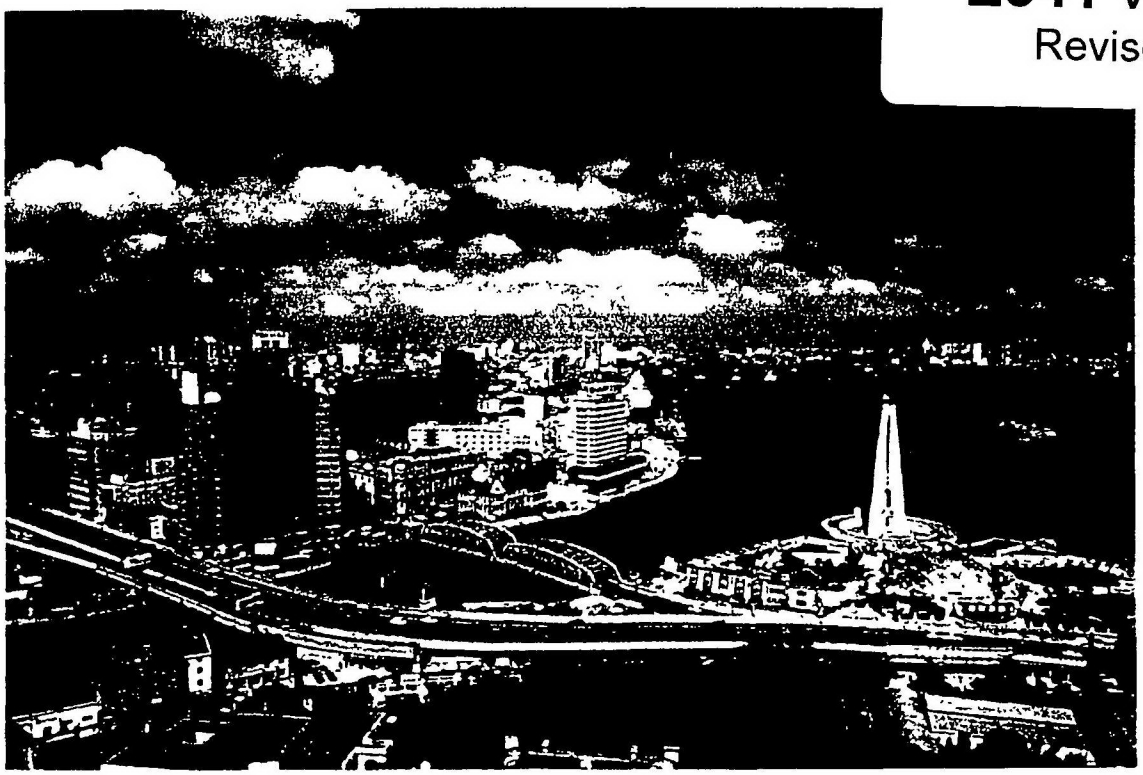
A SUPPLEMENT TO

ENVIRONMENTAL ASSESSMENT FOR

SHANGHAI URBAN ENVIRONMENT PROJECT

– Environmental Assessment for Adjusted

Shanghai Sewerage Project Phase III



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SAES

A Supplement to Environmental Assessment for Shanghai Urban Environment Project

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Acronym

A/O	Anaerobic/Oxydic
APL	Adaptable Programme Loan
BAF	Bio-Aerating Filtration
BOD_5	5 day Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPBs	Environmental Protection Bureaux
LAS	Linear Alkyl Benzene Sulphonate
PV	Permanganate Value
PRC	People's Republic of China
RMB	Renminbi (Chinese currency yuan)
SAES	Shanghai Academy of Environmental Sciences
SEPB	Shanghai Environmental Protection Bureau
SHUEP	Shanghai Urban Environment Project
SMG	Shanghai Municipal Government
SMSC	Shanghai Municipal Sewerage Co. Ltd.
SS	Suspended Solids
SSPIII	Shanghai Sewerage Project Phase III
SWA	Shanghai Water Authority
SWEC	Shanghai Water Environment Construction Co. Ltd.
TOC	Total Organic Nitrogen
TSS	Total Soluble Solids
WWTP	Wastewater Treatment Plant

A Supplement to Environmental Assessment for Shanghai Urban Environment Project

— Environmental Assessment for Adjusted Shanghai Sewerage Project Phase III

1 Background

Shanghai Sewerage Project Phase III (SSPIII) is one of components included in Shanghai Urban Environment Project (SHUEP) to seek an Adaptable Programme Loans (APLs) facility from the World Bank. The Environmental Assessment (EA) of SSPIII was reviewed by Shanghai Environmental Protection Bureau (SEPB) in February 2002.

In October 2002, Shanghai was awarded to host the Expo for 2010. To prepare the 2010's Expo, an ambitious redevelopment programme for riversides along the Huangpu has been launched. As the previous proposal of Minxing wastewater treatment plant for Area B of SSPIII seems contrary against the redevelopment programme, Shanghai Planning and Development Commission and Shanghai Construction Commission organised Shanghai Water Authority (SWA) and other concerned agencies to further study and adjust the scheme. A supplementary feasibility study report was submitted and reviewed following the planning formality.

According to the remark given by SEPB to the Environmental Impact Statement (EIS) for SSPIII, should there be any changes in components, characters, scale or siting of the project, the EIS ought to be resubmitted for review and approval. Therefore, a supplementary report to the EIS for SSPIII has been prepared to reflect the adjustment and for submission.

The changes of adjusted SSPIII are mainly in the scheme for Area B (Table 1).

Table 1 Comparison of scheme for adjusted SSPIII

Item	Previous scheme	Adjusted scheme	Comparison
Service area (km^2)	163.34	168.87	+ 5 53
DWF (Mm^3/d)	1.06	1.09	+ 0.03
Trunk length (km)	4.60	14.15	+ 9.55
WWTP location	Minxing (by Huangpu)	Zhuyuan (by Chang Jiang)	
Treatment process	High efficiency precipitation + BAF	A/O phosphorus removal	
Investment (M yuan RMB)	4,740	4,680	− 60

2 Adjusted Scheme for Area B of SSPIII

The previous scheme for Area B of the SSPIII covered 31.56 km^2. Now it is expanded to 37.09 km^2 by including four self-draining areas in Hongkou and Yangpu districts and Minxing catchment. The design dry weather flow is increased from 405,200 m^3/d to 431,000 m^3/d whilst the capacity of sewage treatment plant will still be kept at 500,000 m^3/d.

The site of sewage treatment plant is moved from Minxing Road in the previous scheme to Zhuyuan, and the alignment of main sewer is changed accordingly (Fig. 1).

2.1 Main Engineering Work for Area B

The main engineering work for Area B of SSPIII includes sewage collection system and treatment facilities.

1) Sewage collection system:

Link sewers in sub-service areas, main storm-water drainage system, main sewer, and a midway pump station. The total length of the sewers is 14.15 km

2) Construction of a sewage treatment plant at southeast side of Zhuyuan No.1 WWTP at Chang Jiang estuary:
   - Wastewater treatment — sewage treatment plant;
   - Wastewater discharge — head tower, outlet pumping station and outfall.

2.2 Wastewater Treatment Plant

2.2.1 Design capacity

The design capacity of Zhuyuan No.2 Sewage Treatment Plant (for telling from Zhuyuan No.1 WWTP of SSPI) is 0.5 million m^3/d 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/s. Most of the service area of the treatment plant is combined sewerage service area with an interception ratio of 1.5 or 3.0 (interception ratio n is defined as the total capacity of collection system being (n+1) times dry weather flow). Thus, the storm peak flow is 21.26 m^3/s.

2.2.2 Design Strength of Influent and Effluent

Based on a survey, the strength of influent sewage is proposed. The effluent strength should be in compliance with Grade 2 of integrated wastewater discharge standard (GB 8978-1996) (Table 2).

Table 2 Design strength of influent and effluent in sewage treatment plant of SSPIII

Item	COD_{Cr}	BOD_5	SS	NH_3-N	Total P
Influent strength (mg/L)	300	150	200	25	4.0
Grade 2 of discharge standard (mg/L)	120	30	30	25	1.0

2.2.3 Sewage Treatment Process

The sewage treatment plant at Zhuyuan will use an A/O process. It comprises two biological steps namely anaerobic and oxydic processes respectively to remove phosphorus and BOD in the sewage (Fig. 2).

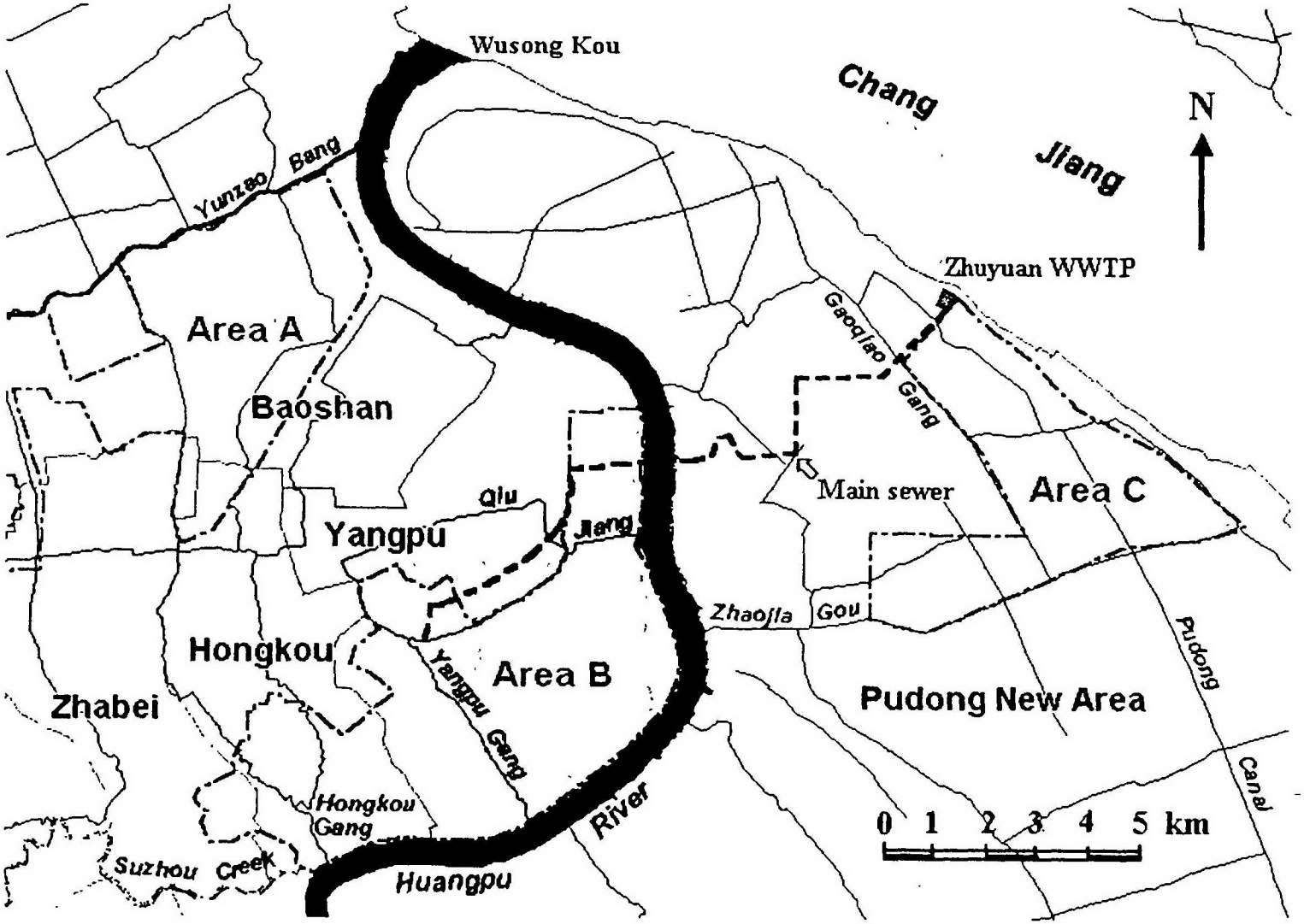

Fig. 1 Service area and main sewer for Area B of SSP-III

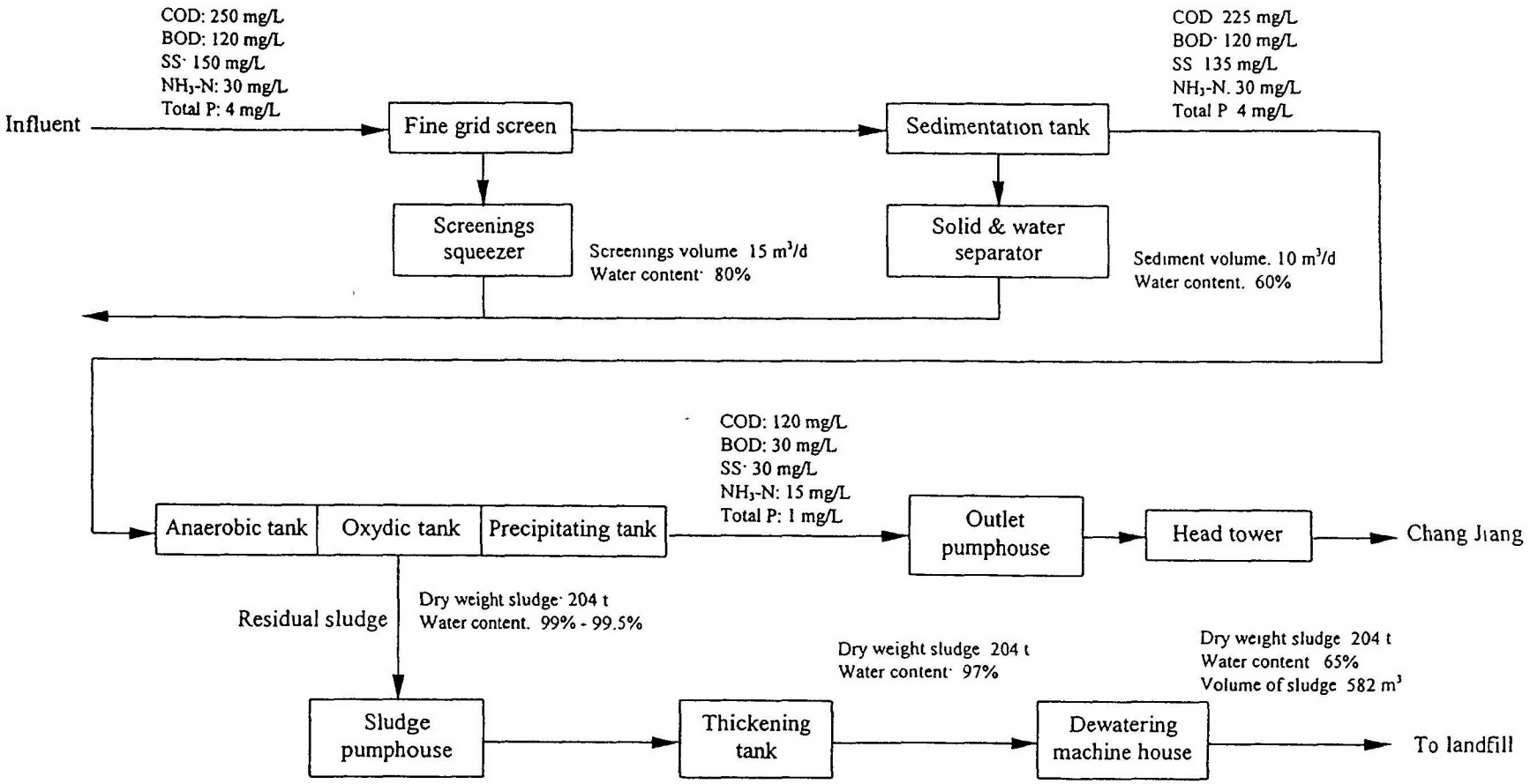

Fig.2 Flow chart of A/O phosphorus removal process

Having been pretreated by grid screening and sedimentation, the influent is introduced into an anaerobic tank, in which phosphorus in the sewage will be released in a form of ortho-phosphates into the mixed liquor Through a retention interval, the sewage flows into an oxydic tank, in which ortho-phosphates in the mixed liquor will be drastically absorbed by the sludge in an aerobic condition. Thus, the content of phosphorus in the liquid phase of sewage will be significantly decreased. After a secondary sedimentation, the effluent with lower phosphorus can be discharged whilst higher content of phosphorus remaining in the separated residual sludge.

In the application of A/O biological phosphorus removal process, a ratio of BOD_5 to total phosphorus in the sewage is a key factor to affect the phosphorus removal efficiency. If the ratio is too low, phosphorus-absorbing microorganisms in the sludge will be unable to sufficiently take up phosphorus, and the content of phosphorus in the effluent will not be dropped to a possibly lower level. It is reported that to achieve the phosphorus content lower than 1 mg/L, the ratio of BOD_5 to total phosphorus in the influent should be higher than 20, or a ratio of dissolved BOD_5 to dissolved phosphorus greater than 12. Based on the design strength of the influent of SSPIII, the ratio of BOD_5 to total phosphorus can meet the requirement for biological phosphorus removal, and the phosphorus content in the effluent is expected to be in compliance with the limit set in the Grade 2 of integrated wastewater discharge standard (GB 8978-1996). The anaerobic step in the process, however, is unfavourable to nitrogen removal. Like the conventional biological treatment process, the nitrogen removal is only about 20%. If the total nitrogen content in the influent is not so high, the effluent can be in compliance. As the operation and management of the A/O biological phosphorus removal process are rather simpler, and there is mature experience for the operational management available in China, this process is therefore suitable.

2.2.4 Discharge Outfall and Handling of Sludge

An outfall is to be set at bankside of the Chang Jiang estuary at Zhuyuan for normal discharge of the effluent, but a deep-water outfall will be set for emergency discharge.

The sludge generated in the sewage treatment process is handled with mechanical thickening and dewatering. 582 m^3/d sludge cake with water content of 65% will be hauled by trucks to a sludge treatment works at Bailong Gang.

2.3 Rationale of WWTP Siting at Zhuyuan

An analysis of the wastewater treatment plant alternatives in SSPIII, i.e., Minxing option and Zhuyuan option, has been conducted during the previous EA in terms of social and environmental impacts. It was found that the both water bodies at Zhuyuan of Chang Jiang estuary and in the lower reaches of the Huangpu River would unlikely cause significant impacts if the effluent had been subject to appropriate treatment. The assimilative capacity of Chang Jiang estuary, however, is comparably much higher than that of the Huangpu River, and moreover, the Zhuyuan option could eventually get rid of almost all the pollution loadings collected by this system away from the Huangpu River, whilst the Minxing option still allow the return of part of the loadings back to the Huangpu River by release of the effluent. From a water quality point of view, especially no effect on the Upper Huangpu water resources, the both options could be acceptable if relevant measures were taken for minimising unanticipated impacts.

Then it was called for further consideration particularly in terms of economic, planning and risk prevention aspects. Some incompatibility did exist between the WWTP siting of Minxing option and regional planning. For the Comprehensive Redevelopment Programme of Riversides along the Huangpu is an ambitious plan launched by the SMG, all the development projects should be in line with this core task, and the SSPIII scheme could be no exceptions. Hence, the Minxing option seemed to be not consistent with this ambitious plan.

Since the successful awarding of hosting the 2010's Expo, the redevelopment of riversides along the Huangpu River has become one of focal tasks in Shanghai before the year 2010. More conflicts with the redevelopment plan have emerged in respect to siting the WWTP at Minxing Road. Thus, the adoption of the Zhuyuan option becomes more rational in respect to not only being in favour of the improvement on water quality of the Huangpu River, but also the consistency with the regional planning in particular.

3 Potential Environmental Impacts of Adjusted Scheme for Area B

3.1 Impact of Effluent Discharge on Water Body of Chang Jiang Estuary

The potential environmental impacts of the adjusted scheme for Area B of SSPIII on water body of Chang Jiang estuary have been analysed in the previous EA report. It is summarised as follows.

Based on modelling simulations, in general, it was found that the body of water in the Zhuyuan area has a great capability of dilution. The discharge of wastewater after primary enhanced treatment/secondary treatment into the area will not generate any notable effect on the water quality in the surrounding body of water at Zhuyuan. Even under emergency conditions (without treatment for a short period of time, e.g. a couple of days), the effect of the wastewater discharge will be quite limited in a very small area. It was believed that with a better design of the diffuser system, the effect could be limited further.

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 occur. 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 the estimation by modelling, in very dry season when annual Chang Jiang River discharge flow is 7,500 m^3/s (occurrence is over 95%), the COD_{Cr} increment at Lingqiao will be 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 will have little impact on Lingqiao water intake even by the effluent of primary enhanced treatment in SSPI combined with the effluent of the SSPIII.

3.2 Impact on Ambient Air

Sludge disposal procedure at Zhuyuan WWTP will need 960 m distance for hygiene protection, and therefore three surrounding farmer village will come under impact. If treatment measures are adopted and pollutant removal rate can reach 90% or above, then the hygiene protection distance will reduce to 250 m, and those three surrounding villages will not be impacted by sludge disposal procedure.

3.3 Impact of Noise

Zhuyuan No. 1 WWTP is located on the northwest of the proposed Zhuyuan No. 2 WWTP, the west of which is Haixu Road, the east is Yantang Road, and 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 border all will exceed Class 2 limit value 50 dB(A) in «Noise standard at boundary of industrial enterprises (GB 12348-90)», with the highest exceeding 9 dB(A). It reveals that some mechanical noise in the Zhuyuan WWTP will not meet the requirements at the factory boundary. As the site of the Zhuyuan WWTP is a widely open field at the bank of Chang Jiang, the village dwellers are rather farther away so that little impact of noise will be exerted on them.

3.4 Impact on Social Environment

In light of the need for construction of a siphon tunnel across the Huangpu River, a midway pump station and more main sewer to convey the collected sewage to the Zhuyuan WWTP, it

is required to acquire and borrow more land As more civil work will be carried out in rural area of Pudong, the resettlement of enterprises will be less but the impact on cultivated land and road will be more (Table 3).

Table 3 Main social impacts of Area B scheme with Minxing and Zhuyuan options

No	Item	WWTP option	
		Minxing	Zhuyuan
1	Land acquisition (ha)	19 45	29.44
2	In which Cultivated land acquisition (ha)	-	21 96
3	Land of dwelling to be acquired (ha)	0.07	3 58
4	Land of enterprises to be acquired (ha)	19.38	3.90
5	Land borrowed (ha)	5.70	16 10
6	Number of households to be resettled	4	388
7	Number of inhabitants to be resettled	26	1382
8	Area of dwelling house to be demolished (m^2)	792	71,032
9	Number of enterprises to be moved	24	25
10	Building area of enterprise to be demolished (m^2)	129,458	39,677
11	Affected employees	4,475	699
12	Quantity of spoil (Mm^3)	0.418	0.358
13	Affected green space (m^2)	8,000	5,900
14	Number of affected trees	5,100	1,700

According to «Land Administration Law of PRC» and relevant regulations of land acquisition and resettlement for municipal construction projects in Shanghai, the project proponent SWEC will allocate special budget and cooperate with district and township governments to appropriately dispose the inhabitants to be resettled.

Along with the economic development of rural area and expansion of urbanised area in Shanghai, a lot of farming labours have turned to industrial sectors. Most farmers would not very much mind losing land and having a city life. The rural resettlers will be generally provided with housing in neighbouring newly-built farmer town, or according to relevant laws and regulations with homestead and fund for building new houses by their own, or just with cash. In the urban area, the resettlement will be carried on generally by providing new commodity housing, or giving monetary redress.

The enterprises to be resettled will be relocated according to district and township plans. They will obtain compensations for the loss of fixed assets and partly non-fixed assets by the project proponent.

Through the resettlement, the dispersed farmers' households will be assembled gradually so as to make the land use more rational and improve the living standard of farmers.

Some of enterprises will incur economic losses by the relocation. They will face production halts, rebuilding and transforming. The workers in those enterprises will lose job in this period, and their earning will decrease. It may raise some social problems of growing number of such personnel who are waiting for job.

3.5 Impacts of Sludge Transport

The sludge produced in the sewage treatment process is black to brown in colour, and contains about 35% to 55% of carbon, 4% to 6% of hydrogen, 20% to 30% of oxygen, 1.5% to 6% of nitrogen, 0 5% to 4.5 % of sulphur, and a little quantity of heavy metals. The contents of its leachate show that it is not a kind of hazardous wastes. It reveals that the landfill is an appropriate way for disposal of the sewage treatment sludge.

The means of transporting the sludge cake will be watertight trucks, and the travel distance from Zhuyuan to Bailong Gang sludge landfill is about 16 km. It will take about an hour for a round trip without passing through the urban area.

The potential impact of conveying 582 m^3/d sludge cake with 65% water content (about 204 t/d in dry weight) could be spill on the way, washing of trucks, and traffic noise and vehicle exhaust. If the trucks are sealed up and have anti-leakage device, the spill of sludge can be minimised to the least. Washing facility will be used to clean up the residual sludge attached on the wheels and out side surface of truck bodies before leaving the loading or unloading site. The wash water should be drained to sewerage system other than released to storm-water drain system or casually discharged into surface water directly.

3.6 Potential Impact of Construction Activities

Major environmental impacts in the construction phase include road excavation, traffic disruption, effects on land and water system quality as well as impacts of dust, excavated spoil and noise on surrounding areas. Actually, this is the stage with most serious environmental impacts. Along with the conclusion of the construction, most of those impacts would vanish, and local social, natural and ecological environment would get recovered.

3.6.1 Impact on Surface Waters

The area that construction will take place is quite flat and characterised with a network of rivers and creeks. The proposed sewer will pass across a number of waterways. Therefore, following impacts may be unavoidable from project construction on surface water in the area:

- During the construction period, the land surface vegetation coverage rate would be decreased drastically (even down to zero, i.e., all exposed) and dumps of soils and spoils would be increased, thus resulting in an increased content of pollutants in run-off and, in turn, directly impact the quality of water environment.
- As the groundwater table in the construction area is comparatively high, it is necessary to pump out impounded water. If directly discharged into the rivers or into municipal storm-water drain system, it will increase solids in receiving water bodies to accelerate the silt-up of riverbed; or may cause pipe blocking to result in flooding in the drainage service area.

3.6.2 Impact on Road Traffic

The construction will involve some pieces of roads, which are often quite busy. During the construction, the work will either traverse roads, or go along roads. Thus, the traffic will be influenced a lot. Some of roads have to be temporarily closed, and others may be not closed but dumped with different kind of debris or materials along the roads to make them narrower. Traffic congestion among motorised vehicles, bikes and pedestrians may cause the roads in a great mess or even accidents.

Haulage of spoil is another potential impact on the road traffic. Considerable amount of spoil could be generated in the project components. If a truck is overloaded, spill of the spoil may occur along the way, and moreover, cloud of dust flying up in dry weather or muddy surface in wet weather could influence the travel of pedestrians and vehicles as well as the environmental quality

3.6.3 Impact on Inland Water Traffic

As river courses have to be closed during construction period, boats are required to change their routes. The time to be lasting for a river course to reopen to traffic depends on river width, construction scale and complexity. It usually takes four months within which water transport will be greatly affected.

The blocking of some navigable channels may influence certain enterprises that use those waterways for transport of their materials. Some economic losses may be incurred to them. It could only be restored when the construction finished.

3.6.4 Impact of Fly Dust

During the construction, building demolition work is the first and direct source of the fly dust. Excavated spoil usually temporarily heaped up at the construction sites is another major source, and its duration may last several weeks or even several months. Wind blowing or vehicle travelling nearby could raise a cloud of dry dust over the sky resulting in sharp increase in fine particulate content in the ambient air and serious impairment of the city's look and surrounding landscape. When it rains or snows, construction sites would become muddy due to flushing by rainfall or smelt snow water plus pressing by vehicles. It would make inconvenience to pedestrians. Relatively, duration of the demolition work will be shorter, but the excavation work may last longer.

3.6.5 Impact of Noise

Main sources of noise could be falling down of the building being demolished, operation of construction machines and traffic horning of vehicles transporting demolished materials or building materials. If the construction activities are carried on at night, the disturbance could be very serious to prevent the nearby inhabitants from working or sleeping, in particular, some part of work are to be carried on in densely populous area.

3.6.6 Impact of Debris and Domestic Refuse

Some of usable materials from building demolishing may be reused, but the rest may be unusable such as broken bricks/tiles and debris. If they are disposed of improperly, the tidiness of the area and future use of the land could be impaired. Especially, if they are thrown into rivers or ditches, it could result in the waterways blocked up.

At the construction sites, there could be about thousands of workers and staff members accommodated with lodging and catering on-site. Therefore, it is very important to have proper facilities available for water and power supply as well as waste collection in those temporary construction camps. Otherwise, seriously adverse effect on sanitary environment of the construction sites may be caused to result in poor health condition of the working people there. Much worse it might cause epidemic diseases greatly influencing construction progress. Meanwhile, the inhabitants in surrounding areas would also suffer from mosquitoes, flies, offensive odour and diseases.

4 Environmental Management

4.1 Mitigation of Environmental Impacts

4.1.1 Construction Stage

The project proponent will put environmental requirement for the construction activities explicitly in the contract to be signed with the contractors so that the latter can follow the prescribed measures to control the pollution that may raised during the construction period by their own will and the proponent may strengthen its supervision according to the contract.

To alleviate environmental problems and troubles to the surrounding residents that may occur during construction stage, management will be strengthened with regard to noise from construction activities, traffic jamming due to materials/spoil transport, flying dust raised from the ground due to material handling and earthwork and other wastes from construction camps:

- Regularly spray the construction sites, transport routes and materials handling sites with water in dry and windy days, especially in congested downtown area, or near sensitive receptors, such as villages and residential areas;
- Carefully schedule construction activities to minimise the impact of noise from construction machinery to the surrounding environment, and prohibit uses of certain noisy machines such as pile drivers, concrete vibrators, etc. at night-time;
- Prepare road and river traffic plans in conjunction with relevant authority ahead of construction in the congested urban centres, particularly in areas where roads or waterways must be closed or semi-closed for pipe and sewer laying, and on river side or in water construction;
- Collect and divert sewage and other waste from construction camps to municipal systems to avoid contamination of the surrounding areas;
- Compensate appropriately and promptly the relocated and resettled residents, farmers, commercial operations, schools, institutions and other organisations according to relevant laws, regulations, guidelines and rates of the government or the World Bank;
- Well plan temporary land occupation, particularly in the farmland, ahead of the construction in consultation with the farmers and others affected to minimise the loss of crops, and restore the land to its original state at the end of the temporary uses; and
- Properly dispose of debris from demolishing buildings and spoil from earthwork at construction sites in designated ways only, and strictly prohibit disposal of such wastes in farmland, ponds or rivers.

4.1.2 Operational Stage

In the operational phase, appropriate mitigation measures will be taken for minimising the avoidable environmental impact and keeping the system performance in anticipated status so as to enhance the environmental effectiveness of all project components:

- Properly follow the operation procedures and ensure the Zhuyuan WWTP and sludge disposal facilities operation as designed;

- Develop contingency plans for power failure, overflows, equipment malfunctioning and other conditions which may affect the proper functioning of the plant resulting in discharge of untreated wastewater into the receiving environment;
- Develop a management plan for pesticide and fertiliser application in the green area to protect the safety of the public and workers; and
- Maintain regular consultation with the residents in the nearby communities and respond promptly any concerns they may raise with regard to the operations of the wastewater treatment, pumping station and sludge handling and disposal facilities.

4.2 Prescribed Mitigation Measures

In order to minimise the potential environmental impacts in the course of construction and after commissioning of SSPIII as possible, the mitigation measures that may put to use have been proposed (Table 4).

Table 4 Mitigation measures proposed for SSPIII

Item	Potential adverse impact	Mitigation measures	Execution/monitoring
Inhabitants	Resettlement derived by sewer laying, sewage treatment plant, pump station construction	Prepare scheme for resettlement; Abide by relevant Chinese law: (1) compensation; (2) equal or better housing	SWEC/district governments
Enterprises	Economic loss	Provide compensation, new location according to Chinese and local laws	SWEC
Farmland cultivation	Temporary lose of borrowed land	Prepare land use plan	SWEC/township governments
	Permanent 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/SWEC
		Divert water by pumps	
	Farm roads destroyed	Construct temporary access	
Traffic	Influence on road traffic	Pave temporary detour and civilised manner in construction	contractors/SWEC
	Influenced by demolishing bridges	Reconstruct route or erect temporary bridge	
	Close river temporarily	Navigation via other rivers	SWEC/Inland Water Shipping Dept.
		Show caution signal at night	
Rivers and channels	Water pollution by construction drainage	Set up grit-removal basins	contractors/SWEC
Huangpu River	Water pollution by effluent discharge	Strictly control Classes 1 & 2 pollutants to meet Grade 2 discharge standard	SMSC/ SEPB
Receptors around construction sites	Noise disturbance during construction	Not allow operation at night within 200 m from residential area, and erect sound barrier	contractors/SWEC

Item	Potential adverse impact	Mitigation measures	Execution/monitoring
Spoil disposal	Stacking of remained spoil	Handle according to a spoil disposal plan	contractors/SWEC
		Not allow disposing of spoil into farmland or to fill rivers, channels, ponds, etc.	
		Use spoil for fill-up of base of newly-built building or other project	SWEC/spoil dealers in related districts
		Transport by professional haulier	contractors/SWEC
Fly dust	Derived by spoil	Haul spoil away immediately	contractors/SWEC
		Cover or spray spoil stack	
		Clean up wheels of hauling lorries	
		Don't overload hauling lorries	
		Don't be exposed when used to refill roads	
Domestic waste	Damage sanitary condition	Haul waste away in time	Sanitation company /contractors
Vegetation	Reduction or loss	Plant trees and lawn once construction finished or reduce transplanting as possible	SWEC/district afforestation administrations
Power, communication	Destroyed	Contact concerned authority in advance, or make a detour as possible	SWEC
Cultural property	Nothing found up to now	Make a halt and report to relevant agency if discovered	contractors/SWEC
Tombs	Relocate	Give advance notice, and respect folkways	contractors/relevant district government
Buildings beyond resettlement scope	Collapse or crack of buildings	Carefully survey and construct	contractors/SWEC
		Demolish and rebuild	
		Repair in time	
Disposal of sludge	Impact of heavy metals on farmland	Set quality limit for sewage connection	SMSC
	Explosion by CH_4	Set vent hole in landfill site	SWEC/SEPB
	Greenhouse effect of CH_4	Collect and reuse	
	Leachate from landfill	Take account in design and construction	
Maintenance of sewer	H_2S poisoning	Strengthen occupational safety education	SMSC
Toxic and harmful substances	Diffusion, poisoning, contamination, not observed	Timely report to local EPBs and take appropriate measures immediately if observed	contractors/SWEC
System running	Overflow into inland water system in case of system failure	Strengthen maintenance of facilities, set dual line power supply at key positions	SWEC/SMSC /SEPB
	Pollutants in wastewater	Strictly manage & operate treatment system, train & check staff to ensure effluent compliant	

4.3 Monitoring Requirement

An environmental management sector for construction stage should be set up within Shanghai Water Environment Construction Company (SEWC), the project proponent.

Requirements for the environment monitoring in the operation period are proposed and listed in Tables 5 and 6.

Table 5 Monitoring programme for pump stations and WWTP in operation stage

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

Table 6 Monitoring programme for Chang Jiang estuary

Section	Items to be monitored	Frequency
Wusong Kou, Zhuyuan, Bailong Gang	physico-chemical: water temperature, pH, SS, DO, PV, BOD_5, COD_{Cr}, NH_3-N, NO_2-N, NO_3-N, 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	3 times a year to represent dry, average and flood period