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## **PART 2 MASTER PLAN FOR SANITATION IMPROVEMENT FOR THE STUDY AREA**

### **I. FRAMEWORK AND OUTLINE OF THE SANITATION MASTER PLAN**

#### **1.1 Necessity and Concept for the Formulation of the Sanitation Master Plan**

##### **1.1.1 Necessity of the Sanitation Master Plan**

Haiphong City is one of the most important cities in Vietnam with the third largest population. Recently, increases in the population and economic growth have increased various forms of pollution and environmental quality, including surface water quality, has been degraded. Due to the peculiarity of the city as a low lying and flat delta area, flooding occurs almost every year due to the inadequate drainage system. The collection and disposal capacity of the solid waste system will soon be exhausted, endangering the sanitary condition of the residents. Although some sanitation plans have been prepared, and some of these have been implemented they are limited in area and scale.

A long-term sanitation improvement plan should be prepared for the improvement of the sectors of water supply, drainage, sewerage and solid waste management as well as the surface water improvement in Haiphong City. Institutional and organizational plans and recommendations should be made to support the improvement of facilities and systems. Among the formulated projects/measures, priority projects should be selected for short-term implementation and a F/S should be carried out to formulate detailed contents.

The Sanitation Master Plan for Haiphong City (SMP) is, therefore, needed and will be worked out in this JICA Study in cooperation with HPPC.

##### **1.1.2 Concept of the Sanitation Master Plan**

In principle, the formulation process for a Sanitation Master Plan comprises:

- grasping the current conditions and problems
- predicting future degradation
- working out alleviation measures and improvement plans together with cost estimates and implementation schedules

More specifically, the formulating procedure for the current SMP is as given hereunder:

- Determination of the Study Scope

- Collection of data, information, carrying out field surveys/analyses, interviews, discussion with the cooperation by HPPC and other concerned organizations, etc.
- Grasping the Current Conditions
- Setting the Future Macro-frame
- Consultation with the Authorized Plans & Coordination with the Relevant Plans
- SMP Formulation
  - Classification of the Study Area based on
  - Basic direction/strategy by classified area and determination of the depth of study required in the Study
  - Sanitation improvement plans by sector (facility/system plans)
  - Sanitation improvement plans (Institutional measures)
- Selection of the Priority Projects
- Financial Requirement, Implementation Schedule and Affordability for Implementation
- Assessment of Improvement of Sanitation Condition to be Achieved by SMP
- Carrying out F/S on the Selected Priority Projects
  - 3 Priority Projects: Drainage, Sewerage, Solid Waste Management
  - Facility/system plans, cost estimate, implementation plan, project evaluation
- Implementation of Pilot/Demonstration Project

## **1.2 Macro-Frame for the Sanitation Master Plan**

### **1.2.1 Population Flame for the Study Area**

The population of Haiphong City is expected to increase to about 2.1 million in the year 2020 from the current 1.7 million, about a 1.12 % increase per year on average.

The population of the Effective Study Area will increase to 892 thousand in 2020 from 659 thousand in 1999 or accounting for about 42 % of the future city population.

## Population Flame for the Study Area set by the JICA Study Team

	1999 (persons)	2005 (persons)	2010 (persons)	2015 (persons)	2020 (persons)	Area (km <sup>2</sup> )
<b>Study area</b>						
1. Hong Bang Dist.	97,565	103,715	108,796	113,844	118,861	15.20
2. Ngo Quyen Dist.	171,623	177,017	181,890	186,765	191,642	12.24
3. Le Chan Dist.	146,204	151,036	155,327	159,616	163,904	4.42
4. Kien An Dist.	73,001	82,594	90,432	98,269	106,107	26.70
5. Do Son Town	30,560	33,580	36,262	38,944	41,626	39.50
6. Quan Toan	4,161	4,994	5,827	6,410	6,993	5.00
7. Minh Duc	19,197	22,806	26,158	29,908	33,658	15.62
8. Dinh Vu						11.52
9. New Development Area	12,280	17,237	21,216	25,197	29,179	22.13
SA total	554,591	592,978	625,908	658,954	691,969	152.33
<b>Augmented area</b>						
South of Hong Bang						
Nam Son Com.	6,288	7,417	8,546	9,674	10,803	3.99
An Dong Com.	14,608	17,440	20,076	22,371	24,654	6.77
South of Hong Bang Total	20,896	24,856	28,621	32,045	35,457	10.76
South of Le Chan						
Du Hang Kenh Com.	22,801	28,739	34,046	38,776	43,473	2.69
Vinh Niem Com.	11,102	15,543	19,984	24,424	28,865	5.63
South of Le Chan Total	33,903	44,282	54,029	63,200	72,339	8.32
Southeast of the City						
Dong Hai Com.	16,180	19,604	22,749	25,508	28,251	9.52
Dang Lam Com.	10,115	13,150	16,184	19,219	23,265	4.62
Dang Hai Com.	7,522	9,403	11,283	13,164	15,044	2.98
Nam Hai Com.	7,543	9,429	11,315	13,200	15,086	5.74
Trang Cat Com.	7,971	8,755	9,598	10,277	10,955	14.94
Southeast of the City Total	49,331	60,340	71,128	81,367	92,601	37.80
Augmented Area Total	104,130	129,478	153,779	176,612	200,397	56.88
<b>Effective Study Area Total</b>	<b>658,721</b>	<b>722,456</b>	<b>779,686</b>	<b>835,566</b>	<b>892,366</b>	<b>209.21</b>
<b>Hai Phong City</b>	<b>1,677,465</b>	<b>1,797,542</b>	<b>1,909,322</b>	<b>2,015,649</b>	<b>2,120,692</b>	<b>1,507.66</b>

### 1.2.2 Economic Frame for the Study Area

The 2 growth scenarios envisaged by HPPC and 2 short-term GDP projections by the World Bank for Vietnam are considered, with adjustment of the latter to be applicable to Haiphong city. Consequently, until 2010 medium growth rate among the rates assumed in the above projections has been adopted. After 2010 it is assumed in the Study for the purpose of formulating an economic frame for the JICA Sanitation Master Plan, that the growth pace will be lowered to an annual growth rate of 5 %. The assumed growth pace is given hereunder. HPPC Expenditure is assumed to grow at the same rate as GRP of the city.

#### GRP Growth Rate, Haiphong City and Study Area: Years 2001 - 2020

	Unit	2001-2005	2006-2010	2011-2020
GRP Growth Rate Total Haiphong	%	6.8	9.3	5
GRP Growth Rate Study Area	%	7.7	10.9	5

The value of the GRPs for Haiphong City and the Study Area and HPPC expenditure are given below.

#### Projected GRP Values for Haiphong City and Study Area

million US\$, In 2000 constant price

	1998	2000	2005	2010	2020
GRP Total Haiphong	605	654	908	1419	2312
GRP Study Area	367	397	574	964	1568
HPPC Expenditure	55	59	82	128	208

Projections of the above aggregate GRP data are presented below in per capita terms as well as in terms of disposable income.

#### Projected Per Capita GRP and Disposable Income, Haiphong City and Study Area: Average Scenario: Years 2005, 2010, 2020

US\$, In 2000 constant price

	2005	2010	2020
Per Capita GRP Total Haiphong	505	743	1090
Per Capita GRP Study Area	968	1540	2266
Disp. Inc. Haiphong	253	371	545
Disp. Inc. Study Area	484	770	1133

It is assumed that the Per Capita GRP for the Effective Study Area is equal to the Study Area. The value of GRP for the Effective Study Area is given below.

#### GRP Values for Effective Study Area

million US\$, In 2000 constant price

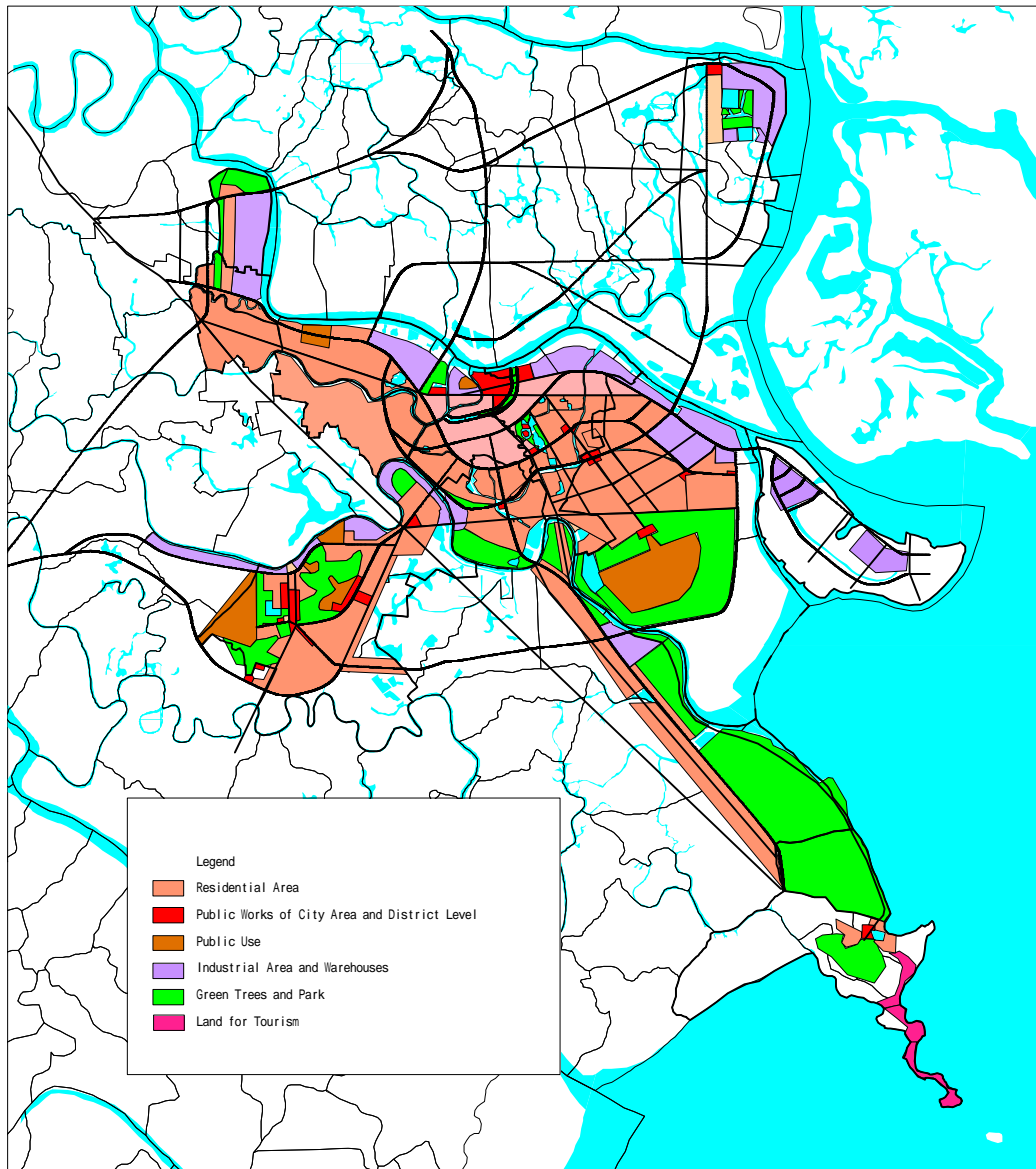
	2005	2010	2020
GRP Effective Study Area	699	1201	2022

### 1.2.3 Future Land Use and Zoning

The future land use plan was prepared based on the amended Haiphong City Master plan with some adjustments considering the followings:

- Smaller population for the city is assumed in the Study than the amended Master Plan and therefore the development area is reduced
- Population inflow into the new urban area is assumed to be from the three central urban districts
- Considering the development achievements to date, and downward revision envisaged by HPPC, the future industrial zone development is reduced

Future Land Use Plan for 2020



The Study Area is classified into 3 categories in consideration of the following:

- Population density, and the expansion trend of the urban area
- The direction of development envisaged in the amended Master Plan and Land Use Plan for the Study

Zone A

- Areas where there is already a high population density
- Population density is higher than 40 pers/ha, including Three Urban Districts

Zone B

- The area where urbanization has been rapidly proceeding in recent years
- High growth area, including Kien An, Do Son and Quan Toan

Zone C

- The area outside of Zones A and B, including Minh Duc, Dinh Vu and New Development Area

In order to facilitate planning for water supply, drainage and sewerage, the above zoning is adjusted to three phased planning areas, i.e., Class A, B and C area, based on the following considerations:

- Needs for improvement
- Topographical and administrative boundaries
- Existing facilities (treatment plant, water supply and sewerage network, etc.)
- Existing plans and projects

Top priority is placed on Class A area for earliest implementation, being followed by Class B and Class C area.

### **1.3 Outline of the Sanitation Master Plan**

The Sanitation Master Plan consists of five sectors for the target year 2020. These are:

- Water Supply
- Drainage
- Sewerage
- Water Quality Improvement for Lakes and Channels
- Solid Waste Management

Brief outline is given in the following and the details are given in subsequent parts.

### 1.3.1 Water Supply

The targets of the water supply plan are to: i) cover entire Study Area by basic water supply network by 2020, ii) meet the peak demand in 2020, iii) satisfy water quality targets and Vietnamese domestic water standard, and iv) reduce Non-Revenue Water to 20 % of the total production by 2020.

World Bank/FINNIDA 1A and 2A Projects consist of the major parts of the plan.

The salient features of the water supply improvement plan are given below:

- Service area in 2020 approx. 195 km<sup>2</sup>
- Service population in 2020 794,000
- Total water supplied in 2020 197,400 m<sup>3</sup>/d
- Unit domestic consumption in 2020 130 lcpd
- Non-revenue water in 2020 20 %
- Service coverage in 2020
 

Hong Bang	100 %
Le Chan	100 %
Ngo Quyen	99 %
Kien An	84 %
Do Son	90 %
Quan Toan	40 %
Minh Duc	9 %
New Development Area	65 %
Augmented Area	95 %
Dinh Vu	N/A
- New intake and WTP  
Hoa Binh intake/WTP
- Rehabilitation of intake and WTP  
Cau Nguyet WTP  
Vat Cach WTP  
Do Son WTP  
Quan Vinh intake
- New transmission mains  
City Center, Vat Cach-Quan Toan,  
Do Son, other
- Improvement of distribution network all area
- Total Capital Cost US\$ 62.7 million
- Implementation period 2001-2020

### 1.3.2 Drainage

Target of the drainage improvement plan is to reduce flood occurrence in the Study Area. For Class A area, this is achieved by integrating three drainage catchments namely, Southwest, Northeast and An Kim Hai, and by increasing storage capacity by rehabilitating channels and constructing new sewers and lakes. For Class B area, this is achieved by constructing and rehabilitating new sewers, rehabilitating tidal gates and constructing new channels.

The salient features of the drainage improvement plan is given below.

#### Class A Area, short term up to year 2010

- Area 1103 ha
- Population 240,000 (in 2010)
- Rehabilitation of existing sewer 170 km
- Construction of new sewer 7.6 km
- Rehabilitation of channels Southwest and Northeast channels
- Rehabilitation of lakes 4 nos.
- Rehabilitation of tidal gates 6 nos.
- Pumping stations 2 nos.
- Rehabilitation of existing channel An Kim Hai Channel, 10 km
- Construction of new channel 500 m
- Channel maintenance road 21 km
- Demolition of tidal gate One at Cam River
- Construction of tidal gate Two, at Cam River and Lac Tray River
- Discharge gate One at Du Hang
- Phoung Luu site development 28 ha
- Phoung Luu Lake construction 24 ha
- Road from Road No. 5 to lake site 400m
- Box culvert 450m
- Implementation Period 2001 to 2009

#### Class A Area, long term up to year 2020

- Area 5241 ha
- Population 575,000 (in 2020)
- Construction of storage lake 2 nos., 51 ha
- Rehabilitation of storage lake 3 nos.
- Rehabilitation of channels 5.5 km
- Pumping stations 8 nos.
- Retarding basin 2 nos.



- Tidal gates 9 nos.
- New pipes 87 km
- Box sewers 300m
- Implementation Period 2011 to 2020

#### Kien An (Class B)

- Area 2670 ha
- Population 106,000 (in 2020)
- Rehabilitation of sewer 10 km
- New pipes 17 km
- Construction of channel 5 km
- Rehabilitation of tidal gates 7 nos.
- Implementation Period 2011 to 2020

Total Capital Cost for Drainage Improvement Plan: US\$ 238.6 million

### 1.3.3 Sewerage

Sewerage improvement plan for Class A area recommends collecting and treating all wastewater satisfying Vietnamese standard. Where combined sewer exists combined sewer system will be used, while where no combined sewer exists, separate sewer system is recommended. For Class B area, central sewerage, simplified sewer system and septic tanks are proposed based on population density.

The salient features of the sewerage improvement plan is given below.

#### Class A Area, short term up to year 2010

- Area 1103 ha
- Population 240,000 (in 2010)
- Collection System Combined Sewer System
- Estimated Sewage 36,000 m<sup>3</sup>/day (in 2010)
- Combined Sewer Overflow 61 nos.
- Sewer pipeline 20 km
- Manhole 190 nos.
- Pumping Station At An Da (30 m<sup>3</sup>/min)
- Treatment Plant Near Vinh Niem Tidal Gate
- Treatment process Aerated lagoon
- Treatment capacity 36,000 m<sup>3</sup>/day
- Implementation Period 2004 to 2010

## Class A Area, long term up to year 2020

• Area	5241 ha
• Population	575,000 (in 2020)
• Collection System	Combined and Separate Sewer System
• Estimated Sewage	71,000 m <sup>3</sup> /day (in 2020)
• Combined Sewer Overflow	60 nos.
• Sewer pipeline (big dia)	35 km
• Sewer pipeline	370 km
• Pumping Station	5 nos.
• Treatment Plant	2 nos.
• Treatment capacity	72,000 m <sup>3</sup> /day
• Implementation Period	011 to 2020

## Kien An (Class B Area)

• Area	2670 ha
• Population	106,000 (in 2020)
• Central treatment plant	1 nos. (8,000 m <sup>3</sup> /day)
• Main pumping station	2 nos.
• Simplified treatment plant	3 nos.
• Sewer pipe	160 km
• Implementation Period	2004 to 2020

## Do Son (Class B Area)

• Area	3950 ha
• Population	42,000 (in 2020)
• Simplified treatment plant	2 nos.
• Sewer pipe	49 km
• Implementation Period	2004 to 2020

The Sewerage Improvement Plan also includes Septage Collection & Disposal Plan (Total Direct Cost US\$19.4 million).

Total Direct Cost for Sewerage Improvement Plan: US\$299.6 million

### 1.3.4 Water Quality Improvement for Lakes and Channels

Lakes and channels in urban Haiphong area are heavily polluted by sewage, and they have to be rehabilitated urgently. In the water quality improvement plan for lakes and channels, a series of measures were proposed, which supplement the proposed sewerage and drainage plans in the Sanitation Master Plan. The main target of the plan is to meet the Environmental Standard, TCVN 5942-1995.

The salient features of the water quality improvement plan are given below. The main components of the plan are based on on-going World Bank 1B Project and rehabilitation plan by Park Service.

Construction of Interceptor Sewers around Lakes

- Interceptor Sewers
 

Tien Nga Lake	0.6 km
Sen Lake	0.4 km
An Bien-Mam Tom Lake	1.6 km
- Implementation Period
 

2001 to 2004
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Lake Rehabilitation Projects (Dredging)

- Target Lakes
 

Tien Nga Lake	2.3 ha
An Bien Lake	20.0 ha
Mam Tom Lake	2.1 ha
Sen Lake	2.0 ha
Du Hang – Lam Tuong Lake	6.6 ha
- Implementation Period
 

2001 to 2004
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Strategic Operation of Drainage System for Water Quality Improvement

- Target Lakes and Channels
 

all lakes and channels
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- Total Direct Cost
 

N/A
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- Implementation Period
 

2001-2020
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Total Capital Cost for Water Quality Improvement Plan: US\$2.9 million

**1.3.5 Solid Waste Management**

The solid waste management improvement plan cover the following three aspects, i.e. 1) waste collection and transport, 2) waste disposal, and 3) hospital waste management, each of which is an integral part of the solid waste management. Salient features of each aspect are given below.

A. Waste Collection and Transport

- Planning Objective
 

Improvement of efficiency and sanitation
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- Principle Direction
 

From “Open system” to “Closed system”
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- Proposed System
 

<ul style="list-style-type: none"> <li>• Mechanical waste loading into vehicles,</li> <li>• Direct collection system using bins placed at fixed locations</li> </ul>
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- Target for the Direct Collection      35 % of the solid waste will be collected by applying the direct collection system by 2005.
- Target Collection
 

	<u>Generation</u>	<u>Target Collection</u>
- 2000	630 ton/day	471 ton/day (75 %)
- 2005	899 ton/day	761 ton/day (85 %)
- 2010	1,148 ton/day	1,086 ton/day (95 %)
- 2020	1,517 ton/day	1,441 ton/day (95 %)
- Collection Service Target      Target collection rate will be 95 % in 2010 in term of collection quantity. In terms of population, 100 % of non-agricultural population by 2010 in the 4 urban districts, and by 2012 in Do Son.
- Main Types of Equipment
  - Waste discharge      Use of bins to be placed at fixed locations
  - Waste collection vehicles      Compactor with mechanical lifter
- Institutional Recommendations
  - Legal improvement for clearer definition of responsibility of generators of industrial waste, and demolition waste, etc, and the stronger enforcement
  - Increases in cost recovery through fee collection
  - Strengthening of URENCO’s capacity as service provider
  - Promotion of privatization (contracting out) and socialization and competition

B. Waste Disposal

- Disposal Method      Sanitary landfill
- Locations of Future Landfill Sites
  - For Hong Bang, Le Chan & Ngo Quyen: Trang Cat Site (see below)
  - For Kien An
    - 2001 – 2004: Trang Cat Phase 2 Landfill Site
    - 2005-2011 (7 years): Planned site is in An Lao District. 10 ha. Joint Use with An Lao District
    - 2012-2020 (9 years)Planned site is in An Hai District, inside the dyke of Van Uc River. 9 ha.
  - For Do Son      Landfill site near the existing Do Son landfill for 2003 – 2020 period (13 ha)
- Phased Development Plan of Trang Cat Site
  - Phase 1 Landfill (existing site): 5 ha1998 –2001 (to be filled up soon)
  - Phase 2 Landfill: 11 ha2001 - 2005 (own fund of HPPC)

- Phase 3 Landfill :33 ha 2005 - 2014 (subject to the F/S)
- Phase 4 Landfill 2015 - (outside of 60ha)
- Types of Waste to be Received
  - Solid waste excluding industrial waste
  - Incineration residue of medical waste leachate treatment sludge
- Main Facilities to be Provided
  - Dyke (waste retaining structure)
  - Leachate collection & treatment system
  - Liner (Artificial liner in Phase 3 and thereafter)
  - Gas ventilation system
  - On-site road
  - Heavy equipment
  - Weighbridge
  - Heavy equipment
  - Environmental monitoring facility
- Cover Soil Weekly application
- Post-Closure Site Management Leachate collection/treatment and environmental monitoring should continue as long as leachate is generated, and land level is stabilized.

### C. Hospital Waste Management

- Objective Safe disposal of infectious waste eliminating risks of transmission of infectious diseases that may arise by contacting infectious waste
- Proposed System Consists of the following components:
  - In-hospital storage room for infectious waste
  - Waste collection vehicles
  - Treatment (incineration)
  - Landfill for incineration residue
- Method of Treatment Incineration
- Direct Beneficiaries 18 health care organizations (9 hospitals and 9 medical centers, located in the 4 urban districts and Do Son Town, as well as people who may directly contact infectious waste.)
- Indirect Beneficiaries Whole population of the 4 urban districts including neighboring areas and Do Son Town (704,000 in 2005)
- Cost Recovery Hospitals should pay the fees.

Total Direct Investment Cost for Solid Waste Management Improvement Plan: US\$52.6 million duly 2001-2020

## II. IMPROVEMENT PLAN FOR WATER SUPPLY

### 2.1 Current Conditions of Water Supply System and Review of Existing Plans

#### 2.1.1 Current Water Supply System

##### (1) Service Area

The existing water supply systems cover Urban Center, Kien An, Vat Cach and Do Son areas. According to the estimate by WSCO in 1999, 370,550 people were served through house connections. The coverage is 68 % in the urban center, 35 % in Kien An, and 37 % in Do Son. Other areas (Minh Duc, Dinh Vu and sub-urban part of An Hai District) do not have public water supply systems.

##### (2) Water Consumption

The current water consumption for the public water supply system in Haiphong is about 111,000 m<sup>3</sup>/d.

**Water Consumption in Different Distribution Areas in 1999.**

Consumption category	Urban Center m <sup>3</sup> /d	Kien An m <sup>3</sup> /d	Vat Cach m <sup>3</sup> /d	Do Son m <sup>3</sup> /d	Total m <sup>3</sup> /d
Domestic consumption	33,790	2,410	720	760	37,680
Industrial consumption	5,840	140	710 <sup>1)</sup>	140	6,830
Commercial consumption	2,240	60	310	600	3,210
Institutional and other consumption	5,530	1,070	150	520	7,270
Total consumption	47,400	3,680	1,890	2,020	54,990
Non-revenue water	40,000	10,500	3,800	1,910	56,210
Average water production	87,400	14,180	5,690	3,930	111,200

1) Includes also Nomura industrial zone

2) source: 2A Interim Report

##### (3) Intakes and Treatment Plants

Table below summarizes the existing intakes and the treatment plants in Haiphong.

**Present water treatment plants in Haiphong**

Service Area	Intake	Treatment plant	Design capacity m <sup>3</sup> /d	Ave. Produc. m <sup>3</sup> /d
Urban Center	Quan Vinh	An Duong	60,000 <sup>1)</sup>	87,400
Kien An	Da To	Cau Nguyet	60,000 <sup>2)</sup>	14,200
Vat Cach	Vat Cach	Vat Cach	11,000	5,700
Do Son (New Ind. Area)	Song He	Do Son	5,000	3,100
		Song He		800
Total			136,000	111,200

The total capacity of water supply facilities meets the present total demand. However, An Duong water treatment plant, which serves the majority of the urban

population, is already operated at 20-30 % over the design capacity. Other facilities also need upgrading.

#### (4) Water Quality

Raw water qualities in Haiphong are generally satisfactory, although turbidity and salinity of the raw water are high. Water treatment and disinfection are essential before consumption.

#### (5) Leakage and Non-Revenue Water

The Non-Revenue Water (NRW), which includes leakage, faulty meters and other water losses, has decreased rapidly during the past several years. The NRW will be further reduced when the 1A Project and other new water metering projects are launched.

**Past NRW Records in Haiphong**

	1993	1994	1995	1996	1997	1998	1999
Non-Revenue Water %	71	69	68	64	57	54	49.7

### 2.1.2 Review of Existing Plans

#### (1) 1A Project

Started in 1999, 1A Water Supply Project (total investment cost US\$23.2 million) is improving the capacity of An Duong treatment plant, raw water supply to the An Duong plant and transmission and distribution systems in the urban center. The major part of the investments is targeted to the network components. The project is expected to last until the end of 2002. The main components of the 1A Project are as follows:

- Construction of new raw water transmission main from Quan Vinh to An Duong, about 3.7 km, DN 1000 mm pre-stressed concrete pipes
- Rehabilitation of Quanh Vinh pumping station
- Upgrading of An Duong treatment plant to design capacity 100,000 m<sup>3</sup>/d
- Construction of about 27 km new transmission mains from DN 300 to DN 600
- About 40,000 new house connections with new water meters in the 15 phuongs
- Construction of new 4,000 m<sup>3</sup> reservoir and booster pumping station at May To Phuong
- Others

(2) 2A Project

Haiphong 2A Water Supply Project, which is under feasibility study, covers some densely populated areas in urban districts, especially along new ring road and Kien An District, as well as Do Son and Vat Cach areas. The implementation is scheduled for 2002-2006, the estimated investment cost is US\$24.6 million. The proposed main components are as follows:

- Construction of new water treatment plant at Hoa Binh channel (10,000 m<sup>3</sup>/d)
- Cau Nguyet water treatment plant rehabilitation (20,000 m<sup>3</sup>/d)
- New transmission main from Quan Vinh raw water intake to An Duong water treatment plant
- Construction of new treated water reservoir at An Duong (4,000 m<sup>3</sup>)
- Kien An transmission mains, 12 km, and Kien An distribution pipes and consumer connections (13,000 house connections)
- City center transmission mains alongside the ring road, 12 km, and City center distribution pipes and consumer connections (14,000 house connections)
- Do Son road transmission mains, 7 km, and Do Son road distribution pipes and consumer connections (1,000 house connections)
- Vat Cach transmission mains, 5 km, and Vat Cach distribution pipes and consumer connections (3,500 house connections)
- Others

## 2.2 Estimated Water Demand

Total water consumption consists of i) domestic consumption, ii) industrial consumption, iii) commercial consumption, iv) institutional consumption, and v) non-revenue water. In order to estimate the water demand, these five categories of water consumption were estimated separately. All estimates are in accordance with the recent estimates by WSCO, which World Bank Projects has also adopted. The population figures were updated based on the estimate by JICA Study Team. The anticipated water demands to 2020 are summarized below.



**Projected Water Demand by Areas in Haiphong in 1999-2020**unit: m<sup>3</sup>/d

Water demand	1 999	2 000	2 005	2 010	2 015	2 020
<b>Class A;</b>						
Urbanized area						
Hong Bang <sup>1</sup>	17 119	19 718	26 293	31 312	34 508	36 438
South of Hong Bank <sup>2</sup>	467	464	1 599	3 221	3 995	4 669
Le Chan	27 712	29 272	28 904	32 390	33 736	33 858
South of Le Chan <sup>3</sup>	0	0	2 881	7 022	10 100	13 672
Ngo Quyen	43 061	42 173	37 372	42 319	43 465	43 501
Southeast of Ngo Quyen <sup>4</sup>	0	0	1 846	5 178	8 386	13 057
Total average demand	88 359	91 627	98 895	121 442	134 190	145 195
Total max day demand	101 456	106 831	117 362	143 984	157 990	171 247
<b>Class B;</b>						
Developing area						
Kien An	14 180	14 390	15 073	15 610	16 804	17 916
Do Son Town	3 112	3 095	4 209	6 041	7 042	8 060
Quan Toan	280	300	580	941	1 734	3 173
Total average demand	17 572	17 785	19 862	22 592	25 580	29 149
Total max day demand	18 924	19 188	22 363	26 823	31 031	35 681
<b>Class C;</b>						
Sub-urban area						
Minh Duc				4 265	6 463	8 270
Dinh Vu		11	1 650	6 000	7 950	10 538
New Dev. Area	677	929	1 336	1 817	2 792	4 229
Total average demand	677	940	2 986	12 082	17 205	23 037
Total max day demand	733	1 031	3 290	13 425	19 131	25 660
<b>Grand total average</b>	<b>106 608</b>	<b>110 352</b>	<b>121 743</b>	<b>156 116</b>	<b>176 975</b>	<b>197 381</b>
<b>Grand total max day</b>	<b>121 113</b>	<b>127 050</b>	<b>143 015</b>	<b>184 232</b>	<b>208 152</b>	<b>232 588</b>

**2.3 Planning Framework for Water Supply****(1) Service Area**

Access to safe drinking water is a fundamental need of people in Haiphong. Hence, the target is to cover entire Study Area with basic water supply network by 2020 (see Figure 2.3.1). This includes 4 urban districts (Hong Bang district, Ngo Quyen district, Le Chan district and Kien An district), Augmented Area around urban districts, Do Son District, New Development Area, Minh Duc area, planed industrial areas Quan Toan, and Dinh Vu.

<sup>1</sup> Includes Nomura industrial area<sup>2</sup> Augmented Area 1<sup>3</sup> Augmented Area 2<sup>4</sup> Augmented Area 3

## (2) Demand

The future demand has been estimated in the previous section. The target is to meet the peak demand in 2020.

## (3) Water Quality

The water quality targets have been set in Corporate Plans of HPWSCO, and the same target was adopted in this Study. The general target is that water quality at customer's taps meets the requirement of Vietnamese domestic water standard.

## (4) Reduction of Non-Revenue Water

Out of the total water production of WSCO in 1999, 50.3 % was sold and 49.7 % was non-revenue water. Non-revenue water was attributed to leakage, inaccurate or non-working water meters, meter reading and billing errors, and unknown or non-defined losses. When the transmission and distribution system is improved in all distribution areas, the share of non-revenue water should be reduced to about 20-25 % of the total water production by 2020

**Table of water loss target**

Unaccounted for water	2000	2005	2010	2015	2020
Total NRW %	46	34	26	25	20

## 2.4 Preliminary Design and Cost Estimation for the Optimum Measures

### (1) Preliminary Design of the System and Facility

Figure 2.3.1 shows the proposed water supply facilities. The major components of the plan are based on 1A and 2A Projects.

#### 1) Class A

Implementation for the city center network rehabilitation, An Duong water treatment plant, May To booster station construction, Quan Vinh raw water intake rehabilitation and new raw water main construction are going on. Among the main components are:

- Expanding transmission mains and distribution network in Vat Cach-Quan Toan, and Hung Vuong areas
- Expanding transmission mains, distribution pipes and house connections along ring road in the southern part of City Center
- Expanding reservoir capacity by 4,000m<sup>3</sup> in An Duong

- Construction of new raw water transmission pipes Quan Vinh – An Duong
- 2) Class B
- Expanding transmission mains, distribution pipes and house connections in Kien An
  - Rehabilitation of Cau Nguyet water treatment plant
  - Construction of new Hoa Binh raw water intake and water treatment plant
- 3) Class C
- Construction of new transmission main, distribution pipes and house connections alongside Do Son road between Song He- Cat Bi.
  - Construction of new Hoa Binh raw water intake and water treatment plant (partly for Do Son, partly for New Development area)

(2) Cost Estimation

The estimated overall costs are as follows:

**Estimated Overall Cost of Water Supply Plan**

Component	Cost (US\$ million)
Construction Cost (2001-2020)	33.7
Land Acquisition (2001-2020)	1.1
O&M Cost in 2020	0.27

**2.5 Phased Development and Distribution Schedule**

The improvement of water supply system will be implemented in 2 phases; Phase 1 (2001-2010) and Phase 2 (2011-2020).

**2.6 Strengthening Management Organization and Manpower Training**

**2.6.1 Improvement of Management and Operation and Maintenance**

(1) Strengthening Autonomy and Management Decision Making of WSCO

The success of WSCO in receiving financing for the World Bank 1A Water Supply Project, coupled with its capable management of the project are evidence of the WSCO’s ability to undertake major capital projects. However, the planning and approval process, such as recruitment, adjustment of tariff structure for loan repayment, etc., still requires rigid approval procedures in HPPC. As more innovative financing arrangements become necessary (e.g. joint ventures, private

sector participation, or BOT), WSCO will need more flexible and autonomous mechanisms for obtaining investment.

### **2.6.2 Organizational Changes**

The WSCO organization structure requires little change, as the company has recently been reorganized. However, depending on the timing of the 2A Project, the project management capability of WSCO will have to be strengthened.

In the near future, WSCO will increase its efforts to protect water sources and the water supply system. The main objective will be the protection of water quality in raw water intakes and in water supply facilities including treatment plants, raw water mains, and the distribution network. It is anticipated that work in this area will grow and Water Source Protection Unit will be needed as early as 2004. This unit will become part of the production department.

In addition, following organizations and management structures were proposed to effectively implement the non-revenue water reduction programs:

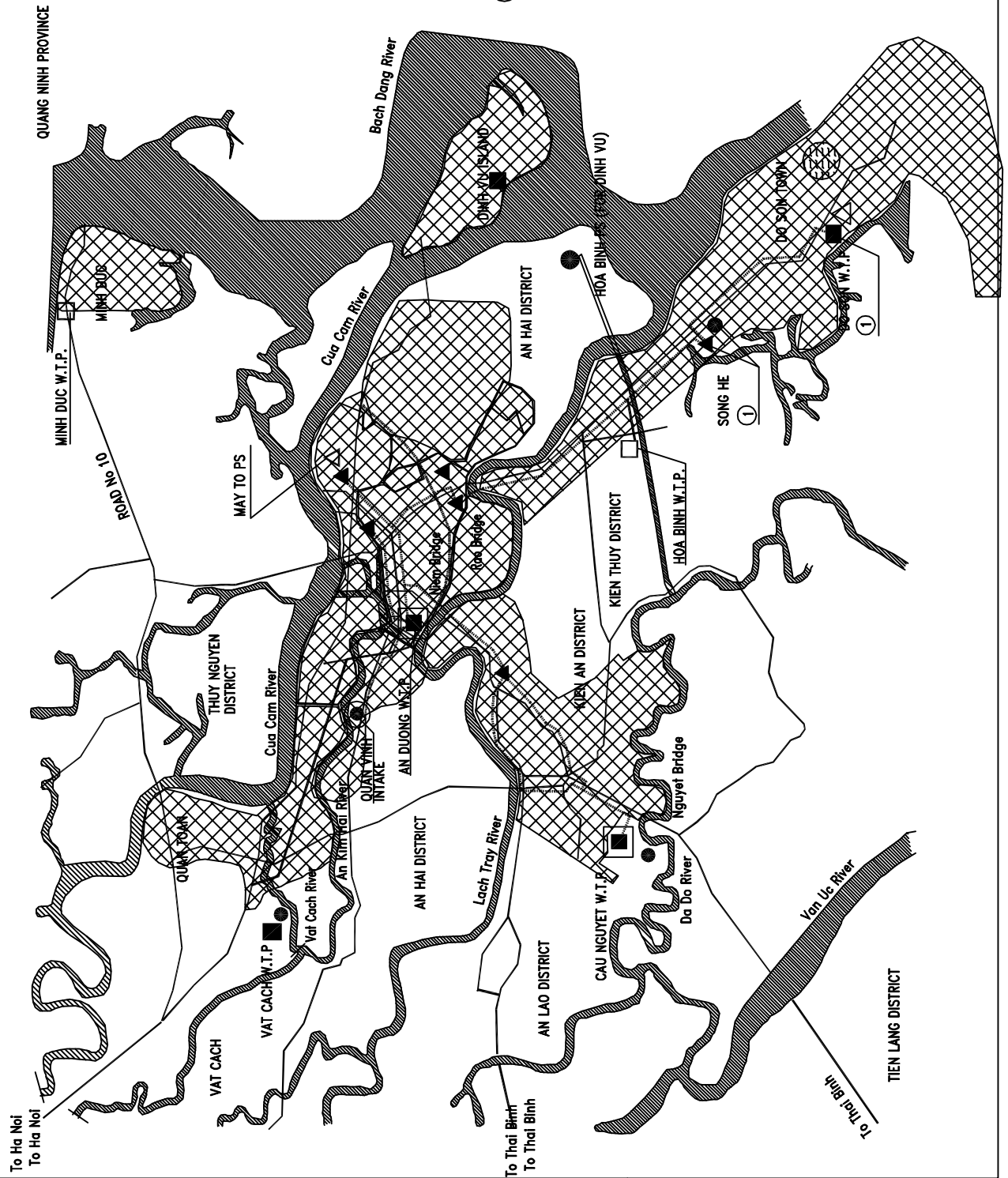
- Consumer Service Department
- Water Meter Workshop
- Phuong Offices
- Network Department

The anticipated staffing levels in 2020 will be about 1600.

### **2.6.3 Man Power Training**

WSCO needs the basic human resource development in the following areas:

- Strengthen the capacity of the project management unit (PMU) to ensure that it can effectively implement the capital investment projects
- Improve administrative efficiency throughout the organization
- Increase the technical competence of operations and maintenance staff to ensure sustainability of new system improvements
- Upgrading managerial skills to introduce modern management methods
- Introduce business planning methods to foster the development of the organization into an autonomous and commercially viable business entity



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Figure 2.3.1  
Proposed Water Supply Area

Japan International Cooperation Agency

### III. IMPROVEMENT PLAN FOR STORM WATER DRAINAGE

#### 3.1 Present Flooding Conditions and Review of Existing Plans

##### 3.1.1 Class A Area

Flooding occurs regularly in the three urban districts of Class A area. These districts contain the highest population in the Study Area.

Quantitative data on flooding occurrences has been reported by SADCo for the three urban districts in Class A area and is presented in the following table.

**Present Flooding Conditions Reported by SADCo**

Approximate Frequency	Rainfall	Maximum Rainfall Intensity	Tide Conditions	% of Total Area
2 year ARI	60-65 mm	30-40 mm/hr	Low tide	30 % of street areas
	65-80 mm	30-40 mm/hr	Rising/Falling	39 % of street areas
	60-80 mm	30-40 mm/hr	Low tide	13 % of alley areas
	60-80 mm	30-40 mm/hr	Rising/Falling	15 % of alley areas
5 year ARI	180-190 mm	40-60 mm/hr	Low tide	49 % of street areas
	120-150 mm	40-60 mm/hr	Rising/Falling	63 % of street areas
	180 mm	40-50 mm/hr	Low tide	46 % of alley areas
	130-150 mm	40-60 mm/hr	High tide	56 % of alley areas

For the storms with a frequency of 2 year ARI, the flooding magnitudes in the street and alley areas was reported as 20-40 cm with a 4-6 hour duration. For the storms with a frequency of 5 year ARI, the flooding magnitudes in the street and alley areas was reported as 30-50 cm with 1-3 hour duration.

##### 3.1.2 Class B Areas

In Class B area flooding occurs regularly in main commercial areas. In these areas the degree of urbanization is higher than in other areas, which are mostly suburban and residential. Because of these localized urbanized conditions, storm water runoff is high, which causes flooding, but the flooding magnitude is not great.

##### 3.1.3 Class C Areas

Drainage systems have not been constructed for Class C area, because these areas are not yet developed to an extent where flooding occurs because of storm water runoff. Urbanization is not expected in the near future in these areas, and there is no immediate need for drainage improvements in these areas.

### 3.1.4 Review of Existing Development Plans

The Haiphong Sewerage and Drainage Master Plan has been prepared by Haiphong City and provides comprehensive development plans for the drainage systems for all of the areas in the Study Area to the Year 2010.

The Haiphong Sewerage and Drainage Master Plan has been reviewed and considered when developing the improvement plans for storm water drainage.

## 3.2 System and Facility Measures for Storm Water Drainage Improvements

### 3.2.1 Planning Objectives

Planning objectives for storm water drainage are as follows:

- Main objective is to improve and upgrade storm water drainage system to promote healthy living environment and favorable urban development
- Improvements in storm water drainage are directed to flood areas where flood reductions have greatest socio-economic impacts
- Selected measures for storm water drainage should be sustainable and compatible with local standards and practices

Flooding problems are associated with the incidences and depths of flooding as well as flood durations. Highest priority is given to areas which experience frequent flooding with deep flood depths and long flood durations.

### 3.2.2 Planning Strategy

Urbanization and population density is the key factor determining appropriate drainage interventions. The following land use based selection criterion is adopted to select required storm water drainage system in the Study Area.

**Parameter Determining Investments in Storm Water Drainage**

Ratio of developed area	Range	Target
High	$\geq 0.4$	Storm water collection and disposal system
Low	$< 0.4$	Natural Drainage

In areas where ratio of paved or developed area is high, drainage system should be developed so that storm water can be collected and disposed. For areas with low ratio of developed area, natural drainage capacity is sufficient to drain the storm water and no drainage systems are proposed.

Based on the ratio of developed area, appropriate target drainage systems until the Year 2020 are selected as follows.

**Appropriate Target Drainage Systems in Study Area**

Area	2020
3 Urban Districts	Drainage System
Kien An District	Drainage System
Do Son Town	Natural Drainage
Quan Toan	---
Minh Duc	Natural Drainage
Dinh Vu	---
New Development Area	Natural Drainage

The three Urban Districts and Kien An District are to be served with drainage system, and the rest of the Study Area is to be served by natural drainage.

For areas with industrial zones like Dinh Vu and Quan Toan, drainage will not be the responsibility of public sector. Economic Zone Authority should take the responsibility for the drainage.

### 3.2.3 Phased Implementation

The following schedule is adopted to allow phased implementation improvements in storm water drainage:

- Year 2010: Short term
- Year 2020: Long term

### 3.2.4 Target Areas

Selection of the target areas are based on the adopted planning strategy. Target areas are Class A area and Kien Anh District.

## 3.3 Preliminary Design and Cost Estimates for Measures for Class A Area

### 3.3.1 Target Planning Areas

Three target planning areas were defined in the Drainage Improvement Plan for Class A area. Definition of the target planning areas was based on the following considerations:

- Current and future planned population densities
- Natural conditions related to drainage, including land levels, number of outlets connected with tidal rivers, channels, and lakes
- Whether combined sewers presently exist or not



The target planning areas are located in Le Chan District, Ngo Quyen District, Old City Center within the Hong Bang District, 2 communes located outside and south of Le Chan District, and 4 communes located outside and east of Ngo Quyen District. The total coverage area is 5,240 ha. Characteristics of each target planning area is presented in Figure 3.3.1.

The six non-urban communes are included in the target area because of their high present population density and strong possibility of including in the urban district in near future.

### **3.3.2 Selected Planning Criteria**

Three different drainage target levels were identified for consideration for the target planning areas. These levels were based on the frequency of high tide conditions and the frequency of expected storms and rainfall magnitudes.

High tide conditions with a frequency of a 10 year average recurrence interval (ARI) was selected for all three drainage target levels.

However, the frequency of the expected storms and rainfall magnitudes were different for each considered drainage target level and are defined as follows:

- Level A Storm with a frequency of 10 year AR
- Level B Storm with a frequency of 5 year ARI
- Level C Storm with a frequency of 2 year ARI

Target drainage levels are defined for different elements of the drainage system. The levels of the different elements of the drainage system are defined as follows:

- Grade A Storage lakes, drainage channels, and pumping stations
- Grade B Main and branch combined sewers
- Grade C Tertiary sewers

### **3.3.3 Formulation of Planning Alternatives**

Four alternatives for storm water drainage improvements were identified as shown in the following table.

**Alternatives for Drainage Improvement Plan in Class A Area**

	Target Area	Target Drainage Level	
		Grade A Level	Grade B Level
<b>Alternative D1</b>	Central Area	5 Year ARI Storm	2 Year ARI Storm
	New Urban Area	5 Year ARI Storm	2 Year ARI Storm
	Old City Center	No Action	No Action
<b>Alternative D2</b>	Central Area	5 Year ARI Storm	2 Year ARI Storm
	New Urban Area	5 Year ARI Storm	2 Year ARI Storm
	Old City Center	2 Year ARI Storm	2 Year ARI Storm
<b>Alternative D3</b>	Central Area	10 Year ARI Storm	5 Year ARI Storm
	New Urban Area	10 Year ARI Storm	5 Year ARI Storm
	Old City Center	2 Year ARI Storm	2 Year ARI Storm
<b>Alternative D4</b>	Central Area	10 Year ARI Storm	5 Year ARI Storm
	New Urban Area	10 Year ARI Storm	5 Year ARI Storm
	Old City Center	5 Year ARI Storm	5 Year ARI Storm

**3.3.4 Selection of Optimum Planning Alternative**

Alternative D2 is selected as the optimum planning basis for Class A area. The basis for this selection includes the following:

- Complete coverage of the planning area
- Target drainage levels are adequate
- Most cost effective for largest coverage

The selected alternative D2 covers the whole of the target area of 5,240 ha including the Old City Center with 547 thousand inhabitants.

As a summary, the selected Drainage Improvement Plan for Class A area have target drainage levels and a phased implementation schedule as presented in the following table.

**Planning Criteria for Drainage Improvement Plan for Class A Area**

Target Area	Target Drainage Level			Implementation
	Grade A	Grade B	High Tide Level	
Central Area	5 year ARI	2 year ARI	10 year ARI	Phase I
Old City Center	Not Applicable	2 year ARI	10 year ARI	Phase II
New Urban Area	5 year ARI	2 year ARI	10 year ARI	Phase II

**3.3.5 Related On-Going Projects in Class A Area**

At present there are two related on-going projects in Class A area: World Bank Sanitation (1B) Project and FINNIDA Project. Implementation of the these two projects are a given condition and are part of the improvement plan.

Both projects include measures for drainage improvements in both the Old City Center and the Central Area. General aspects of these two projects are summarized in the following sections.

(1) World Bank Sanitation Project

In the Old City Center and Central Area, the existing combined sewers are to be cleaned and inspected. Sewers needing rehabilitation are then identified, and these sewers are either repaired or replaced. In addition about 7 km of new combined sewers are to be constructed to reduce flooding in prioritized flood areas.

In the Central Area, the Northeast and Southwest Channels are to be rehabilitated by dredging the channels and constructing embankment works and maintenance roads. May Den and Vinh Niem Tidal Gates at the outlets of these channels are also to be rehabilitated.

In the Central Area, Tien Nga, Sen, Lam Tuong and Du Hang Lakes are to be rehabilitated by dredging the lakes and constructing embankment works and maintenance roads.

For the Old City Center and Central Area, vehicles and equipment are procured for cleaning, inspecting and maintaining the combined sewer network.

Also, treatment facilities at Trang Cat Landfill are provided for treating and disposing the sludge which is dredged from the channels.

(2) FINNIDA Project

In the Central Area two storm water pumping stations are to be constructed. The pumping stations are located at May Den and Vinh Niem Tidal Gates. Total capacity of each pumping station is 9 m<sup>3</sup>/s.

**3.3.6 System and Facility Measures for Class A Area**

(1) Facility Measures for Phase I

Implementation of the World Bank and FINNIDA Projects is a given condition and would occur in Phase I. However, additional works are proposed for the Central Area to be also implemented during Phase I. Preliminary designs of the main components of these additional works for Phase I have been prepared. The scope of works are presented in the following table.

**Main Components and Quantities in Phase I Works**

<b>Component</b>	<b>Unit</b>	<b>Amount</b>
Rehabilitation of existing channels	m	10,000
Construction of new channel	m	500
Construction of channel maintenance roads	m	21,000 m
Construction of new storage lake	ha	24
Construction of lake site area and roads	ha	4
Construction of access road to lake	m	400 m
Box culvert 3 x (3000 mm x 2000 mm)	m	450 m
Tidal gates and structures at rivers	nrs.	2
Discharge gates and structures at lakes	nrs.	2

Supplementary components are also included in Phase I. The scope of works are presented in the following table.

**Supplementary Components and Quantities in Phase I Works**

<b>Component</b>	<b>Unit</b>	<b>Amount</b>
New main and lateral sewers	m	10,000
Channel road bridges	nrs.	15
Ancillary works for channels	m	21,000
Ancillary works for lake site area	ha	4

**(2) Facility Measures for Phase II**

Preliminary designs have been prepared Phase II of the drainage improvement plan for Class A Area. The scope of works are presented in the following table.

**Main Components and Quantities in Phase II Works**

<b>Component</b>	<b>Unit</b>	<b>Amount</b>
Construction of new storage lake 1	ha	37.5
Construction of new storage lake 2	ha	13.5
Pumping station, 18 m <sup>3</sup> /s	nrs.	1
Pumping station, 6 m <sup>3</sup> /s	nrs.	2
Pumping station, 4 m <sup>3</sup> /s	nrs.	2
Pumping station, 3 m <sup>3</sup> /s	nrs.	1
Pumping station, 1.5 m <sup>3</sup> /s	nrs.	2
Construction of retarding basins	nrs.	2
Tidal gates and structures	nrs.	9
Rehabilitation of storage lakes	nrs.	3
New main and lateral sewers	m	87,000
Box sewers 3000x2000 mm	m	300
Rehabilitation of channels	m	5,500

(3) Cost Estimates

The total facility measures for Class A area is presented in Figure 3.3.2. Cost estimates for works in Class A area are presented in the following table.

**Construction Costs (US\$ million) for Works in Class A Area**

	<b>Sub-Total</b>	<b>Total</b>
Facilities costs of World Bank and FINNIDA Projects	32,798	
Land acquisition costs of World Bank and FINNIDA Projects	0,122	32,920
Facilities costs of Phase I main components	24,909	
Facilities costs of Phase I supplementary components	10,758	
Land acquisition costs of Phase I components	3,700	39,367
Facilities costs of Phase II components	91,506	
Land acquisition costs of Phase II components	4,641	96,147
<b>TOTAL</b>		<b>168,434</b>

**3.4 Preliminary Design and Cost Estimates for Measures for Class B Area**

**3.4.1 Target Planning Areas in Class B and C Area**

For Class B area, the degree of developed land in Kien Anh is great enough, so that a developed drainage system is needed. For the other sub-areas, the degree of developed land is not great, and natural drainage is sufficient.

**3.4.2 System and Facility Measures for Class B Area**

(1) Facility Measures

The components of the proposed drainage improvement plan for Kien Anh are presented in the following table.

**Proposed Drainage Improvement Plan for Kien Anh**

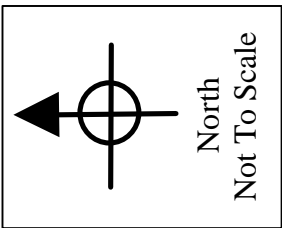
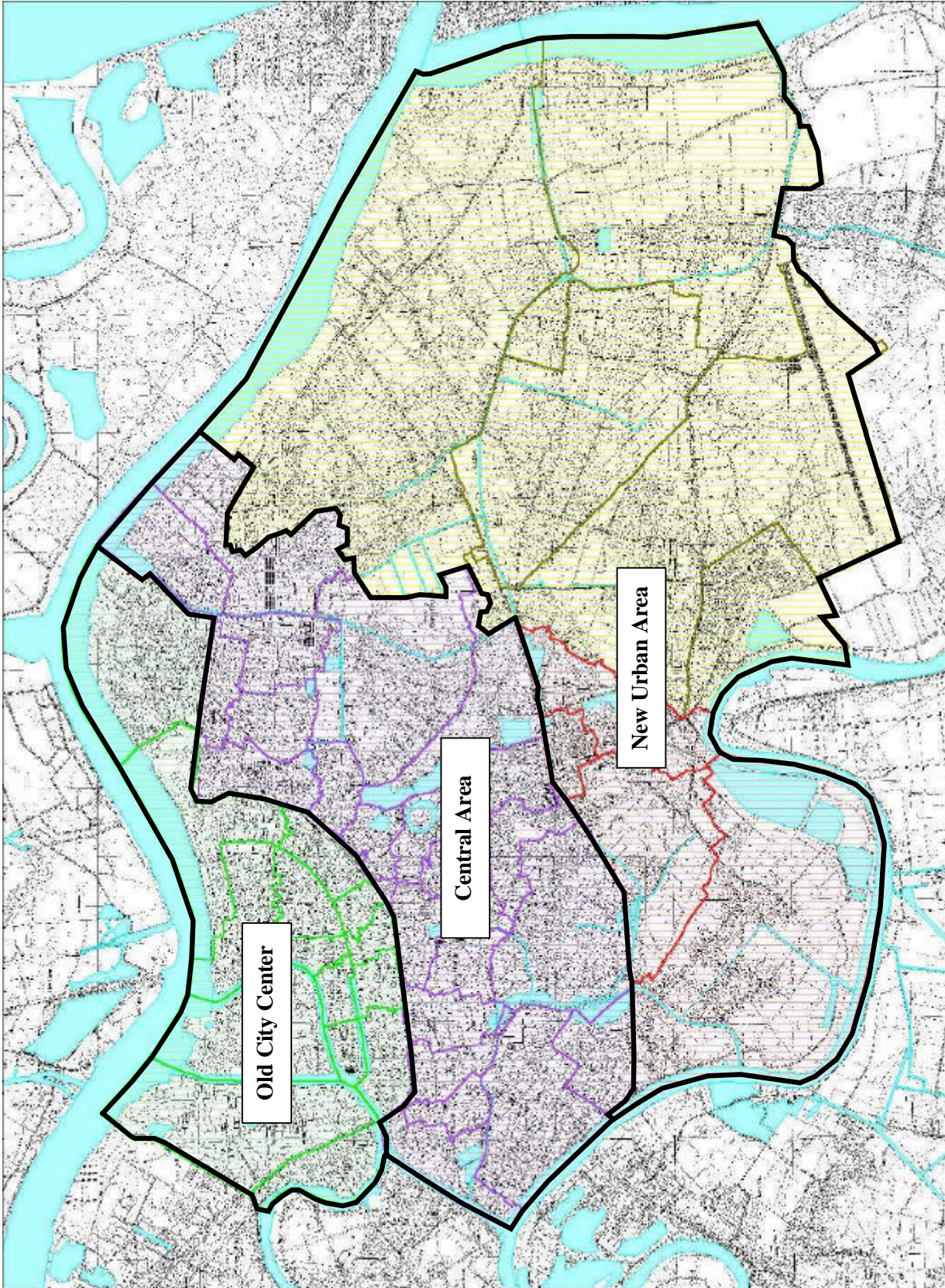
<b>Item</b>	<b>Unit</b>	<b>Amount</b>
Rehabilitation of existing sewer	km	10.0
Construction of new sewer	km	17.2
Construction of main drainage channel	km	5.0
Rehabilitation of tidal gate	nrs.	7

(2) Costs Estimates

Facilities costs for Kien Anh is estimated as US\$10 million. Land acquisition costs is estimated as US\$0.5 million. Total direct costs is US\$10.5 million.

### **3.5 Phased Development and Disbursement Schedule**

The World Bank and FINNIDA Projects are expected to be completed by the Year 2004. Phase I of the Class A area is proposed to be implemented between the Year 2004 and 2009. Phase II will start from the Year 2011 and will complete in the Year 2020. The construction works for Kien An is proposed to start from the Year 2011 and complete in the Year 2020.



**PLANNING CRITERIA**

**PHASE I**

**Central Area**

Surface Area: 1,275 ha  
Grade A: 5 Year ARI Storm  
Grade B: 2 Year ARI Storm  
10 Year ARI High Tide

**PHASE II**

**Old City Center**

Surface Area: 857 ha  
Grade A: 2 Year ARI Storm  
Grade B: 2 Year ARI Storm  
10 Year ARI High Tide

**New Urban Area**

Surface Area: 3,108 ha  
Grade A: 5 Year ARI Storm  
Grade B: 2 Year ARI Storm  
10 Year ARI High Tide

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Figure 3.3.1 Location of Target Planning Areas in Class A Areas and Planning Criteria for Drainage Improvement Plan

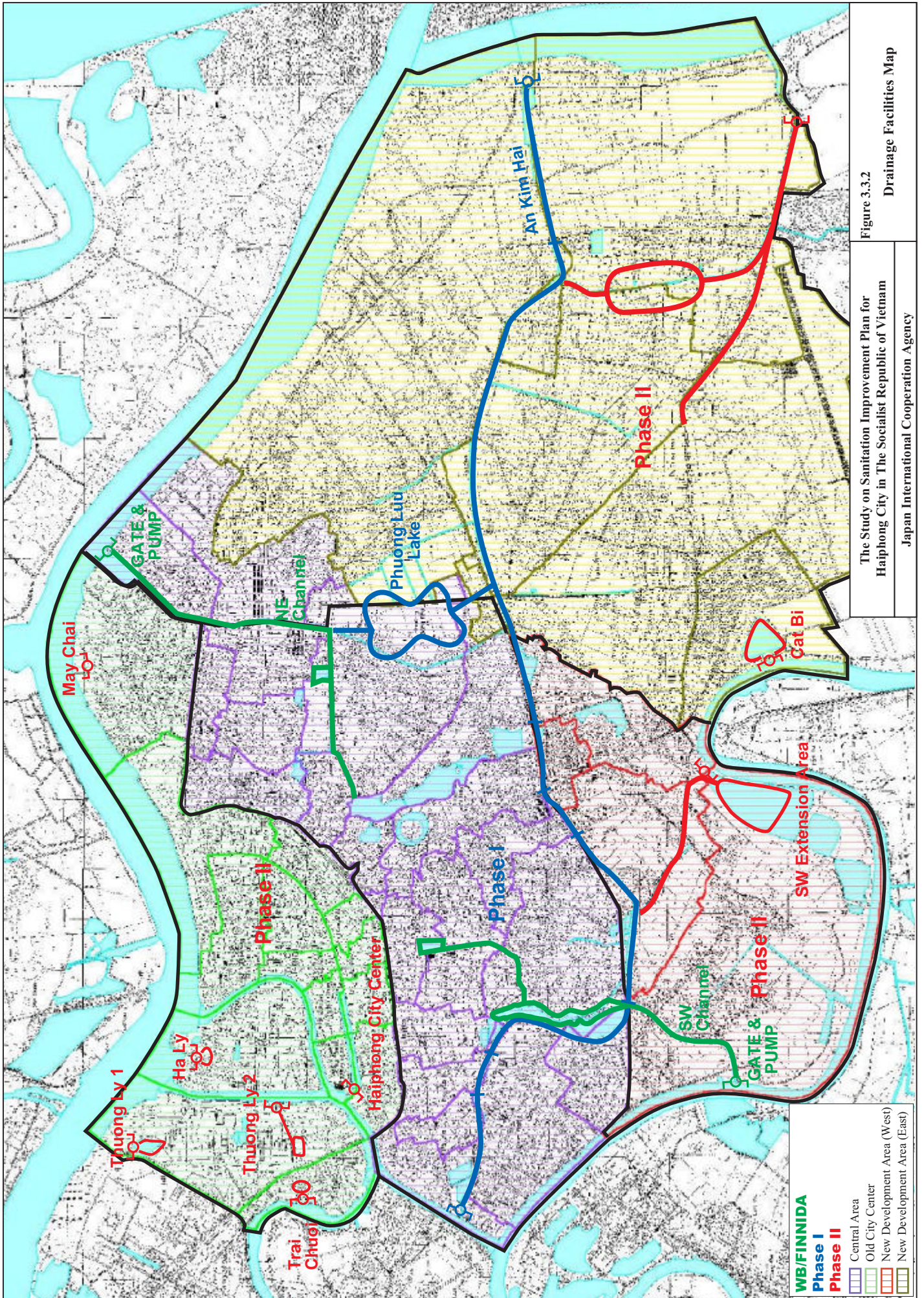


Figure 3.3.2

Drainage Facilities Map

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