⑦ Agusuhin Pt.
⑧ Agusungin Pt.

d) Superposition of Waves generated inside and outside the Bay

Considering its practical usage for zoning purpose, the superposition of waves, those generated offshore and inside the bay, is conducted simply assuming the corresponding energy is additive, i.e., the wave height after superposition (H) is expressed as follows:

$$H = \sqrt{(Ho'^2 + Hi'^2)}$$

where, Ho': Significant Wave Height generated offshore after refraction and shoaling,
Hi': Significant Wave Height generated inside the Bay

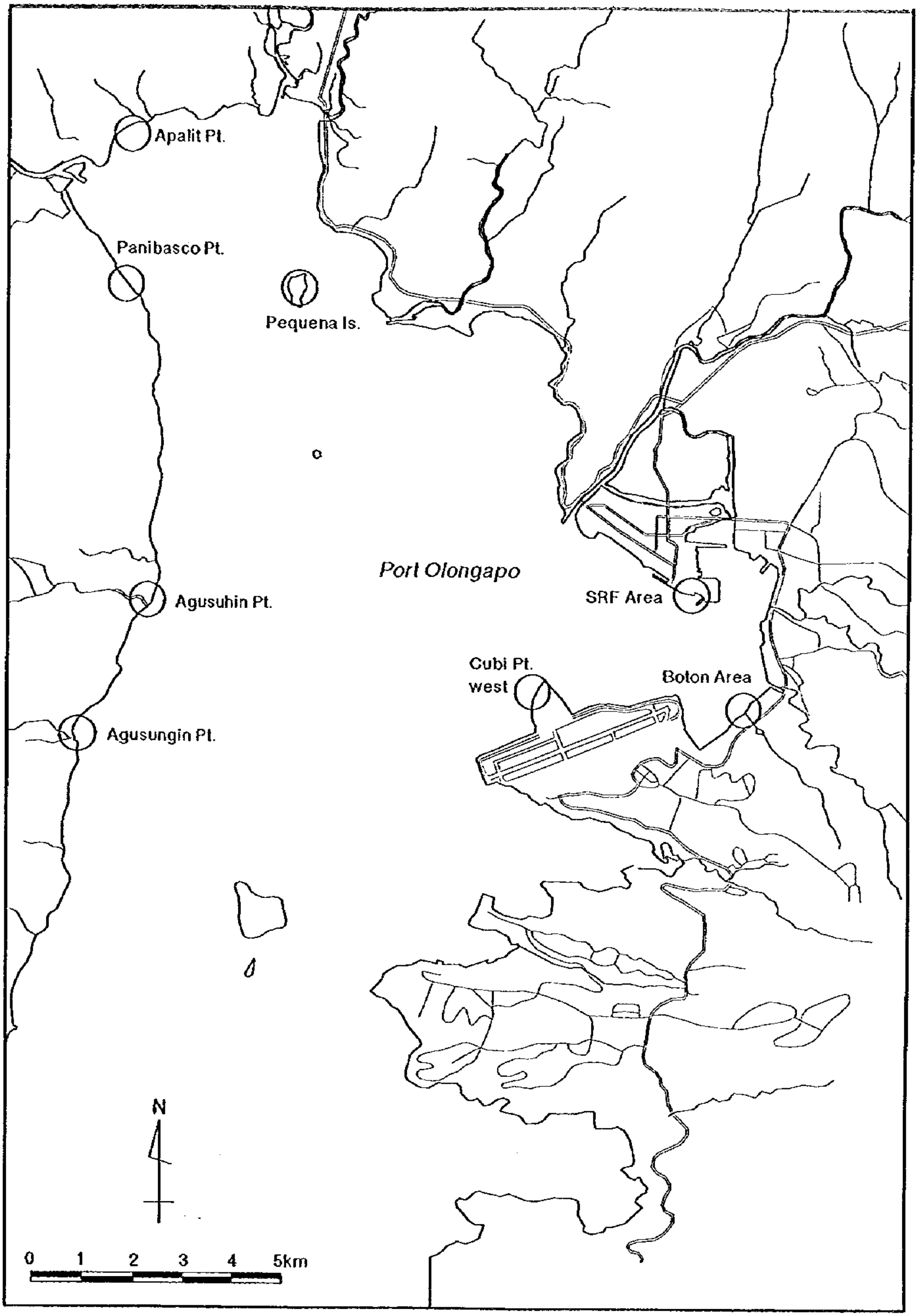


Figure 6.1.2-4 Possible Project Sites for Wave Calmness Assessment

3) Wave Calmness Study and Summary of Wave Hind-casting

By compiling the results so far presented together with the wind data obtained, assessment of wave calmness at each project site is carried out, which is one of the bases for possible port development zoning in Subic Bay.

Summary of the wave hind-casting both for extreme and normal conditions are shown in Table 6.1.2-1.

Table 6.1.2-1 Summary of Wave Hind-Casting

(Wave Height in m)

Site	Normal Condition			Wave Height in Extreme Condition
	Exceedance Percentage			
	3 %	5 %	10 %	
Cubi Pt.	0.325	0.275	0.220	0.801
Boton	0.185	0.175	0.155	0.534
SRF Zone	0.200	0.180	0.150	0.454
Pequena Is. (North)	0.215	0.200	0.180	0.801
Pequena Is. (East)	0.360	0.230	0.185	1.282
Pequena Is. (South)	0.315	0.240	0.195	1.442
Pequena Is. (West)	0.315	0.260	0.205	1.388
Apalit Pt.	0.210	0.180	0.145	0.748
Panibasco Pt.	0.240	0.220	0.190	0.267
Agusuhin Pt.	0.405	0.350	0.275	2.083
Agusungin Pt.	0.360	0.300	0.265	1.602

From the above results, it has been understood that the wave calmness inside the Bay is secured fairly enough for the port operation. This implies the possibility of the port development without breakwaters.

6.1.3 Topography

A topographic survey was conducted in 1998 by the JICA Study Team. The reference point for elevation used for the survey is located at the side of the existing bridge, at junction of the Rizal Highway/Olongapo Drainage Channel R.L. + 4.072 m which is above M.L.L.W. The coordinates are based on the PRS 92 System, and confirmed/counter-checked with the reference points ZBS 22, 23 and 24 which are located at the Maritan Point, the Rivera Wharf and the north side of Kalaklan River's mouth respectively. These coordinates are used for both topographic and bathymetric survey maps as tabulated below.

Table 6.1.3-1 List of Reference Points used for Surveys

Bench Mark	Kalalake Bridge	R/L. + 4.072 m
Station Name	Easting	Northing
ZBS-22	424,046.420	1,637,808.204
ZBS-23	423,342.016	1,638,376.048
ZBS-24	421,082.467	1,639,586.925

The topographic survey covers the following areas as shown in Figure 6.1.1-1.

Topographic survey along the shoreline of NSD zone, from the estuary of Kalaklan river to Boton Wharf East:	100 ha.;
Topographic survey at Binictican area and the north east shoreline of SBIA from Boton Wharf West to Cubi Pt.:	85 ha.;

Based on the survey results, topographic maps in each area have been produced in scales of 1:2,000 and 1:5,000.

6.1.4 Bathymetry

The JICA Study Team conducted the bathymetric survey by using an echo sounder at an interval of 50 m and approx. 500 m seaward in 1998. The survey covers the following areas.

Bathymetric survey along the shoreline of NSD zone, from the estuary of Kalaklan river to Boton Wharf East:	350 ha.;
Bathymetric survey at Cubi Pt. offshore:	100 ha.;
Bathymetric survey along the north east offshore of SBIA from Boton Wharf West to Cubi Pt.:	68 ha.

Bathymetric maps have been created in a scale of 1:5,000 and superimposed on the topographic maps.

6.1.5 Siltation and other Coastal/Shoreline Characteristics

No significant siltation has been identified in Subic Bay, other than some estuaries of the rivers affected by the eruption of Mt. Pinatubo, where sea/river beds were covered with the volcanic ashes/sands. As a whole, sufficient water depths around the existing port facilities have been maintained since US naval period and no maintenance dredging has been taken place.

As a part of the field investigations, seabed sampling at twenty-six (26) points and their gradation analysis were conducted as presented in the next sub-section.

In vicinity of the estuary of River Kalaklan, the seabed is covered with silty soils of "Lahar" origins discharged from the river. Along the shoreline of Subic Bay, other than estuaries of major rivers, sandy soils are predominant on the seabed.

In relation to the above discharge, measurement of the flow velocity was conducted at the mouths of River Kalaklan, Kalalake, Malawaan and Boton from 15 to 17 July 1998. As precipitation during the period was minimum, the velocities observed were less than 0.20 m/sec resulting in the maximum discharge of 31.8 cu.m/sec measured at Kalaklan River. Due to insignificant discharges from the rivers, no suspended sediments or wash-loads were identified in the absence of turbulent flows. The results of the discharge measurement are summarised in the Table below.

Table 6.1.5-1 Discharge at River Mouth

River Mouth	Average Flow (m/sec.)	Discharge (cu. m/sec.)
Kalaklan	0.20	31.8
Kalalake	0.04	8.0
Malawaan	0.08	5.1
Boton	0.16	3.6

6.1.6 Geotechnical Conditions

(1) General Soil Charcteristics

Sub-soils around Subic Bay are mostly volcanic origin of andesite, basalt and agglomerates supplemented by coralline materials from relatively fringing reefs. These soils are considered to be mainly generated by a volcanic mudflow in late tertiary of early quaternary periods, 10 to 12 million years ago. This mudflow containing andesite boulders was transported to the coastal area, where marine sand/silt materials form the overlying deposits. Mixture of the andesite and shallow marine materials through sedimentation and consolidation, eventually constitute a hard stratum of conglomerates and sand/silt stones.

(2) Soil Investigation in this Study

Quite a bit of borings and soil exploration have been carried out inside the Bay, particularly in vicinity of the existing port facilities, whereas only little information is available for the offshore areas outside the NSD zone.

The Study Team, considering this, conducted a series of soil investigations consisting of thirteen (13) offshore and two(2) on-land borings in the Bay. During these boring works, Standard Penetration Test (SPT) and disturbed/undisturbed sampling for laboratory tests were also conducted. All the samples taken were subjected to the laboratory tests for physical and mechanical properties, including gradation, specific gravity, consistency, e.g. Atterberg limits, undrained compressive strength and consolidation characteristics.

(3) Boring Logs

The boring logs are shown in Figures 6.1.6-1 to 6.1.6-6 and the general stratification at each location is briefly described hereunder.

1) BH-No.1 (Cubi Pt.)

Except for the seabed surface, the upper layers mostly consist of sandy soils of medium dense to loose condition. Below the depth of 8 m, silty or clayey materials become dominant until the bearing stratum of andesite. These cohesive soils are very stiff or hard, of which natural moisture content is less than the plastic limit. The SPT-N values below MLLW -15 m, i.e. about 12 m in depth, are well over 50 blows/ft.

2) BH-No.2 (Boton)

Below upper 2 m in depth are mostly cohesive soils of hard or stiff formation. Hard stratum was encountered at only 10 m deep, i.e., MLLW - 14m.

3) BH-No.3 (Bravo)

From 4 to 12 m deep is a silty sand layer of loose to medium dense condition, which SPT-N values are about 10 blows/ft. Cohesive layers continue thereunder until 42 m in depth, of which natural moisture content is in between the liquid limit and plastic limit. The SPT-N values for these layers scarcely exceed 10 blows/ft. The hard bearing stratum of sandy/gravelly soils or andesite is encountered at 42 m deep, i.e., MLLW -50m.

4) BH-No.4 (Alava)

Until 17 m in depth, most of the layers consist of sandy or silty soils, from loose to medium dense condition, which SPT-N values are almost less than 10 blows/ft. Cohesive soils, then continue to 35 m in depth, where SPT-N values are almost below 10 blows/ft other than very stiff or hard stratum existing at 22 to 25 m deep. Layers of silty soils and sand with fines exist further deep until the bearing stratum of andesite at 47 m deep, where SPT-N increases.

5) BH-No.5 (Matagan)

Upper 4 m from the seabed, silty sand deposit forms a very loose layer, which is susceptible to seismic liquefaction, for the gradation exhibits fairly uniform constitution of the particle sizes, as well as low SPT-N values less than 5 blows/ft. Cohesive silt materials continue thereunder until 11 m in depth, while the SPT-N values increases from 5 to 20 varying soft to firm condition. Deeper than 11 m, sandy soils or coralline limestones are dominant. SPT-N values increase along the depth, finally reaching more than 50 blows/ft at 23 m in depth.

6) BH-No.6 (Calapacuan)

Until 9 m in depth, sandy soil deposit shows variety of gradation and sedimentation, resulting in vaiety of SPT-N values within the layers. Lenses of very loose state are encountered at some elevations. From 12 to 18 m are layers of silty soils, classified as SC to SM, silty to clayey sand, which have an intermediate nature either of cohesionless or cohesive soils. The upper silty sand layers indicate relatively moderate SPT-N values of about 10 blows/ft, whereas the lower clayey sand layers fall under 5 blows/ft of SPT-N. Deeper than 19 m, increases SPT-N values along the depth from 10 to 15 blows/ft until the bearing stratum of very hard silty clay at 26 m in depth.

7) BH-No.7 (Cayuan)

Silty sand layers form upper sediment to 16 m in depth, where SPT-N values increase along the depth to 20 blows/ft. At 10 m deep exists a stiff to very stiff sandy silt layer, of which SPT-N value is about 15 blows/ft. Beneath the upper layers, low SPT-N values less than 5 blows/ft are recorded from 17 to 20 m in depth for two different deposits, i.e., poorly graded sand in very loose condition and very soft silty clay or clayey silt. Underlying are dense clayey sand and hard sandy silt layers, where SPT-N values recorded are well over 40 blows/ft. Deeper than 23 m, SPT-N values become more than 50 blows/ft.

8) BH-No.8 (Binictican South, on-land)

From the ground surface to a depth of 6 m, layers of clayey sand and clayey/silty sand in loose/soft deposits continue, where SPT-N values are less than 6 bls/ft. A silty clay layer of 6 m thick underlies from soft to stiff formation. Within this layer, the SPT-N increases along the depth from 0 to 11 bls/ft and natural moisture content decreases between liquid and plastic limit. Below this, layers of sandy soils such as silty/clayey or poorly graded sands deposit in medium dense state, wherein SPT-N also increases from 17 to 30 bls/ft. Bearing stratum of andesite appears at 19 m deep, whereon a very dense gravel of poorly graded is encountered in a thin layer.

9) BH-No.9 (Cubi Point, off-shore)

From the seabed surface to a depth of 9 m, layers of sand either poorly or well graded in medium dense to dense state exhibit SPT-N values from 13 to 22 bls/ft in the upper 6 m and more than 50 bls/ft thereafter. Within a stiff to very stiff clayey silt layer of 2 m thick below these sand deposits, SPT-N values drop to minimum 15 bls/ft. Poorly graded gravel in very dense state overlies the bearing stratum of andesite found at 12 m deep.

10) BH-No.10 (Binictican North, on-land)

The ground surface is covered with very loose sand. Up to 6 m deep, including the successive sandy silt layer, the SPT-N values are less than 5 bls/ft. SPT-N values, then change at each depth from 8 to 15 bls/ft in the following sand layers. Core of hard gravel and cobbles are encountered at 16.5 m deep.

11) BH-No.11 (Binictican South, off-shore)

The seabed surface is covered with a thin clayey sand layer. Soft slty clay deposits, of which natural moisture content are close to the liquid limit, form a relatively uniform layer, where SPT-N values are 7 bls/ft all along. Much softer clayey silt can be found thereunder, e.g. SPT-N values of 2 or 3 bls/ft. Layers of sand/gravels in medium dense state, between 20 to 28 bls/ft of SPT-N values, underlies the upper soft sediments in 5 to 6 m thick on a hard stratum of andesite at 15.5 m deep.

12) BH-No.12 (Binictican Center, off-shore)

A typical alluvial formation is demonstrated at this bore hole, where very thick soft silt/clay deposits continue deeper to the bearing stratum. It has been, however, recognised that these soft deposits have still low SPT-N values from 3 to 9 bls/ft, unlike mucky sediments without SPT-N resistance. The natural moisture content of these soft silts/clays never exceeds its liquid limit. The andesite appears at 33 m deep, whereon sand/gravel layers overly about 2 m thick.

13) BH-No.13 (Binictican North, off-shore)

The overall formation is similar to that of BH-No.12, other than an intermittent sand layer at 15 m deep. The andesite appears at 35 m deep overlain by a little stiffer silty clay layer.

14) Borehole BH-14 (Sattler Pier, off-shore)

This is another typical formation of alluvial deposits in coastal area. There are upper loose sand layers from the seabed to 4 m deep, followed by a thick layer of soft silty clay to a depth of 17 m. Blow these upper soft/loose sediments, medium to very dense sand deposits from 8 to 19 bls/ft of SPT-N values overly on the andesite stratum at 21 m deep.

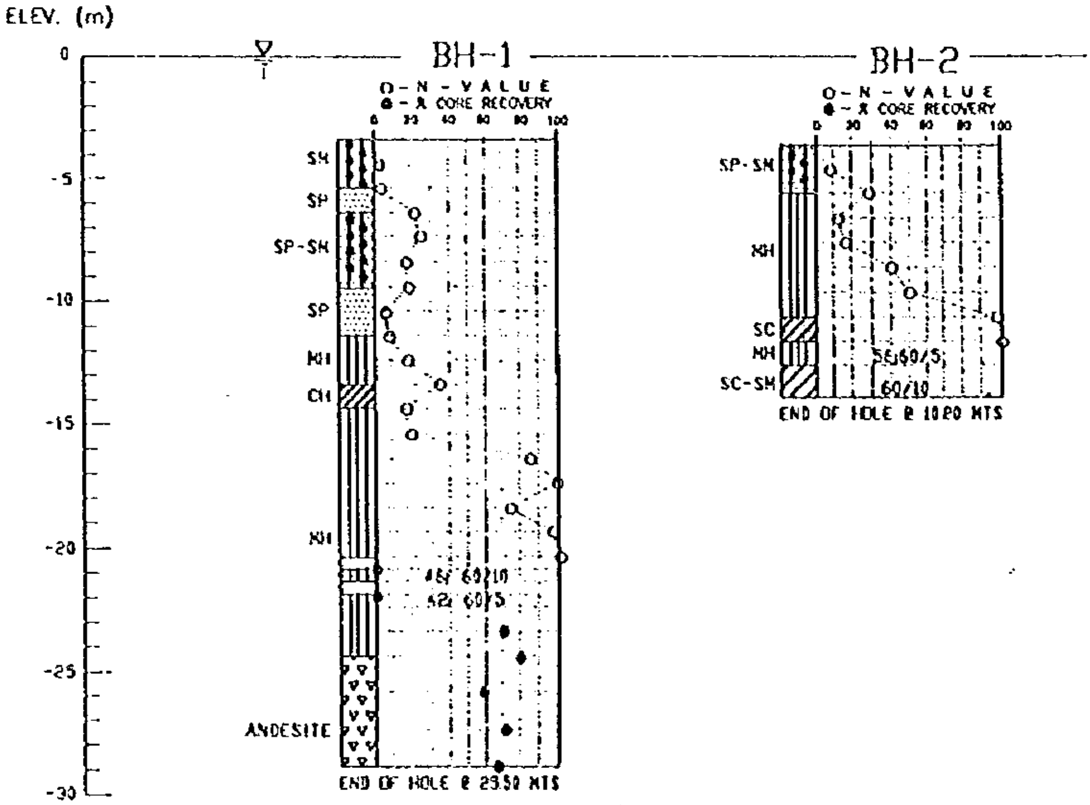
(4) Laboratory Test Results

All the results from soil investigations and laboratory tests have been summarised. As an example, the summary for BH-No.1 at Cubi Pt. is shown in Table 6.1.6-1and Figure 6.1.6-7.

1) Gradation Analysis

About 170 samples have been subjected to the gradation analysis. Based on these results, an assessment of seismic liquefaction was made as demonstrated as an example in Table 6.1.6-2 and Figure 6.1.6-8.

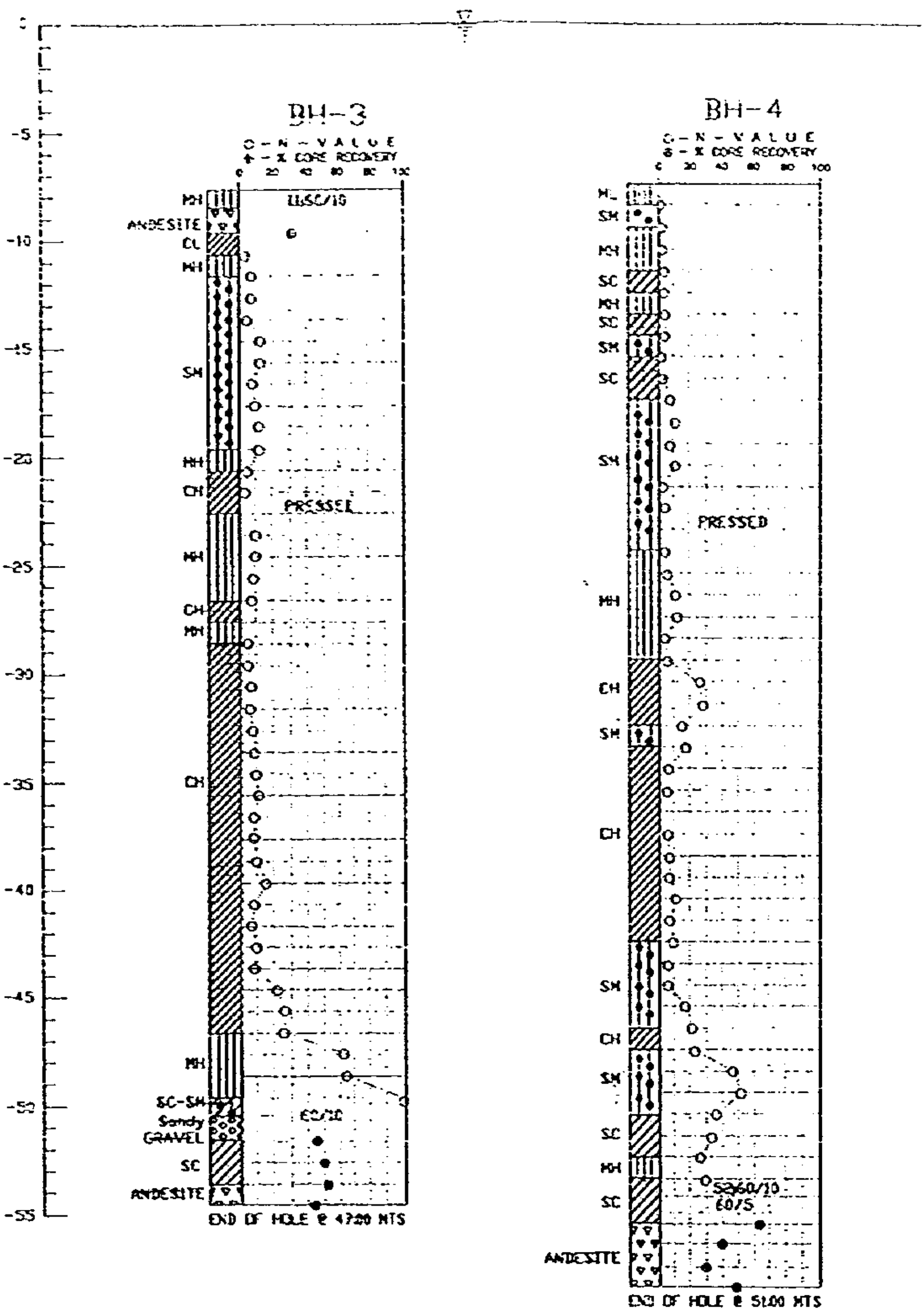
From the assessment, it has been confirmed that there are some sediments susceptible to exhibit liquefaction during large earthquakes. These liquefiable sediments are, however, generally found relatively shallower zone of the sub-soils. Accordingly, these sediments will not be a serious factor in structural design of the port facilities.



L E G E N D :

CH	-	Silty CLAY
MH	-	Clayey SILT
ML	-	Sandy SILT
SC	-	Clayey SAND
SM	-	Silty SAND
GP	-	Poorly graded GRAVEL
SC-SM	-	Clayey silty SAND
SP-SM	-	Poorly graded SAND with silt
GP-GM	-	Poorly graded GRAVEL with silt

Figure 6.1.5-1 Soil Profile (BH-1 & BH-2)



L E G E N D :

CH – Silty CLAY
MH – Clayey SILT
ML – Sandy SILT
SC – Clayey SAND
SM – Silty SAND
GP – Poorly graded GRAVEL
SC-SM – Clayey silty SAND
SP-SM – Poorly graded SAND with silt
GP-GM – Poorly graded GRAVEL with silt

Figure 6.1.5-2 Soil Profile (BH-3 & BH-4)

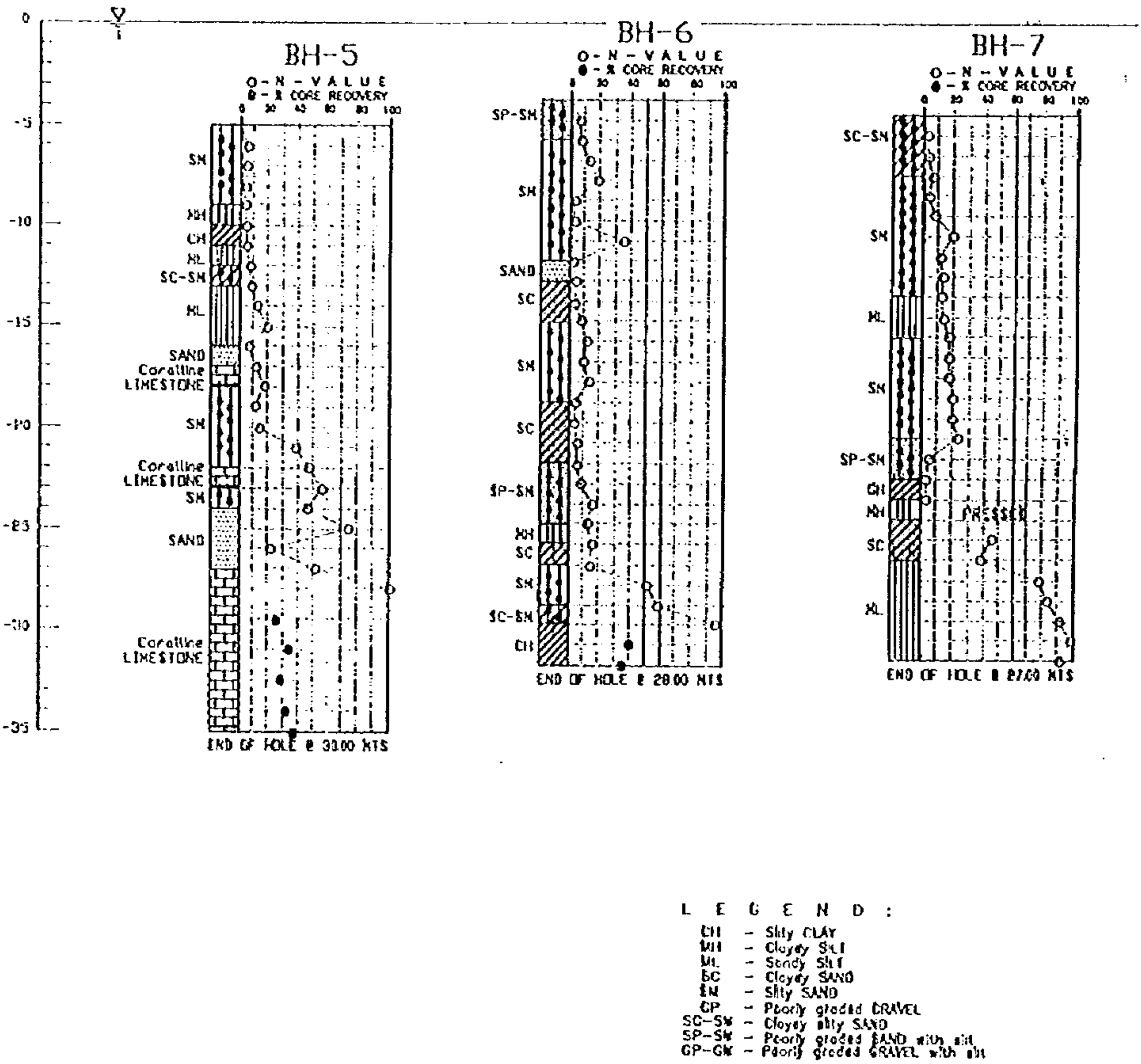
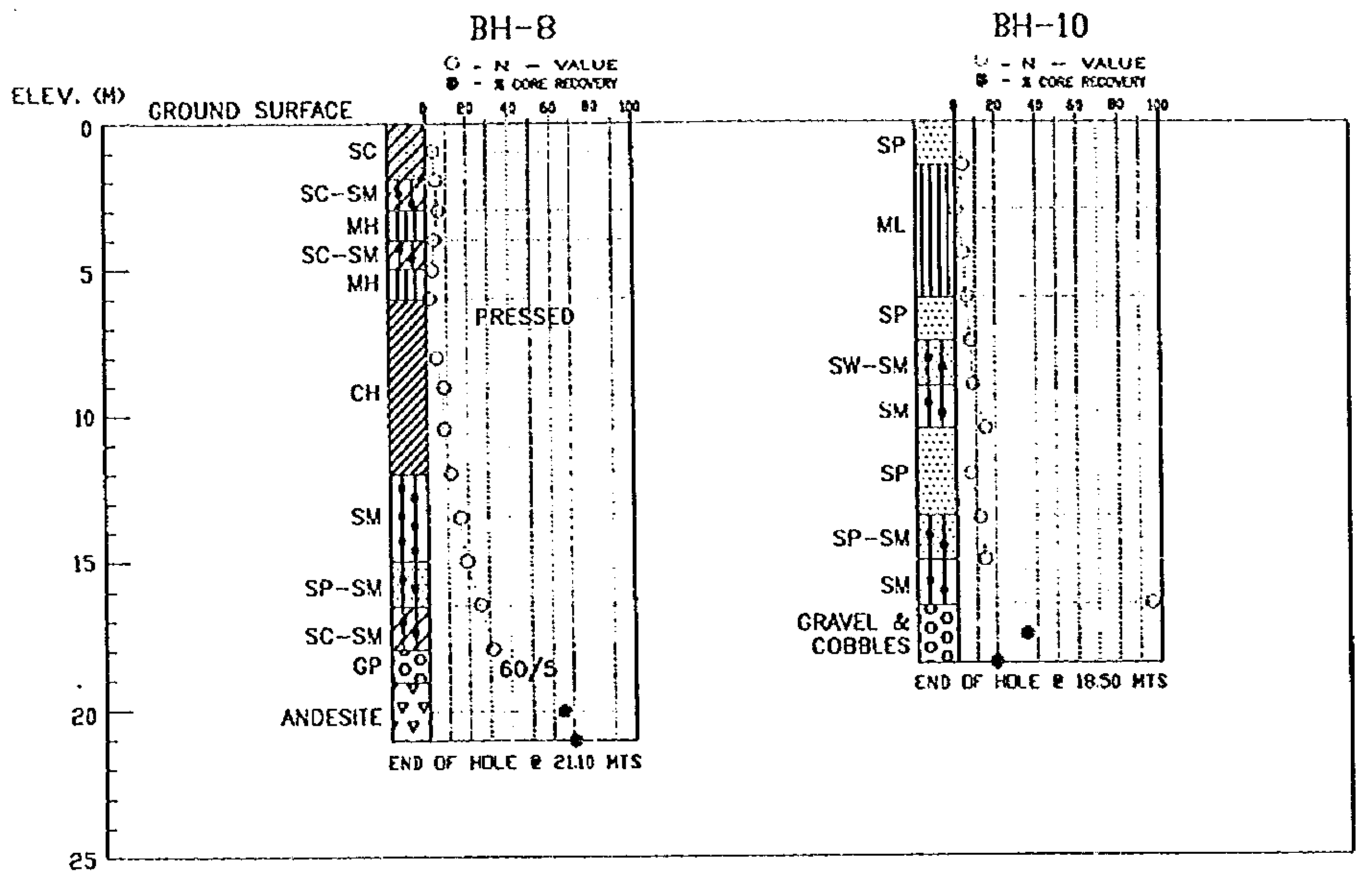


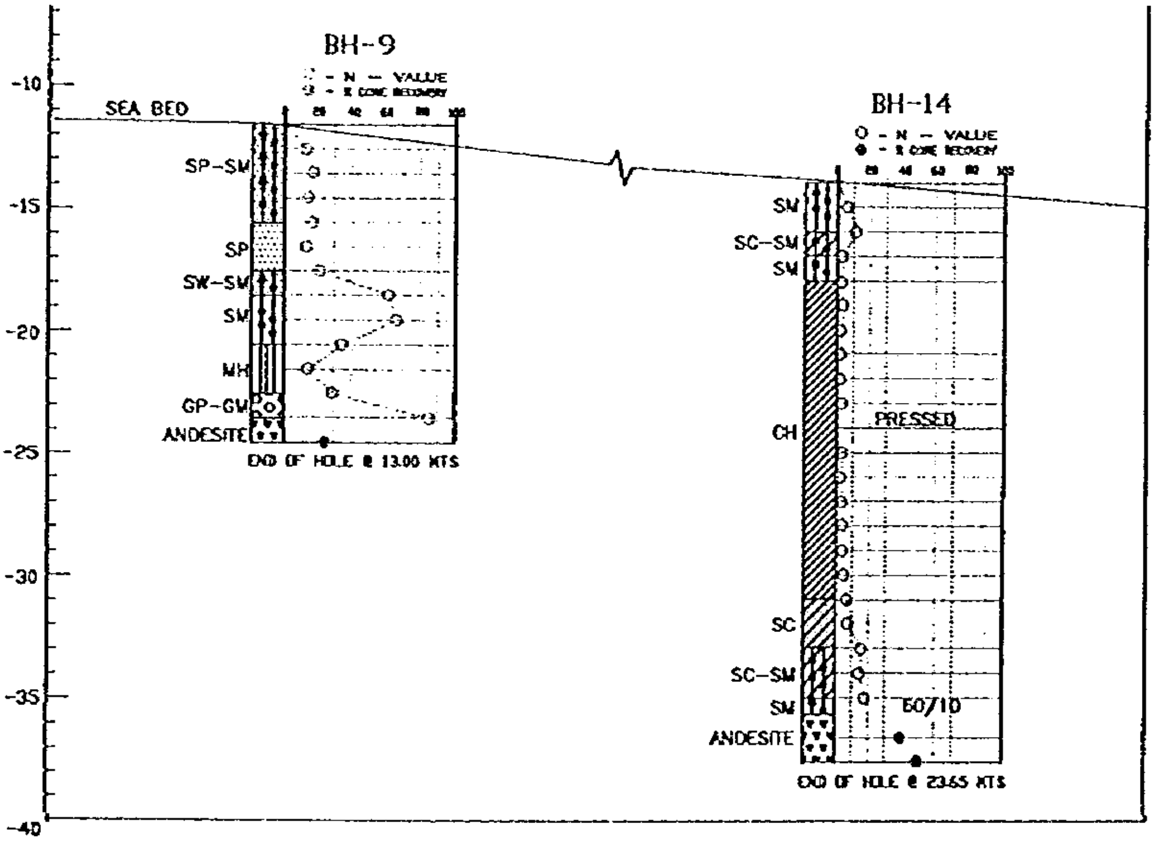
Figure 6.1.5-3 Soil Profile (BH-5, BH-6 & BH-7)



L E G E N D :

CH	-	Silty CLAY	SP	-	Poorly graded SAND
MH	-	Clayey SILT	SC	-	Clayey SAND
ML	-	Sandy SILT	GW	-	Well graded GRAVEL
SD	-	SANDSTONE	SW-SM	-	Well graded SAND with silt
SST	-	SILTSTONE	SP-SM	-	Poorly graded SAND with silt

Figure 6.1.5-4 Soil Profile (BH-8 & BH-10)



LEGEND:

CH	– Silty CLAY	GM	– Silty GRAVEL
CL	– Sandy CLAY	GP	– Poorly graded GRAVEL
MH	– Clayey SILT	SC-SM	– Clayey silty SAND
ML	– Sandy SILT	SP-SM	– Poorly graded SAND with silt
SC	– Clayey SAND	GP-GM	– Poorly graded GRAVEL with silt
SM	– Silty SAND	LMS	– LIMESTONE

Figure 6.1.5-5 Soil Profile (BH-9 & BH-14)

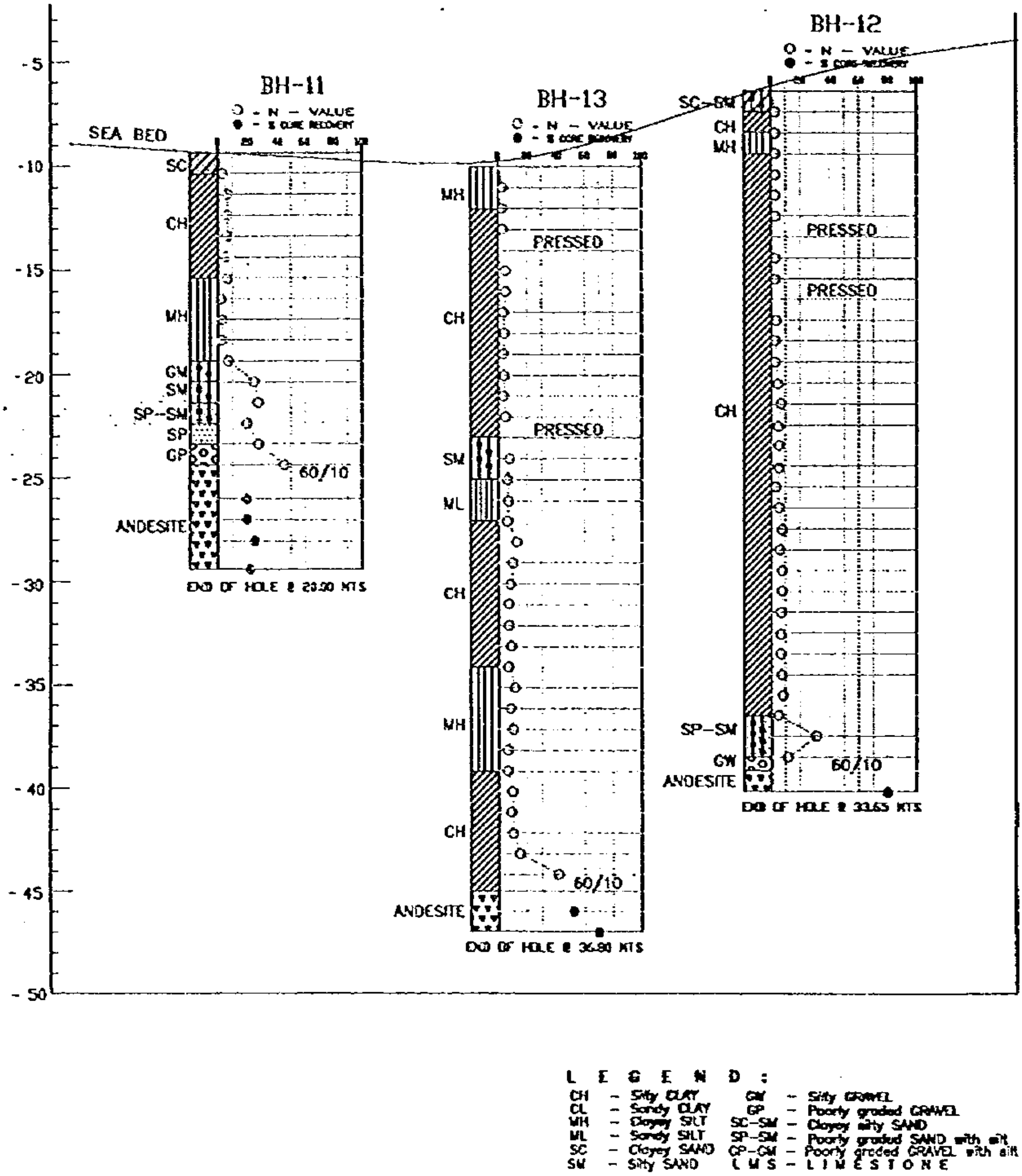


Figure 6.1.5-6 Soil Profile (BH-11, BH-13 & BH-12)

Table 6.1.5-1 Summary of Soil Investigation (BH-No.1, Cubi Pt.)

BORE HOLE No. 1 (Cubi Pt.)

ELEV. FROM MLLW (m)	DEPTH INTERVAL (m)	CLASSIFICATION	SPECIFIC GRAVITY Gs	Sample No.	NMC w (%)	LIQUID LIMIT LL (%)	PLASTICITY INDEX IP (%)	PLASTIC LIMIT PL (%)	SPT N VALUE (bl/ft)	Blows per 15 cm 1st	2nd	3rd
-3.35												
-4.35	1.00	SM	2.68	S-1	25				2	1	1	1
-5.35	2.00	SM							3	1	1	2
-6.35	3.00	SP	2.65	S-3					22	10	10	12
-7.35	4.00	SP-SM	2.65	S-4	24				25	9	10	15
-8.35	5.00	SP-SM							18	5	9	9
-9.35	6.00	SP-SM		S-6					19	6	9	10
-10.35	7.00	SP	2.65	S-7	23				6	4	4	2
-11.35	8.00	SP							8	3	3	5
-12.35	9.00	MH	2.70	S-9	26	62	30	32	19	6	6	13
-13.35	10.00	MH							33	10	15	18
-14.35	11.00	CH	2.70	S-11					18	15	8	10
-15.35	12.00	MH	2.70	S-12	23	52	21	31	20	12	9	11
-16.35	13.00	MH		S-13	26	60	28	32	85	10	28	57
-17.35	14.00	MH							99	20	39	60
-18.35	15.00	MH		S-15		56	25	31	74	18	34	40
-19.35	16.00	MH		S-16	22	58	26	32	97	21	39	58
-20.35	17.00	MH		S-17		50	20	30	100	22	40	60
-21.35	18.00	MH		S-18	23				226	13	46	180
-22.35	19.00	MH		S-19		54	22	32	402	14	42	360
-23.35	20.00	MH								Coring		
-24.35	21.00	MH								Coring		
-25.85	22.50	Andesite								Coring		
-27.35	24.00	Andesite								Coring		
-28.85	25.50	Andesite								Coring		

SIEVE ANALYSIS % PASSING, PARTICLE DIAMETER (mm)

ELEV. FROM MLLW (m)	25.0 (1)	19.0 (3/4)	9.5 (3/8)	4.75 (4)	2.0 (10)	0.85 (20)	0.42 (40)	0.25 (60)	0.106 (140)	0.074 (200)
-4.35	100	100	100	100	100	98	94	88	57	43
-5.35										
-6.35	100	100	100	98	70	34	7	5	4	4
-7.35	100	100	81	62	49	41	35	14	9	8
-8.35										
-9.35										
-10.35	100	100	97	95	63	27	7	5	4	3
-11.35										
-12.35	100	100	100	100	100	99	96	94	89	88
-13.35										
-14.35	100	100	100	100	100	99	96	93	87	86
-15.35	100	100	100	97	91	86	82	77	69	66
-16.35	100	100	100	100	99	96	94	91	85	83
-17.35										
-18.35	100	100	100	100	92	85	82	79	73	72
-19.35	100	100	100	100	98	93	89	85	75	73
-20.35	100	100	100	100	95	90	85	80	68	65
-21.35	100	100	100	97	93	87	81	76	63	60
-22.35	100	100	100	100	95	88	83	79	71	69

Hydrometer, PARTICLE DIAMETER (mm)

ELEV. FROM MLLW (m)	0.0732	0.0526	0.0382	0.0277	0.0201	0.0146	0.0105	0.0079	0.0057	0.0041	0.0030	0.0020
-12.35	87	84	78	73	67	61	55	49	44	38	30	20
-14.35	85	82	77	71	65	60	54	48	40	31	23	17
-15.35	65	62	58	53	48	43	38	34	29	22	14	10
-16.35	82	79	73	68	62	56	51	45	39	34	25	17
-18.35	71	69	64	59	54	48	43	38	33	28	20	13
-19.35	72	70	65	60	55	50	45	40	35	27	20	12
-20.35	64	62	57	53	48	44	39	35	30	23	16	12
-21.35	59	56	52	48	43	39	35	30	26	19	13	9
-22.35	68	65	61	56	51	46	41	37	32	24	17	12

Table 6.1.5-2 Assessment of Liquefaction (BH-No.1, Cubi Pt.)

Possibility of Liquefaction (BH No.1, Cubi Pt.)

ELEV. FROM MLLW (m) -3.35	DEPTH INTERVAL (m)	CLASSIFICATION	SPECIFIC GRAVITY Gs	Void Ratio e	Unit Weight γ (t/m3) from w data	assum.	Gradation: Grain Diameter (mm) D10	D30	D60	Uniform Coef. U=D60/D10	3.5<?	Gradation Curve Range
-4.35	1.00	SM	2.64	0.670	1.01	1.00		0.05	0.12	NA	U>3.5	A
-5.35	2.00	SM	2.64			1.00		0.05	0.12	NA	U>3.5	
-6.35	3.00	SP	2.65			1.00	0.05	0.08	1.5	18.75	U>3.5	Ds
-7.35	4.00	SP-SM	2.65	0.636	1.01	1.00	0.15	0.35	5	14.29	U>3.5	
-8.35	5.00	SP-SM	2.65			1.00	0.15	0.35	5	14.29	U>3.5	
-9.35	6.00	SP-SM	2.65			1.00	0.15	0.35	5	14.29	U>3.5	
-10.35	7.00	SP	2.65	0.610	1.03	1.05	0.5	0.9	1.9	2.11	U<3.5	Ds
-11.35	8.00	SP	2.65			1.05	0.5	0.9	1.9	2.11	U<3.5	
-12.35	9.00	MH	2.70	0.702	1.00	1.00	0.0015	0.003	0.012	4.00	U>3.5	
-13.35	10.00	MH	2.70			1.00	0.0015	0.003	0.012	4.00	U>3.5	
-14.35	11.00	CH	2.70			1.00	0.0012	0.0038	0.012	3.16	U<3.5	
-15.35	12.00	MH	2.70	0.567	1.08	1.10	0.0021	0.0062	0.048	7.74	U>3.5	
-16.35	13.00	MH	2.70	0.702	1.00	1.00	0.0013	0.004	0.015	3.75	U>3.5	
-17.35	14.00	MH	2.70			1.00	0.0013	0.004	0.015	3.75	U>3.5	
-18.35	15.00	MH	2.70			1.00	0.002	0.0046	0.027	5.87	U>3.5	
-19.35	16.00	MH	2.70	0.594	1.07	1.05	0.002	0.0046	0.027	5.87	U>3.5	
-20.35	17.00	MH	2.70			1.05	0.002	0.006	0.045	7.50	U>3.5	
-21.35	18.00	MH	2.70	0.621	1.05	1.05	0.0021	0.0073	0.023	10.0	U>3.5	
-22.35	19.00	MH	2.70			1.05	0.002	0.0052	0.04	7.69	U>3.5	
-23.35	20.00	MH	2.70			1.05	0.002	0.0052	0.04	7.69	U>3.5	
-24.35	21.00	MH	2.70			1.05	0.002	0.0052	0.04	7.69	U>3.5	
-25.85	22.50	Andesite	2.70			1.05						
-27.35	24.00	Andesite	2.70			1.05						
-28.85	25.50	Andesite	2.70			1.05						

ELEV. FROM MLLW (m)	Corrected N for Fine/Silty Sand N' (bl/ft): Correction	N'	Equivalent SPT-N: σ'v (kgf/cm2)	(N)0.66 (bl/ft)	Factor for Fine Content	Corrected (N)0.66	Equivalent Ground Acceleration (αmax 176.40): σv (kgf/cm2)	αeq (gal)	Critical Acceleration, A: I~II	II~III	III~IV	IIc/IIf: I~II	II~III	III~IV	Liquefaction Possibility Zone (I~IV)
-4.35	NA	2	0.10	3.89	0.50	1.95	0.20	243.76	43.11	27.81	18.91	Not IIc/IIf	Not IIc/IIf	Not IIc/IIf	I(A)
-5.35	NA	3	0.20	3.00	1.00	3.00	0.40	239.55	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-6.35	NA	22	0.30	26.46	1.00	26.46	0.60	235.85	Not A	Not A	Not A	3,618.12	2,274.10	1,584.93	IV(IIc/IIf)
-7.35	NA	25	0.40	25.00	1.00	25.00	0.80	232.14	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-8.35	NA	18	0.50	18.00	1.00	18.00	1.00	228.44	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-9.35	NA	19	0.60	19.00	1.00	19.00	1.20	224.73	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-10.35	NA	6	0.71	5.81	1.00	5.81	1.41	220.25	Not A	Not A	Not A	686.50	438.97	301.97	IV(IIc/IIf)
-11.35	NA	8	0.81	8.00	1.00	8.00	1.61	215.98	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-12.35	NA	19	0.91	19.00	1.00	19.00	1.81	212.46	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-13.35	NA	33	1.01	33.00	1.00	33.00	2.01	208.89	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-14.35	NA	18	1.11	18.00	1.00	18.00	2.21	205.29	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-15.35	NA	20	1.22	20.00	1.00	20.00	2.42	200.86	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-16.35	NA	85	1.32	85.00	1.00	85.00	2.62	197.31	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-17.35	NA	99	1.42	99.00	1.00	99.00	2.82	193.74	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-18.35	NA	74	1.52	74.00	1.00	74.00	3.02	190.15	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-19.35	NA	97	1.62	97.00	1.00	97.00	3.22	186.26	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-20.35	NA	100	1.73	100.00	1.00	100.00	3.43	182.40	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-21.35	NA	226	1.83	226.00	1.00	226.00	3.63	178.58	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-22.35	NA	402	1.94	402.00	1.00	402.00	3.84	174.77	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-23.35			2.04	50.00	1.00		4.04	170.98	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-24.35			2.15	50.00	1.00		4.25	167.21	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-25.85			2.31	50.00	1.00		4.56	161.59	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-27.35			2.46	50.00	1.00		4.86	155.98	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
-28.85			2.67	50.00	1.00		5.17	150.40	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Categories: I: Liquefaction; II: Liquefiable; III: Not Liquefiable; IV: No Liquefaction

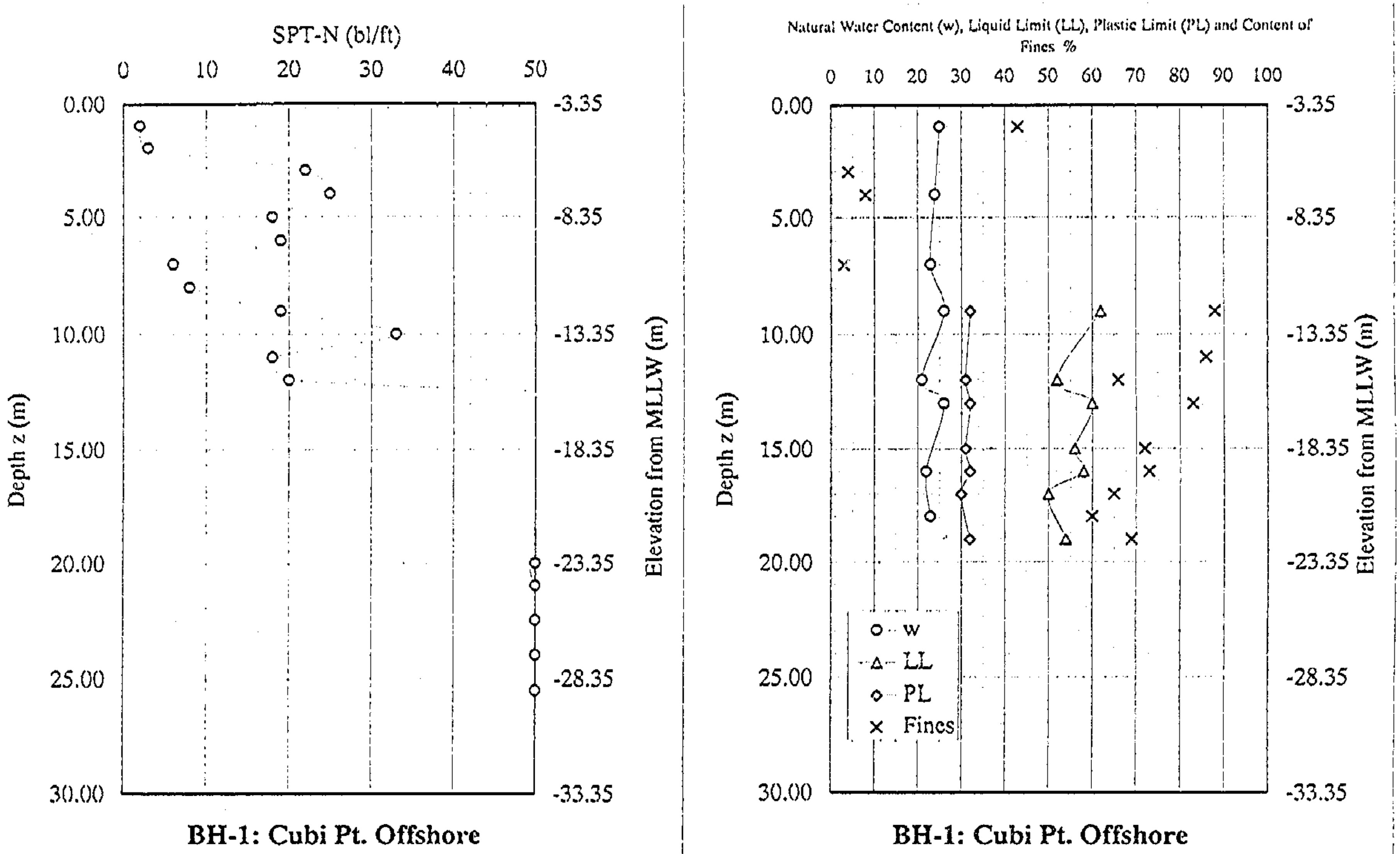
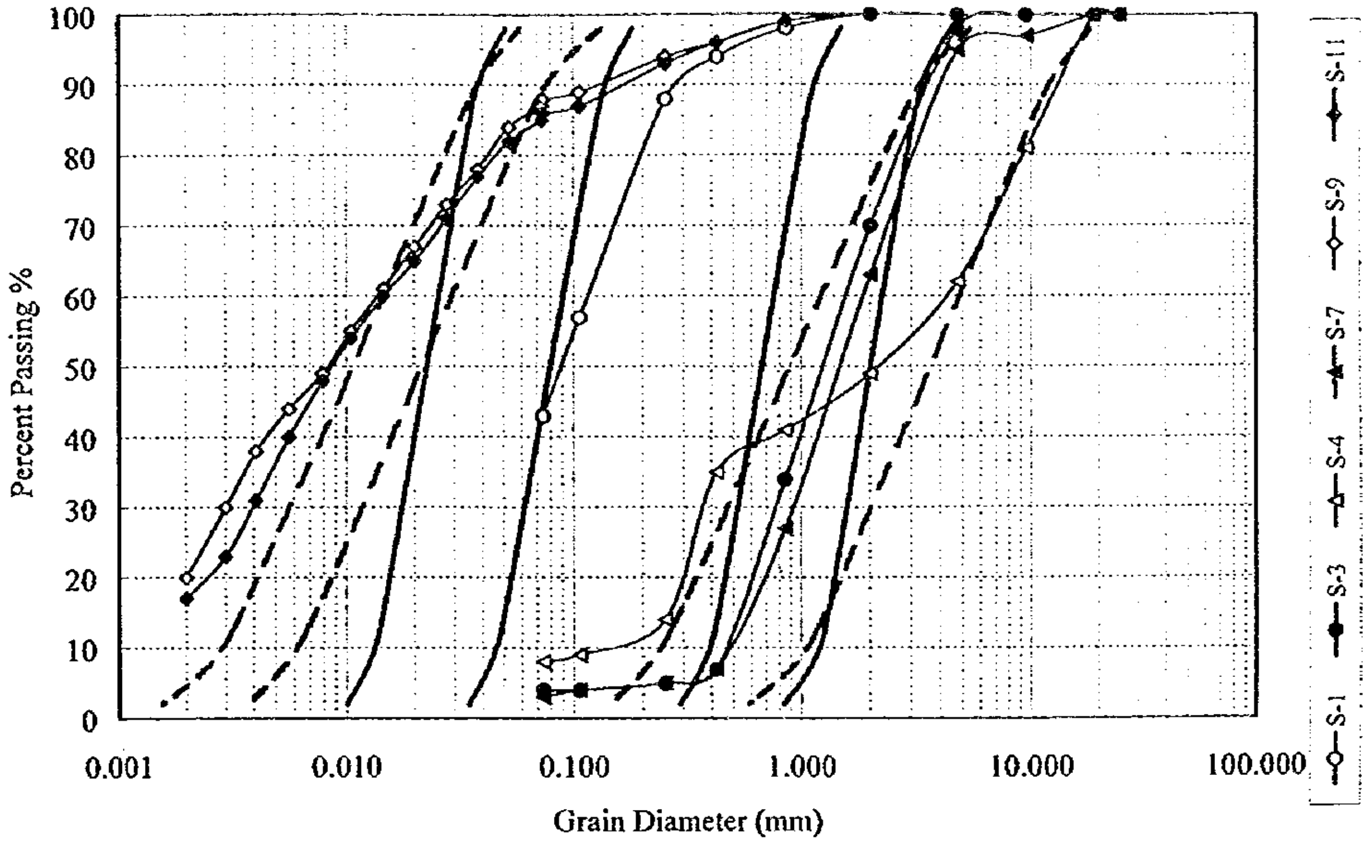


Figure 6.1.5-7 Summary of Soil Investigation (BH-No.1, Cubi Pt.)



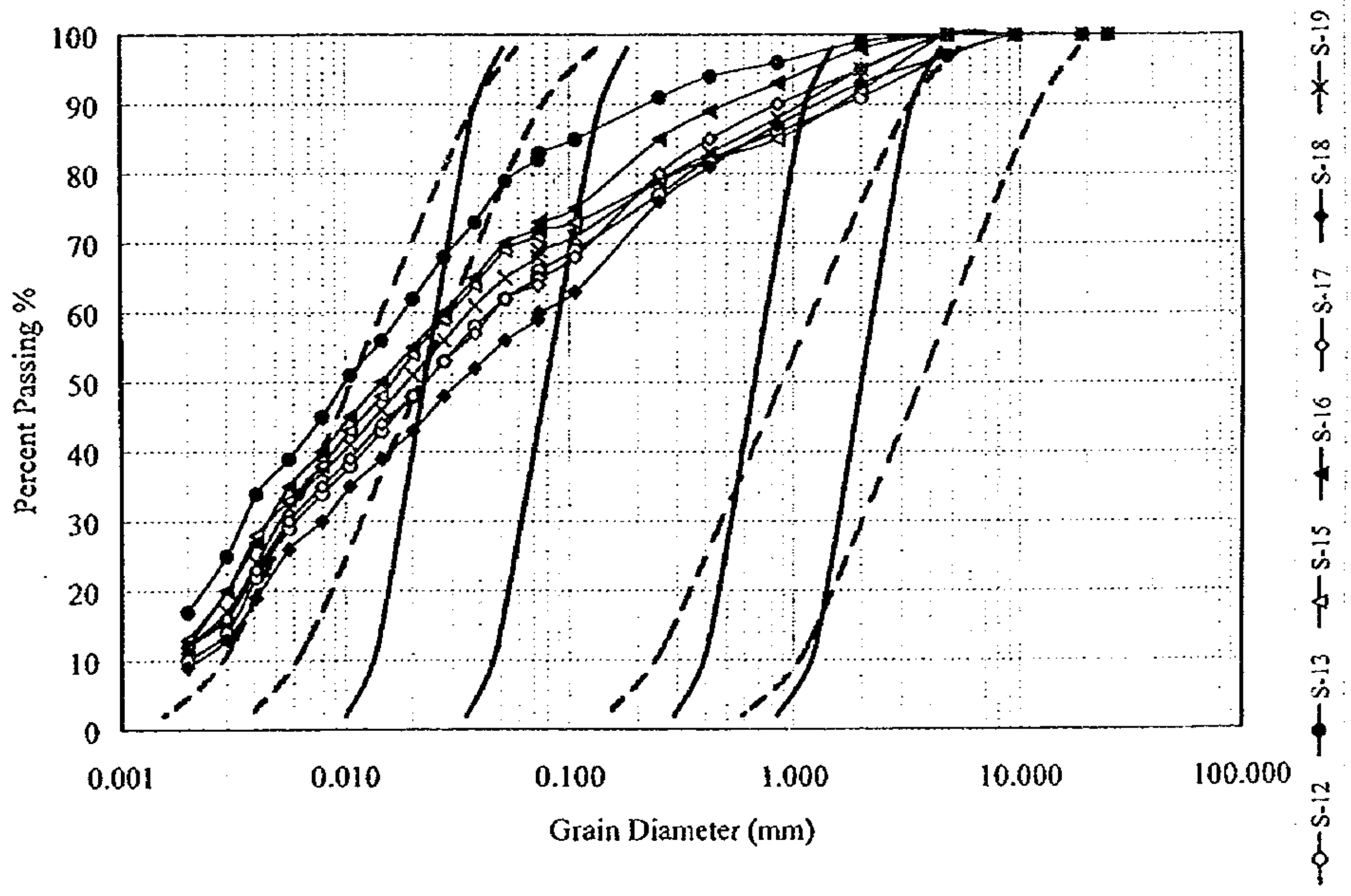


Figure 6.1.5-8 Gradation Curves (BH-No.1, Cubi Pt.)

2) Consolidation Test

Results of consolidation test are summarised in Table 6.1.6-3 below.

Table 6.1.6-3 Results of Consolidation Test

Sample	Initial Void Ratio : eo	Initial Unit Weight : γo (tf/m3)	Specific Gravity : Gs	Compression Index : Cc	Yielding Stress : py (kgf/cm2)
BH No.3 S-15	1.325	1.69	2.69	0.382	0.88
BH No.3 S-20	1.781	1.54	2.70	0.574	0.61
BH No.4 S16	1.018	1.54	2.58	0.315	3.3
BH No.4 S-29	1.501	1.69	2.76	0.518	2.2
BH No.7 S-20	1.473	1.69	2.70	0.331	0.6
BH-8/UDS-1	1.790	1.67	2.79	0.42	0.68
BH-12/S-7	1.933	1.57	2.75	0.57	0.84
BH-12/S-10	1.956	1.58	2.80	0.47	0.64
BH-13/S-13	1.856	1.55	2.81	0.51	1.1
BH-14/S-10	1.719	1.57	2.78	0.47	0.63

3) Unconfined Compression Test

Results of unconfined compression test are summarised in Table 6.1.6-4 below.

Table 6.1.6-4 Results of Unconfined Compression Test

Sample	Unit Weight : γo (tf/m3)	Strength : qu (kgf/cm2)	Strain at Failure : ε_f %	Remarks
BH No.3 S-2	2.50	986.5	1.43	Andesite Core
BH No.3 S-15	1.78	0.52	10.83	Silty Clay
BH No.4 S-29	1.72	1.17	6.33	Silty Clay
BH-No.8 UDS-1	1.66	0.03	10.42	Silty Clay
BH-No.12 S-7	1.58	0.37	8.83	Silty Clay
BH-No.12 S-10	1.65	0.14	11.67	Silty Clay
BHNo.-13 S-4	1.66	0.36	10.42	Silty Clay
BH-No.13 S-13	1.58	0.21	10.00	Silty Clay
BH-14 UDS-10	1.65	0.35	8.83	Silty Clay

(5) Seabed Soil Sampling

Seabed soil samples were collected at 26 points in the Subic Bay and gradation analysis of the samples were conducted to assess not only anchor holding capacity, but also possible siltation/littoral drift depending on soil types.

Results of the test are summarised in the following Table 6.1.6-3.

Table 6.1.6-3 Results of Gradation Analysis for Seabed Samples

Sample No.	Designation	D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	Uc	Uc'
S-1	Fine to coarse SAND	0.13	0.285	0.36	2.77	1.736
S-2	Fine to coarse SAND	0.175	0.35	0.61	3.49	1.148
S-3	Fine sandy SILT	0.0023	0.0079	0.13	56.52	0.209
S-4	Fine sandy SILT	0.0013	0.0047	0.029	22.31	0.586
S-5	Fine sandy SILT	0.0017	0.0066	0.0732	43.06	0.350
S-6	SILT	0.0022	0.0079	0.082	37.27	0.346
S-7	SILT	0.0032	0.012	0.165	51.56	0.273
S-8	Fine sandy SILT	0.001	0.003	0.0105	10.50	0.857
S-9	Fine sandy SILT	0.001	0.0033	0.014	14.00	0.778
S-10	Fine sandy SILT	0.001	0.0046	0.03	10.50	0.857
S-11	Fine to coarse SAND	0.22	0.32	0.45	2.05	1.034
S-12	Fine sandy SILT	0.001	0.0024	0.0086	8.60	0.670
S-13	Fine to coarse SAND	0.25	0.42	0.62	2.48	1.138
S-14	Clayey SAND	0.0074	0.035	0.18	24.32	0.920
S-15	SILT	0.001	0.003	0.01	10.0	0.900
S-16	SILT	0.001	0.0024	0.01	10.0	0.576
S-17	Silty SAND	0.001	0.0032	0.015	15.0	0.683
S-18	Fine to coarse SAND	0.25	0.42	0.64	2.56	1.103
S-19	Fine to coarse SAND	0.0146	0.19	0.76	52.05	3.253
S-20	SILT	0.0146	0.19	0.76	52.05	3.253
S-21	Fine to coarse SAND	0.05	0.15	0.25	5.00	1.800
S-22	Fine to medium SAND	0.145	0.37	0.64	4.41	1.475
S-23	SILT	0.001	0.0027	0.013	13.00	0.561
S-24	Fine SAND	0.0201	0.25	0.62	30.85	5.015
S-25	Fine to medium SAND	0.146	0.135	0.25	1.71	0.499
S-26	Fine to coarse SAND	0.0054	0.025	0.185	34.26	0.626

* $Uc=D_{60}/D_{10}$, $Uc'=D_{30}^2/(D_{10}D_{60})$

As can be seen in the table above, on the coast from the Boton Wharf to the mouth of the Kalaklan River through POL Pier, Bravo, Rivera, and Alava Wharves, seabed is covered with silt or silty soils. Near the estuary of main rivers, the same sediment is supposed to be originated from "the Lahar", transported by discharge of the rivers.

In conclusion, sandy seabed is mostly found along the coast except for the estuaries, river mouth or outlet, where silt or silty soils forms the seabed surface.

6.1.7 Seismology

Subic Bay is located near the Manila Trench lying west of the Luzon Island, characterised by the North Luzon Ridge and North Luzon Trough forming a focal mechanism of strike-slip type. There are some active faults generating earthquakes such as Cagayan, Digdig, and Lubang faults. Accordingly, the PPA manual categorised the area in the seismic zone of 3, where regional seismic coefficient is 0.15, the largest in the criteria.

The port facilities originally designed and constructed by US Navy were generally considered 10 % of dead load and 200 PSF (0.98 tf/m2) for seismic loading, which may result in a little lower lateral forces than the above.

6.1.8 Record of Natural Disasters

(1) Great Eruption of Mt. Pinatubo, June 15, 1991

Early in the afternoon of June 15, 1991, darkness covered the Subic Naval Complex as ash from a massive explosion of the Mt. Pinatubo filled the air. Continuing into the night, more than 15 cm of ash/sand fell mixed in the rains of tropical storm. Lightening, numerous earthquakes, total darkness and continuous ash/sand fallout created a doomsday environment.

During the night, numerous facilities collapsed due to the weight of ash/sand/water. However, the loss of life was minimized. According to the damage assessment of US Navy facilities and infrastructures, the cost to restore the base to its former condition was estimated to be $369 Million. A significant portion of the restoration cost was associated with the clean-up and removal of the ash on vehicles, equipment, utilities systems, buildings, drainage structures and roadways/runways. It was estimated that approximately $119 Million would be required to clean-up ash alone.

Numerous earthquakes have been experienced since the Great Eruption. Although no destructive damage has been reported to permanent facilities, numerous buildings have experienced minor cracking. Further damage to some buildings which previously damaged and stressed by the heavy ash/sand loads has occurred due to earthquake activity.

(2) Earthquakes of Baguio, June 1990

No significant damages had occurred in the Subic Bay Feeport area during the Earthquakes of Baguio.

(3) Tsunamis (Tidal Waves)

Tsunamis are not normally experienced on the west coast of the Philippines.

(4) Inundation

There are no areas subject to significant flooding in the Subic Bay Freeport Secured Area. The extensive system of rivers indicates an well-developed natural drainage that evolved with the area's heavy rainfall.

6.1.9 Sources of Reclamation Material

As a part of the natural condition surveys, source of materials for the possible reclamation/fill work has been searched in the surrounding.

Within SBMA, a quarry site at Mt.Maritan behind the POL Pier has supplied filling and aggregate materials for construction. The quarry is currently operated by a private firm and is said to have more than one million cubic meters of its reserve. This site will be an appropriate quarry site for the port development in this study.

In addition to the above on-land quarry site, there are some shoals in Subic Bay, where good reclamation materials are obtainable. Both Caiman and Carasco Shoals near Cubi Pt. will be used for such sources by dredging.

There are some other possible quarry sites in Redondo Peninsula, Agusuhin Pt. for example. It is, however, understood that these sites have not been used as quarries and will require basic provision of the facilities for operation.

Locations of these possible sources of the reclamation/fill materials are shown in Figure 6.1.9-1.

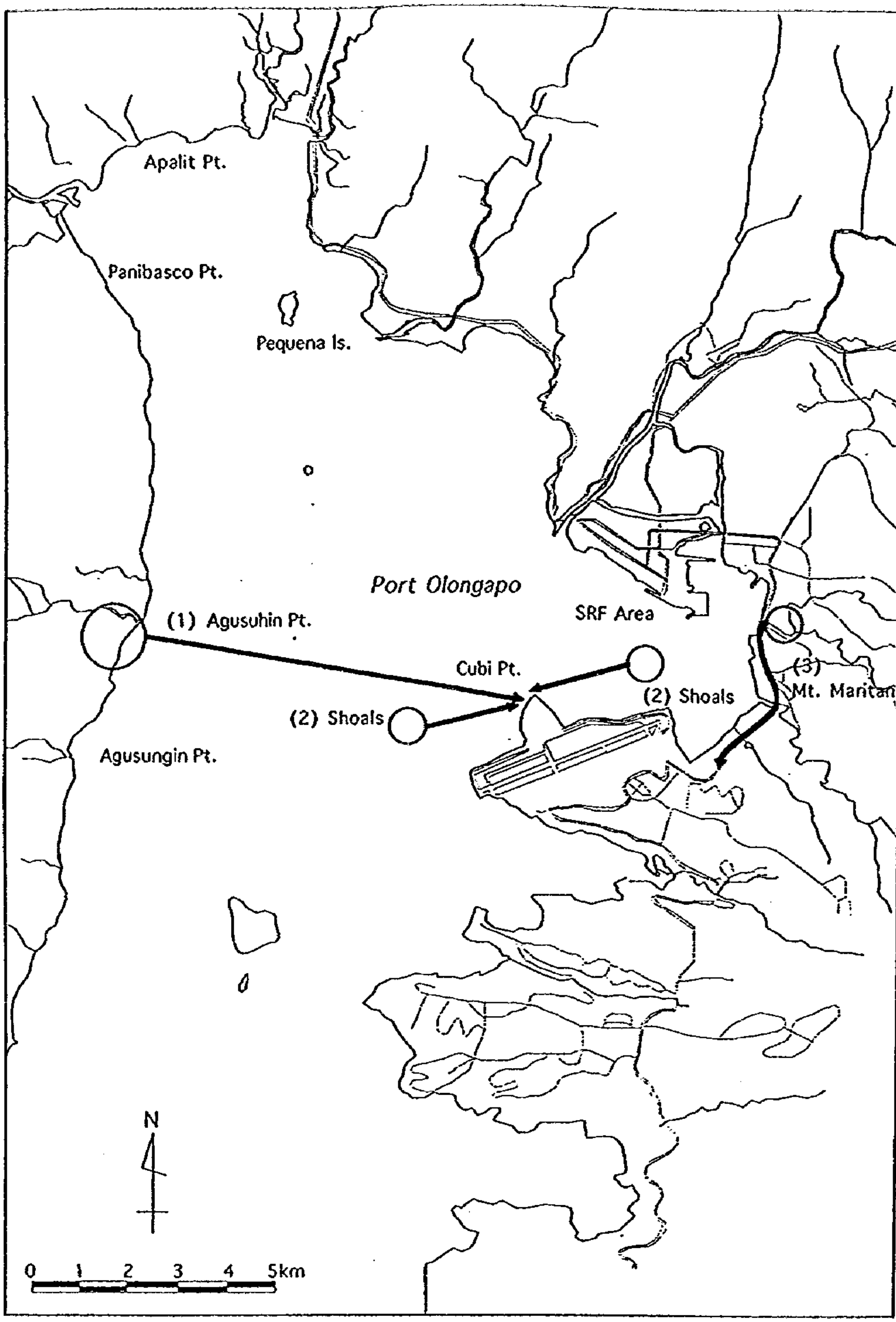


Figure 6.1.9-1 Possible Quarry/Sand Sites for Reclamation