Environmental Assessment for Shanghai Urban Environment Project

(Draft)

Table of Contents

1 INTRODUCTION 4

1.1 BACKGROUND 4
1.2 LEGISLATIVE AND REGULATORY CONSIDERATIONS 5

2 PROPOSED APL DEVELOPMENT PROGRAMME 6

2.1 OVERALL STRUCTURE OF THE STRATEGIC FRAMEWORK 6
2.2 PRELIMINARY PHASING ARRANGEMENT OF THE PROPOSED APL PROGRAMME 7
2.2.1 Phase One 7
2.2.2 Phase Two 9
2.2.3 Phase Three 12
2.3 SUMMARY OF THE PROPOSED APL PROJECT 13

3 ASSESSMENT OF THE PROPOSED APL STRATEGIC FRAMEWORK 15

3.1 ANALYSIS OF COMPATIBILITY OF APL STRATEGIC FRAMEWORK WITH SHANGHAI MASTER PLAN 15
3.2 COMPATIBILITY WITH COMPREHENSIVE REDEVELOPMENT PROGRAMME ALONG RIVERSIDES OF THE HUANGPU RIVER 17
3.2.1 Briefing on Comprehensive Redevelopment Programme along Riversides of the Huangpu River 17
3.2.2 Analysis of Compatibility of APL Strategic Framework with Comprehensive Redevelopment Programme of Riversides along the Huangpu 18
3.3 ASSESSMENT OF IMPACT ON REGIONAL ENVIRONMENT QUALITY IN SHANGHAI 19
3.3.1 Regional Environmental Objectives in Shanghai 19
3.3.2 Actions Planned to Improve Local Environment in Shanghai 20
3.3.3 Potential Impact of the Strategic Framework on Regional Environment 21
3.4 ASSESSMENT OF SOCIAL IMPACT 22
3.4.1 Potential Impact of Land Acquisition 22
3.4.2 Impact on Living Standard of Resettlers 23
3.4.3 Impact on Population Distribution 24
3.4.4 Impact on Scenery Views 24
3.4.5 Impact on Cultural Property 24

3.4.6 *Impact of Policy and Institutional Reform* 25
3.4.7 *Influence on the World Bank* 25

4 DESCRIPTION OF SHUEP IN APL PROGRAMME PHASE ONE COMPONENTS 26

4.1 GENERAL 26
4.2 SHANGHAI SEWERAGE PROJECT III 26
4.2.1 *Service Area* 27
4.2.2 *Main Elements of the SSP-III* 27
4.2.3 *Sewage and Storm Runoff Collection System and Diversion* 27
4.2.4 *Wastewater Treatment Plant* 28
4.2.5 *Environmental Measures Planned* 31
4.2.6 *Total Loading of Pollution Derived from the SSP-III* 32
4.3 LAOGANG LANDFILL EXPANSION PROJECT IV 32
4.3.1 *Status of Previous Laogang Landfill Projects* 32
4.3.2 *Briefing of the Laogang Landfill Expansion Project IV* 34
4.3.3 *Project Scheme* 34
4.3.4 *Environmental Measures Planned* 36
4.3.5 *Management of Site Closing and Its Ultimate Use* 38
4.3.6 *Total Loads of Pollutant Emission* 38
4.4 UPPER HUANGPU PROTECTION WASTEWATER MANAGEMENT (FIG. 6) 39
4.4.1 *Jinshan Sewerage Project* 39
4.4.2 *Fengjing Wastewater Treatment Plant* 39
4.4.3 *Fengxian South Sewer Wastewater Treatment Plant* 40
4.5 SHANGHAI OLD TOWN GREENBELT RING PROJECT 40
4.5.1 *Location and Scale of the Project* 40
4.5.2 *Resettlement* 41

5 DESCRIPTION OF THE ENVIRONMENT 42

5.1 PHYSICAL ENVIRONMENT 42
5.1.1 *General* 42
5.1.2 *Aquatic Environment* 42
5.2 BIOLOGICAL ENVIRONMENT 43
5.2.1 *Terrestrial Ecosystem* 43
5.2.2 *Aquatic Ecosystem* 44
5.3 SOCIO-ECONOMIC ENVIRONMENT 44
5.3.1 *Population* 44
5.3.2 *Industries* 45
5.3.3 *Infrastructure* 46
5.3.4 *Living Standard* 47
5.4 ENVIRONMENTAL PROBLEMS 47
5.4.1 *Water Pollution Loadings* 47
5.4.2 *Water Pollution* 47
5.5 COMPONENT SPECIFIC ENVIRONMENTAL CONDITION 47
5.5.1 *Environmental Condition at Laogang Landfill* 47

6 ANALYSIS OF ALTERNATIVES OF THE PROJECT 49

6.1 ANALYSIS OF SEWAGE TREATMENT PLANT SITING ALTERNATIVES 49

6.1.1 Comparison of Project Scale and Investment 49

6.1.2 Compatibility Comparison with Planning 50

6.1.3 Capacity Comparison of Effluent Receiving Water Bodies 51

6.1.4 Preliminary Conclusion of Siting Alternative Comparison 52

6.2 ANALYSIS OF WASTEWATER TREATMENT OPTIONS FOR REFUSE LANDFILL LEACHATE 52

7 ASSESSMENT OF ENVIRONMENTAL IMPACTS OF THE PROJECT 55

7.1 ENVIRONMENTAL IMPACT OF SHANGHAI SEWERAGE PROJECT PHASE III 55

7.1.1 Impacts on the Huangpu River and Chang Jiang Estuary 55

7.1.2 Impacts on Air and Acoustic Environment 55

7.1.3 Impacts on Social Environment 56

7.1.4 Impacts on Sludge Transport 57

7.2 ENVIRONMENTAL IMPACT OF LAOGANG LANDFILL PROJECT IV 57

7.2.1 Impact on Ambient Air 57

7.2.2 Impact on Surface Water 57

7.2.3 Impact on Groundwater 58

7.2.4 Impact on Soil 58

7.2.5 Impact on Ecosystem 58

7.2.6 Impact on Fly's Density in the Vicinity of Laogang Landfill Site 59

7.3 ENVIRONMENTAL IMPACT OF UPPER HUANGPU WASTEWATER TREATMENT 59

7.3.1 Impact of Fengxian South Sewer Wastewater Treatment Plant 59

7.4 ENVIRONMENTAL IMPACT OF OLD TOWN GREENBELT RING PROJECT 59

7.4.1 Impact on Socio-Economic Condition 59

7.4.2 Impact on Ambient Environment 60

7.4.3 Preservation of Cultural Properties 60

7.4.4 Implication in Pest Management 60

8 PUBLIC PARTICIPATION 61

8.1 PUBLIC PARTICIPATION IN SSP-III 61

8.2 PUBLIC PARTICIPATION IN LAOGANG LANDFILL PROJECT 61

8.3 PUBLIC PARTICIPATION IN OLD TOWN GREENBELT RING PROJECT 62

9 ENVIRONMENTAL MANAGEMENT PLAN 63

9.1 MITIGATION OF ENVIRONMENTAL IMPACTS 63

9.1.1 Recommended Mitigation Measures for Shanghai Sewerage Project-III 63

9.2 INSTITUTIONAL STRENGTHENING AND TRAINING 63

9.3 MONITORING 63

9.3.1 Monitoring Requirement for Shanghai Sewerage Project-III 63

9.3.2 Monitoring Programme for Laogang Landfill Expansion Project IV 63

10 CONCLUSION 68

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(Draft)

1 Introduction

1.1 Background

The Shanghai Municipal Government (SMG) has adopted an ambitious and forward looking Five Year Development Plan in which it seeks to enhance the economic, financial, trade and manufacturing stature of Shanghai, with Shanghai becoming a sustainable global competitive city-region, and an international economic, trade and shipping centre at the heart of the important Yangtze Delta. The SMG places a high priority on meeting six overall goals:

1) developing Shanghai's economic strengths, keeping a sustainable, rapid and sound economic growth;
2) developing Shanghai's services sector, particularly its functions as a centre of international trade and high value-added manufacturing, building Shanghai as a city with plenty of business opportunities and comparatively low cost for both domestic and foreign investors;
3) improving Shanghai's environmental conditions towards a Liveable City, to enhance the living conditions of the city's citizens, and to attract foreign and domestic investment;
4) developing Shanghai's innovation capacities, particularly education and R+D;
5) improving urban management, exploring new measures to manage this emerging modern city; and
6) improving the citizen's quality of life.

Attainment of these goals will require substantial investments and improvements in urban environmental management and in urban development management.

The policies and programs through which these goals are being addressed are outlined in sector master plans for wastewater management, solid waste management, and forestation. The recent revision of these plans has all been completed, and is currently being reviewed by the government. They are expected to be approved for implementation very soon.

Based on SMG's Long Term Development Strategy, and the comprehensive Tenth Five Year Plan, very specific performance targets and action plans have been prepared in each of these revised sector master plans. These sector master plans have outlined the specific targets, and provided a solid foundation for the proposed Shanghai Urban Environment Project (SHUEP).

Collaboration with the World Bank in urban infrastructure and environment investments during the last decade has been very successful. The Shanghai Municipal Government wishes to continue this collaboration through an integrated program of investments and associated reforms under a proposed Adaptable Program Loan (APL).

1.2 Legislative and Regulatory Considerations

In accordance with the requirements of «Environmental Protection Law of People's Republic of China» and «Guidelines for Environmental Management of Construction Projects», environmental impact assessment (EIA) shall be conducted to any proposed new construction, reconstruction or expansion projects. An environmental impact statement should be prepared to address the present environmental quality at location where a proposed project has been sited, and assess possible impacts in both construction period and after its commissioning. There have been a series of regulations and standards both at State and local levels available for governing the assessment. Besides, the environmental impact statement should include stipulated measures for pollution prevention and control. The statement shall be submitted to the administrative departments responsible for environmental protection for approval. The planning departments shall not approve a project until its environmental impact statement has been reviewed and approved.

According to World Bank's policies, environmental impact assessment (EIA) is an instrument to identify and assess the potential environmental impacts of a proposed project, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures. The SHUEP has been determined by the Bank to be subject to Category A EA requirements, based on the fact that a number of the individual investment components will require a Category A environmental assessment.

As a topic of the environment has been concerned world-wide, the World Bank provides guidance for Bank-financed projects on EA to cover specific sectors as well as cross-sectoral issues. In the Bank statements, some of the emphasised issues that may be related to the proposed SHUEP include environmental action plans; water resources management, pest management, safeguarding cultural property, involuntary resettlement, and etc. Those topics should be addressed in the EA report.

2 Proposed APL Development Programme

2.1 Overall Structure of the Strategic Framework

A preliminary Development Programme for the proposed APL is based on the detailed assessment of practical demands, urgency of projects in each environmental infrastructure sub sector, status of project preparation, and careful review of a wide range of institutional and other actions proposed by the government's agencies that are desirable, practical and attainable as triggers in the APL.

The SMG has adopted an ambitious and forward looking Five Year Development Plan in which it seeks to enhance the economic, financial, trade and manufacturing stature of Shanghai, with Shanghai becoming a sustainable global competitive city-region, and one of international economic, finance, trade and shipping centres at the heart of the important Yangtze Delta. The APL aims to help the government to implement its development strategy in an environmentally and institutionally sustainable manner, it aims to provide major long term environmental benefits to the millions of citizens and to the ecology of the greater Shanghai region, and aims to help SMG in its goal of developing innovative policies, institutional reforms and financing methods that will not only transform the way SMG operates, but more importantly will serve as models for local government and environmental reform throughout China.

Three phases are proposed. Phase One will focus on wastewater infrastructure and a first set of high priority solid waste infrastructure investments serving the City Proper (the area within the Outer Ring Road) and the Upper Huangpu Catchments Area. It will continue and expand on the strategic investments made with the World Bank on the Shanghai Environment Project (SEP) and Shanghai Sewerage Projects. In addition, redevelopment of the historic area in the city centre, and an urban landscaping component to improve Shanghai's urban environment are also included. Phase One will start in the second half of 2002 and extend to the end of 2007.

Phase Two, while still addressing infrastructure and environment needs in the City Proper dominated by the investment of Solid Waste #2 and Urban Landscaping, will provide an opportunity to support the efforts of suburban District and County governments in improving the level and quality of urban infrastructure services, particularly the investment of several waste water treatment plants in the rural area. Phase Two will start a program of redeveloping large industrial communities within the city to improve the urban environment and serve SMG's strategy of building an ecological Shanghai. Innovative institutional and financing arrangements will be tested in Phase Two, both in the City Proper and in suburban Districts. Phase Two would commence in the second half of 2003 and extend to 2008.

Phase Three, while continuing the efforts of redeveloping large industrial communities in the city, will focus on the air pollution management, particularly, prompting CNG for public buses to replace gasoline, and building CNG gas stations. This is one of the measures that SMG has now considered under its energy restructuring strategy to manage the emerging trend that the increasing vehicle pollution is now gradually becoming the major source of air pollution in this city. In Phase Three, priority is also given to the rehabilitation of infrastructure that has reached its useful service life in the City Proper. It is tentatively planned to commence at the start of 2006 and extend to the end of 2010.

2.2 Preliminary Phasing Arrangement of the Proposed APL Programme

2.2.1 Phase One

The objectives of Phase One are to:

1) support the implementation of the government's wastewater master plan by investing in strategic collection, treatment and conveyance infrastructure;
2) support the implementation of the government's solid waste management master plan by investing in two urgent projects;
3) support the implementation of SMG's landscaping master plan by investing in a large scale public green space;
4) support SMG's program to protect and improve the historic area in the city core;
5) support the government's efforts to protect the water resource in Upper Huangpu River by investing in wastewater treatment facilities in Upper Huangpu area;
6) implement improvements to automated information management that are essential for the operation of solid waste management facilities and monitoring of urban environmental infrastructure services in Shanghai.

Phase One would comprise several policy, financial and institutional reform measures, including:

- implementation of a comprehensive public outreach water conservation program;
- a comprehensive solid waste management plan, encompassing the adoption of market-based instruments user charge instruments and waste reduction;
- policies and enabling regulations for service/management contracts and/or concessions;
- plan and prospectuses for new forms of infrastructure and environment protection financing, and an independent mechanism for price setting for water and wastewater (regulatory authority or commission), with tariffs being reviewed and regulated by this agency.

Physical urban environment investments would be in wastewater management, Upper Huangpu River wastewater management, solid waste management, urban infrastructure upgrading, urban environment improvement, environmental quality monitoring, and senior management training and institutional strengthening. The details are as follows:

1) *Urban Wastewater Management.* Completion of wastewater collection systems and treatment facilities to treat all wastewater generated in the Shanghai metropolitan urban area, including sludge disposal;
2) *Urban Solid Waste Management.* Expansion of the existing Lao Gang sanitary landfill, setting up a collection system for food waste, and developing a GIS-based computerised MIS;
3) *Urban Infrastructure Upgrading.* Repair and renewal of infrastructure that has served its useful life,
4) *Urban Environment Improvement.* Development of the first phase of a central public open

space in Shanghai;

5) *Upper Huangpu Wastewater Management.* Wastewater collection and treatment for priority towns in the Upper Huangpu River Protection Zone; and

6) *Institutional Strengthening and Training.* Technical assistance for municipal executive development, capacity building in implementing agencies.

Five components are proposed:

1) *Shanghai Wastewater Management #3*, which consists of five major infrastructure investments.

2) *Solid Waste # 1*, which would comprise investments in:

   - food services solid waste management: the city is facing a challenge of managing the wet waste caused by an unanticipated surge in small restaurants, and the growing number of small-scale food vendors;
   - the expansion and upgrading of the strategic Laogang landfill (Phase IV) over a four-year period; and
   - addition of facility management capacities to the Sanitation Bureau's GIS to improve infrastructure operations.

3) *Investment in three small-scale wastewater treatment plants* identified in the Upper Huangpu Protection Plan.

4) *Shanghai Old Town Greenbelt Ring Project*, an 8.96 ha node in north east corner of the Shanghai Old Town in Huangpu District as part of the government's ongoing program of constructing a round greenbelt enclosing the Old Town.

5) Investment to protect and rehabilitate Shanghai's historic area in former Nanshi District (now amalgamated into Huangpu District).

Actions that the Shanghai Municipal Government is currently considering to propose as the "triggers" of Phase One include:

1) Prepare a satisfactory Letter of Development Programme and related Project Program;

2) Prepare an updated Wastewater Management Plan, including the management of disposal of sludge;

3) Prepare an updated Solid Waste Management Plan;

4) Draft terms of reference for studies on following aspects:

   - government/private sector participation in infrastructure financing;
   - management, operation and routine maintenance of water resource in whole Shanghai (Shanghai Water Authority);
   - policies reflecting a market-oriented comprehensive solid waste management in Shanghai (to support the recycling of solid waste), and necessary institutional restructuring;
   - establish a pilot municipal fund serving construction of the environmental infrastructure

in districts and counties.

5) Launch the water resource protection plan;
6) Agree in principle on the following:
   - extend the role of Shanghai Water Authority to become a Greater Shanghai Water Management Authority with overall responsibility for the planning and co-ordination of all water sector management policies and interventions throughout the area of the Shanghai Municipality;
   - raise domestic capital using appropriate financial instruments, and creating required environment;
   - seek private sector participation in service provision (through bidding process) and remove impediments over time.
7) Extend the current solid waste charges to cover restaurants for food waste.

In addition to the DRA assistance currently being provided through the World Bank's PHRD, SMG is considering possible additional requirements for technical assistance in:

1) Institutional capacity building and training;
2) Urban environment infrastructure assets operation and management (water supply, wastewater and solid waste);
3) Pollution Permit Trading;
4) Technical services for the Survey of Agricultural Pollution in Upper Huangpu Water Resource Protection Region;
5) Metropolitan Water Resource Management & Policy;
6) Metropolitan Solid Waste Management and technical services on the topic of solid waste tariff, solid waste minimisation, Government's Monitoring of Non-State Service Delivery/Operation;
7) Management and treatment technology of Food Waste; and
8) Design and operation of Rural Environmental Infrastructure Investment Revolving Fund (the Rural Water Resource Protection Pilot Fund).

2.2.2 Phase Two

The objectives of Phase Two are to:

1) Continue support for the implementation of the solid waste management master plan;
2) Support the implementation of the government's Landscaping and Forestation Master Plan outside the Outer Ring Road; and
3) Introduce and test innovative approaches to redeveloping of large-scale industrial communities in the city, and introduce innovative approaches to the financing of environmental infrastructure in both the City Proper and in suburban districts.

Phase Two would include further policy and institutional reform measures, including:

- completion of implementation of the first stage of water conservation and sludge management programs;
- Corporatisation of some 50 % of solid waste services, and upgraded institutional arrangements for service providers/producers implemented;
- implementation of upgraded municipal solid waste management program, and a demonstrated (at least 20% social capital ownership and financing) level of social capital participation and new financing approach in the water supply, wastewater and solid waste sectors;
- with long term domestic bonds routinely issued for infrastructure financing.

Physical investments in urban wastewater management, Upper Huangpu River wastewater management, urban solid waste management, urban infrastructure upgrading, urban environment improvement, and institutional strengthening. Four components are under consideration:

1) Solid Waste # 2 which would comprise investments in:
   - Containerisation of solid waste and improvements in transport to landfill, composting and incineration facilities;
   - Separation of solid wastes at source, and transfer to collection stations;
   - Improvements to solid waste haulage from collection stations through fleet upgrading and selected road improvements at regional receiving sites; and
   - Centralised treatment facilities of ordinary industrial solid waste and hospital disposals.
2) Forestation, consisting of three investments:
   - Continue investment in the government's ongoing program of constructing a 500 meter greenbelt along the Outer Ring Road;
   - Reforestation in a strategic corridor along the Upper Huangpu River; and
   - Landscaping along the transportation corridor from Shanghai through Chongming Island, to Northern Jiangsu.
3) To assist the rural district government in their investment of wastewater treatment plants. Priority will be given to the key areas such as Upper Huangpu Water Resource Zone, new seaport area in Nanhui District, and Chongming County. Subject to the approval from central government, an innovative pooled financing vehicle: a pilot Rural Water Resource Area Protection Fund (an Infrastructure Revolving Fund capitalised by SMG under the APL, and from which UDICs and infrastructure operating companies in suburban districts could borrow for capital investments of wastewater management infrastructures) will be explored, and ideally would be tested to finance one wastewater plant in the rural region if feasible.
4) Focusing on redeveloping a large industrial community in the City Proper. SMG has been strongly supporting the redevelopment of sub-standard residential areas throughout the city during the past decade. It is interested in proceeding to the next stage of renewal by addressing the many complex issues surrounding the redevelopment of large tracts of land

occupied by municipally-owned industrial SOEs. These large areas comprise not only industrial sites but also extensive residential and public facilities and supporting infrastructure. Innovative approaches to redevelopment of these areas will be explored, including the codification and transfer of property rights, asset valuation, and the formation of public-private land development corporations to access non-state financing. The site for this component need to be identified, but the industrial communities in Yangpu District is recommended at this point with a consideration that sewage system of this area will be improved under Wastewater Management #3 in APL Phase 1, it would make more sense if a urban redevelopment component would follow.

Actions that SMG is currently considering to propose as triggers to Phase Two include:

1) Approval of Huangpu Water Resource Protection Master Plan and Catchment Management Plan, including control of all pollution sources within the catchment area, and the related institutional framework;
2) Implementation of a comprehensive public outreach water conservation program;
3) Approval of a comprehensive solid waste management plan, including the adoption of market-based instruments for user charges, treatment, disposal and tipping fees, service pricing policies, waste reduction, recycling, resource recovery and the handling and disposal of hazardous and hospital waste;
4) Completion of policy and enabling regulation for service/management contracts and/or a concession, and the signing of a social capital participation contract (BOT or concession) for a wastewater treatment facility;
5) Completion of plan and prospectus for the issuance of long term domestic bonds for infrastructure financing. Shanghai will make its best efforts to obtain approval of the national government;
6) Studies on the policies and plans for establishing pilot municipal fund for water resource protection;
7) Regulation drafted and submitted for municipal approval for agricultural pollution control in greater Shanghai area.

Technical assistance requirements for Phase Two could include:

1) Continue TA on institutional capacity building and training;
2) Advisory services on Urban Landscaping and Large Scale Public Green Space focused on the issues of physical planning, financing & investment management, cost sharing and recovery, relocation and O+M mechanism;
3) Wastewater Sludge Management;
4) Private Participation in Service Delivery, and Commercialisation of Infrastructure Service Delivery, (in particular the performance monitoring for non-state delivery);
5) Advisory services on Regional Service Delivery Mechanisms; and
6) Other necessary TAs that might be identified during the APL implementation.

2.2.3 Phase Three

The objectives of Phase Three are to:

1) support government's program of redeveloping large industrial communities within the city that are undergoing pressures from industrial re-structuring;
2) support the implementation of SMG's CNG program under its energy restructuring strategy targeted for improving the air quality in the city, and
3) rehabilitation and upgrading of the more and more existing over-run wastewater treatment facilities in the old city proper.

Phase Three would include physical investments in Upper Huangpu River wastewater management, urban infrastructure upgrading, urban environment improvement, and institutional strengthening. Three components are being considered:

1) Industrial Community Redevelopment #2. Project site is to be identified close to the end of Industrial Community Redevelopment #1 under APL Phase Two. Possible sites could be an expanded area in Yangpu District (if Yangpu is selected for Industrial Community Redevelopment #1 under APL Phase Two) or communities in Wusong and Taopu industrial areas within the city proper (in Outer Ring Road).
2) Municipal environment improvement project including city greening phase 3 and the investment of renovation of public buses for CNG, construction of CNG gas stations, coal de-sulphuring and probably the CNG thermal power plants. SMG gave a high priority to this component in Phase Three so as to manage the growing pressure of vehicle pollution to the city's air quality in addition to the other measures that the government has put in place such as new standards of exhaust gas for automobiles, etc.
3) Wastewater Infrastructure Rehabilitation. A considerable proportion of collection networks in older urban areas is becoming obsolete, and need to be upgraded. In addition, older wastewater treatment facilities in selected areas are occupying what has become valuable land; their relocation, consolidation or closure could be undertaken in this component of the APL.

Actions that the government is currently considering to trigger Phase Three include:

1) Completion of implementation of the first stage water conservation and sludge management programs;
2) Corporatisation of 30% to 50% of solid waste services, and upgraded institutional arrangements for service providers/producers implemented;
3) Implementation of upgraded municipal solid waste management program, including waste minimisation, recycling, residential user charges and tipping fees;
4) Level of social capital participation and new financing approach in water supply, wastewater and solid waste sectors reaches to 10% to 20%;
5) Under the precondition of obtaining the approval from the State government, the planned long term domestic bonds will be issued;

6) Under the precondition of obtaining the approval from the State government, water resource protection funds will be established;
7) The 10th Five Year Plan targets relating to water, wastewater, solid waste, and environmental pollution control service levels and benchmarks met.

Technical assistance that could be required for Phase Three includes:

1) Continue TA on institutional capacity building and training;
2) Advisory services on Urban Energy Restructuring Strategy, focused on the issues of CNG buses and CNG thermal power plant; coal de-sulphuring, and other clean energy technology, international best practice, etc;
3) Urban Redevelopment Advisory;
4) Design and Issuance of Long Term Revenue Bond to finance urban environmental infrastructure investment; and
5) Other necessary TAs that might be identified during the APL implementation.

2.3 Summary of the Proposed APL Project

Here is a summary of the strategic framework and development programme of the SHUEP (Table 2-1).

Table 2-1 Summary of Strategic Framework and Development Programme of SHUEP

Phase No.	Project component (tentative)	Cost/WB Loan (million USD)	Institutional strengthening measures
Phase One (2002 ~ 2007)	1. Shanghai Sewerage Project III 2. Solid Waste Management #1: (1) Laogang Landfill Expansion IV; (2) Food waste collection system; (3) GIS-based computerised MIS. 3. Upper Huangpu wastewater treatment plants: (1) Fengjing Wastewater Treatment Plant; (2) Xinjiang Wastewater Treatment Plant; (3) Fengxian South Sewer Treatment Plant. 4. Urban Environment Improvement #1: Shanghai Old Town Greenbelt Ring Project.	684.7 / 250	1. Approval of Water Resources Master Plan; 2. Cost recovery from service fees levied on users; 3. Social capital participation in supply of public services; 4. Issuance of a domestic bond for infrastructure financing 5. Set-up of an independent mechanism for price setting for water and wastewater

Phase Two (2003 ~ 2008)	1. Solid Waste Management #2: (1) Containerization and upgrading transport system; (2) Sorting, collection and transfer (3) Renovation and upgrading of containerised land- and sea-transport system 2. Urban Environment Improvement #2: NW Park 3. Upper Huangpu wastewater treatment plants; 4. Urban infrastructure upgrading; 5. Environmental quality monitoring.	--- / 250	1. Completion of implementation of the first stage of water conservation and sludge management programmes; 2. Corporatisation of 50 % of solid waste services; 3. At least 20% social capital ownership and financing in public services; 4. Long term domestic bonds routinely issued for infrastructure financing.
Phase Three (2006 ~ 2010	1. Renovation of old industrial areas; 2. Urban Environment Improvement #3 3. Upper Huangpu wastewater treatment plants; 4. Urban infrastructure upgrading.	-- / 200	

3 Assessment of the Proposed APL Strategic Framework

3.1 Analysis of Compatibility of APL Strategic Framework with Shanghai Master Plan

It is stated in Article 29 of Planning Law of P. R. China that all the land use and construction within the city planning area shall comply with the city planning, and following related administration. Based on Shanghai City Master Plan (1999 ~ 2020) and Instruction for Shanghai City Master Plan (2010) endorsed by China State Council in May 2001, the assessment will address the compatibility of the strategic framework for APL Shanghai Urban Environment Project with Shanghai City Master Plan.

The analysis shows that APL strategic framework is in full compatibility with Shanghai City Master Plan (Table 3-1).

Table 3-1 Comparison of APL Strategic Framework with Shanghai City Master Plan

APL Strategic Framework	Shanghai City Master Plan
Development objective	*Item 7 Feature of the City*: Shanghai is the largest economic and shipping centre, as well as a national historical city in China. Shanghai is targeted to be an international centre for economy, finance, trade and shipping.
Implementation period	*Item 4, Chapter 1 of Instruction*: To close the linkage between Shanghai Master Plan and National Economic and Social Development Plan, ending term for Shanghai Master Plan is set to be 2010.
Implementation: 1. Set-up of sewage collection, treatment and disposal facilities, including WWTPs at Upper Huangpu catchment	*Item 64 Sewerage System* Centralised sewage treatment, a major approach, will be set up combining with decentralised sewerage system. Sewerage system will be improved for drinking water source protection and water environment improvement. For Upper Huangpu catchment, regional centralised WWTPs will be setup, and treated wastewater will be discharged into nearby water body. At Upper Huangpu drinking water protection zone, projects with sewage discharge will be strictly controlled, meanwhile, higher waste treatment level is required. *Item 39 Environmental Protection and Sanitation*: Enhance protection at upper Huangpu drinking water protection zone Increase full use of water resource, control over total mass load of urban wastewater, increase centralised treatment of urban wastewater, and reduce discharge of industrial wastewater
Implementation: 2. Providing environmental-safe facilities for solid waste treatment and disposal	*Item 39 Environmental Protection and Sanitation*: Solid waste management Landfill, incineration, bio-treatment and comprehensive utilisation will be the major options for treating and disposal of domestic refuse in an environmental-friendly way. Garbage sorting and collection system will be set up together with a waste minimisation, recycling and reusing system. A safety landfill for hazardous wastes will be set up. Shanghai will basically realise non-hazardous disposal of domestic wastes and comprehensive utilisation of industrial solid wastes based on a wide waste management network.

APL Strategic Framework	Shanghai City Master Plan
Implementation: 3. Environment protection and greening project	*Item 35 Objectives for Landscape*: With greening, environmental improvement and pollution control projects, the overall environmental quality in Shanghai will be improved. Landscape design, together with heritage conservation, will be improved to perfect the visual appearance, and form an eco-environment with human and nature in harmony. *Item 36 Greening*: Following the strategy of harmonious cohabitant of human and nature, greening landscapes will be optimised. Ring, notch, corridor or round shaped greening landscapes in downtown areas together with large coverage of man-made forests in rural areas will form the greening landscape in Shanghai, greatly improve the eco-environment. By 2020, per capita public green space in Shanghai will be over 10 m^2, per capita green land index will be over 21 m^2, and green coverage will be greater than 35%. Some green landscapes, larger than 1 ha with service radius of 500 m, will be set up in downtown area to fill the area vacant of greening. For districts in central areas, one more pieces of 20 ha is required. Each district will own a green space at least 4 ha in size and each neighbourhood community will own at least 1 ha green space. Each town in the rural area will own a public green space above 3 ha and a forest belt of 50 m wide surrounding the town. *Item 41: Principle for Historical Site Preservation* Shanghai is a national historical city. Historical site and cultural heritage will be preserved and co-existed with modern development. Shanghai will become a city with rich history and various culture combinations. *Item 43 Historical Site Preservation* Tradition Old Town of Shanghai, located at Renmin Road and Zhonghua Road, will be preserved. Yu Garden, Chenxiang Pavilion, Wen Miao (Culture Temple) and Dajing Pavilion, and etc. will be the preservation targets.
Implementation: 4. Infrastructure construction	*Item 57 Overall Objectives for Infrastructure Construction*: With comprehensive planning and proper layout, infrastructure construction will be upgraded to catch up with the level of mid-developed countries at the same period in general. *Item 1, Chapter 11 of Instruction*: Infrastructure in Shanghai, both of its quantity and quality, shall be satisfied with the growing demand from economic and social development as well as living improvement for fulfilling the long term development objectives and solidifying foundations for future growth. By 2010, infrastructures such as water supply, power, gas, communication, sewerage facilities will meet related demands. Planning and construction of key infrastructures need to comply with the city's sustainable development.
Implementation: 5. Improvement of city-wide water resource management and solid waste management, strengthening of institutional arrangement for environmental protection 6. Set-up of financing mechanism for environmental infrastructure	*Item 90 Planning Implementation Mechanism*: Improve policy mechanism for city planning implementation. With law, administrative and economic instruments, planning will be implemented in a proper way.

3.2 Compatibility with Comprehensive Redevelopment Programme along Riversides of the Huangpu River

3.2.1 Briefing on Comprehensive Redevelopment Programme along Riversides of the Huangpu River

The municipal government of Shanghai formally launched a Comprehensive Development Programme on Riverside along the Huangpu River on the 10th Jan 2002. It will be another ambitious project following Pudong development started 12 years ago in Shanghai. The project aims to developing riversides along the Huangpu River into an international-level one, demonstrating the city's image. The riversides will be shifted from current warehouses and docks to financial and trade zone, tourist attraction, and residential areas. It will help Shanghai to reach its long-term objective, i.e., an international centre of economy, finance, trade, and shipping. Total investment is expected to be 100 billion yuan RMB.

The ambitious project will cross five administrative districts as Pudong, Luwan, Huangpu, Hongkou and Yangpu. Total planning area is 2,260 ha with riverbank of 20 km long. Four areas are planned to be the focal points:

- *Yangpu Bridge*: This area, 1.99 km^2, will be a residential area as well as an education, science & technology park.
- *Shanghai shipyard to north Bund*: This area, 1.06 km^2, will be renovated focusing on shipyard rebuilding and international water transport centre setup. Docks at Shanghai Shipping Yard will be rebuilt into a tourist and entertainment site, meanwhile, office and residential buildings will be set up along the riverside. These constructions at the crossing of Huangpu River and Suzhou Creek together with buildings at Bund and Liujiazui Financing and Trade Zone will form a unique landscape in Shanghai.
- *Shiliu Pu to Dongchang Area*: This area, 0.35 km^2, will be developed into a residential area. Existing water transport station will be removed, and some warehouses will be rebuilt into a holiday market. An Old Town will be set up as a new tourist and shopping centre among the traditional architectures of Yu Garden. The Old town and new development zone, past and future will be linked here.
- *Nanpu Daqiao*: This area is about 3.43 km^2 large. It will be developed into an area for living, working and entertainment. The site of 2010 Expo will be the hot spot in this area. It is planned that a man-made isle will be set up, like Fuxing Isle at downstream of the Huangpu.

When all the development projects along the Huangpu are completed, two axes in the City will come into being. One is a east-to-west axis from Century Park in Pudong to Hongqiao Development Zone in Puxi, and the other is a north-to-south axis that is along the city's artery, Huangpu River, and will be the shining star demonstrating Shanghai's development in the 21st century.

3.2.2 Analysis of Compatibility of APL Strategic Framework with Comprehensive Redevelopment Programme of Riversides along the Huangpu

Comprehensive redevelopment of riverside of the Huangpu is the core project for Shanghai to implement the City Master Plan in the new century. Therefore, all the construction projects shall be in line with this core task, helpful to the environmental improvement and functional change of the Huangpu River.

1) Sharing common development target

These two projects are bearing the common strategic objectives that are to build Shanghai into an international centre of economy, trade, finance and shipping, to improve the overall environmental quality and living standard, and to upgrade the sustainability of Shanghai. The two projects are compatible and supplementary to each other.

2) SHUEP in APL Programme will facilitate the comprehensive redevelopment on riverbank site along Huangpu

   - The service area of SSP-III covers Baoshan, Hongkou, Yangpu and Pudong districts. Except Baoshan District, the rest areas are included in the major redevelopment zone in Huangpu River project;
   - Construction of WWTPs at Upper Huangpu aims to protect drinking water source and improve water quality at water intake. Downstream users will be benefited;
   - Solid waste management project will provide a sound solution for the domestic refuse, restaurant wastes, hospital wastes through waste minimisation, reusing and recycling;
   - The Old Town project, listed in the SHUEP, is also suggested in Huangpu River redevelopment project.
   - Some urban infrastructure engineering and rehabilitation of industrial zones are also covered in Huangpu River redevelopment project.

3) Policy mechanism for Huangpu River redevelopment project is just what is advocated in APL strategic framework

To facilitate the comprehensive redevelopment of riversides along Huangpu River, the SMG has released a group of favourite policies. The role of government will be changed with planning, policy support and service as major tasks. Shanghai has established Huangpu River Redevelopment Investment (Group) Ltd. to care the project physical operation. In the APL strategic framework it is stressed that the role of government should be changed from an investor of environmental infrastructure and a direct service provider into an organiser and a mediator. Financing through various sources and establishing environmental industries to provide services are advocated. In fact, China's entry into WTO has already laid a common platform for the SHUEP in APL Programme and Comprehensive Redevelopment Project of Riversides along Huangpu River. These two projects are with same innovative policy mechanism.

3.3 Assessment of Impact on Regional Environment Quality in Shanghai

3.3.1 Regional Environmental Objectives in Shanghai

3.3.1.1 Objective of Ambient Air Quality

An integrated objective of ambient air quality by 2005 is to make Shanghai a metropolis with good ambient air quality, suitable for business development and living whilst the main index of ambient air quality should reach the average level of same kind of metropolis in developed countries in mid 1990s. By 2010, the main index of ambient air quality will reach the same level of developed countries.

3.3.1.2 Objective of Surface Water Quality

Objective of water quality in the end of "the tenth five year" period is to let the black and stink be eliminated in main waterways in city proper area, the pollution of suburban waterways be arrested, water quality of Suzhou Creek and The Huangpu River improve continuously, so as to improve the aquatic ecosystem step by step, and let fishes return in river.

A long-term objective is to overall meet the requirement for water environmental functions, let fishes appear in rivers with beautiful scenery along rivers, so as to create a good ecological environment in Shanghai.

3.3.1.3 Objective of Acoustic Environment

Short-term objective of the acoustic environment is:

- 100% compliance for regional ambient noise;
- 90% compliance for traffic noise;
- 90% compliance for stationary sources;
- 15 more neighbourhoods and areas in compliance.

Long-term objective:

- 100% compliance for regional ambient noise;
- 95% compliance for traffic noise;
- 100% compliance for stationary sources;
- 28 more neighbourhoods and areas in compliance.

3.3.1.4 Objective of Solid Waste Disposal

Focused on no harm disposal of domestic garbage, to establish a service system of sorting, collection and minimisation and reusing, to construct secure landfill site for hazardous wastes, thus form a sanitary management and garbage disposal system for a mega-metropolis. By 2005, 90% of city proper area will practise sorted collection of domestic garbage, the garbage reuse rate will reach 64%. In the "tenth five year" period, it is planned to invest 8.4 billion yuan to construct 53 garbage handling facilities and 11 comprehensive solid waste treatment plants basically to realise the no harm of domestic garbage and comprehensive utilisation of industrial solid wastes.

3.3.1.5 Objective of Greening Planning

The new round of integrated planning objective is to readjust the layout of green land, compliment types of green land, make city scenic spots abundant, and improve urban environment quality. The objective is to form a large greening system in urban environment of city proper which take "circulation, insertion, gallery, garden" as the basic, combining with forest land at seashore, green land in beaches, shelter green land and greening along both sides of main traffic roads and the corridor of high tension lines, greening belts along rivers, orchards, economical forests, scenery areas and special green lands.

Near-term objective is to achieve over 6 m^2 of public green space per capita, over 12 m^2 of green space per capita, and greening rate > 18%, greening coverage rate > 30%.

Long-term objective by 2020 is to reach public green space per capita > 10 m^2, green space per capita > 21 m^2, greening coverage rate > 35%.

3.3.2 Actions Planned to Improve Local Environment in Shanghai

To continuously improve the environment and provide a sound environmental infrastructure for living and business in Shanghai, an environmental planning, the objectives for medium and long term environmental protection, as well as the action plan for 2001 ~ 2005 have been set out in Shanghai based on the city master plan. The implementation of projects according to APL strategic framework along with city renewal will push the city-wide implementation of the environmental plan.

3.3.2.1 Actions for Ambient Air Protection

The actions planned to improve ambient air will be:

- to relocate polluting enterprises within the city centre;
- to make balanced use of energy such as prohibiting new installation of coal-fired facilities within Inner Ring Road and promote electricity-based energy consumption;
- to renovate coal-fired industrial boilers of small-and-medium size with natural gas fired ones;
- to introduce clean coal technology and establish co-generation facilities within the area between Inner Ring Road and Outer Ring Road; and
- to promote cleaner production technology and enhance pollution control over existing point sources.

To ensure the roadside air quality compliant with Class 2 level of National Ambient Air Quality Standard, following measures will be implemented:

- To enforce a more rigid vehicle exhaust standard for new vehicle, European III standard will be enforced on light-duty vehicles by the year 2008, while for heavy-duty vehicles and motorcycles, it is required that the emission standard shall be in line with the international practice by the year 2010.
- To improve inspection and maintenance on the vehicles in use;
- To promote cleaner fuel application for vehicles;
- To boost mass transportation and implement a regional traffic volume control programme, and etc.

3.3.2.2 Actions for Water Environment Protection

Following actions planned will be implemented for the water environment improvement:

- The industries with direct discharge of effluent into The Huangpu River will be relocated;
- Dry weather flow being discharged into The Huangpu River via pumping stations will be intercepted into the sewerage system;
- Sewage interception system for Pudong section of SSP-II will collect the sewage which is currently directly discharged into The Huangpu River, and completed during 2001 ~ 2005;
- The existing hydraulic infrastructure will be fully deployed to regulate the water flow in some small-and-medium sized waterways;
- Land areas between Nanpu and Yangpu Bridges will be rehabilitated based on the scheme approved by SMG.

3.3.3 Potential Impact of the Strategic Framework on Regional Environment

3.3.3.1 Improvement on Air Quality

As the air pollution is quite concerned in Shanghai, SMG gave a high priority to it. An air pollution control component could be included in APL Programme. This could comprise the conversion of boilers used for district heating, and conversion of buses and taxis for use of cleaner fuel, e.g., CNG, etc. to deal with the growing pressure of vehicle pollution to the city's air quality. Such kind of action is actually a part of the planned measures to be taken for improving the ambient air, and will no doubt benefit the environment in Shanghai.

In addition, in connection with the proposed components in the programme, a series of different sectoral actions are closely related to the improvement of local air quality. Those could include the upgrading of operation process in collection, transport and disposal of garbage by solid waste management, greening and landscaping for city centre upgrading by urban rehabilitation, eliminating of the black and stink in the waterways in the city proper by wastewater management, and so on.

3.3.3.2 Improvement on Water Environment

It is expected that the implementation of proposed APL strategic framework will reduce sewage of considerable amount directly discharged into the Huangpu River and its tributaries. This will somewhat improve the water quality.

If the implementation of projects of APL is coincided with Shanghai Tenth Five-Year Water Environmental Plan, there will be a great improvement in the water environment in Shanghai. At that time, over 70% of direct loadings in the middle and lower reaches of The Huangpu River could be reduced to result in the water quality there meeting Category IV level; whilst over 40% of direct loadings in the upper Huangpu would be cut down to make the water quality achieving Category III. For the major waterways in the City Proper, Category V level could be met.

Meanwhile, the rehabilitation on land area along the downtown section of The Huangpu River will be synchronically implemented. Bustling downtown together with rivers and green pedestrian corridors will be a unique feature for Shanghai, a city by water.

3.3.3.3 Improvement on Treatment and Disposal of Solid Waste

The implementation of the SHUEP will form an overall process management system for handling solid waste from its source to the ultimate disposal. Sorting collection, containerised transport, recycling and reuse, sanitary landfill, incineration, biochemical treatment, and etc. will be applied.

By 2010, the sorting collection of domestic refuse in the urban area of Shanghai would be near to 98%, recycling for reuse 20%, compacting collection 95%, thus, the transport of refuse will be basically sealed and containerised. In the whole city proper, the reuse of domestic refuse could be expected to reach 70%, non-hazardous disposal 100%, and 75% night soil disposal would be conveyed by sewers.

By 2010, the sorting collection of domestic refuse in the rural area of Shanghai would be near to 98%, recycling for reuse 15.2%, compacting collection 80%, and the collection system of refuse will be all established in all villages. In the whole rural area, the reuse of domestic refuse could be expected to reach 75.1%, non-hazardous disposal 100%, and 50% night soil disposal in towns would be conveyed by sewers.

3.3.3.4 Improvement on Ecological Condition

Greening and landscaping will form a variety of beautiful scenery. It will help Shanghai improve bio-diversity and create a better eco-environment.

1) To alleviate "heat island" effect in city

Because of the thermal pollution from industrial and scarcity of green space, the city proper has a serious "heat island" effect regardless of the waterways such as the Huangpu River, Suzhou Creek traversing. The vegetation, especially big trees, is a useful tool to regulate the air humidity and temperature, prevent strong wind, and improve local climate. According to a research on the effect of Yanzhong Green Space in the downtown in 2001, it has been found that the green space is capable of alleviating the intensity of local heat island by decreasing 0.6°C of the air temperature.

Greening project of APL Programme will increase the green coverage and improve the local eco-environment. It will play an important role in alleviate local "heat island" effect and create a comfortable living surroundings.

2) To beautify the city

The Old City and others are the areas mixed with industries, residents and docks at present, and are all planned to renew. The APL Programme will improve those areas for providing good entertainment and relaxation sites for the citizens and visitors.

3) To clean air and reduce noise

Green plants have a unique function in respect to cleaning the air. They can reduce dust, absorb toxic or harmful gases, and release healthy negative ions. A green corridor can also reduce noise as well.

3.4 Assessment of Social Impact

3.4.1 Potential Impact of Land Acquisition

1) To accomplish the renewal of areas which land is to be acquired

The land to be acquired in the projects in APL Programme is mostly in the areas, which are old and mess with lack of availability of good infrastructure and green space in Shanghai. In the new round of Shanghai Master Plan, they have been prioritised to rehabilitation. The implementation of the APL Programme will speed up this plan to realise and enable those areas to shift their functions more rational.

2) To raise land value

It is estimated that the price of real estate may several folds increase in such as Old Town Greenbelt Ring, NW Park and their vicinity. The steep rising for the price of properties along the riversides due to the successful project of Suzhou Creek Rehabilitation and establishment of Lujiazui Financial and Trade Centre are convincing examples.

3.4.2 Impact on Living Standard of Resettlers

In the proposed sites to be acquired in the projects of APL Programme, most residents are living in old houses, and some even in sheds and shacks. Incomplete infrastructure, dense population and environmental degradation result in unsatisfactory living conditions for residents. All of the industrial polluters, together will those old residential houses will be relocated. The residents will move into some larger residential areas, constructed according to the city master plan.

Taking a certain residential area in the Old City as the example, the living condition there is compared with another one for resettlement located between Inner Ring Road and Outer Ring Road (Table 3-2).

Table 3-2 Example for Comparison of Living Conditions before and after Resettlement

Item		An old residential area	A residential area near Outer Ring Road
Environment	Type of land	Mixed with residences, stores, factories	Large residential area
	Environmental quality	Per capita green space is zero, with noise and poor sanitation	30% green coverage with quiet and comfortable surroundings
Housing	Per capita living area	4-5 m^2	About 20 m^2
	Type of housing	Old 1-2 story building or shacks	Six story building with good sunshine
	Facilities	With town gas, but no sanitation, shared kitchen	Town gas, sanitation, individual kitchen
Shops	Shop scale	Various, from large to small	Medium and small sized shop, enough for living necessities
	Shopping	convenient	Not bad
Education	Schools	Various school, primary, secondary, high school and professional school, in short distance,	Primary school and middle school, but rather far away
	Education quality	good	Normal
Communicatio	Mass transport	many bus lines	Limited bus line

ns	Road condition	congested	Smooth
Health care	Hospital level	hospitals at municipal. district or neighbourhood level	hospitals at district or neighbourhood level
Entertainment	Amount	Many, cinema, shopping mall and cafeteria, and etc.	Scarce

It is illustrated there will be a great improvement regarding living environment and housing, however, education, communications, health care and entertainment facilities will be not so convenient and facilitated as the downtown areas. However, the overall living conditions for the resettlers will be greatly improved.

3.4.3 Impact on Population Distribution

The SMG is making efforts to optimise the population structure and improve citizen's quality. Reduction of the population density, particularly in the downtown area, is one of the tasks. The resettlement at such as Old Town Greenbelt Ring is in line with this trend. There will be a great change regards to the population distribution and structure in this area.

3.4.4 Impact on Scenery Views

The Old Town Greenbelt Ring and upgrading of wastewater management and solid waste management systems are also parts of the comprehensive development project along the Huangpu River. The Huangpu River is the major waterway in Shanghai. The waterway rehabilitation together with greening and landscaping programme has been prioritised in the Shanghai Master Plan. This is the first largest landscaping project in Shanghai for the new century. This is a planning at higher standard and higher level. The waterways will create a harmonious and dynamic environment for Shanghai. According to this master plan, some key industrial polluters like shipyards, steel plants, and construction material plants will be removed. The areas along the Huangpu River will be redeveloped into a relaxation and recreation site for visitors and citizen. It will become a key scenery spot and a symbol of Shanghai in the 21st century. It will be no doubt to support and promote the realisation of this ambitious plan by providing with adequate infrastructure through implementation of the APL Programme.

3.4.5 Impact on Cultural Property

A city's architecture is the showcase of its history. The Old Town Greenbelt Ring in the APL Programme, for instance, is to be located in the old town, which represents the unique tradition of Shanghai. Yu Garden and Chenxiang Pavilion are the state-level preserve properties, together with 10 city and district level ones, and some tradition residential areas and shops. Surrounded by Yu Garden on the north, Wen Miao (Culture Temple) on the south, and Shuyin Pavilion on the east, this whole area is preserved as a small traditional old town of Shanghai. In particular, the proposed site of the Old Town Greenbelt Ring will be closely linked with the Bund Historic and Cultural Style Preserve Zone and its opposite, the Lujiazui Financial and Trade Zone, across the Huangpu River.

The Bund is an outstanding architectural showcase, and nearby Shanghai General Post Office is another state-level preserve building. Lujiazui Financial and Trade Zone is the demonstration of the city's recent development since 1990. It is a picture of modern Shanghai. From Yu Garden, Old

Town, the Bund, to Lujiazui, and other development projects along the riversides of the Huangpu River, it is a track of five-hundred-year development and history of Shanghai.

Therefore, the APL Programme will actively promote the historic and cultural property preservation in this area.

3.4.6 Impact of Policy and Institutional Reform

The development target of SHUEP in APL Programme will come true through a package of measures in policy, institutional and financial reform, and physical project investment. The reason why the World Bank wishes to provide loan to SMG depends to a considerable degree upon the innovation capacity in respect to policies, institutional arrangement, and Shanghai's wish to become an example for other cities in China. Just as the preparation for the APL project, the SMG is continuing to change from a direct service provider to more of a regulator and facilitator, and to implement the project according to market operational mechanism. Shanghai is seeking for domestic and overseas outstanding enterprises, qualified personnel and capital to participate in development of projects, and to promote the construction for urban environment in Shanghai. Therefore, the APL strategic framework will certainly give Shanghai impetus to further reform and opening.

Besides, the APL is an appropriate vehicle to improve the management of the Huangpu River catchment. A catchment should be managed as a whole regardless of its extent across the administrative boundaries. There has been a lot of lessons by the responsibilities for water resources management split among different agencies. The APL Programme may be expected to give impetus to change such a situation. It could greatly benefit the whole catchment.

3.4.7 Influence on the World Bank

Now, Asia-Pacific region is taking a leading role in the global economic development. China has become one of the countries with highest economic growth and highest international investment. Shanghai is the leading city and the most dynamic areas in China. Selecting Shanghai to implement the APL Programme would be a sensible choice.

Shanghai, as so called a "dragon's head" of the Chang Jiang, has an enormous influential capacity to the inland part of China. As Shanghai is situated at the middle of the western coastline of Pacific Ocean, it can play an example role in developing countries all over the world through the widespread exchange with the global community for the latest 200 years. The SMG is one of the strongest local governments possessing market consciousness and highest efficiency. All of these would be of great advantage to ensuring the security of World Bank loan, and to managing the implementation and finally to realising the development targets of APL Programme.

Therefore, the implementation of APL Programme in Shanghai could further promote the influence of APL itself as well as the World Bank in the world. It can become a bridge to connect the whole world.

4 Description of SHUEP in APL Programme Phase One Components

4.1 General

Phase One of SHUEP in APL Programme is composed of five components. Table 4-1 lists the characters of those sub-projects.

Table 4-1 Characters of five sub-projects

Name of project	Construction site	Project scale and scope of service	Character
Shanghai Sewerage Project (Phase III)	Baoshan, Hongkou, Yangpu Districts, and Pudong New Area	Total service scope: 167.61 km^2 and 2.13 million population. Project includes: sewage treatment plant (design capacity 0.50 million m^3/d), 19 sewage pump stations, and 16 storm drainage ones	Wastewater collection and treatment project
Laogang Landfill Expansion Project (Phase IV)	Laogang Town of Nanhui District	Design capacity: 4,900 t/d, service area: urban area and Nanhui District	Domestic solid waste disposal project
Greening and historical city park around old zone	Huangpu District	Construction area: 89,600 m^2, with 5,357 households and 254 units to be resettled	Historical zone reformed and greening project
Fengjing Wastewater Treatment Plant	Fengjing Town of Jinshan District	Design capacity: 14,000 m^3/d	Wastewater collection and treatment project
Jinshan Xinjiang Wastewater Treatment Plant	Tinglin, Jinshanwei, Shanyang and Zejing, 4 Towns of Jinshan District		Wastewater collection and treatment project
Fengxian South Sewer Treatment Plant	13 towns of Fengxian District		Wastewater collection and treatment project

4.2 Shanghai Sewerage Project III

Since 1980s the SMG has reinforced the input on environmental programmes, the SSP-I and SSP-II were completed, improving the water quality of the Huangpu River and Suzhou Creek. But sewages from some areas of Suzhou Creek catchments and parts of Huangpu, Baoshan, Zhabei Districts as well as part of Pudong Area still discharged to the Huangpu River, to damage the water environment and to restrict the sustainable development of Shanghai. In order to improve the drainage system, solve the problem of mixing of sewage and storm runoff, the SSP-III is expected to effectively solve the problem of handling the sewage of North and Northeast parts of urban area. It also provides the solution to the intercepted sewage from tributaries of Suzhou Creek and Hongkou Gang and Yangpu Gang areas, and then improves water quality of Suzhou Creek, Huangpu River and their tributaries.

4.2.1 Service Area

Total service area is 163.34 km^2 to serve population of 2.39 million with a sewage flow rate of 1.06 million m^3/d.

The service area mainly consists of three parts, i.e.:

Area A: South of Shidong Kou sewage discharge system (Yunzao Bang as boundary), north of service area of SSP-I. Its service area covers 117.2 km^2 serving population of 1.41 million.

Area B: North of Suzhou Creek, west of the Huangpu river, south of service area of the SSP-I. Its total service area covers 31.56 km^2 serving population of 0.88 million.

Area C: North of Zhaojia Gou in Pudong which is not served by the SSP-I. Its total service area is 14.58 km^2 serving population of 93,100.

Fig. 2 and 3 illustrate the range and geographical positions of various service areas. Table 4-2 Gives the service areas and population of this engineering and planned sewage quantity.

Table 4-2 Service areas of SSP-III

Area	Service area (km^2)	Service population (million)	Planned sewage flow (Mm^3/d)
A	121.58	1.4126	0.6000
B	31.56	0.8802	0.4052
C	14.58	0.0931	0.0547
Sum	163.34	2.3859	1.06

4.2.2 Main Elements of the SSP-III

1) Sewage collection system:

Trunk sewer and link sewers in sub-service areas, main storm runoff drainage system in Baoshan District.

2) Construction of Minxing Sewage Treatment Plant, or No.2 Zhuyuan Sewage Treatment Plant:

Wastewater treatment — sewage treatment plant;

Wastewater discharge — outlet pumping station and outfall.

4.2.3 Sewage and Storm Runoff Collection System and Diversion

4.2.3.1 Area A

1) Collection system and pipe alignment

Most part of this area is using separate system. In order to avoid re-excavating the roads due to laying sewage sewer and storm drainage sewer not at same time, the construction of both systems will carried out at same time.

It will serve the area south of Yunzao Bang (including the area in Zhabei District which has not been served by the SSP-I and the Suzhou Creek tributary catchment interception project).

Total service area is 55.56 km^2 with population of 0.5511 million and design capacity of 0.2334 million m^3/d.

134.63 km trunk sewer will be build, meanwhile 3 sewage pump stations at Minzhu, Wenshui and Zhangmiao will be build. Of 136.45 km storm draining pipes, 82.515 km will be laid in the near future whilst the rest 53.93 km will be in the far future. Of total 16 storm drainage pump stations, 10 ones will be built in the near future.

2) Sewage discharge

To utilise the spare capacity of the SSP-I and Shidong Kou Sewage Treatment Plant, they may receive 0.40 million m^3/d and 0.60 million m^3/d of sewage flows respectively.

4.2.3.2 Area B

1) Discharge option

There are two options for discharge in the Area B:

Option 1: On-site treatment by construction of a sewage treatment plant with a capacity of 0.50 million m^3/d to meet the requirement for Class 2 of Shanghai Integrated Wastewater Discharge Standard and then discharge its effluent into the Huangpu River.

Option 2: Conveyance of the sewage in the Area B to Zhuyuan where the Zhuyuan No.2 Sewage Treatment Plant to be facilitated to meet the requirement for Class 2 of Shanghai Integrated Wastewater Discharge Standard and then discharge its effluent into Chang Jiang

2) Collection system and pipe alignment

Service area of the collection system is Changbai, Kongjiang, Da Dinghai, Zhoujiazui and Fuxing Isle drainage systems, east of Yangpu Gang, covering an area of 11.37 km^2 with population of 0.307 million and design capacity of 1.63 million m^3/d.

6 trunk sewers are to be laid with a length of 9.54 km in total, and a sewage pump station at the Jiamusi Road is to be built.

If the sewage is sent to Minxing Sewage Treatment Plant, 3.554 km long trunk sewer in 3,500 mm in diameter will be built whereas 13.524 km trunk sewer in 2,700 ~ 3,500 mm in diameter for the Option 2.

4.2.3.3 Sewage Collection System in Area C and Pudong New Area

It will be implemented by near-term and long-term steps:

Near-term: the secondary trunk sewer (including pump station) is designed based on projected sewage flow, 5 pieces with 34.2 km long in total and 7 midway lifting pump stations will be constructed.

Long term: the tertiary trunk sewer with 248.28 km long in total for all towns, and 8 local pump stations are to be built.

4.2.4 Wastewater Treatment Plant

A sewage treatment plant is to treat the sewage from the Area B. There are two options: on-site treatment and diversion to outside. On-site treatment is to build a sewage treatment plant beside the

Huangpu River and release its effluent into it. Diversion to outside is to collect the sewage and send to Zhuyuan, then discharge into Chang Jiang after being treated.

Siting of the sewage treatment plant has two options: Minxing Sewage Treatment Plant and Zhuyuan No 2 Sewage Treatment Plant.

4.2.4.1 Design capacity

The design capacity is 0.5 million m^3/s with average dry weather flow of 5.79 m^3/s, dry weather peak flow of 7.52 m^3/s and minimum flow of 3.47 m^3/d, and storm peak flow of 21.26 m^3/s.

4.2.4.2 Design Strength of Influent and Effluent

Based on the survey of sewage water, the strength of influent is proposed. The effluent strength should be in compliance with Class 2 of the Shanghai local discharge standard (Table 4-3).

Table 4-3 . Design strength of influent and effluent of the sewage treatment plant

Item	COD_{Cr}	BOD_5	SS	NH_3-N	TP
Influent strength (mg/L)	300	150	200	25	4.0
Class 2 of local standard (mg/L)	120	30	30	10	1.0

4.2.4.3 Sewage Treatment Plant Site Alternatives

Option 1: The location is selected at the area east of Jungong Road, north of Minxing Road, south of Gongqing Nursery, west of planned road (Fig. 3).

Option 2: The location of the plant is selected at south side of Zhuyuan No.1 Sewage Treatment Plant. The land is under reservation by Zhuyuan No 1 Sewage Treatment Plant (Fig. 3).

4.2.4.4 Sewage Treatment Process Alternatives

1) Minxing Sewage Treatment Plant

Secondary treatment process is adopted, plus nitrification and phosphorus removal, the effluent is to be disinfected prior to being discharged and partly be recycled.

There are three options for the sewage treatment scheme:

a. A^2/O nitrogen and phosphorus removal technology is adopted, the effluent reused for landscape.

b. High efficiency sedimentation pond + bio-filtration treatment, half underground.

c. High efficiency sedimentation pond + bio-filtration treatment, underground.

2) Zhuyuan No 2 Sewage Treatment Plant

A^2/O nitrogen and phosphorus removal technology is adopted.

4.2.4.5 Comparison of Alternative Technologies

Two different treatment technologies at the same location is compared (Table 4-4).

It seems that both sewage treatment technologies all could meet the requirement for «Shanghai Integrated Wastewater Discharge Standard», thus both are feasible.

4.2.4.6 Discharge Outlet

1) Discharge into Chang Jiang

The sewage collected from the Area B is to discharge into Chang Jiang at Zhuyuan, just south of the existing outfall of the SSP-I. A head tank would be combined with that of the outlet pump station into one located at inside 100 m from of the dyke. The discharge mode would be beside the bank. When an emergency discharge happens, a deep outfall would be used.

Table 4-4 Comparison of alternative treatment technology

No	Comparison content	Chemical sedimentation + bio-filtration	A^2/O nitrogen and phosphorus removal
1	Total investment (million yuan)	609.8005	635.8212
2	Unit investment (yuan/m^3/d)	1,220	1,272
3	Staffing (person)	106	110
4	Dosage of polypropylene acylamide (kg/d)	725	325
5	Dosage of liquid poly-aluminum (kg/d)	45,000	-
6	Unit power consumption (kWh/m^3)	0.348	0.189
7	Annual electric consumption (MWh/a)	63507.1	34446.5
8	Sludge quantity (m^3/d)	271	186
9	Annual total cost (million yuan)	104.9881	109.6415
10	Unit cost (yuan/m^3)	0.58	0.60
11	Annual running cost (million yuan) (not including depreciation or amortisation)	75.6719	79.0746
12	Unit running cost (yuan/m^3)	0.41	0.43
13	Use of environmental capacity	Partly	Partly
14	Effluent compliance	Meet the requirement for Class 2 of Shanghai discharge standard	
16	Operation management	more complex	simple

* not including depreciation or amortisation

2) Discharge into the Huangpu River

The outlet is to be set below the average level split into 2 ~ 3 ones with 30 m interval in between. The size of the outlet is 3,500 mm in diameter. During the dry season, the average flow rate is at 3 ~ 4 m^3/s each. When an emergency happens, the sewage is to directly discharge into the Huangpu River via a bypass.

4.2.4.7 Treatment and Disposal of Sludge

The sludge generated in the process of high efficiency sedimentation plus bio-filtration treatment will be 271.4m^3/d with water content of 65%; whilst in the process of A^2/O nitrogen and phosphorus removal will be 186 m^3/d with the same water content.

Sludge treatment will use mechanical concentrating and dewatering process; and its disposal will use barges or vehicles to send to a sludge treatment works at Bailong Gang.

4.2.5 Environmental Measures Planned

4.2.5.1 Treatment of Stink

1) Minxing Sewage Treatment Plant

The foul smell generated from the sewage treatment plant will be collected and treated with bio-filtrator, and finally emitted through a 16 m high stack. The biological technology could decompose pollutants in the waste gas into CO_2 and H_2O so as to avoid causing the secondary pollution. The installation of this process will need certain area but can be under the ground and covered as the top keeps the same level of the ground.

2) Pumping Stations

The grid basin in the pumping stations will be covered with shelters, in which the foul stink gases would be concentrated and drawn to the treatment cabins before exhausted into the air.

4.2.5.2 Noise Prevention

1) Minxing Sewage Treatment Plant

All the installations are to be set under the ground thus to mitigate the noise disturbance.

2) Pumping Stations

Basically, submersible pumps are to be used in the pumping stations. The noise intensity of such kind of pumps will be 15 dB(A) lower than that of ordinary axial pumps. Meanwhile, the sound insulated doors and windows of the pump houses are to be used to greatly reduce the impact of noise to the surroundings.

4.2.6 Total Loading of Pollution Derived from the SSP-III

The release of pollution loads from the SSP-III has been estimated (Table 4-5).

4.3 Laogang Landfill Expansion Project IV

4.3.1 Status of Previous Laogang Landfill Projects

The Laogang Landfill started to construct in 1985, and its Phase I was commissioned in 1990 with an operation area of 1.5 km^2. Since then, the Phase II was completed in the end of 1993, and the Phase III was in the early 2000. The total investment for the three phases amounted to 320 million yuan RMB, and the Landfill has covered an area of 3.2 km^2 and a disposal capacity increased from 2,500 t/d to 7,500 t/d as a whole. At present, its actual capacity has reached 9,500 t/d. It is the only scaled landfill site for disposal of 90% of domestic refuse in Shanghai.

In the present time the Laogang Landfill has not met the requirement for a sanitary landfill site. The major problems are as follows:

- no reliable anti-permeating measures in the landfill site;
- the treatment of leachate incompliant with a discharge standard;
- serious stink due to the exposure to the air when handling refuse on docks and filling work area;
- no separate drainage system facilitated to finished landfill cells;
- water quality in the harbour basin polluted;
- offensive smell emitted from leachate treatment system and regulating pond;
- no overall plan for the utilisation of the finished landfill site.

In 2001, the annual wastewater discharge from the Laogang Landfill amounted to 3.865 m^3, in which, 0.365 million m^3 were leachate, 36,500 m^3 were domestic wastewater, and the rest was the amount for changing the water in harbour basin. The annual pollution loads amounted to 1,091 t of COD_{Cr}, 279 t of BOB_5, 0.16 t of petrol, 151 t of NH_3-N, and 817 t of SS.

Table 4-5 Estimates of pollution loading of the SSP-III

Type	Item	Option 1	Option 2	Option 3	Option 4
Wastewater	COD_{Cr} (t/d)	≤60			
	BOD_5 (t/d)	≤15			
	NH_3-N (t/d)	≤5			
	TP (t/d)	≤0.5			
	SS (t/d)	≤15			
Solid waste	Grit	4.4t/d (water 80%)			
	Sediment	2.9t/d (water 60%)			
	Sludge (water 65%) (m^3/d)	271.4	186	186	271.4
	Spoil (m^3)	924418	774803	846049	876879
Noise [dB(A)]	Foul/storm conveying pump	72-85			
	Inlet pump house	80-85			
	Aeration bio-filter	95-100			95-100
	Sludge scrapper	85-90			
	Air blower (A^2/O)		95-100	95-100	
	Outlet pump house	80-85			
	Sludge dewatering house	90-100			
	Sludge recycle pump	75-85			
	Residue sludge pump	75-85			
Stink pollutants					
Sewage treatment plant	H_2S (kg/h)	0.144			
	NH_3 (kg/h)	0.540			
	Stink intensity	2000 (no dimension)			
Pump station	H_2S (mg/h)	124-1533			

The gases generated from the filled area of the Laogang Landfill amounted to 23.98 million m3 annum, in which 13.19 million m^3 were methane, 7.19 million m^3 were carbon dioxide, 3,000 m^3

were hydrogen sulphide, and 0.206 million m^3 were ammonia.

4.3.2 Briefing of the Laogang Landfill Expansion Project IV

Laogang Landfill Expansion Project Phase IV for disposal of 4,900 t/d of domestic refuse is to be located on the reclaimed shoals east of the previous landfills (Fig. 4). The proposed area will cover 3.36 million m^2 (4,200 m from north to south, and 800 m from east to west) to fill up from +2 m to +13 m with a volume of 35 million m^3. Its expectation life will be 18 years. The total investment will be 973.389 yuan RMB, and it will be completed and commissioning in 2004.

The technical standard of sanitary landfill is taken as technical requirements for construction and operation of the Project. Vertical barrier and HDPE liner as an artificial anti permeating system will be built to enclose the operation area, and a separate drainage system and leachate treatment system will be facilitated as well. The way of transporting garbage will gradually be containerised. The filling operation uses such processes of compacting by layers, daily covering, interim covering and finishing covering after slope filling. The gas will be exhausted in the early stage, and collected and utilised to evaporate the leachate later.

The refuse to be disposed of by the Project is mainly domestic from the urban area, and could be something additional from rural area and residues from reusing process after 2005. The composition of domestic refuse to be disposed of could be different from time to time (Table 4-6).

Table 4-6 Composition of domestic refuse in the different periods

Unit: % of wet weight

Year / Type	2005	2010	2015
Food waste & peel	62.37	58.76	55.78
Debris	2.17	1.92	1.79
Paper	10.83	12.82	15.44
Plastics	13.21	12.98	12.62
Textile	3.21	4.41	5.28
Wood & bamboo	1.93	2.49	2.86
Glass	5.45	5.64	5.36
Metals	0.83	0.98	0.87

4.3.3 Project Scheme

4.3.3.1 Layout of the Phase IV Landfill Zone

The base of landfill zone is at a level of about 3.4 m above the datum enclosed by a cofferdam with a top elevation of 8.0 m. The area of filling zone is over 320 ha.

The main road system consists of the roads in direction from east to west and from north to south connected with a circular round on the top of the cofferdam to form a complete round line. The landfill site is by those roads divided into four sub-zones each with two anti-permeating subzones in a size of 500 m (N-S) × 800 m (E-W) The anti-permeating subzones are separated by E-W dikes with 5.0 m in width on the top at the elevation of 4.5m and 1:2 side slope, and N-S dikes with 1.0 m in width on the top at the elevation of 4.5m and 1:2 side slope. Thus, an operation unit is in size of 500 m (N-S) × 133 m (E-W).

4.3.3.2 Anti-Permeating System

Vertical permeation prevention is to build a vertical barrier enclosing the sites of the Landfills I, II and III. The barrier will be based on a natural horizontal anti-permeating layer existing at the elevation of –10 m to effectively cut off the connection of inside contaminated groundwater from the outside.

Horizontal permeation prevention is structured in a consecutive order from bottom to top as follows (Fig. 5): groundwater collecting system, 20 cm thick sand drainage layer, up to 25 cm thick clay layer, base of anti-permeating film (400 g/m^2 long fibre polyester geo textile with a permeability $K<1\times10^{-12}$ cm/s), 2 mm thick HDPE anti-permeating film, covering layer (400 g/m^2 long fibre polyester geo textile), duct for draining leachate, 10 cm thick earth net, 20 cm thick sand layer, and 10 cm thick gravel layer.

4.3.3.3 Separate Drainage and Storm Runoff Diversion

Three keys in the separate drainage for wastewater and rainwater in the Phase IV are to control that during operation, after the formation of intermediate covering, and after finished covering. Thus, the measures to be taken are to drain the runoffs in the underground intruding the layer beneath the anti-permeating layer, in the base between filled and unfilled units, on road surface, on the intermediate covering surface and finished covering surface.

4.3.3.4 Options for Discharge of Storm Runoff

Along the outside of Phase III cofferdam, an open ditch is to lay for collecting the runoff from the finished covering of the previous three Phases into an open drainage channel discharging to the East China Sea. The runoff generated in the four units from north to south of the Phase IV will be collected by gravity into either open ditches along the outside of Phase III cofferdam or the inside of eastern cofferdam of Phase IV, and then released into the open drainage channel.

4.3.3.5 Filling Operation and Covering

1) Transport of refuse

Based on the current situation, the transport of refuse will be in compatible mode by using containers and in bulk. Having left docks, transfer trucks will be driven eastwards along the trunk roads across the zones of the previous Phases. Then the trucks pass the roads on the unit separate dikes via those on the main separate dykes and enter a filling operation unit to unload refuse.

2) Filling operation

The filling operation can be done in two working spots simultaneously. Three bulldozers at each spot and three compacting rollers shared by three spots will be equipped. Bulldozers will spread and level a 0.6 m thick single layer, and conduct primary compacting before a special compacting machine rolls 3 times to reach a dry compacting density not less than 0.6 t/m^3 (corresponding to 1.1 ~ 1.2 t/m^3 of wet weight based on the present garbage composition). Then, refuse spreading and compacting on the next layer will be repeated.

Corresponding to the three operational elevations (+4.5 m, +8 m and +13 m), the filling operation will adopt a scheme to reach the final level through two stages. Thus, the loading can be increased on the foundation stage by stage to suit the characters of lower bearing capacity and higher subsidence in the filling zones, as well as to help reduce the wastewater generation and ease the separate draining, collecting and discharging.

Refuse landfill operation at the first stage is accomplished in two steps, i.e., filling up to +4.5 m elevation in the first step and then filling from +4.5 m to +8 m elevation in the second step. The first step of filling operation (+4.5 m elevation) adopts pit-filling method while the second one (+4.5 m to +8 m elevation) adopts piling method on an inclined plane.

The second stage of filling operation (+8 m ~ +13 m elevation) adopts piling method on a inclined plane with 5 m thick refuse filling layer.

3) Covering

There are three types of covering in the refuse landfill process:

- Daily covering — After the filling operation has been finished every day, daily covering should be conducted with the material of degradable plastic membrane (degraded within one year) by a special scroll mounted at the back end of the bulldozer as a laying tool.
- Intermediate covering — When the first stage of landfill started from the bottom of a unit is up to the top of the main separate dyke, the intermediate covering should be carried out with a 30 cm thick compacted earth layer.
- Slope piling and finished covering — When the first stage of landfill is finished in a landfill zone, the slope piling will be started until the final elevation of +13 m reached and then a finished covering will be made.

The surface area of the final covering of the Phase IV will be about 2.80 million m^2. The top covering will be 50 cm thick soil layer and 20 cm nutrient soil.

4.3.4 Environmental Measures Planned

4.3.4.1 Treatment and Discharge of Wastewater

It is an expansion project. Wastewater in the landfill could be from three sources: leachate from filled units, leachate from the units of the Phase IV being filled, and washing water from docks. The wastewater amounts to 2,600 m/d in total with average strength of 10,000 mg/L of COD_{Cr}, 2,500 mg/L of BOD_5, 1,200 mg/L of NH_3-N, and 500 mg/L of SS.

In the feasibility study report, it is indicated that the option by treatment to meet the Grade 3 of «Shanghai Wastewater Integrated Discharge Standard (DB31/199-1997)» and then convey to Bailong Gang Sewage Treatment Plant has a predominant advantage in technical and economical terms, and has recommended as the most suitable alternative for upgrading the leachate treatment system in the Laogang Landfill Expansion Project IV. The recommended process is to build up two sets of treatment facilities, each of which has a capacity of 1,300 m^3/d.

Based on the existing system of oxidation pond, the wastewater will run through a regulating pond (partially to be refilled), anaerobic biochemical process, A/O intra-cycling biochemical denitrification, chemical coagulation — coarse filtration — ultrafiltration and man-made wetland system, and then the effluent will be conveyed to Bailong Gang Sewage Treatment Plant.

The expected effluent can meet the Grade 3 of the local standard.

4.3.4.2 Generation and Control of Stink

Food residues and rinds can account for two thirds of all the municipal waste in Shanghai. The organic in household refuse in forms of protein, fat and polysaccharose such as starch and cellulose may be fermented and decomposed by anaerobic micro-organisms in the course of garbage collection, transfer, transport, and arrival to the docks at the Laogang Landfill. In the process, offensive smelled gases are produced containing ammonia (NH_3), CH_3SH, H_2S, $(CH_3)_2S$ and etc. Those gases will release in the processes of unloading and spreading whilst refuse entering the landfill site.

Based on an experiment on the emission of foul smell from domestic refuse in Japan, the emission strength of major substances would be at rates of 9.2 kg/d of H_2S, 68 kg/d of NH_3, 0.97 kg/d of CH_3SH from 2,000 t of refuse.

Presumably, 15% of the stink substances have dissipated during water transport, and 60% of the rest would be concentrated released in the course of loading, unloading and landfill within about seven hours and half. The foul gases can be herefrom estimated to emit during handling 4,900 t/d of refuse in rates of 1.53 kg/d of H_2S, 11.3 kg/d of NH_3, and 0.16 kg/d of CH_3SH.

As compacting and covering will be done timely after refuse has been filled, the refuse exposure area and duration can be reduced so as to control the emission of foul gases. It could be also helpful to reduce the release of stink in the course of loading and unloading at docks whilst adopting containerised transport.

4.3.4.3 Generation, Control and Use of Methane

The filled domestic refuse can generate gases mainly containing methane (CH_4), carbon dioxide (CO_2) and etc. (Table 4-7). The yield rate may be up to 48 m^3 per tonne of refuse within five years, and 25%, 40%, 20% 10% and 5% of the total would be released in the first, second, third, fourth and fifth year respectively. Therefore, the yield of landfill gas in the operation period of the Laogang Landfill Expansion Project IV can be estimated to be in the range of 0.035 ~ 0.235 million m^3/d with the fifth through fifteenth years being a peak period (Table 4-8).

Table 4-7 Major constituents in landfill gas

Constituent	CH_4	H_2S	NH_3
Content (%) (v/v)	55	0.00013	0.0086

Table 4-8 Estimated yield of landfill gas

Order of operation year	1st	2nd	3rd	4th	5th	6th~15th	16th	17th	18th
Gas yield (million m^3/d)	0.0588	0.153	0.200	0.223	0.235	0.235	0.176	0.0823	0.0353

In the initial operation period of the Landfill, the gas yield would be rather lower. In this case, natural exhaust of the gas may be a good choice. Wells in a size of 800 mm in diameter will be laid crisscross with an interval of 40 m centred by perforated PVC pipe in DN150 and filled with crushed stone of 32 ~ 100 mm in diameters. They are built up in sections with top of the wells and the gas leading pipes being 0.5 m and 1.0 m above the covered surface respectively. As designed, on top of the wells there will be mounted a kind of burning device for landfill gas. The collected flammable gas will be automatically ignited through an automatic detector when a certain concentration is reached. It will exhaust and burn out the landfill gas in time so as to remove the stink and ensure the safety in filling operation as well.

Three years after the commissioning of landfill, the landfill gas generated in the covered landfill units could be put to use. The PVC collection mains will link all the landfill gas pipes. The collected gas will be conveyed to a purifier by a compressor and used for evaporating the landfill leachate.

4.3.4.4 Control of Flies

In the course of transport of refuse, using compacting sealed trucks can control the flies' breeding. Killing flies at the Laogang Landfill will use special processing measures assisted with some pesticides. The process will use concentrated filling within subzones and cover it in time to reduce the exposure of refuse and cut off the course of flies' breeding.

4.3.4.5 Control of Noise

Noise of the Phase IV would be mainly from loading and unloading activities at docks, running of transfer trucks from docks to landfill sites, and landfill operation.

The control measures can be by using equipment with lower noise, limiting operation hours, avoiding idle running of machines so as to mitigate the impact on the surroundings of the landfill site as possible.

4.3.4.6 Isolating Green Belts

As the Phase IV is a consecutive project of the previous Phase III, the arrangement of isolating green belts should be consistent with original plan. The kind of trees should well be selected such as fast-growing tall trees, evergreens, and coniferous trees alternating with broadleaf trees.

4.3.5 Management of Site Closing and Its Ultimate Use

The stabilisation period of landfill refuse is rather long and may extend for about 20 ~ 40 years. The practicability of ultimate using closed site will closely rely on the management of site closing during the stabilisation period. According to the location of Laogang and the requirement for development of green spaces in Shanghai, the ultimate use of the Phase IV area should be as a nursery base and a recreation park. Thus, it is better to work out a greening plan as early as possible, and support the vegetation restoration programme in the period of management of site closing.

4.3.6 Total Loads of Pollutant Emission

The annual loading in the Phase IV is summarised as follows: 0.949 million m^3 of wastewater flow, 228 t of COD_{Cr}, 87.3 t of BOD_5, 19 t of NH_3-N; 4.3 t of H_2S, 0.4 t of CH_3SH, and 34.9 t of NH_3 (Table 4-9).

Table 4-9 Total loads of pollutants

Pollution variable		Emission (m^3/d)	Before treatment			After treatment		
			Conc. (mg/L)	Emission		Conc. (mg/L)	Emission	
				(t/d)	(t/a)		Per day	Per annum
*Foul gas	H_2S						11.8 kg	4303 kg
	CH_3SH						1.2 kg	438 kg
	NH_3						95.5 kg	34870 kg
Waste-water	COD_{Cr}	2600	10000	26	9490	240	0.6 2t	228 t
	BOD_5		3500	9.1	3322	92	0.2 4t	87.3 t
	NH_3-N		1400	3.6	1329	20	0.052 t	19 t
Spilling			—	0.7	256	—	0.47 t	172 t
Fly						10 ind./cage		

4.4 Upper Huangpu Protection Wastewater Management (Fig. 6)

4.4.1 Jinshan Sewerage Project

Jinshan Sewerage Project is located in the eastern of Jinshan District of Shanghai. The project includes sewage discharge trunk sewer, 4 sewage pump stations, sewage discharge outlet and Xinjiang secondary sewage treatment plant. Total investment is 17.14864 million yuan RMB (1997 price).

The project collects the industrial wastewater, domestic wastewater and a small amount of animal wastewater. The service area is 30.48 km^2.

Xinjiang sewage treatment plant occupies an area of 4.45 ha and adopts A-A-O sewage treatment technology. The final design treatment capacity is 100,000 m^3/d.

4.4.2 Fengjing Wastewater Treatment Plant

The Fengjing Wastewater Treatment Plant will be built in southwest of junction of Huanfeng Road (N) and Qixian Jing, east by Qixian Jing and opposite Fengjing railway station.

The whole project is separated by three steps. Phase I, design capacity of the wastewater treatment plant is 14,000 m^3/d covering 2.47 ha; 28,000 m^3/d covering 5.27 ha in next phase.

The project belongs to municipal and environmental infrastructure. Its total investment is 87.2 million yuan RMB, among which 31.04 million yuan RMB for the plant for wastewater collection system. The construction period is 2 years.

The project includes two parts: the wastewater plant and wastewater collection system. The plant will construct inlet pump, sedimentation tank, anaerobic tank and oxidation ditch, secondary sedimentation tank, chlorinating contact tank, and sludge thickening tank and balancing tank, residual sludge pump, dewatering machine house, and other auxiliary buildings. The collection system consists of sewer and lifting pump station.

COD_{Cr} and NH_3-N in the wastewater are main impact factors in the project. In normal operation, the concentration increment of COD_{Cr} and NH_3-N would be 0.7799 mg/L and 0.0014 mg/L, 4.15% and 7.0% of concentration at present respectively.

After the project commissioning, most of wastewater being discharged into the river without any treatment will be collected and treated in the new plant. Thus, the gross pollutant will be cut down and water environment will be improved. It will contribute to the protection of the Upper Huangpu catchment.

Whilst in an abnormal operation, the pollution load of the discharge into river will be increased. The concentration increment of COD_{Cr} would be 1.253 mg/l, 6.66% of that at present. The increment of unionised ammonia would account for 9.5%. Thus, the water intake of Fengjing Brewery in its upstream may be influenced.

4.4.3 Fengxian South Sewer Wastewater Treatment Plant

Fengxian South Sewer Wastewater Treatment Plant consists of four parts: 1) a wastewater treatment plant; 2) collection sewer; 3) six pump stations; 4) an outlet

The wastewater treatment plant will be located in end of No.4 Road in Fengxian District. Distance to #6 pump station is about 900 m. It is a rectangle area with 480 m from east to west and 339 m from north to south. On the land of the proposed site, there are now the shrimp breeding ponds. Total investment of the plant costs 199.6 million yuan RMB, and the land area is about 16.3 ha.

Wastewater treatment process is aeration circulation oxidation ditch (Carrousel 200 oxidation pond). Sludge is to be treated by three steps: thickening, dewatering and sending out to disposal in short term, whilst digestion being under consideration for future.

Wastewater to be collected is from industries, animal farms and households, and the domestic origin accounts for 58% and the rest is from industries and animal farms.

Solid waste will be produced from screening, sand sedimentation and secondary sedimentation (Table 4-10).

Table 4-10 Generation of solid waste in different scale

Scale of plant (m^3/d)	16.000	50.000	100.000	150.000
Solid waste from screening (water content 85% ~ 90%) (m^3/d)	0.8	2.5	5.0	7.5
Solid waste from sand sedimentation (water content 60%) (m^3/d)	0.5	1.5	3.0	4.5
Residual sludge (t/d of dry solid)	1.0	3.1	6.2	12.5
Residual sludge (water content: 80%; most organic) (m^3/d)	5.0	15.5	31.0	62.4
Domestic waste (kg/d)	35	35	56	84

4.5 Shanghai Old Town Greenbelt Ring Project

4.5.1 Location and Scale of the Project

The Old Town Greenbelt Ring will be located on the NE corner of the greenbelt around the Old

Town situated in Huangpu District. The green space will cover an area of 8.96 ha.

The aim to build this Park is at further improvement on the urban eco-environment by increase in green space in downtown along with promotion of the areal development and the forming of its unique style.

4.5.2 Resettlement

The Old Town Greenbelt Ring Project should resettle inhabitants amounting to 5,357 households, 254 units and 175 small-scaled private business, and demolish houses with 200,000 m^2 of floor area. The budget allocated for the resettlement amounts to 1.238,6 billion yuan RMB. There are two types for conducting the resettlement, i.e., housing resettling and monetary resettling; whilst financial compensation for resettling the units.

5 Description of the Environment

5.1 Physical Environment

5.1.1 General

Facing the East China Sea, Shanghai is the most populous city in China, and situated at 31'14"N of latitude and 121'29"E of longitude in the front of an estuarine delta of Chang Jiang (Yangtze River). The estuary borders in the north, Hangzhou Bay in the south, and the sea in the east (Fig. 1).

The city had a total area of 6,340.5 km^2 at the end of 2000, 0.06% of China's total territory. The city extends about 120 km from north to south and nearly 100 km from east to west. Shanghai has an urban area of 3,924.24 km^2 and rural area of 2,416.26 km^2. Its land area covers 6,219 km^2 and water area runs 122 km^2. Chongming Island is the third largest island in China, covering an area of 1,041 km^2.

Shanghai is formed by silting up gradually under the reciprocity between the estuarine river and the tide. Its topography is plain, morphology is simple with the altitude higher in the Southeast and lower in Northwest between 3.5 ~ 4.5 m or even up to 5 m somewhere. The average elevation is 3.87m above Wusong Datum. The groundwater table is relatively high, in general in the range of 0.5 ~ 1.5 m.

Shanghai has a subtropic monsoon climate with distinct four seasons. In general, it is mild and humid in spring, hot and much rainy in summer, clear and crisp in autumn, and cold and less rainy/snowy in winter. Its annually average temperature is in range of around 15°C with extremes of over 40°C and about -10°C. The annual precipitation reaches about 1,100 mm, 60% of which fall in the period from May to September. Especially, in June and July every year, here is a so-called plum raining season which may last for over 40 days at most whilst reaching a maximal 370 mm of rainfall in total. The prevailing wind directions are from SE in April through August, from NW in November through February next year, and are changeable (mostly from NE) in March, September and October. The annually mean speed of wind is about 3.0 m/s.

5.1.2 Aquatic Environment

5.1.2.1 General

Netted with many rivers and lakes, the Shanghai area is known for its abundant water resources, with the water area accounting for 11% of total.

Chang Jiang estuary is an enormous water body subject to irregular semi-diurnal tide. It is dominated by fresh water of an average river flow of 29,000 m^3/s. Regards tidal levels, for example at Wai Gaoqiao, the highest tidal level is 5.64 m and the lowest one is -0.43 m. The average duration of flood tide is 4.55 hours and of ebb tide is 7.86 hours. With vast water-and-air interface, it has very favourable reaeration capability. In general, it is in good water quality though the river has received considerable amount of pollution loads along the way from upstream towards the East China Sea. The changes in silt load follow seasonal and tidal patterns with an average level of about 0.5 kg/m^3 and an uppermost level reaching 5.0 kg/m^3. Thus, the water uses of Chang Jiang estuary as drinking water sources are limited by rather higher silt load, especially in flood season, and several incidents of saline intrusion during drought period.

The water of Hangzhou Bay is brackish and unsuitable for drinking. Its silt load is obviously lower than that in Chang Jiang estuary. It is generally in good condition in exception of higher nitrogen and phosphorous contents.

Both of those water bodies are ecologically important sustaining aquatic life forming a major fishing ground in China.

The Huangpu River traverses the city proper and its drainage area covers over 5,000 km^2 in Shanghai in a form of waterway network in the alluvial plain. It is the last tributary of Chang Jiang, and is situated in the downstream of Taihu Lake Basin. About 50% of the Lake water are released via it with an annually mean river discharge flow of about 318 m^3/s.

The Huangpu River is classified as a lake-original tidal river and is also subject to a type of irregular semi-diurnal tide. At Wusong Kou, the mouth of the Huangpu River, the highest tidal level has ever reached station 5.74 m in the record whilst the average one is 3.28 m. The average tidal range is 2.27 m with the biggest one of 4.48 m. The flood tide lasts 4 hours and 33 minutes whilst ebb tide does 7 hours and 52 minutes in average. About 12 hours and 25 minutes form a tidal cycle. Tropic storm and extreme-cold air also influence its tidal levels.

At the mouth, the maximum inflow in flood tide reaches 12,100 m^3/s, and the maximum current velocity during flood tide is 1.8m/s.

It has been suffering from water pollution caused by human activities to some extent to threaten its rational uses. As tidal-influenced, the river current is reversible back and forth for several times before the water can empty into Chang Jiang estuary. When low flow comes from upstream, or even higher tidal level meets from downstream to hinder a free release of the river water, the wastewater discharged into the river will be retarded around the received reaches much longer to result in undesirable consequences of pollution build-up. The tidal inflow from Chang Jiang estuary, however, has somewhat alleviated this problem, in particular, in the lower reaches of the Huangpu River.

Though the Huangpu River is not the only water resources available in Shanghai, however, it has been playing a very important role in sustaining the socio-economic development of Shanghai. The river system has multiple functions including providing as water sources for agricultural, industrial as well as domestic uses, as navigable channels for communication and transport, as a water body receiving runoff as well as industrial and domestic effluents, etc.

5.2 Biological Environment

5.2.1 Terrestrial Ecosystem

5.2.1.1 Vegetation in Wetland

The intertidal zone at the south of Chang Jiang estuary grows commonly. Because of the influence of reclamation, the higher tidal zone is relatively narrow. There are rivers crossover on the land and a lot of pools as well. So wetland vegetation includes intertidal zone vegetation at the foreland of Chang Jiang estuary and aquatic vegetation in freshwater. Intertidal zone vegetation is dominated by reed community, and etc. They grow at the foreland of Chang Jiang estuary. Aquatic vegetation in freshwater includes foxtail alga community, goldfish alga community, black alga community, duckweed, purple float, hollow amaranth, water lettuce, water hyacinth, etc. They grow at rivers inside of the levee and pools, rills, ditches, etc.

5.2.1.2 Artificial Vegetation

The most common artificial vegetation in this area is artificial forest belt along the road, shelterbelt along the bank and farm, and shelterbelt along the coast, etc. Generally, sycamore and metasequoia are planted. And poplar, Cinnamomum camphora, elm are also planted.

Secondary, it is afforestation plants in the town. There are some areas in the park and near the houses for afforestation plants. The most common plants are Cinnamomum camphora, Magnolia grandiflora L., cedar, Chines rose with red autumnal leaves, Cape jasmine, metasequoia, larch, holly, coral tree, etc, which are artificial cultivated.

The crop community includes foodstuff, nursery, vegetable and cole, etc. Generally, the community is a combination of foodstuff and economic crop.

5.2.2 Aquatic Ecosystem

5.2.2.1 Aquatic Ecosystem in Chang Jiang Estuary

There are nearly 170 species of freshwater fish, salt-fresh water fish, saltwater fish, marine-freshwater migrant and marine fish at the area.

There are nearly 100 species of benthic organisms. The dominant species is corbicular of Mollusca and *Branchiura sowerbyi*, *Limnodrilus hoffmeisteri* of Annelida.

There are nearly 120 species of zooplankton, such as Cladocera, rotifer, decapods, amphipoda, euphausiid shrimp.

5.2.2.2 Aquatic Ecosystem in the Huangpu River

The common species of phytoplankton are Melosira in the project area of the Huangpu River. The common species of zooplankton are *Labidocera eucnaeta* at Wusong Kou area; and there are a lot of attached biota which are enduring to pollution at the mouths of Yunzao Bang and Suzhou Creek. The dominant species of benthic organisms in Wujing section of the Huangpu River are *Tubifex*, and *Limnodrilus* of oligochaete in annelid.

5.3 Socio-Economic Environment

5.3.1 Population

By the end of 2000, Shanghai had a total population of 16.74 million (including the floating population) and the registered population had 13.22 million, 1% of total population in China. In 2000, the average population density in the city stood at 2,084 inhabitants per square kilometre, whilst 2,897 in the urban area.

The city's natural population growth rate was -1.9‰ in 2000, with the birth rate reaching 5.3‰ and mortality rate 7.2‰.

5.3.2 Industries

5.3.2.1 Primary Industry

In 2000, the agricultural sector in Shanghai was reported to have an added value of 8.165 billion yuan RMB, an increase of 16.8% over that of 1995. The total agricultural output value reached 21.65 billion yuan in 2000, 17.9% rise over that in 1995 and representing an annual growth rate of 3.4%.

During the 1995 ~ 2000 period, the proportion of planting in the total agricultural output value decreased from 42.6% to 41.5% and that of animal husbandry went down from 44.7% to 40.3%, while fisheries rose from 12.5% to 17.5%. The output value of vegetable, fruit, flower, poultry, fresh milk production and special breeding also reported remarkable increase during the period.

5.3.2.2 Secondary Industry

In 2000, Shanghai realised an industrial added value of 199.160 billion yuan, jumping 58.9% over 1995 according to the comparable prices, and representing an annual growth rate of 9.7%. Of the total, heavy industrial sector made up for 120.659 billion yuan while light industrial sector accounted for 78.501 billion yuan.

The city's total industrial output value reached 691.536 billion yuan, a whooping increase of 78.6% over 1995 according to the comparable prices, and representing an annual growth of 12.3%.

Shanghai's six pillar industries, namely the automobile industry, the electronic and telecommunications equipment industry, the iron and steel industry, the petrochemical and fine chemical processing industry, the power station complete sets and parts manufacturing industry and the home electric appliances industry, have further consolidated their dominance by technology renovation and product upgrading and maintained the role as the powerhouse in the local industrial economy. Their total output value hit 329.2 billion yuan in 2000, up 18.7% from the previous year and accounting for 53.6% of the city's total industrial output value. The added value of the six pillar industries totalled 54.728 billion yuan, making up 71.1% of the city's total from the industrial sector. In the same year, the six pillar industries generated a combined profit of 23.368 billion yuan, growing 41.2% from 1999 and accounting for 61.4% of the city's total industrial profit.

5.3.2.3 Tertiary Industry

Shanghai has adhered to the policy of giving first priority to development of the tertiary industry, actively restructuring the secondary industry and steadily improving the performance of the primary industry. As a result, the city has made salient progresses in the strategic restructuring of the local industries and has reported rapid development of its tertiary industry focusing on finance, trade and information technology. The city's industrial structure has been further optimised.

In 2000, the output value of the city's tertiary industry reached 228.26 billion yuan, an increased of 100% over that of 1995 according to the comparable prices.

The output value of the tertiary industry for the first time accounted for more than 50% of the city's GDP in 2000, with the ratio of the city's primary industry, second industry and tertiary industry readjusting from 2.5:57.3:40.2 in 1995 to 1.8:48:50.2.

5.3.2.4 Employment

Since early 1990s, the number of labourers employed in different economic sectors has been changing with economic restructuring. The number of labourers working in the secondary industry dropped from 59.3% of the city's total workforce in 1990 to 42.1% in 2000. Meanwhile, the figure with the tertiary industry continued to increase, jumping from 29.6% in 1990 to 46% in 2000. The tertiary industry has provided a growing number of jobs for surplus labourers, helping to ease the city's unemployment problem.

5.3.3 Infrastructure

In the last decade starting from the beginning of 1990s, Shanghai invested a total of more than 310 billion yuan in its urban construction projects, representing an average annual growth of 33%, and the capacity of the infrastructure has been drastically enhanced (Table 5-1).

Table 5-1 Infrastructure Availability Statistics in Shanghai

Item	Unit	1990	2000
Production of tapping water	million m^3/d	4.63	10.48
Pipe length of water supply	km	3483	15943
Production of coal gas	million m^3/d	3.38	9.84
Pipe length of coal gas supply	km	2700	6606
Household of coal gas cooking	million	1.13	2.56
Road length in city	km	1663	5204
Area of city road	million m^2	17.87	63.93
Sewerage pipe length	km	1892	4452
Treatment capacity of wastewater	million m^3/d	0.410	1.890
Area of green space	ha	3570	12119
Public green area	ha	983	4555

In 2000, Shanghai achieved the phase goal of getting rid of black and stink for the main stream of Suzhou Creek. The quality of the main water body of the Huangpu River had also somewhat improved. The total pollutant discharge volume had declined and the content of TSP and NO_X in the air dropped by 7.1% and 8.1%, respectively, from the previous year.

In 2000, Shanghai added 828 ha to its public green space, built 30 pieces of large greenbelts in size of over 3,000 m^2 each, and opened seven new parks, including the Century Park and the Hongqiao Central Park. At the same time, 350 ha of green space had been added to the newly completed residential areas.

By the end of 2000, green area made up 22% of the city's urban area, 1.7% up over that of the previous year. The per capita green area reached 4.6 m^2, 0.98 m^2 up.

5.3.4 Living Standard

The average expense of each inhabitant in Shanghai in 2000 was 11,546 yuan RMB. The sum of wages was 61.453 billion yuan whilst the average one was 15,420yuan, 9% higher than that in the previous year. The net income per capita in the rural area was 5,596 yuan, 2.1% higher than that in the previous year. The popularity of coal gas has been 100%. There have been 55 beds in hospitals, 81 health care professional staff and 38 doctors per every 10,000 inhabitants. There are 4.6m^2 green space per capita, 1.0 m^2 more than that in the previous year.

5.4 Environmental Problems

5.4.1 Water Pollution Loadings

Based on an investigation on water pollution sources in 2000, there are 55,979 pollution sources in Shanghai. The volume of wastewater reaches 5.04 million m^3/d with COD_{Cr} loading of 1,704 t/d and ammonia nitrogen loading of 123 t/d. According to statistic data, the proportion of the wastewater from industrial, municipal, and animal farm pollution sources is 40.6%, 58.7% and 0.7% respectively, whilst the COD_{Cr} loadings from those sources are 22.0%, 61.5% and 16.5%, and ammonia nitrogen loadings are 21.7%, 68.9% and 9.4%, respectively.

Statistics depending on discharge routes show that the wastewater from 15,340 pollution sources is centralised to discharge amounting to 1.45 million m^3/d. Wastewater from 6,860 pollution source goes into sewage treatment plants with a volume of 0.77 million m^3/d. Wastewater from 33,779 pollution sources goes directly or via municipal discharge outlets into the surface water in a quantity of 2.82 million m^3/d without being properly treated.

5.4.2 Water Pollution

The wastewater discharge has seriously polluted the main waterways in Shanghai. Based on the classification of water quality, the Upper Huangpu Water Source Protection Zone is classified as Category II, the Sub-Zone as Category III, while its lower reaches as Category IV. The observations have shown that water quality of almost all functional zones has not always met with their functional requirements. For instance, the water quality at Songpu Bridge is basically at Category III, whereas that at Wusong Kou reaches Category IV but some indices are inferior.

5.5 Component Specific Environmental Condition

5.5.1 Environmental Condition at Laogang Landfill

5.5.1.1 General

The proposed Laogang Landfill is located at Laogang Township in Nanhui District about 60 km away from downtown. It adjoins Zhaoyang Farm and Binhai Township, is 3 km from Laogang Town on the west and 3 km from Dazi Canal on the south. The nearest residences are located 1,000 m away.

The Expansion Project IV will lie at reclaimed shoal, which elevation has been at 3.8 m above datum with an outward slope of about 1/1,000. As the shoal was formed in the last decade, there are no buildings on it, and merely a few human activities such as gathering in reeds etc. Thus, there are no cultural properties at all. According to the reference about planning for nature preserves in

Shanghai, this site is not a forest nor a kind of nature preserves.

5.5.1.2 Ambient Air Quality

It has been found by monitoring that H_2S and NH_3 concentrations in the air at the Laogang Landfill site and its vicinity were partly incompliant to the standard in the rang of about 30% ~ 90% and 6% ~ 13% higher than their relevant limits in maximum, and their foul smell intensity reached Classes 2.3 and 1.3 respectively. The methane concentration at outlets of the leading pipe were all less than 5%, in compliance with the requirement set in «Technical Standard for Sanitary Landfill of Municipal Solid Waste (CJJ17-88)».

5.5.1.3 Quality of Surface Water at Laogang Landfill Site

In the water body at harbour where refuse is handled, the concentrations of total phosphorus and COD_{Cr} are incompliant to Category V of the surface water quality standard, and that of NH_3-N at a chemical enterprise even once reaches up to nearly triple limit level. In respect to the water body in Chang Jiang estuary at Laogang Landfill, except the concentrations of NH_3-N, petrol and total phosphorus are slightly over the limits, that of COD_{Cr}, BOD_5 and cyanides are all in compliance with the Category II requirements of surface water quality standard.

5.5.1.4 Quality of Groundwater and Soil at Laogang Landfill Site

The groundwater at Laogang is brackish and very hard. In the groundwater, chlorides, NH_3-N and hardness are almost all much higher than their limits, whilst PV (permanganate value) and As are 60% and 10% respectively incompliant to Category V of «Groundwater Quality Standard (GB/T14848-93)». The others such as pH value, fluorides, cyanides, volatile phenols, LAS, Cu, Zn, Hg, Cr, Cd, Pb and Ni are all in compliance.

It is observed that in the soil surrounding the Laogang Landfill, As, Cr and Cd are in compliance with Class 1 of «Soil Environmental Quality Standard (GB15618-1995)», whilst Hg, Pb, Cu, Ni and Zn are in compliance with Class 2

6 Analysis of Alternatives of the Project

6.1 Analysis of Sewage Treatment Plant Siting Alternatives

6.1.1 Comparison of Project Scale and Investment

6.1.1.1 Capital Cost Comparison

Because of difference in treatment processes and overall layouts of the sewage treatment plants, the project scale of construction and equipment installation differs greatly (Table 6-1).

Table 6-1 Cost comparison of different treatment options

No	Plant site option	Process/workshop structure	Cost (million yuan RMB)			
			construction & installation	Trunk sewer	Miscellaneous	Sum
1	Minxing Road	high efficiency sedimentation + bio-filtrator/ All under ground	715.1312	93.8722	10.5657	819.5691
2		A^2/O nitrogen and phosphorus removal/ All on ground	635.821	93.8722	7.4001	737.0933
3		high efficiency sedimentation + bio-filtrator/ Half under ground	609.801	93.8722	10.3857	714.0589
4	Zhuyuan	A^2/O nitrogen and phosphorus removal/ All on ground	608.535	448.6156	7.4001	1064.551

It can be seen that if only take the cost for construction, installation and trunk sewer into account, the investment cost of Zhuyuan No 2 Sewage Treatment Plant is the highest among the four options. It is because that the plant at Zhuyuan needs to build trunk sewer from Puxi to Pudong. The cost of the plant at Minxing Road which adopts high efficiency sedimentation plus bio-filtrator and all under the ground will be ranked the second.

Actually, the plant at Minxing Road could need less land, shorter sewer to be laid and fewer midway pump station to be built than that of Zhuyuan.

6.1.1.2 Gross Investment Comparison

According to the Feasibility Study Report, the option of sewage treatment plant to be built all under the ground at Minxing Road has been recommended. The gross investment comparison between recommended option and Zhuyuan option can be seen in Table 6-2.

Regards the gross investment, the cost of Minxing Sewage Treatment Plant is 250 million yuan RMB higher than that of Zhuyuan No.2 Sewage Treatment Plant. This is mainly because that Minxing Sewage Treatment Plant is to be located at the bank of the Huangpu River, as the resettlement cost within the Outer Ring Road is much higher than that of Zhuyuan No.2 Sewage Treatment Plant, which is to be located beside Chang Jiang, out of the Outer Ring Road with much lower land price.

Table 6-2 Gross investment comparison of Minxing plant and Zhuyuan plant

Plant	Process/workshop structure	Cost (million yuan RMB)				
		Construction & installation	Trunk sewer	Miscellaneous	Land acquisition & resettlement	Sum
Minxing	High efficiency sedimentation + bio-filtrator/ All under ground	715.1312	93.8722	10.5657	786.00	1605.569
Zhuyuan	A^2/O nitrogen and phosphorus removal/ All on ground	608.535	448.6156	7.4001	291.09	1355.641

6.1.1.3 Running Cost Comparison

The estimation of running cost has shown that the unit total cost and running cost of Minxing Sewage Treatment Plant are higher than that of Zhuyuan Sewage Treatment Plant (Table 6-3), i.e., the running cost 0.016 yuan RMB or 3.8% higher. One thing should be mentioned is that in the estimation of running cost, the transport cost for sludge has not been included. If it has been covered, the running cost of Minxing option should be further higher

Table 6-3 Running cost of sewage treatment plants

No.	Plant	Total cost (yuan/m^3)	Running cost (yuan/m^3)
1	Minxing Sewage Treatment Plant	0.624	0.436
2	Zhuyuan No.2 Sewage Treatment Plant	0.580	0.420

6.1.2 Compatibility Comparison with Planning

6.1.2.1 Consistency with Planning

The implementation of a sewage treatment plant is to reduce or eliminate the water pollution. Therefore, two alternative sites are consonant with relevant requirements of "Shanghai City Master Plan", "Shanghai Environmental Protection Plan", "Shanghai Water Environmental Rehabilitation and Protection Plan, and the Tenth Five Year Programme" as well as "Shanghai Sewerage System Plan".

6.1.2.2 Compatibility Differences between Different Siting

Regards the compatibility of regional plan, Minxing Sewage Treatment Plant would be located at Wujiao Chang Town of Yangpu District where are mainly industries and warehouses in the region now. According to regional plan of Yangpu District, the land is reserved for industries. Now in the

Comprehensive Redevelopment Programme of Riversides along the Huangpu, Jungong-Xianying Road is the northern end, about 0.5 km far from Minxing Road. According to the planning, the scope may further extend along the Huangpu River stretching both southward and northward. In the Comprehensive Redevelopment Programme of Riversides along the Huangpu, the focused development region of Yuanpu Bridge will be built into a distinguishing riverside settlement with traditional style, and a science-education office park. Landscape will emphasise the line of sight corridor effect to waterside, and combine the historic architecture with bank public facilities to enrich the landscape of both sides. There really exists some incompatibility between the sewage treatment plant construction and regional plan.

Zhuyuan No 2 Sewage Treatment Plant is to locate at the south side of Zhuyuan No 1 Sewage Treatment Plant where the land has been reserved the future development. In the view of the function there in the regional development plan, the sewage treatment plant construction there is relatively coordinate with the plan.

6.1.3 Capacity Comparison of Effluent Receiving Water Bodies

6.1.3.1 Capacity of Chang Jiang Estuary at Zhuyuan Section

The watercourse of Chang Jiang is divided into South and North Branches by Chongming Island. The South Branch is divided into South and North Channels by Changxing Island. Zhuyuan is located between Wai Gaoqiao and Xiao Jiuduan.

Split of river flow by South Branch is much greater than that of North Branch, 98% ~ 99% of water volume descends along South Branch. The flow in South Channel changes between 34.7% ~ 63.7%. The inflow tide may reach about 3.25 billion m^3, whilst up to 4.5 billion m^3 in spring tide.

Flood tide in South Channel lasts a period of 4 hours and 50 minutes (usually 4 ~ 5 hours) whilst ebb tide does 7 hours and 35 minutes (usually 7 ~ 8 hours). The ebb slack lasts for a quite short time. The increase of ebb current velocity after the flood slack is very slow, and the maximal current velocity occurs after about 3 hours.

Residual current in South Channel is all bearing toward sea in the flood season. The residual current in the surface layer in main channel can reach 37 cm/s, while that at the northern flood trench is only 12.4 cm/s. The residual current in the drought season is rather complicated, i.e., that in main channel is bearing seawards, whilst that in flood trench and southern shoal is upstream. There may appear plane circulation on some circumstance, and the surface residual current in main channel may be in the range of 7.5 ~ 29.8 cm/s, lower than that in flood season, depending upon the reaction between river discharge flow and tidal flow. It is benefit for shift and transform of pollution if an outfall is to set at where the residual current bears outwards.

Based on long term observations and the data collected during 1997,1999 and 2000, all have shown that the recent baseline of water quality at Zhuyuan section of Chang Jiang is basically in compliance with Category II of the surface water standard. It means that there exists rather large capacity available. It has also been indicated that nowadays the discharge of sewage from the SSP-I amounting to about 1.40 million m^3/d,

6.1.3.2 Capacity of Lower Huangpu River

Influenced by tide of Chang Jiang estuary, the flow in water system of the Huangpu River is reversible. The maximal tidal inflow entering Huangpu River through Wusong Kou is 12,100 m^3/s, and the largest tide outflow is 6,000 m^3/s, among which about 90% of water released are tidal flow. Daily mean gross tidal inflow is 112 million m^3. Annual inflow may reach 42.3 billion m^3, which account for 80% of gross water volume of the Huangpu River. It means that 80% of surface resources is the inflow via Wusong Kou from Chang Jiang.

Pollution load in the Huangpu River water system was the receiving of about 4.0 million m^3/d of sewage in the 1980s. Nowadays, the load has been reduced to less than 2.80 million m^3/d. Recently, Suzhou Creek has now been under rehabilitation, interception of the wastewater in the catchment of its six tributaries will soon be completed, the rehabilitation of Yangpu and Hongkou Gangs is going on, in the Upper Huangpu cut-down of the pollution is carrying on, and in Pudong the construction of collection system has started. Based on all of these actions, it could be expected that in next three or four years, the pollution load may be reduced to below 1.0 million m^3/d, and the environmental status there could be much better. After several years, there could have be possible for receiving effluent which has been subject to secondary biochemistry treatment and phosphorus removal and denitrification. Though discharging effluent into the Huangpu River may be affected by tidal flow, according to mathematical modelling, under the most unfavourable hydrological circumstance, the trace up distance is still 15 ~ 17 km left from the upstream water intake, so that it would not affect the safety of the drinking water source upstream.

There are some issues on effluent discharge into the Huangpu River that may draw necessary attention to. The mass point trace back doesn't mean the upper limit of the influence. It may be valuable to think about the possibility of releasing the effluent during the ebb tide, and the direct abstraction of river water in the lower reaches for water supply should be controlled.

6.1.4 Preliminary Conclusion of Siting Alternative Comparison

According to the analysis, it is feasible in terms of environmental capacity to discharge the treated effluent into both water bodies at Zhuyuan of Chang Jiang and Minxing Road of lower reaches of the Huangpu River. In addition, when relevant measures are to be taken for minimising the unanticipated impacts, the both alternatives would be environmentally acceptable. They could contribute in a similar way to the improvement on the water environment in Shanghai.

It has not been yet as a conclusion that was derived from an overall and comprehensive analysis. Further elaboration on it would be worthwhile, in particular, in terms of economic aspect and planning consideration. Though the alternative of Minxing plant is compatible with Shanghai City Master Plan, however, some incompatibility might exist between the sewage treatment plant siting and the regional plan. The Comprehensive Redevelopment Programme of Riversides along the Huangpu is an ambitious plan launched by the SMG, thus all the development projects shall be in line with this core task.

6.2 Analysis of Wastewater Treatment Options for Refuse Landfill Leachate

Here are three proposed alternative sets for treatment of leachate:

- *Alternative I*: treatment to meet the Grade 2 of «Shanghai Wastewater Integrated Discharge Standard (DB31/199-1997)» (100 mg/L of COD_{Cr}, 30 mg/L of BOD_5, 15 mg/L of NH_3-N), and then directly discharge to the sea;

- *Alternative II*: treatment to meet the Grade 3 of the Shanghai local standard (300 mg/L of COD_{Cr}, 150 mg/L of BOD_5, 25 mg/L of NH_3-N), and convey to Bailong Gang Sewage Treatment Plant prior to being discharged to the sea;
- *Alternative III*: treatment to meet the Grade 3 of «Pollution Control Standard for Domestic Refuse Waste Landfill (GB16889-1997)» (1,000 mg/L of COD_{Cr}, 600 mg/L of BOD_5), and then convey to Bailong Gang Sewage Treatment Plant prior to being discharged to the sea.

The Alternative I uses a process that needs rather complicated system management and maintenance, and its investment and operating costs are relatively higher, but it has less environmental impact. The Alternative II uses a process that needs generally complex system management and maintenance, and its investment and operating expenses are moderate. Its effluent can directly enter the sewage treatment plant so that there is almost no impact upon the local surface water. As the Alternative III uses a simple process, it is quite easy to manage and maintain, and it needs lower investment and operating cost, but its effluent strength could be two to three times over the requirement for connecting to the sewage treatment plant Table 6-4).

Table 6-4 Comprehensive comparison of alternatives for leachate treatment system

No.	Item	Alternative I	Alternative II	Alternative III
1	Effluent standard	Grade 2 of local standard	Grade 3 of local standard	Grade 3 of sectoral standard
2	Limit of selected variables in standard (mg/L)	COD <100 BOD <30 NH_3-N <15	COD <300 BOD <150 NH_3-N <25	BOD <1000 NH_3-N <600
3	Treatment process	Anaerobic biochemical–A/O biological denitrification–chemical coagulation–artificial wetland–ultrafiltration–osmosis	Anaerobic biochemical–A/O biological denitrification–chemical coagulation–coarse filtration–ultrafiltration–man-made wetland	Oxidation pond–bio-contact–oxidation–man-made wetland
4	Treatment effect (mg/L)	COD=58 BOD=23 NH_3-N=10	COD=240 BOD=92 NH_3-N=20	COD=963 BOD=358
5	Effluent discharging	To Chang Jiang estuary via the beaches	Into a secondary sewage treatment plant at Bailong Gang via sewerage network	
6	Impact on Chang Jiang estuary at Laogang	A little impact	No impact	
7	Impact on Bailong Gang Sewage Treatment Plant	No impact	Effluent quality satisfies requirement for connecting sewage treatment plant	Effluent quality far beyond requirement for connecting sewage treatment plant
8	Complexity of process	Complex	Less complex	Rather simple

9	Technical requirement for management and maintenance	Complex	General	Rather simple
10	Total investment * (million yuan)	54.892	39.9488 (+5.50)	15.352 (+5.50)
11	Unit investment * (1,000 yuan/m^3/d)	21.1	13.1 (+2.1)	5.9 (+2.1)
12	Unit operating cost ** (yuan/ m^3)	25.04	9.55 (+0.47)	6.03 (+0.4)7

* This is the first part of the expenses for the treatment system and drainage system. The figures in the brackets are investment for treatment facilities and sewerage network respectively.

** This is the direct expense for operations, not including depreciation or amortisation.

A comprehensive analysis of the three alternatives with respect to environmental protection requirement, reliability of operational management and control of construction and operation cost indicates that the Alternative II is the optimal one. It has also been recommended by the feasibility study report as a renovating scheme for leachate treatment system of Laogang Landfill IV.

The capacity of Bailong Sewage Treatment Plant in short term will be 1.20 million m^3/d of dry weather average flow. At present, its sewerage network is receiving about 1.00 million m^3/d of wastewater. It means that it is able to receive the flow of 2,600 m^3/d from this project. The effluent strength of the leachate treatment facility could basically meet the requirement for the influent of Bailong Gang Sewage Treatment Plant. Therefore, discharge of the effluent from leachate treatment system into the Bailong Gang collection system would be feasible.

The additional pollution loading to Bailong Gang system would be about 780 kg/d of COD_{Cr}, 390 kg/d of BOD_5, and 65 kg/d of NH_3-N, i.e., only increasing 0.22%, 0.27% and 0.18% respectively. It would impossibly be affecting the treatment effect there.

7 Assessment of Environmental Impacts of the Project

7.1 Environmental Impact of Shanghai Sewerage Project Phase III

7.1.1 Impacts on the Huangpu River and Chang Jiang Estuary

7.1.1.1 Impact of Effluent on the Huangpu River

When the effluent enters Minxing Road reaches of the Huangpu River, it goes back and forth with tidal current, and is gradually diluted, migrated, transformed and degraded during the course of movement. According to calculation by mathematical model, the farthest trace distance would not affect Daqiao water intake in the dry season with 17 ~ 20 km left from Daqiao (hydrological occurrence of 90%). It means that it must have no impact on the upstream water intake. Minxing Road reaches are situated at 14 km away from Wusong Kou, 8.5 km away from Yangshupu Waterworks, 11.5 km away from the mouth of Suzhou Creek, 18 km away from Nanshi Waterworks. The effluent can quickly be diluted after having entered the Huangpu River.

In the scenario of 90% occurrence during dry condition, after having discharged 7.52 m^3/s of the effluent, the largest concentration increment of COD_{Cr} at Yangshupu Waterworks is 3.01 mg/L and that of BOD_5 is 0.75mg/L; whilst at Nanshi Waterworks that of COD_{Cr} is 2.86 mg/L and that of BOD_5 is 0.7 mg/L.

7.1.1.2 Impact of Effluent on Chang Jiang Estuary at Zhuyuan

When the effluent enters Chang Jiang estuary at Zhuyuan, it will be mixed with river water, and some particulates in the effluent will be collided with those in river water, and then a series of bio-geo-physicochemical reaction process such as adsorption, exchange and complex will happen. It is a kind of purifying process. Lingqiao emergency water intake is a key object there (about 8 km upstream from Zhuyuan proposed outfall). According to estimation by the model, in very dry season when annual flow is 7,500 m^3/s (occurrence is over 95%), the COD_{Cr} increment at Lingqiao is some 0.24 mg/L, BOD_5 about 0.055 mg/L, NH_3-N 0.046 mg/L, and total P 0.00185 mg/L. It would have no impact on Lingqiao water intake even by the effluent of physicochemical treatment in SSP-I combined with the effluent of the SSP-III.

It seems that either at Chang Jiang estuary or at Lower reaches of the Huangpu River, the discharge of effluent subject to secondary treatment would unlikely cause big impacts. Comparably, the capacity at Chang Jiang estuary is higher than that at the Huangpu River, however, the length of trunk sewer will be shorter if the sewage treatment plant is to site at the Huangpu River that reveals its advantage.

7.1.2 Impacts on Air and Acoustic Environment

7.1.2.1 Impacts on Ambient Air

As Minxing Sewage Treatment Plant adopts underground sealed structure, foul gases is to gather and treat. When hydrogen sulphide and ammonia have met the limit set in "Stink Pollution Emission Standard", they are to discharge by a 16m high stack. After calculation, under the circumstance of common climate, pollutant concentration is lower than the requirements of "harmful pollutant in ambient in residential area air permit once highest concentration", impact on ambient environment is very small. But H_2S concentration will be incompliant to the standard within 40 ~ 250 m from the source, whilst NH_3 within 40~70 m under inverse temperature.

It is uncertain that if Zhuyuan No 2 Sewage Treatment Plant adopts measures to gather and treat foul gases. But if not, then the sludge disposal procedure needs 960 m distance for hygiene protection, and three surrounding farmer village will come under impact. If adopting treatment measures and pollutant removal rate reaching 90% and above, then the hygiene protection distance could reduce to 250 m, and those three surrounding villages would not be impacted by sludge disposal procedure.

7.1.2.2 Impacts on Acoustic Environment

As Minxing Sewage Plant adopts completely sealed structure, according to an analogy analysis of an underground water pump house of the People's Park with similar structure, machinery noise from the sewage treatment plant would basically have no impact on ambient environment.

Zhuyuan No 1 Sewage Plant is located on the north of the proposed Zhuyuan No 2 Sewage Treatment Plant, the west of which is Haixu Road, the east is Yantang Road, there are some residents on the south. According to the modelling, on daytime, the noise contribution of its inflow pump house to the south and north factory boundary, air blower room, sludge dewatering machines and surrounding factory boundary all could exceed Class 2 limit value (50 dB(A)) in "Industrial Enterprise Boundary Noise Standard", with the highest exceed 9 dB(A). It reveals that some machine noise of Zhuyuan No 2 plant can not meet the requirements within the factory boundary.

7.1.3 Impacts on Social Environment

There are difference in the social impacts between Minxing and Zhuyuan No 2 Sewage Plants (Table 7-1). It can be seen that the floor space, borrow land area and road impacted are all greater at Zhuyuan than that at Minxing. Moreover, as Minxing Sewage Plant is located in a build-up region in Puxi, while Zhuyuan sewage plant is in rural area in Pudong, therefore, the latter involves cultivated land acquisition and dweller resettlement, but less in enterprise resettlement.

Table 7-1 Main social impacts of Minxing and Zhuyuan No.2 Sewage Treatment Plants

No	Item	Minxing	Zhuyuan No.2
1	Land acquisition (ha)	19.5	29.4
2	Land borrowed (ha)	5.7	16.1
3	Cultivated land acquisition (ha)	-	3.6
4	Household to be resettled	4	388
5	Area of dwelling house to be resettled (m^2)	800	71000
6	Units to be affected	24	25
7	Area of enterprise to be resettled (Mm^2)	0.129	0.040
8	Affected staff and workers	4475	699
9	Affected roads	9	13
10	Quantity of spoil (Mm^3)	0.418	0.3518

11	Green space (m^2)	8000	5900
12	Affected trees	5100	1700

7.1.4 Impacts on Sludge Transport

No matter what the location selected is, sludge disposal is through machinery thickening, centrifugation dewatering and then sent to Bailong Gang sludge landfill.

The difference between two location is the difference of transport distance. If it is at Minxing Road, then adopting vehicle transport for distance of 32km, passing through major traffic line of Shanghai, making a round trip will take 2 hours. If it is at Zhuyuan, it is 16 km away from Zhuyuan to Bailong Gang, the transportation distance could shorten one half, so that the transport could take shorter time. Therefore, just for the sludge transport, the impacts of Minxing Road option would be greater than that of Zhuyuan option.

7.2 Environmental Impact of Laogang Landfill Project IV

7.2.1 Impact on Ambient Air

As organic contents in the refuse to be disposed of in the Laogang Landfill Expansion Project IV could be about 13% decreased from that of present one, and the measures of compacting layer by layer and timely covering would also be taken, the diffusion of foul pollutants could be reduced to some extent. Meanwhile, farther distance between the landfill operation spots and the residential areas could further alleviate the impact.

Estimated by computation, the concentrations of H_2S and NH_3 at residential area 1,000 m leeward could be in compliance with their relevant standard limits in the case of either average wind velocity or breeze, but in the case of fume, incompliance incident may locally occur for a spell. Although the landfill units of the previous phases have been already filled and finished with covering so as to ease the release of stink gases whilst the Project IV is put into operation, however, the intensity of foul gases could be at a slightly perceptible level in the condition of breeze during summer time at residential areas 1,000 m away.

In respect to the influence of waste gas emission from the operation machines, the concentrations of SO_2, NO_X, and TSP at residences 1,000 m leeward could still be in compliance with Class 2 of National Ambient Air Quality Standard.

7.2.2 Impact on Surface Water

After commissioning of the Laogang Landfill Project IV, 2,600 m^3/d of wastewater generated will be treated and its effluent will be diverted to Bailong Gang Sewage Treatment Plant. The pollution impact on the surface water at Laogang section of Chang Jiang estuary and other local water bodies could, therefore, be basically avoided.

As the implementation of the Laogang Landfill Project IV will take over problems existing in systems of the previous phases, the efficiency of wastewater treatment could be enhanced and the effluent would be diverted to Bailong Gang for further treatment. It could result in dramatic reduction in pollution loading and notable progress in eliminating the direct discharge of leachate only treated by oxidation pond without compliance at present at Laogang.

7.2.3 Impact on Groundwater

The observation indicates that the refuse landfill leachate from the previous three phases has caused influence on the surrounding groundwater to certain degrees, as there has been no anti-permeating measures available.

In the Project Phase IV, anti-permeating measures will be adopted so as to prevent effectively the groundwater from being contaminated by the landfill leachate. The vertical barrier to be built to enclose the landfill site of the previous three phases could effectively halt the horizontal movement of the leachate. As there has been no anti-permeating liner available on the bottom of the existing landfill site, a vertical permeation of the leachate could still occur. Along with the ageing of the filled refuse, leachate strength could be lowered so that the impact on groundwater may be eased.

7.2.4 Impact on Soil

In domestic garbage there are waste batteries, fluorescent tubes, dyestuff, paint, and etc. containing heavy metals. After such wastes were disposed of in the landfill, the contained metals could be gradually transformed into a kind of soluble cation or anion complex compounds under the reaction with weakly acidic organic. It will result in soil contamination along with the landfill leachate enters the soil.

The observations in the period from 1994 through 2001 indicate that in the soil around the Laogang Landfill site, contents of the heavy metals tend to increase whilst all are still in compliance with Class 2 of soil quality standard without degradation. In the Project IV, anti-permeating measures will be taken, the contamination of heavy metals to the soil through the leachate may be effectively prevented. Thus, further contaminating the soil may be unlikely.

7.2.5 Impact on Ecosystem

The Laogang Landfill Expansion Project IV is located in a reclaimed shoal, in which, though part of the habitat has been polluted by the leachate from the previous phases, the destruction of vegetation and the migration of birds could be an irreversible consequence. Beyond this area, the vast and constantly growing shoal could, however, compensate for it, and in its vicinity there also have been sizeable shoals, plus the broad Jiuduan Sha Wetland Nature Preserve just opposite located. It seems that this Project would unlikely bring about obvious impact on the wetland and rare birds in Shanghai.

In the filled area of the previous three phases, only some kind of weeds in voluntary community has occurred, and no indication of birds' and other animals' return has been found. Promoting the planning and implementation of the ecological restoration and re-cultivation as well as compensating the ecological demands of habitants and nature may ease the environmental pressure.

After the commissioning of the Project IV, the leachate generated from the previous phases will not be discharged again so that the impact on the reclaimed shoal on the east could be minimised.

Though the storm runoff will still be discharged into the reclaimed shoal, the separate system could alleviate the impact on it.

Once the landfill units have been filled, the direct pollution from the operation of landfill will not exist basically. If the ecological restoration could start as early as possible, it would form an important isolating belt to separate the Project IV from the residential area. In addition, more advanced means of transport and landfill process will be adopted in the Project IV, the impact of its operation could be much lesser.

7.2.6 Impact on Fly's Density in the Vicinity of Laogang Landfill Site

A routine monitoring has shown that a change in the fly's density is not notable though the disposal amount of refuse at Laogang Landfill site is progressively increased. The fly's density is dependent upon the operation spot, i.e., the farther the distance away from the operation spot, the lower the density. The fly's densities are not very much different in spring and autumn. The wind direction has shown its remarkable effect on the fly's density, and on the south of the landfill site, it is more affected than that on the north.

Referring to an experiment, by means of all measures to be taken in the Phase IV to reduce the exposure of refuse to the air, at the operation spot where the fly breeds, the density may be controlled within 2 ind./cage/d. Therefore, the influence of fly's breeding could be anticipated to be much lesser.

7.3 Environmental Impact of Upper Huangpu Wastewater Treatment

7.3.1 Impact of Fengxian South Sewer Wastewater Treatment Plant

By now there have been 16,000 m^3/d wastewater discharge into Hangzhou Bay from the existing South Sewer, and the water quality of the receiving water body has still been in original level with no indication of being polluted. It means that the condition of dilution and diffusion in Hangzhou Bay is rather favourable for siting this outfall there.

Inorganic nitrogen is main pollutant in the water body of Hangzhou Bay. In the period from July to November in 2000, monitoring results show that the content of nitrogen exceeded Class 3 of the Sea Water Quality Standard in a rate from 12.5% to 18.8%. The dominant pollution factor is inorganic nitrogen.

Pollution of heavy metals is slight, and Cu、Cr、Ni concentrations are lower than detection limited and Zn concentration is lower than Class 1 limit.

7.4 Environmental Impact of Old Town Greenbelt Ring Project

7.4.1 Impact on Socio-Economic Condition

In general, the resettlement is proceeding smoothly, the proponent of the Project is carrying out the resettlement in accord with relevant policies. Up to now, the resettlement has almost completed and the inhabitants have moved and resettled according to a plan, and the budget has been available. Basically speaking, the resettlement proceeded satisfactorily.

For most resettlers, the population density in the Old Town is too high to live, not only in terms of tight living space, but also of lacking sanitary facilities. The resettlement may give them an opportunity to improve their living condition. Though their new homes are rather far away compared with that in the Old City, however, they have a choice to adopt a way of buying desirable housing by themselves if the monetary resettlement mode accepted. As regards the units, the resettlement may also give them an opportunity to reorganise for developing new channels for business.

The social benefit of the project is distinct, i.e., improving inhabitants' living environment of the Old City, boosting the tourism development of Yu Garden area, promoting area land value and improving investment environment, etc.

7.4.2 Impact on Ambient Environment

The impact of the Old Town Greenbelt Ring Project on the air would only limited in the period of building demolition and by other construction activities. The impacts could include fly dust, noise, and inconvenient communication. Such impacts would be almost unavoidable for the construction sites are located in so densely populous area. The only way for mitigation would be by careful management of construction.

The eco-environmental benefit of the project are adjusting local climate, decreasing city heat island effect, absorbing carbon dioxide, giving out oxygen, increasing the concentration of negative ion in the air, absorbing toxic and harmful gases, decreasing dust content and capturing dust, etc.

7.4.3 Preservation of Cultural Properties

There are historic sites of Dajing Pavilion and Shanghai Bookstore as a revolutionary ruins in the project area. They have been named as cultural preservation heritage by the SMG municipal government. The project has fully considered the preservation and resettlement of those two buildings in the initial stage of the project implementation. The measures to reserve Dajing Pavilion is suitable, and the scheme that first removing Shanghai Bookstore and then rebuilding it at other place is feasible.

7.4.4 Implication in Pest Management

The pesticides and fertiliser used by green land of the project have no distinctly impact on the environment. Strengthening management and reasonably planting can effectively prevent plant from harm of diseases and insect pests. Safe biological pesticide will be adopted once plant diseases and insect pests occur. Special pesticide storehouse does not need to be built and insect pesticide will not be used.

8 Public Participation

8.1 Public Participation in SSP-III

Most public think project is very essential, and the support rate is more than 73%, whilst at the same time 32% public hold free and easy attitude for not knowing about the project.

66% persons express understanding of the impact in the construction period, and 72% public think that they can overcome environmental problems such as traffic and noise.

37% public express complaint about noise from the operation of the project, 55% persons think impact of foul smell can not be tolerated.

Of the affected inhabitants, 48% persons express that they are ready to move, 48% ones are ready to accept monetary compensation and new dwellings, 52% persons still have some worrying about the resettlement or did not express any of their opinion.

8.2 Public Participation in Laogang Landfill Project

An announcement about the Project was publicized by the client on Wen Hui Bao on the 29th December 2001, as well as by the EA team on website of Shanghai Environment Online (http://www/envir.online.sh.cn), and meanwhile a 24-hour telephone hot line has been opened. The visitors to the website have reached over 50,000 ones, who are from more than 20 countries within those following 20 days.

To conduct the public participation, three types were used: questionnaires, meetings, and on-the-spot interviews. The interviewees were people who live or work in the vicinity and could be affected, or staffs in local governments, or representatives of social organisations, or ordinary inhabitants.

100 copies of questionnaires had been sent and 96% returned. Sexes, ages, educational levels and occupations of the interviewees could well reflect the situation of the area.

Most of the interviewed villagers have rather well known this project and its significance. 63% of the interviewees think it is necessary, 21% stand by and 57% understand this project, whereas only 8% don't support it. Most enterprises have all well known the main elements of the project as well as its importance.

The public comments include:

- The Phase IV should become an advanced sanitary landfill site;
- Anti-permeating system should be facilitated in the landfill zones to prevent groundwater and soil from contamination;
- The leachate should be treated in compliance with standard prior to being discharged;
- Timely covering will be necessary over the filled refuse to minimise the diffusion of stink and fly's breeding;
- A green insolating belt in certain width is needed around the landfill site so that the influence of fly on the surrounding inhabitants could be lessened as possible.

8.3 Public Participation in Old Town Greenbelt Ring Project

The inhabitants and units in the area of the project generally support the implementation of the project. Individuals and enterprises to be resettled hope that reasonable resettlement measures are to be adopted, and transparency of the resettlement policies should be enhanced to resolve the resettlers' worrying and the preserve the their interest. The inhabitant around the area of the project requires the contractors to adopt practical measures to guarantee the normal running of requisite facilities.

9 Environmental Management Plan

9.1 Mitigation of Environmental Impacts

9.1.1 Recommended Mitigation Measures for Shanghai Sewerage Project-III

In order to avoid occurring of potential environmental impacts during the course of construction and operation, it has been recommended for the mitigation measures that may use (Table 10-1).

9.2 Institutional Strengthening and Training

9.3 Monitoring

9.3.1 Monitoring Requirement for Shanghai Sewerage Project-III

Environmental monitoring in construction stage mainly includes three aspects, i.e., monitoring pollution from construction activities, wastewater strength and flow, and receiving water quality.

During operation stage, the monitoring includes three parts, i.e., monitoring at dischargers, pump stations and sewage treatment plant, as well as receiving water bodies.

Recommendation and requirements on the environment monitoring both in construction and operation periods listed in Table 10-2 and Table 10-3.

9.3.2 Monitoring Programme for Laogang Landfill Expansion Project IV

A programme for the Landfill Project is necessary to make routine monitoring on foul smell and fly, leachate, sludge and noise (Table 10-4). The sampling sites should be set following the process of generation and migration of the pollutants, i.e., the sources, the outlets of treatment facilities, the ecosystem in the landfill site, at the boundary and beyond.

Table 10-1 Mitigation measures recommended for SSP-III during Construction Stage

Item		Potential adverse impact	Mitigation measures	Execution/monitoring departments
Dwelling house		Resettlement derived by sewer laying, sewage treatment plant, pump station construction	Prepare scheme for resettlement; According to relevant Chinese law: (1) compensation; (2) equal guarantee or better houses	Shanghai water environment construction Co Ltd/district governments
Industrial and commercial house		Economical loss	Provide compensation, new location according to Chinese and local laws	Shanghai water environment construction Co Ltd
Farm cultivation		Temporary lose of borrowing land	Prepare land use plan	Shanghai water environment construction Co Ltd/township governments
		Forever lose of land by acquisition	Legal regulations on compensation in China	
		Fertility lose of soil, and building material scattered all around	Clean up site, refill topsoil, collect manure and fertilisation	contractors and land cultivators
		Irrigation and drainage ditch destroyed	provide temporary ditches	contractors/Shanghai water environment construction Co Ltd
			Pumping water	
		Farm roads destroyed	Construct temporary passage	
Transport	Road	Influence on road traffic	Pave temporary detour and civilised construction	contractors/Shanghai water environment construction Co Ltd
	Bridge	Influence on traffic by demolishing	Reconstruct route or erect temporary bridge	
	River	Close temporarily	Navigation through other rivers	Shanghai water environment construction Co Ltd/Inland Water Shipping Dept.
			Show caution signal at night	
Construction drainage		Pollute rivers and ditches	Set sand sink pool	contractors/Shanghai water environment construction Co Ltd
Huangpu River		Pollute water environment	Strictly control classes 1 & 2 pollutants to meet Category 2 discharge standard	drainage company/ SEPB
Noise		Disturbance during construction	Not allow operation at night within 200 m from residential area and erect sound barrier	contractors/Shanghai water environment construction Co. Ltd
Spoil dispose		Surplus spoil dispose	Carry out according to a spoil disposal plan	contractors/Shanghai water environment construction Co. ltd
			Not allow to release spoil into farmland or to fill rivers, channels ponds, etc.	

		Use spoil for fill-up of base of newly-built building or other project	Shanghai water environment construction Co. Ltd/ Shanghai spoil management station in related districts

Table 10-2 Recommended programme for surface water monitoring

Huangpu River	Dianfeng, Daqiao, Linjiang, Nanshi, Yangpu Bridge. Wusong Kou
Frequency	Daqiao: monthly; others: bimonthly.
Items to be monitored	Physico-chemical index: pH, SS, DO, PV, BOD_5, COD_{Cr}, NH_3-H, nitrites, nitrates, petrol, volatile phenols, cyanides, As, Hg, Cr(VI), Pb, Cu, Zn, Mn, chlorides, total P, total N, LAS; Biological (at Daqiao, Linjiang, Yangpu Bridge): mutability; Sediment: heavy metals
Urban rivers	Qiu Jiang; Yangpu Gang; Taopu River; Yunzao Bang.
Frequency	Bimonthly
Items to be monitored	Physico-chemical: DO, PV, BOD_5, NH_3-N, petrol, volatile phenols, cyanides, Hg, Cr(VI), Pb, Cu, Cd
Suburb rivers	Chuanyang Canal, Zhangjia Bang, Gaoqiao Gang.
Frequency	Bimonthly, sampling once each at ebb.
Items to be monitored	Same as urban rivers
Chang Jiang estuary	Wusong Kou, Zhuyuan, Bailong Gang
Frequency	3 times a year to represent dry, average and flood period
Items to be monitored	physico-chemical: water temperature, pH, SS, DO, PV, BOD_5, COD_{Cr}, NH_3-N, nitrites, nitrates, petrol, volatile phenols, cyanides, Hg, Cr(VI), Pb, Cu, Zn, Mn, Cd, chlorides, total P, total N, conductivity, sulphides, sulphates, orgno-phosphorus pesticides, chlorophyll Biological: benthos at intertidal zone and their tissue Sediment: heavy metals

Table 10-3 Recommended programme for monitoring pump stations and sewage treatment plant during operation

Category	Site	Items to be monitored	Monitoring spot	Frequency
Wastewater	Sewage pump stations	Flow, pH, SS, settable solid, sulphides, BOD_5, COD_{Cr}, PV, TOC, NH_4-N, total N, total P, conductivity, cyanides, volatile phenols, petrol, oil, nitrites, nitrates, fluorides, sulphates, phosphates, LAS, aniline, nitrobenzene, 1,3-dinitrobenzene, 2,4-dinitrotoluene, Cr(VI), Ni, Fe, Mn, Cu, Zn, Cd, Cr, Hg, As, Pb	Inlet, outlet	Monthly
	Sewage treatment plant	BOD_5	Influent & effluent of primary treatment; effluent of secondary treatment	Daily
		TSS*, pH*		Six times per day
		TN, TP, NH_4-N*, flow /water level*	Influent of primary treatment; effluent of secondary treatment	
		DO*, NO_2-N, NO_3-N, coliform group	Effluent of secondary treatment	
		TS, VS	Sludge	Daily
		Settable solid, sulphides, COD_{Cr}*, PV, TOC, conductivity, volatile phenols, cyanides, petrol, oil, fluorides, sulphates, phosphates, LAS, aniline, nitrobenzene, 1,3-dinitrobenzene, 2,4-dinitrotoluene, Cr(VI), Ni, Fe, Mn, Cu, Zn, Cd, Cr, Hg, As, Pb	Influent of primary treatment; effluent of secondary treatment	Monthly
Noise	Pump stations, sewage treatment plant	L_{eq}	1 m from factory boundary	Monthly
Foul smell	Sewage pump stations, sewage treatment plant	H_2S, NH_3, methanethiol, odour intensity	At stack or boundary	Monthly

Table 10-4 Proposed monitoring programme for Laogang Landfill Expansion Project IV

Item	Monitoring site	Object to be monitored	Frequency*
Waste gas	10 m leeward Stage-1 filling zone/LFG burning device	Odour or H_2S, NH_3, CH_3SH, PM_{10}, CH_4	Twice a year
	Discharge roll of combustion chamber in Stage-2		
	1 m from side of axial road		
	1 m from boundary of wastewater treatment system		
	1 m from boundary of landfill zone of the Project		Quarterly
Wastewater**	Influent & effluent of wastewater treatment system	pH, COD, BOD, NH_3-N, SS	Monthly
	Outlet of storm runoff		
Solid waste	Sludge from wastewater treatment	Hg、Cd、Pb、As、Cr	Twice a year
Noise	1m from boundary of Project IV landfill site	L_{eq} (A)	Quarterly
Wetland ecology	Section starting from runoff outlet and perpendicular to east boundary of Project IV, sampling spot at 500 m interval	Terrestrial vegetation, land animals, intertidal zone animals, estuary sediment, phytoplankton, zooplankton, benthos, fishes	Once a year
Groundwater	8 monitoring wells set around beyond the area enclosed by vertical barrier	pH, COD_{Cr}, Cl^-, NH_3-N, Volatile phenols, Total hardness, Cu, Zn, Hg, As, Cr, Cd, Pb	Twice a year
Soil	8 monitoring wells set around beyond the area enclosed by vertical barrier	As, Cd, Pb, Cr, Cu, Hg, Zn, Ni	Twice a year
Fly	8 monitoring wells set around beyond the area enclosed by vertical barrier	Fly density (ind./cage/d)	Twice a year
	Zhaodong, Zhonggang, Gangdong in Laogang Town		

* When do sampling, 2 to 3 samples should be taken a day with parallel analysis;

** The routine parameters in a wastewater treatment station are not included in this programme.

10 Conclusion

Phase I for APL Shanghai Urban Environment Programme is proposed to have four components: Shanghai Sewerage Project Phase III, Solid Waste Management Project Phase I (including three sub-components as Phase IV of Laogang Landfill, Food Waste Collection and Treatment Project, Management Information System for Sanitation Facilities), wastewater treatment plants at Upper Huangpu catchment (including three sub-components: WWTPs at Fengjing, Xinjiang and Fengxian), and Shanghai Old Town Greenbelt Ring Project. It is expected that Phase I of APL will be completed between 2002 to 2007 with total investment of 6.847 million USD, among which 2.5 million USD will be loaned by APL.

The implementation of APL Phase I is in full compliance with the strategic objectives put forward in the Shanghai City Master Plan approved by the State Council and it conforms to the core project, the Comprehensive Redevelopment Programme of Riversides along the Huangpu, in Shanghai in the 21st century. The APL Phase I will lay a solid basis for implementation of Shanghai City Master Plan.

Siting of each sub-component is based on the location of existing environmental infrastructure as well as future layout planning. Location for these components is reasonable.

When APL Phase I is completed, water treatment capacity in Shanghai will increase 714,000 m^3/d. Water environment in the Huangpu River and its tributaries will be effectively protected, and water quality will be improved. In the middle and lower reaches, the water quality will reach Category IV of national classification, while the upper reaches will achieve Category III. Regarding household refuse, 90% will be sorted during collection, 64% will be conveyed by closed lorries, 49% will be recycled or reused and the non-hazardous disposal rate will be over 95%. Shanghai will establish an effective management mechanism over the solid wastes, from cradle to grave. As to old city rebuilding, the Old City Park project will be a combination of heritage preservation and modern development. Environmental objectives for APL Phase I is feasible and accessible.

Implementation of APL Phase I is ensured by a package of favourite policies, institutional and financial support. APL Phase I will help the government in Shanghai to improve its roles in planning and decision making, and it will attract much more qualified enterprises, talents and capital to participate in the environmental infrastructure construction in Shanghai. APL Phase I will push Shanghai toward further reforming in order to follow up with WTO practices.

Based on all the items mentioned above, it is concluded in this assessment that Phase I for Shanghai Urban Environment Project in the APL Programme is feasible.

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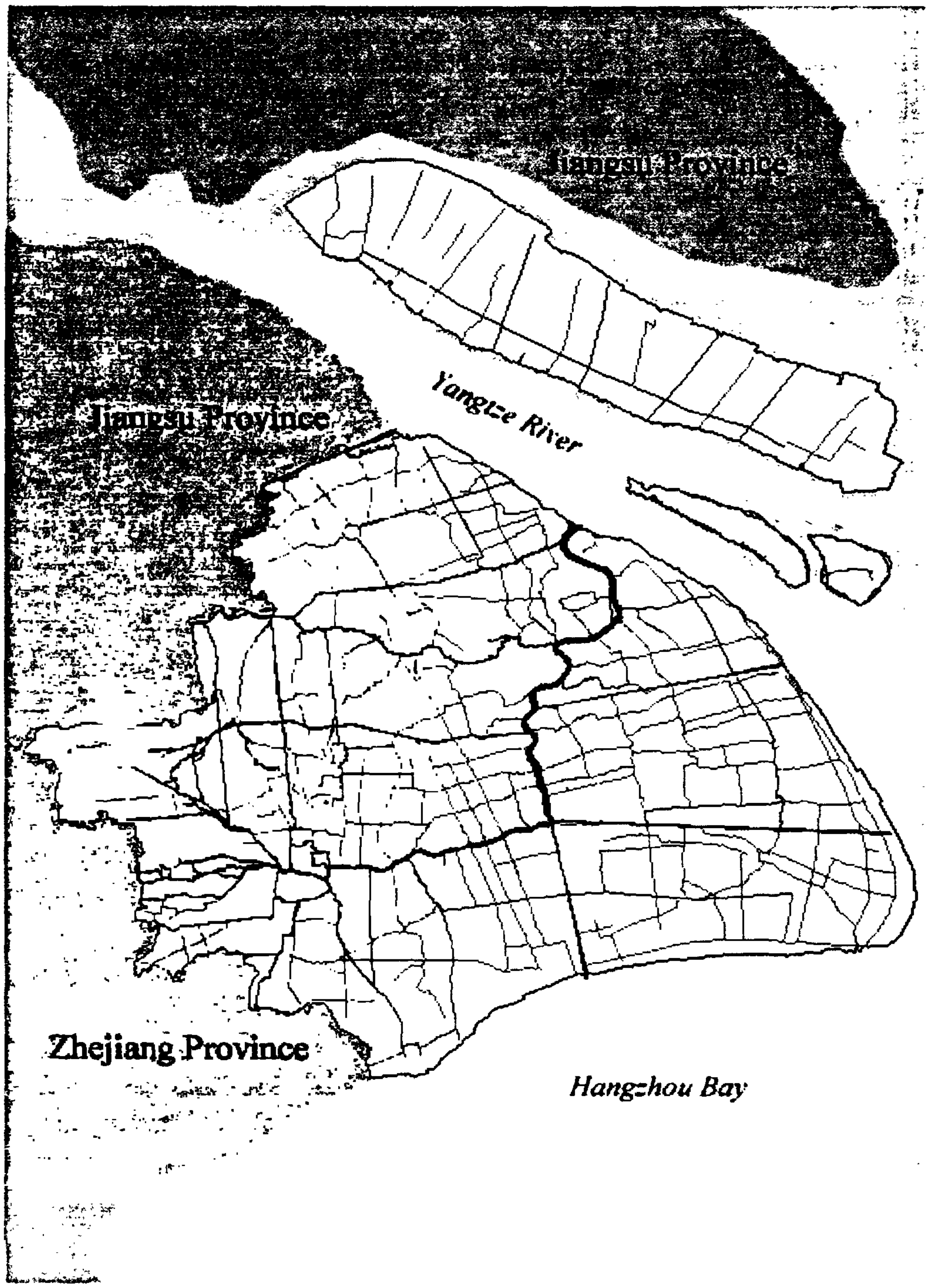

Figure 1 Map of Shanghai

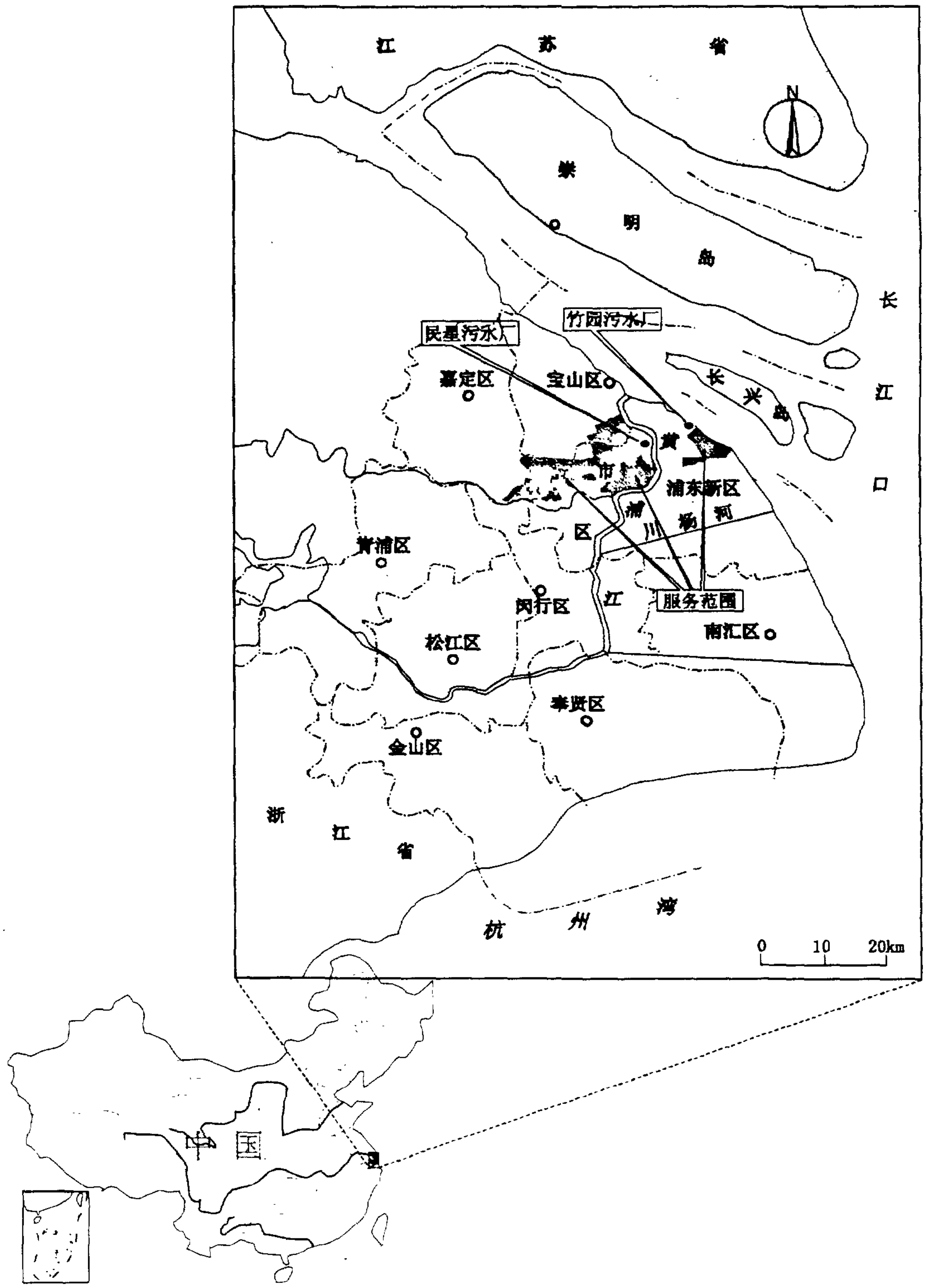

Figure 2 Service Area of SSPIII

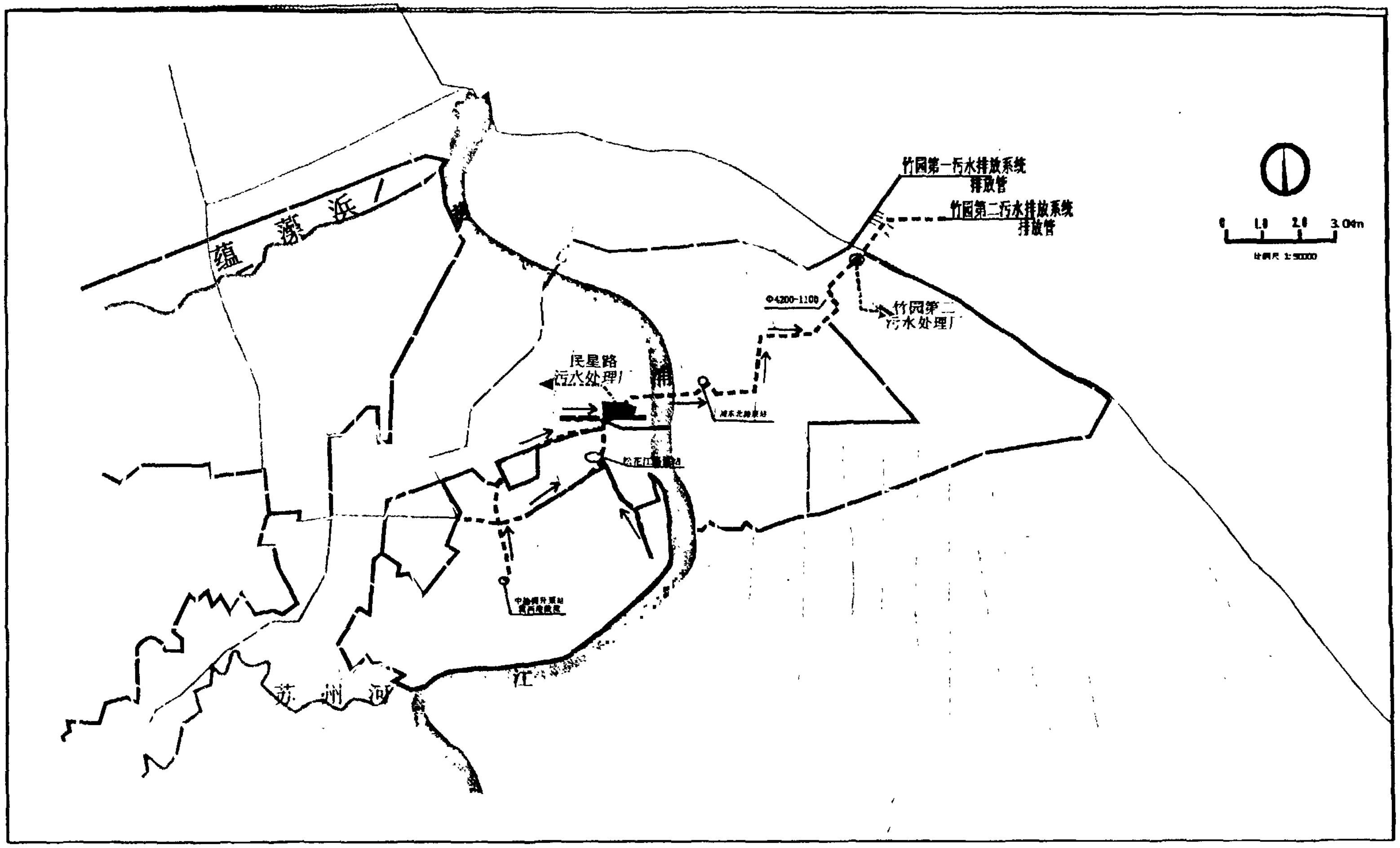

Figure 3 Alignment of SSPIII

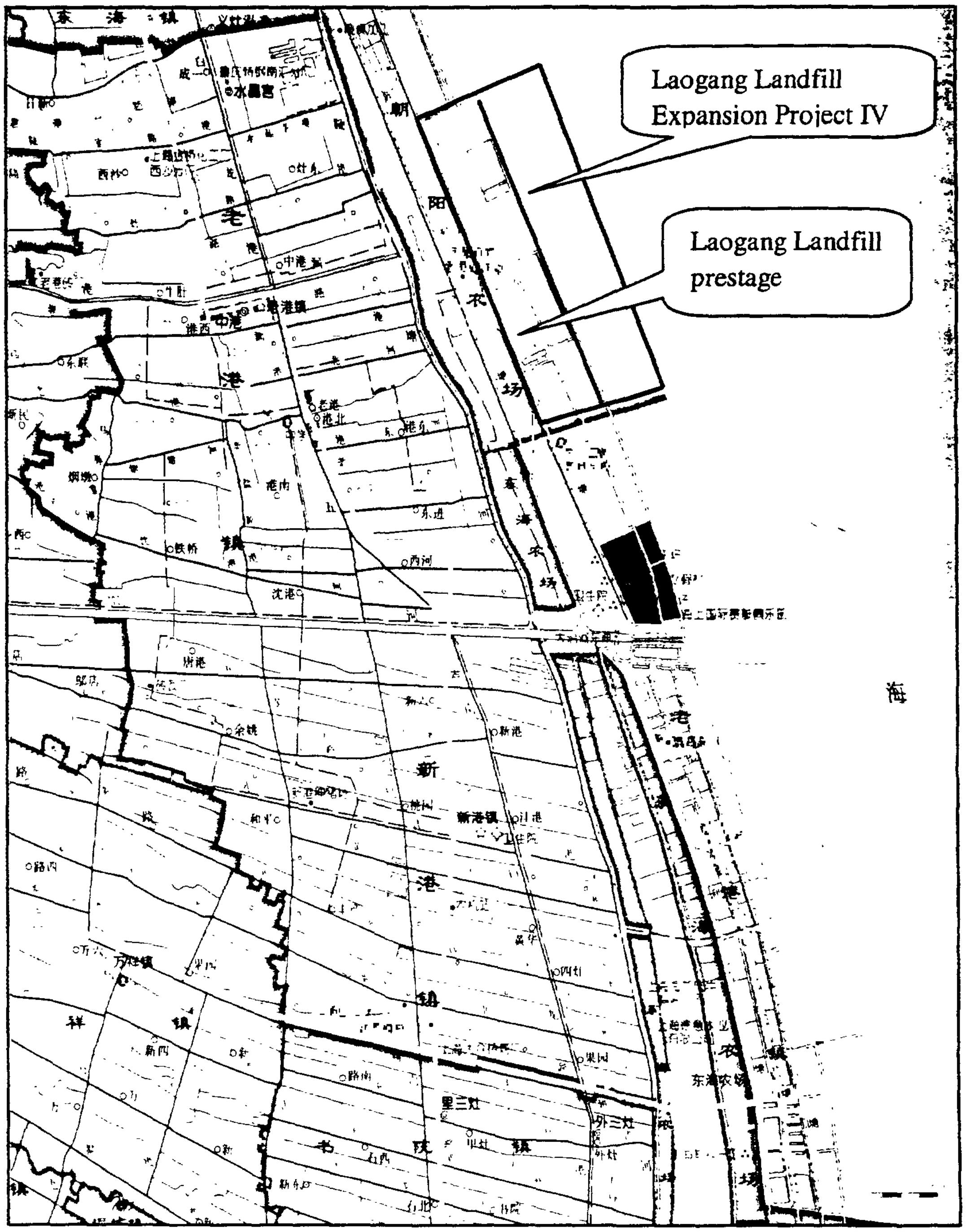

Figure 4 Location of Laogang Landfill

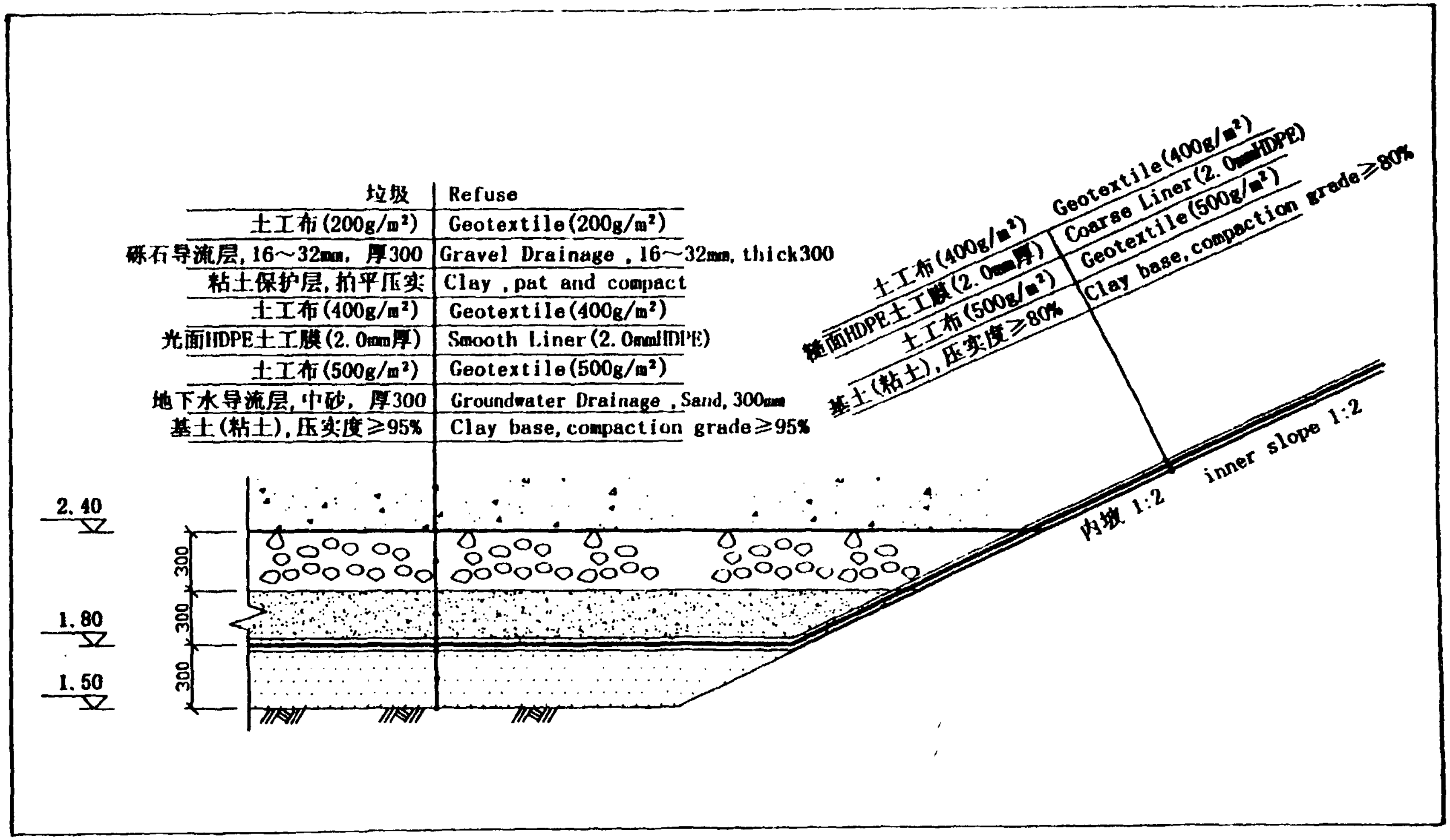

Figure 5 Structural Drawing of Leakage Preventive System

Figure 6 Locations of Proposed WWTP Projects

Figure 2.4.2.7/A