SHANGHAI URBAN ENVIRONMENT PROJECT (SHUEP)

APL3
STRATEGIC STUDIES AND PROJECT PREPARATION

R3 – SUMMARY OF QINGCAOSHA RESERVOIR ENVIRONMENTAL ASSESSMENT

JULY 2008
135 0335 - R3
This document has been produced by SOGREAH Consultants as part of the FASEP Grant (French Government Grant) to Shanghai Municipal Government.

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<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
</tr>
<tr>
<td>AIC</td>
<td>Average Incremental Cost</td>
</tr>
<tr>
<td>APL</td>
<td>Adaptable Program Loan</td>
</tr>
<tr>
<td>BOD</td>
<td>Biochemical Oxygen Demand</td>
</tr>
<tr>
<td>CIECC</td>
<td>China International Engineering Construction Company</td>
</tr>
<tr>
<td>CNY</td>
<td>Chinese Renminbi Yuan (8.3 CNY = 1.0 USD)</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
</tr>
<tr>
<td>DRA</td>
<td>Design Review and Advisory</td>
</tr>
<tr>
<td>QCS</td>
<td>Qin Cao Sha (Reservoir)</td>
</tr>
<tr>
<td>QCSRWC</td>
<td>QingCaoSha Raw Water Company</td>
</tr>
<tr>
<td>PSP</td>
<td>Private Sector Participation</td>
</tr>
<tr>
<td>SS</td>
<td>Suspended Solids</td>
</tr>
<tr>
<td>SDRC</td>
<td>Shanghai Development and Reform Commission</td>
</tr>
<tr>
<td>SHUEP</td>
<td>Shanghai Urban Environment Project</td>
</tr>
<tr>
<td>SMG</td>
<td>Shanghai Municipal Government</td>
</tr>
<tr>
<td>SMEDI</td>
<td>Shanghai Municipal Engineering Design Institute</td>
</tr>
<tr>
<td>SWA</td>
<td>Shanghai Water Authority</td>
</tr>
<tr>
<td>SCC</td>
<td>Shanghai Construction Commission</td>
</tr>
<tr>
<td>SMSC</td>
<td>Shanghai Municipal Sewerage Company</td>
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<tr>
<td>SWEC</td>
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</tr>
<tr>
<td>SOC</td>
<td>Sewerage Operation Company</td>
</tr>
<tr>
<td>SWAOD</td>
<td>Shanghai Water Assets Operation and Development Company</td>
</tr>
<tr>
<td>TKN</td>
<td>Total Kjeldahl Nitrogen</td>
</tr>
<tr>
<td>TP</td>
<td>Total Phosphorus</td>
</tr>
<tr>
<td>TSP</td>
<td>Total Suspended Particles</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>WTP</td>
<td>Water Treatment Plant</td>
</tr>
<tr>
<td>WWTP</td>
<td>Wastewater Treatment Plant</td>
</tr>
<tr>
<td>Mm³/d</td>
<td>Million Cubic Meter/day</td>
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INTRODUCTION

The Shanghai Urban Environment Project (SHUEP) is intended to provide a sustainable environmental setting for the long-term economic and social development in the Municipality of Shanghai while supporting the provision of urban infrastructure, which has been devised as an Adaptable Program Loan consisting of a series of loans over a 7-10 year period, divided into 3 phases.

SHUEP APL3 is planned to continue with the improvements to the infrastructure and environmental needs of the city proper, focusing on the Raw Water Supply and Wastewater sectors. Two main physical works have been identified for World Bank financing as part of APL3 (1) Nanhui Raw Water Conveyor, which is part of the QingCaoSha Raw Water Project (QCSRWP), and (2) Bailonggang Southern Collector Extension.

The QCSRWP as a system comprises 6 components (deemed as linkages to the WB financed Nanhui conveyor), among which QCS reservoir has been of major relevance with regard to WB safeguards due to the possible impact on the ecological conditions of Yangtze Estuary. As a consequence, a summary of the QCS reservoir EA with further supplementary information required by the WB was requested during the preparation mission of January 2008.

This report is a summary of the simplified version (adapted by Chengtou DFV) of the QCS reservoir EA report prepared by Shanghai Investigation Design & Research Institute in November 2007, with certain additional elements from websites, research papers and articles of public domain, which have been noted in the text for sources of additional information.
1 ENVIRONMENTAL ASSESSMENT ARRANGEMENTS

1.1 PROJECT OWNER

The Project Owner for QCS Reservoir is Shanghai QingCaosha Investment Construction &
Development Co. Ltd, which was established in August 2006 and officially registered on Dec. 28,
2007.

1.2 EA PREPARER

The original QCS EA Report was prepared by Shanghai Investigation Design & Research Institute,
under contract with QCSRWC signed in November 2005, in collaboration with

- Shanghai Academy of Environmental Sciences,
- East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences, and
- East China Normal University,
2 PROJECT DESCRIPTION

2.1 PROJECT RATIONALE

At present, the raw water for Shanghai municipal water supply originates mainly from two sources:

- one is upstream of Huangpu river, constructed during the “Eighth Five-year” plan period with an actual supply of 5.67 million m³/d well above the design capacity of 5 million m³/d. It provides about 80% of the municipal current water needs;

- the second is the Yangtze river through the Chenhang reservoir constructed during the “Ninth Five-Year” plan period, with an existing capacity of 1.3 million m³/d; it will be extended to 2.48 million m³/d after the completion of the 3rd phase project.

Three other smaller supply sources contribute: Shugou, Taipu and Xietang River.

The future water demand for Shanghai is 14.28 Mm³/d by 2020, whereas the actual supply is 8.56 Mm³/d (current: 7.11 Mm³/d + extendable 1.45 m³/d). New water resource intakes and WTP will be mobilized to come up with the future water demand.

In accordance with the Shanghai Overall Master Plan (1999 ~2020) a review for the site selection of the future reservoir was carried out by the Construction Committee and the Environmental Protection Bureau (Research on Strategic Measures of Utilization of Water Supply Sources from the Yangtze River in Shanghai and the Environmental Analysis of the Water Resources and Strategic Options in Shanghai, respectively) in December 2005. The conclusion of this study ranked Qingcaoshua¹ as the most suitable area, with a maximum capacity of 7.19 Mm³/day. QCS complies with the relevant plans, the water quality is compliant with GB 3838 – 2002, the pollution risk and impact from the surrounding area is limited and protection of the water source is feasible. The detailed plans, such as reservoir engineering, the pump gate, water pumping stations, pipelines crossing the river and the pipelines’ technical programmes are basically feasible. The total beneficiary population will be over 10 millions (covering fully 10 districts and partially 5 districts); in 2020 the water supply volume will be 7.19 Mm³/d. The total project investment is approximately RMB 4.922 billion, including tentative 2.92% investment for environmental protection, which is about RMB 143.53 million.

In 2006, the Qingcaoshua water resources area has been included in the “Shanghai Master Plan (1999~2020)” approved by the State Council, the “Specific Water Supply Plan” approved by the Shanghai Municipal Government and the “Shanghai Water Environment Functional Zones (revised)”. On 20 January 2006, the construction of the Qingcaoshua water resources area was officially listed in the “Shanghai National Economic and Social Development Outline of the 10th Five-Year Plan” approved by the fourth meeting of the 12th Shanghai Municipal People's Congress.

The construction of QCS reservoir is considered as a priority project; building works have already started since November 2007 and should be finished in 2010 for the Shanghai Expo.

2.1.1 PLAN COMPATIBILITY ANALYSIS

2.1.1.1 COMPATIBILITY WITH THE SHANGHAI MASTER PLAN (1999~2020) AND THE 11TH FIVE-YEAR PLAN

The project has been included in or is conform with the following regional and municipal plans:

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¹ Qingcaoshua Reservoir covers the total area of 2 small islands: Qingcaoshua and Zhongyangsha island and parts of Changxing Island
2.2 DESCRIPTION OF PROJECT ACTIVITIES

The Qingcaoshan reservoir project includes the followings:

✓ the construction of a new dike,
✓ raising the height of the reinforced west dike and south dike,
✓ raising the height of the reinforced Changxing Island seawall and of the reinforced bank of the reclamation area,
✓ the construction of pumping works for water abstraction and supply.

No soil sealing (reservoir soil covered with concrete) is planned for the reservoir bottom.

2.2.1 PROJECT CLASSIFICATION AND DESIGN CRITERIA

In accordance with the “Water Conservancy and Hydropower Project Grading and Flood Standards” (SL252-2000) and the “Flood Prevention Standards” (GB50201-94), the Qingcaoshan reservoir project is defined as a large reservoir of Class I. The central embankment, water pumping stations, dams and other major buildings are also defined as Class I level for building design:

✓ QCS reservoir project scale: Large (2)
✓ Engineering classification: Class I
✓ Main structures of reservoir project: Class I

The criteria of water intake pumping station, gate at upstream and at downstream and water conveyance pumping station are the same as the embankment, and without overtopping design.

Seismic resistance intensity of structures: level VII

2.2.2 RESERVOIR DIKE LAYOUT PLAN

The embankment of reservoir is composed of south embankment, west embankment, north embankment, east embankment and seawall of Changxing Island, the total length is 48.79km. The area of reservoir is 66.26km² (including 2.18km² QCS reclamation area in reservoir). A layout map of the reservoir is provided as below:
TABLE 2-1: TYPICAL WATER LEVEL OF RESERVOIR

<table>
<thead>
<tr>
<th>Salinity intrusion</th>
<th>Non salinity intrusion</th>
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<tbody>
<tr>
<td>Max storage water level</td>
<td>7.0m</td>
</tr>
<tr>
<td>Min operation water level</td>
<td>-1.5m</td>
</tr>
<tr>
<td>Average operation water level</td>
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TABLE 2-2: RESERVOIR CAPACITY

<table>
<thead>
<tr>
<th>By 2010</th>
<th>By 2020</th>
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<tr>
<td>Total capacity</td>
<td>481 million m³</td>
</tr>
<tr>
<td>Available capacity</td>
<td>392 million m³</td>
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Design criteria of outer side of embankment: 1 in 100 years + stormy waves of same frequency.

Exceptional criteria of external side of embankment: 1 in 300 years + stormy waves of same frequency.

Flood control criteria of inner side of embankment: max storage water level + the correspondent stormy waves.

The new embankment design will allow partial overtopping, but not for the inner embankment of Changxing Island.
2.2.3 WATER INTAKE PUMPS AND SLUICE GATES

2.2.3.1 OPERATIONAL PROCESS

The water intake relies on a combination of gravity feeding through sluice gates and pumping operation.

During the flood season, the inflow to the reservoir is controlled only by gravity – the upstream gate is open and lets the water flow in, and the downstream gate may be opened to discharge excess water if needed.
At the beginning of dry period (and of the increase of salinity in the estuary), pumps are used at a capacity of 200m³/s to fill the reservoir. This will increase the water level from normal WL 2 m to a maximum WL 7 m.

The upstream sluice gates control the gravity water inflow into the reservoir during the period outside the salt intrusion events in the estuary. The downstream sluice gate controls the water outflow of the reservoir during the non-salt tide period.

The use of gates and pumps is coordinated in order to improve the water circulation, to reduce the water retention time and thus the risk of eutrophication.

### 2.2.4 WATER CONVEYANCE PUMPING STATION

#### 2.2.4.1 LOCATION

The pumping station is located upstream of the existing dike in the southeast corner of the reservoir, with a total pumping capacity of 7.19 Mm³/d, or 200 m³/s. The chloride content will not exceed 250 mg/L. A location map is provided below.

#### 2.2.4.2 MAIN STRUCTURE OF PUMPING STATION

The main structure comprises the water supply gate and the well. The gate chamber (yellow part of the drawing) uses a caisson structure with two holes. The pumping station covers an area of 475m².

**Figure 2-2: Location of the Water Conveyance Pumping Station**
2.2.5 PROJECT CONSTRUCTION AND ANTICIPATED IMPLEMENTATION SCHEDULE

The project mainly comprises the dike project, pumping and sluice gate engineering and related temporary works. The dike part of the project includes the construction of new roads, the height raising and the reinforcement of the Changxing old seawall, the strengthening and height raising of the Qingcaoasha reclamation area and the renovation of dikes in the Zhongyangsha reservoir. The pump and sluice gate part of the project includes upstream pump and sluice gate work, downstream water dams and water supply pumping stations.

The main work activities cover dredging, geo-textile laying, gravel bedding, stone blocks’ piling, reinforcement of concrete fence panels, reinforcement of the wave-reinforced concrete wall, protection of the bottom, water extraction (upstream) pump, water discharge pump (downstream) and water conveyance pumping station.

The total project construction period is approximately 38 months. The new dike project, which is the key route for the whole project, is scheduled to start in November 2007.

2.2.6 LAND OCCUPATION

According to the project design, the permanent land occupation area is about 38.44 ha, in the sand deposits of Zhongyangsha and the shoal or deep area of Qingcaoasha. During the construction period, land will be taken temporarily for use as a temporary base on Changxing Island and there is a specific construction plan for this area.

The wastewater from the reclamation works will be discharged into the Suitang River (located at Changxing Island close to QCS island) through a discharge channel.

2.2.7 DREDGING OPERATION AND DREDGED MATERIAL MANAGEMENT

The main equipment used for the dredging operation are mechanical and hydraulic dredges. To minimize the pollution and contamination to the raw water, water powered-type of dredger will be used, such as the cutter suction dredger, which will operate in fixed-point locations and generate a relatively small volume of suspended solids. The loosened material will be sucked up into the pipeline preventing re-suspension.

The dredged material (estimated 16 Mm$^3$ during construction stage and additional 20 Mm$^3$ by 2010) will be disposed in a designated disposal area downstream of the eastern dike by hydraulic mean.
3 ENVIRONMENTAL BASELINE INFORMATION

3.1 PRESENTATION OF THE PROJECT AREA

The tidal current moves back and forth inside of the mouth, and the distances of saltwater intrusion
in the Yangtze estuary are highly variable (Chen Jiyu, Shen Huanting, Yun Caixiong et al. Processes of Dynamics and Geomorphology of the Changjiang Estuary. Shanghai Scientific and Technical Publishers. 1988).

As presented later in this report, the estuary includes several types of wetlands which provide a huge diversity in habitats, and a resulting rich aquatic and bird biodiversity. The Yangtze estuary is a staging and wintering site habitat for millions of birds which are flying from Siberia to Australia; as well as a spawning and feeding ground for fish species, including the protected Chinese sturgeon (Acipenser sinensis).

FIGURE 3-1: SATELLITE IMAGE YANGTZE ESTUARY, SHANGHAI

The Qingcaoshana Project Area is located below the diversion of the South and North Branch of the Yangtze, north of Changxing Island, west of Zhongyangsha and within the Beixiaohong and Dongbeixiaohong water area. The location of the QCS is illustrated in the figures below.
3.2 ENVIRONMENTAL FIELD INVESTIGATIONS

The environmental evaluation presented below is based on existing historical data collected over several decades. Research results relating to hydrology, water quality, and biological resources in the Yangtze River Estuary and the Qingcaosha were collected by the Design Institute responsible for EIA preparation.

Further additional investigations on hydrology, water quality and on the ecological environment were conducted within the context of the EIA preparation. Bird and fish observation surveys were carried out in November 2005 and March 2006. The scope of these surveys were focused on QCS reservoir area, but also included extended areas for reference, such as DongTan, JiuDuanSha, the shallow shoals of HengSha, and BianDanSha.

Information on the content of these investigations is provided in the following table.
### Table 3-1: CONTENT of FIELD INVESTIGATION CAMPAIGNS for EIA PREPARATION

<table>
<thead>
<tr>
<th>Sections</th>
<th>Locations</th>
<th>Parameters (Water Quality)</th>
<th>Parameters (Hydrology)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section I: Xuliujing</td>
<td>Southern Bank</td>
<td>(1) Routine monitored parameters: All samples were analyzed against 14 parameters indicated in the surface water quality standard (GB 3838 2002) plus one additional parameter required by the centralized surface water supply source area for drinking: temperature; pH; total phosphorus; permanganate index; dissolved oxygen; volatile phenol; petroleum; ammonia nitrogen; BOD5; copper; zinc; lead; mercury; and nitrate nitrogen. In addition, Q2, Q6, Q8, Q10, and Q11 were tested for the &quot;fecal coliforms&quot;. For Q6 only, fecal coliform was carried on 3 samples taken from the top, middle and bottom of the vertical. For the remaining four stations, verticals, the analysis was only performed on the top-layer samples.</td>
<td>Flow: velocity, direction and rate</td>
<td>Hydrologically monitorin g</td>
</tr>
<tr>
<td></td>
<td>Northern Bank</td>
<td></td>
<td>OBS verticals measurement: Sediment concentration; salinity; temperature</td>
<td>Hydrologically monitorin g, chemical and ecologically monitorin g</td>
</tr>
<tr>
<td></td>
<td>Q1</td>
<td></td>
<td>Four verticals monitoring (Q4-Q7): flow velocity; direction of sediment concentration in separated layers; salinity; temperature; and wind velocity and direction.</td>
<td>Hydrologically monitorin g, chemical and ecologically monitorin g</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q4: South Branch of the Baoshan waterways</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q5: Central Sha'nan side channel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q6: Xinqiao channel (water catchment of Qingcaosh a reservoir)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q7: lower section of the Xinqiao</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section II: bifurcation of NanGang and BeiGang</td>
<td></td>
<td>(2) Specific monitored parameters at Q6: Q6 was tested for nitrite and phosphate and 36 other specific parameters as required by the regulation on centralized drinking water supply source, which include: Carbon tetrachloride; methylene chloride; 1,2- dichloroethane; 1,1- dichloroethene; 1,2-dichlorothene; trichloroethylene; tetrachloroethylene; chloroprene; hexachlorobutadiene; styrene; benzene; toluene; ethylbenzen; xylene; cumene; chlorobenzene; 1,2-dichlorobenzen; 1,4-dichlorobenzene; trichlorobenzene; hexachlorobenzene; nitrobenzene; 2,4 - DNT; 2,4 - Dinitrochlorobenzene; 2,4 - a chlorophenol; 2,4,6 - a chlorophenol; 2,4,6 - triclosan phenol; pentachlorophenol; the aniline; dibutyl phthalate; diethyl phthalate; parathion; methyl parathion; malathion; dimethoate; dichlorvos; PCBs and DDT.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q8 South Channel</td>
<td></td>
<td>Three verticals monitoring (Q9-Q10): flow velocity; direction of sediment concentration in separated layers; salinity; temperature; wind velocity and direction.</td>
<td>Hydrologically monitorin g, chemical and ecologically monitorin g</td>
</tr>
<tr>
<td></td>
<td>Q9 South Channel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q10 North Channel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PuXi (west)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Routine monitored parameters: All samples were analyzed against 14 parameters indicated in the surface water quality standard (GB 3838 2002) plus one additional parameter required by the centralized surface water supply source area for drinking: temperature; pH; total phosphorus; permanganate index; dissolved oxygen; volatile phenol; petroleum; ammonia nitrogen; BOD5; copper; zinc; lead; mercury; and nitrate nitrogen. In addition, Q2, Q6, Q8, Q10, and Q11 were tested for the "fecal coliforms". For Q6 only, fecal coliform was carried on 3 samples taken from the top, middle and bottom of the vertical. For the remaining four stations, verticals, the analysis was only performed on the top-layer samples.

(2) Specific monitored parameters at Q6: Q6 was tested for nitrite and phosphate and 36 other specific parameters as required by the regulation on centralized drinking water supply source, which include: Carbon tetrachloride; methylene chloride; 1,2- dichloroethane; 1,1- dichloroethene; 1,2-dichloroethylene; trichloroethylene; tetrachloroethylene; chloroprene; hexachlorobutadiene; styrene; benzene; toluene; ethylbenzen; xylene; cumene; chlorobenzene; 1,2-dichlorobenzen; 1,4-dichlorobenzene; trichlorobenzene; hexachlorobenzene; nitrobenzene; 2,4 - DNT; 2,4 - Dinitrochlorobenzene; 2,4 - a chlorophenol; 2,4,6 - a chlorophenol; 2,4,6 - triclosan phenol; pentachlorophenol; the aniline; dibutyl phthalate; diethyl phthalate; parathion; methyl parathion; malathion; dimethoate; dichlorvos; PCBs and DDT.
### Sections

<table>
<thead>
<tr>
<th>Sections</th>
<th>Locations</th>
<th>Parameters (Water Quality)</th>
<th>Parameters (Hydrology)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wusongkou in the Huangpu River side)</td>
<td>PuDong (east side)</td>
<td>November 2005, representative of average conditions, and; Second survey on second half of February 2006, representative of low flow conditions. Both surveys covered spring tide and neap tide duration.</td>
<td>by boat: flow velocity; direction and rate of the sections. Middle stream monitoring (Q11): Sediment concentration; and salinity.</td>
<td>al and fishery survey Hydrological monitoring</td>
</tr>
<tr>
<td>Section V: tail Biandansha to head of QCS</td>
<td>S1, S2, S3, S4, S5, S6</td>
<td>Aquatic organism: Chlorophyll a, phytoplankton, zooplankton, zoobenthos, as well as composition, population, biological species and distribution in the intertidal zone. Fishery: spawn, species of fry, population and distribution; type, population, distribution and biological features of fish resources. Terrestrial vegetation and birds: Recent supplementary survey done in Nov-Dec 2005 and March-April 2006.</td>
<td>Method: Following “Ocean Monitoring Specifications” for hydrobiological investigations; Following Bird Census Techniques, RSPB, 1992; and Estuary Ecology, (by LU Jianjian, Ocean Press, 2003) for surveys of birds and vegetation. For investigation of other wildlife, the Estuary Ecology, (by LU Jianjian, Ocean Press, 2003) was adopted, using direct observation and sample survey, as well as local residents consultation.</td>
<td>Ecological and fishery survey</td>
</tr>
<tr>
<td>Intertidal zone ecological monitoring section</td>
<td>C1, C2, C3, C4, C5</td>
<td>Only suspended sand is observed.</td>
<td>Sediment survey</td>
<td></td>
</tr>
</tbody>
</table>

**Method:**
- Following “Ocean Monitoring Specifications” for hydrobiological investigations;
- For investigation of other wildlife, the Estuary Ecology, (by LU Jianjian, Ocean Press, 2003) was adopted, using direct observation and sample survey, as well as local residents consultation.

**Intertidal zone monitoring parameters:**
- Chlorophyll a, phytoplankton, zooplankton, zoobenthos, as well as composition, population, biological species and distribution in the intertidal zone.
- Fishery: spawn, species of fry, population and distribution; type, population, distribution and biological features of fish resources.
1) Hydrological chemical and biological/ ecological
Water Quality Measurements

Section I: (Xuliujing): North, South Bank, Q1, 2, 3,
Section II: Q4- Q7
Section III: Q8- Q10
Section IV: Q11 Wusongkou, Huangpu River

2) Ecological Investigations

Section V: S1-3
Section VI: S4-S6
Intertidal Zone: Transects C1-5
3.3 PHYSICAL ENVIRONMENT

3.3.1 CLIMATE AND HYDROLOGY

3.3.1.1 CLIMATE

The Yangtze estuary is a humid area of subtropical monsoon climate region with mild climate, high rainfall and four distinct seasons. Annual average temperature is about 15 to 15.8°C, average precipitation is 1000 to 1100 mm, with an average sunlight time of 2540 hours. The lowest temperature is between January and February, and the highest between July and August. North and south wind are main wind directions. The highest wind speed is between March and April, the lowest between September and October. The eastern part of Yangtze estuary is covered by mist more than 50 days per year (Chen Jiyu et al., 1988).

3.3.1.2 RUNOFF

The water discharge in the Yangtze River Estuary is very high and highly variable with a maximum discharge of 92,600 m³/s (recorded in 1954) and a minimum discharge of 4620 m³/s (recorded in 1979). The yearly averaged discharge is 29,500 m³/s, and the annual total runoff is almost 1 billion m³ (905,100 million m³ based on the data at Datong Station in Anhui province, at the lower reach of Yangtze river, 640 km upstream the estuary mouth). So the Yangtze river discharge ranks the fifth among the largest rivers of the world (after Amazon, Congo, Orinoco and Ganges-Brahmaputra).

The runoff volume changes seasonally. The period from May to October is the flood season when the runoff amounts to 71.7% of the annual total discharge (peak flow in July). The dry season is from November to April when the runoff amounts to 28.3% (lowest flow in February) (Chen Jiyu et al., 1988).

3.3.1.3 HYDROLOGICAL CONDITIONS

The Yangtze estuary is classified as a meso-tidal estuary showing regular semidiurnal tides out of the mouth, and non-regular semi-diurnal tides inside the mouth. The tidal range of the South Branch decreases upstream the mouth. The North Branch is trumpet-shaped, where the tidal range (40-50 cm) is larger than that of the South Branch, and increases gradually upstream the mouth (Chen Jiyu et al., 1988), because the size of the north branch is smaller with less discharge.

The tidal limit of the Yangtze estuary in dry season is in Datong station. At Datong station the monitoring of hydrology, sediment and all kinds of changes of Yangtze estuary is measured. Furthermore the impacts of the QCS work on hydrology and sediment conditions are monitored in Datong.

3.3.1.3.1 CURRENT DIRECTION

The tidal current moves back and forth inside of the mouth, and is transformed into rotary tidal current out of the mouth. The rotary direction is most clockwise. In general, the velocity of the ebb current is larger than that of the flood current. The tidal flow in the estuary reaches 266,300 cubic meters per second, which is 8.8 times of the average annual tidal range (Chen Jiyu et al., 1988).
3.3.1.3.2 WAVES

The waves of the Changjiang (Yangtze) estuary are mainly wind-driven waves. The direction of wind-driven waves changes very obviously with seasons. Waves with the northward direction prevail in winter, and the southward waves occur in summer. Spring and autumn are transition seasons where directions disperse frequently.

Main conclusions of the hydrological baseline survey:

- In QCS water area, there are 4 tidal stages within one tide cycle: Ebb tide ebb current, Flood tide ebb current, Flood tide flood current and Ebb tide flood current.
- The average flow velocity of ebb tide is faster than that of flood tide, and QCS area is predominated by ebb tide current.
- Ebb tide volume is larger than flood tide volume, with big variation of neap tide volume.
- QCS water area is not affected by Huangpu River.
- Big variation of suspended sand content from 0.0567 kg/m$^3$ to 3.6248 kg/m$^3$.
- QCS water area: saline intrusion did not happen throughout November 2005, but occurred in February 2006, with maximum salinity of 3.09% during spring tide.

**Figure 3-4: Tidal limits of the Yangtze estuary, (location of Datong, Xuliujing hydrology stations)**
3.3.2 WATER QUALITY

3.3.2.1 MONITORING TRENDS

From 1987 to 2002, over 100,000 water quality analyses on 20 monitoring sites were performed between the Xuliujin and the Nanhuizui areas of the Yangtze River Estuary. Data collected in the Nanzhi (South Branch) of the Yangtze River Estuary, showed that the water quality was generally in compliance with Class II of the water quality standards\(^2\) except occasional nonconformity of ammonia nitrogen, total phosphorus, petroleum and mercury. The level of total nitrogen and total phosphorus showed an upward trend; the COD, BOD\(_5\) and Permanganate levels being kept between Class I and Class II standards but with an upward trend; the concentration of petroleum and volatile hydroxybenzene compounds had been decreasing; the concentration of most heavy metals had been also decreasing except mercury. The water quality in the central part the river was significantly better than that nearer to shore.

\(^2\) Water Quality Standard GB3838-2002
From 2000 to 2005, water quality indicators have been maintained between the Class I and II standards, except ammonia nitrogen, total phosphorus, petroleum and volatile hydroxybenzene. Heavy metal concentrations were all far below the Class II concentration levels except for mercury; however its concentration is decreasing.

Ammonia nitrogen is also decreasing while phosphorus shows an increasing trend.

Results of April 2004 water quality range between Class I and Class II, with some exceptions:

- Dissolved Oxygen and Permanganate levels were in compliance with Class I;
- The concentration of ammonia nitrogen was in compliance with the Class II level where the nitrogen content was found in granular form;
- The total phosphorus level was slightly over Class II standard where the phosphorus content was found in a dissolved form;
- The levels of nitric/sulphuric acid salts were in compliance with the required level for collective drinking water sources water quality standards, whereas the petroleum level was not.
From November 2005 to February 2006, water quality results were good with the main indicators in compliance with Class II standards except total phosphorus, petroleum and volatile hydroxybenzene levels which were still higher than the standards. In terms of periodic and spatial fluctuations, water quality was better during normal conditions than in dry seasons, better at the Beigang (North Channel) than at the Nangang (South Channel), better during high tide stage than during low tide and better upstream than downstream.

Water quality at the planned water intake area was in compliance with Class II surface water quality standards with the exception of ammonia nitrogen and total phosphorus levels. No trace of volatile organic compounds, organic phosphorus pesticides or PCS was found.

### 3.3.2 SALINITY

The current system of the Yangtze estuary is influenced by the Taiwan Warm Current, which shows high-temperature, high-salinity, good-transparency, weaker in winter and stronger in summer. The salinity varies in the range of 34.0~34.7‰ and the temperature is 20~28°C in summer, and in winter the salinity ranges between 33.0~34.6‰ and temperature between 10~17°C.

### 3.3.3 NUTRIENTS

The Nitrogen load in the estuary is mainly influenced by the runoff and by the phytoplankton, while Phosphorus is mainly influenced by suspended matters and sediments. During the wet season, the concentration of NO₃-N, NO₂-N, SiO₂-Si is the highest, but the concentration of NH₄-N is the lowest. In October, the concentration of P is the highest.
Researches have also revealed that the estuary tidal wetlands play an active role in the nutrient levels and transformation. Wang Jun et al. (Calculation of Inorganic Nitrogen Fluxes in the Yangtze Estuary Tidal Wetland, Acta Geographica Sinica) have identified that in spring, the tidal wetlands of the estuary release inorganic nitrogen fluxes into water and the quantity for the estuary was estimated at 13,300 tons. During the other 3 seasons, these tidal areas have a reverse effect with their vegetation capturing significant quantities of inorganic nitrogen from the water: they estimated the quantities at 43,600 t in summer, 68,100 t in autumn and 22,400 t in winter.

### Table 3-2: Load of Nutrients in Estuary Water During High and Low Tide (mg/l)

<table>
<thead>
<tr>
<th></th>
<th>STP</th>
<th>TP</th>
<th>NH₄⁺-N</th>
<th>NH₃⁻-N</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jiuduansha (high tide)</td>
<td>0.055</td>
<td>0.208</td>
<td>0.725</td>
<td>0.675</td>
<td>1017.0</td>
</tr>
<tr>
<td>Jiuduansha (low tide)</td>
<td>0.036</td>
<td>3.825</td>
<td>0.566</td>
<td>0.465</td>
<td>3429.2</td>
</tr>
<tr>
<td>Dongtan (high tide)</td>
<td>0.016</td>
<td>0.148</td>
<td>0.118</td>
<td>0.020</td>
<td>523.6</td>
</tr>
<tr>
<td>Dongtan (low tide)</td>
<td>0.030</td>
<td>1.426</td>
<td>0.066</td>
<td>0.170</td>
<td>1597.0</td>
</tr>
</tbody>
</table>

#### 3.3.3 SEDIMENT QUALITY

##### 3.3.3.1 SEDIMENT DESCRIPTION

In the Yangtze Estuary sediments, organic matter accounts for 60%–75% of the total particulate matter. Content of TOC is about 3%–8%, and content of TN ranges from 0.02%–0.11%. The mean grain size of bottom sediments, ranges from 4–7.5µm. Sediment is mainly composed of sand and silt.

The composition of surface sediment in upper Hengsha Island is mainly sand, while in the mouth of the estuary it is mainly clayey silt.

#### 3.3.4 SEA WATER INTRUSION

Saline intrusion in the Yangtze River Estuary is a major constraint to water resource development. The intrusion of salt tide mainly takes place during the dry season and its causes are complex, depending mainly on two parameters: the tide (level and stage), and the Yangtze discharge.

The Qingcaosha water body, located in the South Branch of the Yangtze River Estuary, is submitted to saline intrusion from 3 directions as depicted on the following figure: directly from the sea through the North and South Passages and from the return flow coming from the North Branch.

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3 Fang Shengqiong et al., Preliminary study on the accumulation and transport of pollutants in Yangtze River Estuary. Research of environmental sciences

4 Gao Jianhua et al. Spatial distributions of organic carbon and nitrogen and their isotopic compositions in sediments of the Changjiang Estuary and its adjacent sea area
These three sources of saline intrusion make of course difficult the prevision modeling regarding the salinity level of the future resource as it depends on the complex hydrology involved by the tide, on the wind and on the river flow.

Mathematical modeling exercises using MIKE21 have concluded that the North Branch saline intrusion has a significant impact on the chlorine distribution of the South Branch, particularly in its upstream part (Wusong waters).

To preserve the future QCS reservoir from salinity intrusion, a dual inflow system has been designed (gravity through sluice gates and pumping) and the volume storage considered in the design is 38 days, in order to ensure enough water supply capacity during exceptionally long periods of salinity intrusion. The 38 days period corresponds to the longest consecutive number of days of saline intrusion reported by historical monitoring data.

### 3.3.5 AIR QUALITY & NOISE

Results from EIA of Zhonghai Changxing Island ship repair base and wharf project have been taken as the baseline conditions, which are presented in the two tables below, from which it can be seen that both the ambient air and noise of Changxing Island can meet the levels for Class I classifications.

**TABLE 3-3: AMBIENT AIR QUALITY ASSESSMENT OF CHANGXING ISLAND (mg/L)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Monitoring value</th>
<th>classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO(_2) (average of five days)</td>
<td>0.04</td>
<td>Class I</td>
</tr>
<tr>
<td>TSP (average of five days)</td>
<td>0.08</td>
<td>Class I</td>
</tr>
<tr>
<td>SO(_2) (average of five days)</td>
<td>0.04</td>
<td>Class I</td>
</tr>
</tbody>
</table>
### Table 3-4: Ambient Sound and Noise Assessment of Changxing Island (dB(A))

<table>
<thead>
<tr>
<th>equivalent sound level (Leq)</th>
<th>Monitoring value</th>
<th>classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>day time</td>
<td>52.3</td>
<td>Class I</td>
</tr>
<tr>
<td>night time</td>
<td>42.5</td>
<td>Class I</td>
</tr>
</tbody>
</table>

In addition, as supplementary information about the present condition of air and noise environment quality of Yangtze Estuary, the following data have been collected from related research papers on the internet[1]. Air Quality trends observed in the Yangtze estuary region are presented in the table below.

### Table 3-5: Air Quality in Yangtze Estuary

<table>
<thead>
<tr>
<th>Atmospheric Precipitation Flux</th>
<th>Contaminants Concentration in Aerosol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TSP</td>
</tr>
<tr>
<td>Slight Decrease</td>
<td>Increase</td>
</tr>
</tbody>
</table>

The content of TSP and atmospheric precipitation flux in atmospheric aerosol keep balance. The concentration and atmospheric precipitation flux of Cu, Pb, Cd is rising.

Noise at the project location is mainly the result of the boat traffic in the estuary and of some large construction works as the Chongming island bridge. It may occasionally affect the surrounding birds when noisy works are on-going, but does not represent today a significant issue for the environment.

### 3.4 Biological and ecological environment

#### 3.4.1 Wetlands of the Yangtze Estuary

#### 3.4.1.1 Importance of wetlands and biodiversity

Dominated by a subtle mixture between lands, salt water and freshwater, the Yangtze estuary results in a very diversified range of habitats sheltering a rich biodiversity.

The wetlands at the mouth of the estuary are important sites of China’s coastal estuary wetlands. These wetlands are of great significance for the sustainable development of the natural resources, environment and economy of the Yangtze estuary area.

The estuarine ecosystem is characterized by a high nutrition productivity which attracts many fish and bird species. Large number of birds on their migration route between Russia and Australia stop in the Yangtze estuary wetlands, either for few weeks or for wintering. Furthermore, wetlands provide a significant ecological service function for regulating atmospheric gas and purifying water body.
The estuarine environment is known as an integrated ecosystem including producer, consumer and decomposer. There are vital producer as phytoplankton, macro-algae, benthic algae, sea grass, salt march and mangrove. The predominant consumer communities are zooplankton, benthos, fishes, aquatic mammals and birds. If human activities are not neglected, people are the most important consumer in estuarine ecosystem. Microbiological organisms are decomposing the organic material and are most abundant within the first 5 cm depth of sediment surface.

### 3.4.1.2 WETLAND TYPES AND DISTRIBUTION

According to the definition of wetland given by the Ramsar convention\(^5\), the wetlands observed in the Yangtze estuary and in Shanghai region include most of the registered types: coastal, river, lake, and reservoir/pond wetlands.

A recent study\(^6\) of wetlands in Shanghai Municipality identifies not less than 29 units of wetlands based on the processing of satellite imagery (Thematic Maper, 1997). Location of wetlands is shown on the following Figure and details of areas and categories are provided in the following Table.

The Qingcaosha and Zhongyangsha wetlands are estimated to cover about 15,483 ha, a part of which will be used for the creation of the QCS reservoir.

**FIGURE 3-8: LOCATION OF WETLANDS IN SHANGHAI (ZHAO BIN, 2005)**

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\(^5\) RAMSAR Wetland convention: The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 158 Contracting Parties to the Convention, with 1743 wetland sites, totaling 161 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance. [http://www.ramsar.org/](http://www.ramsar.org/)

\(^6\) Zhao Bin, Li Bo, ZHONG Yang, et al., 2005, Estimation of Ecological service values of Wetlands in Shanghai, Chinese Geographical science, volume 15, number 2, pp. 151-156, 2005, Science Press, Beijing China,
<table>
<thead>
<tr>
<th>Nr</th>
<th>Wetland name or location</th>
<th>Area [ha]</th>
<th>Protection Level and Date of Establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Type 1: Marine and Coastal Wetlands</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rocky marine shores</td>
<td>2 502</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Three Jinshan Islands</td>
<td>2 502</td>
<td>Municipal Level</td>
</tr>
<tr>
<td></td>
<td><strong>Estuarine Wetlands</strong></td>
<td>289 424</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Chongming Dongtan</td>
<td>71 897</td>
<td>National Level, 2005</td>
</tr>
<tr>
<td>3</td>
<td>Chongming Coast</td>
<td>41 188</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Changxing Coast</td>
<td>15 483</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Hengsha Coast</td>
<td>50 549</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Wusongkou – North Baoshan</td>
<td>5 654</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Pudong New Area Coast</td>
<td>5 954</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Nanhui Coast</td>
<td>58 086</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Jiuduansha Island</td>
<td>40 610</td>
<td>National Level, 2005</td>
</tr>
<tr>
<td></td>
<td><strong>Intertidal mud, sand or salt flats</strong></td>
<td>13 494</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Jinshan Coast</td>
<td>5 703</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Fengxian Coast</td>
<td>5 954</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Nanhui County Coast</td>
<td>1 837</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Type 2 Inland Wetlands</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Permanent rivers/streams/creeks</td>
<td>7 190</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Huangpu River</td>
<td>3 797</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Suzhou River</td>
<td>243</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Yunzhaobang</td>
<td>142</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Dianpu River</td>
<td>207</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Lanlugang-Shuliaojing</td>
<td>954</td>
<td></td>
</tr>
</tbody>
</table>
### 3.4.2 EXISTING AND PROPOSED PROTECTED AREAS & NATURE RESERVES

The environmentally sensitive objectives of this project consist mainly of biological resources in the Qingcaosha and Zhongyangsha area, aquatic biota and migratory animals in the Yangtze Estuary and the aquatic area of Qingcaosha, the nature reserve for birds at the DongTan of Chongming Island, the wetland natural reserves at Jiuduansha and the habitats and biological resources at the Chinese Sturgeon (young) nature reserves.

The 3 established Nature Reserves are presented in the following table:

<table>
<thead>
<tr>
<th>Nr</th>
<th>Wetland name or location</th>
<th>Area [ha]</th>
<th>Protection Level and Date of Establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Dazhengkuang-Yuanxiejing</td>
<td>193</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Taipu River</td>
<td>255</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Damaogang-Xupukuang</td>
<td>196</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Jishuigang</td>
<td>1 200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Permanent freshwater lakes (&gt;8 ha)</td>
<td>6 803</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Dianshan Lake</td>
<td>4 760</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Yuandang Lake</td>
<td>324</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Xueluodang Lake</td>
<td>129</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Wangyangdang Lake</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Dalian Lake</td>
<td>147</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Dafengyang Lake</td>
<td>1 420</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Type 3: Man made Wetlands</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water storage bodies</td>
<td>299</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Baogang Reservoir</td>
<td>164</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Chenxing Reservoir</td>
<td>135</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL WETLAND AREA</strong></td>
<td>319 714</td>
<td></td>
</tr>
</tbody>
</table>
### Table 3-7: Nature Reserves (NR) in Yangtze Estuary

<table>
<thead>
<tr>
<th></th>
<th>Chongming Island - DongTan Birds NR &amp; Chinese Sturgeon (young) NR</th>
<th>Jiuduansha Wetland NR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td><strong>Dong Tan Bird NR:</strong> National (since 2005) <strong>Chinese Sturgeon (young) NR:</strong> Shanghai Municipal</td>
<td>National (since 2005)</td>
</tr>
<tr>
<td>Area (km²)</td>
<td>326.1 km², comprising a core zone (246 km²), a buffer zone (18.8 km²) and an experimental zone (61.3 km²). The total area of the aquatic zone is 146 km².</td>
<td>450 km². The northern boundary of the Jiuduansha protection zone is the middle line of the southern and northern passage at the Yangtze River Estuary. The eastern boundary is the line of the embankment (-6m); the southern boundary is the northern line of the south passage Yangtze River and the western boundary is the line of the embankment (-5m). The Jiuduansha protection zone is considered as a new estuary alluvial island. There are no inhabitants to date; therefore the original ecological conditions have been preserved. Jiuduansha consists of ShangSha, ZhongSha and XiaSha.</td>
</tr>
<tr>
<td>Function</td>
<td>&quot;Kingdom of wading birds&quot; The DongTan of Chongming Islands has the typical features of an estuarial mudflat wetland and is also one of the key global ecologically sensitive zones. The primary protection objectives are water birds and the wetland ecological system. The East Tideland is famously known as the King of Wading Birds. Migrant goose and ducks have also a significant research and economic value inhabit the Chongming Islands during the winter season.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The Jiuduansha Wetland is located at the Yangtze River Estuary. It is useful in collecting sediments, purifying the water, and accelerating nutritional circulation as well as protecting the coastline from erosion. The wetland in Jiuduansha is large enough to absorb the substances in the wastewater discharged from the Yangtze River Delta to the East Sea, preventing the occurrence of red tide (caused by eutrophication) in the East Sea. The incoming sea water into the Yangtze River will be decreased relatively significantly once the South to North Water Diversion Project is implemented and the Jiuduansha Wetland will play an important role in both avoiding saline intrusion and protecting the ecological safety of Shanghai. The Jiuduansha Wetland is an important habit area for birds migrating from East Asia to Australia. Furthermore, it plays an important role in the worldwide avian protection network and makes a significant contribution to those species which are</td>
<td></td>
</tr>
</tbody>
</table>

7 Ramsar Convention, Chongming Dongtan Nature Reserve, [http://www.ramsar.org/wn/w.n.china_14newsites.htm](http://www.ramsar.org/wn/w.n.china_14newsites.htm)
### Biodiversity

**Chongming Island - DongTan Birds NR & Chinese Sturgeon (young) NR**

**Birds**

- Total: 108 species: long distance migratory birds, most of which are shorebirds, geese and ducks
- **>6 species: Class I nationally-protected birds**
  - the white crane, the hooded crane and the Chinese merganser; the black-faced Spoonbill, the little swan and the Nordmann's Greenshank.
- **7 species: Class II for national protection.**

International migratory birds protection agreements between China/Japan (81 species) and between China/Australia (41 species)

- 33 species of water or wading birds go through the winter just in Chongming Dongtan of Yangtze estuary and include particularly:
  - Anas platyrhynchos, Anas poecilorhyncha, Anas acuta, Tadorna tadorna, Anas penelope, Anas strepera, Anas querquedula, Cygnus cygnus, Cygnus columbianus, Grus monacha, Grus vipio, Grus leucogeranus, Aix galericulata,

- An ongoing project, parts of it with support from GEF and WWF, is developing the site into a centre for environmental education and training. (source www.ramsar.org site).

**Fish**

Chinese Sturgeon Protection reserve – this is one of the last areas where the chinese sturgeon (young) can breed and is still present

**Jiuduansha Wetland NR**

- protected by the China-Japan and China-Australia conventions. Aside from these, the Jiuduansha Wetland is also a valuable location for the ecological research of migratory birds.

**Birds**

- Total: 113 bird species live in the protection zone.
- **8 species: Class II for national-protection;**

International migratory birds protection agreements between China/Japan (84 species) and between China/Australia (40 species)

- 6 bird species: “China’s ‘Rare and Endangered Red Book”

**Fish**

- 7 fish species: national-level protected wild fish specifically in the Yangtze River (Chinese Sturgeon, Chinese Paddlefish, Anguilla Marmorata, Myxocyprinus asiaticus and Trachidermus)

1/3 of 16 national level protected wild fish, like:

- Eriocheir japonica sinensis, the propagating grounds for Coilia mystus and Estuarine tapertail anchovy and the migration area for Japanese Anguilla japonica
Figure 3-9: Detailed Map of Yangtze Estuary, with Important Wetlands and Nature Reserves

Distribution of Important Wetlands and Nature Reserves in Yangtze Estuary

<table>
<thead>
<tr>
<th>Name</th>
<th>Area (10^4 ha)</th>
<th>Date Established</th>
<th>Protected Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanghai-Chongming Wetland</td>
<td>3.28</td>
<td>1990/07/29</td>
<td>Yangtze Estuary, Shanghai</td>
</tr>
<tr>
<td>Yangtze Estuary Nature Reserve</td>
<td>3.55</td>
<td>1990/07/29</td>
<td>Yangtze Estuary</td>
</tr>
<tr>
<td>Shanghai-Songming Wetland</td>
<td>0.47</td>
<td>1990/07/29</td>
<td>Yangtze Estuary, Shanghai</td>
</tr>
<tr>
<td>Yangtze Estuary Nature Reserve</td>
<td>0.36</td>
<td>1990/07/29</td>
<td>Yangtze Estuary</td>
</tr>
<tr>
<td>North Jiangsu Wetland</td>
<td>3.76</td>
<td>1990/07/29</td>
<td>Yangtze Estuary, Shanghai</td>
</tr>
</tbody>
</table>
3.4.3 TERRESTRIAL ECOLOGY

In the project area, the vegetation covers about 10 km² where the dominant species are a reed (*Phragmites australis*), Southernwood (*Artemisia carvifolia*) and *Zizania caduciflora*. These dominant plants are accompanied by a diversity of 22 other plant species. Respective distribution areas are presented on the following Figure.

The vegetation on Project site differs from the other shoals (Jiuduansha, Chongmingdongtan, Baimaoshsha and Biandansha) generally dominated by *Scirpus mariqueter*.

**Figure 3-10: Distribution of Dominant Plant Species**

3.4.4 BIRD BIODIVERSITY

As presented in the previous Table, the Yangtze estuary is visited by the birds migrating from China to Japan and from China to Australia. This situation has even be formalized by agreements on the migrating species between China and Japan and China and Australia.

From the 277 species of birds migrating between China and Japan, 84 species are observed in the Yangtze estuary, and from the 81 species of birds migrating between China and Australia, 43 species are observed in the Yangtze estuary. (See table 3-7)

Most common species include: *Pluvialis dominica*, *Pluvialis squatarola*, *Charadrius alexandrinus*, *Charadrius mongolus*, *Charadrius leschenaultii*, *Limosa lapponica*, *Numenius borealis*, *Numenius phaeopus*, *Numenius madagascariensis*, *Tringa totanus*, *Tringa stagnatilis*, *Tringa nebularia*, *Tringa glareola*, *Xenus cinerea*, *Arenaria interpres*, *Calidris canutus*, *Calidris tenuirostris*, *Calidris ruficollis*, *Calidris acuminata*, *Calidris alpina*, *Calidris ferruginea* and *Limicola falcinellus*. 
Birds observed in the project area and in adjacent natural habitats are mainly migratory bird and passing birds dominated by Anseriformes and Charadriiformes groups. Bird population and diversity in Chongming Dongtan and Jiuduansha are higher than those in the project area. The number and frequency of observations of protected species in the project area are relatively small (<1% of total population quantity). Biandansha and Baimaosha which are under development show a limited bird population when compared to the project area. This is mainly due to the increase of boat traffic and population linked to the Chongming eco-island project, which creates a pressure on bird habitats. Main bird population areas now concern preferentially Chongming Dongtan, Jiuduansha, and Chongming North Lake.

**TABLE 3-8: DISTRIBUTION OF BIRD SPECIES AROUND THE PROJECT AREA**

<table>
<thead>
<tr>
<th>location</th>
<th>Species of birds</th>
</tr>
</thead>
<tbody>
<tr>
<td>QCS Reservoir area</td>
<td>95 species</td>
</tr>
<tr>
<td>QCS periphery area</td>
<td>192 species</td>
</tr>
<tr>
<td>Chongming Dongtan</td>
<td>184 species</td>
</tr>
<tr>
<td>Jiuduansha</td>
<td>112 species</td>
</tr>
<tr>
<td>Biandansha</td>
<td>17 species</td>
</tr>
<tr>
<td>Baimaosha</td>
<td>7 species</td>
</tr>
</tbody>
</table>

The following observations have been made during the two field surveys carried out in 2005 and 2006 in the Zhongyang and Qincaosha wetlands areas:

- ✓ No Class I protected species was identified.
- ✓ 5 species are Class II protected species included in the *List of Wild animals for National Priority Protection* were observed.
- ✓ 62 species of China-Japan Agreement for the Protection of Migratory Birds
- ✓ 33 species of China-Australia Agreement for the Protection of Migratory Birds.
- ✓ A total of 95 bird species (11 orders and 22 families) has been observed.

These are mainly winter migrant birds (staying on the island during winter) or temporarily passing migrant birds in the spring, summer and autumn seasons. The dominant species are Anseriformes (swimming birds) in winter, and Snipe and Charadriiformes (wading birds) in spring, summer and autumn. All of these species have been observed within the project area and the Chongming and Jiuduansha wetland areas, but with a significantly lower density in the project area compared with the later two areas.

**3.4.5 AQUATIC ECOLOGY**

Two surveys for aquatic ecology have been performed for the purpose of the EIA in the Project area. Identified aquatic biodiversity includes 62 species of phytoplankton, 38 species of zooplankton, 16 species of benthos and 24 species of fishes.
The relatively rich biodiversity results from the variation of salinity in the area, attracting particularly characteristic species from fresh and brackish waters. When compared to historical survey data, the aquatic biodiversity is on a decreasing trend, probably resulting from the marine climate variability, the water pollution and the changes in Yangtze hydrology because of the water projects (dams, diversions) in the river catchment.

The Yangtze estuary is rich in plankton and mudflat vegetation because of the rich nutrient load from the Yangtze River. The area attracts several fresh and brackish water fishes for feeding and breeding, or as a passage for migration. More than 60 species of salt water fishes and more than 50 species of fresh water fishes have been historically recorded, including the Chinese sturgeon presently threatened and considered nearly extinct.

The results of the 2 field investigations surveys carried out in 2005 and 2006 in Zhongyang and Qingcaosha are the followings.

- 24 fish species observed;
- the area is rich in fishery resources but a downward trend in the recent years is reported;
- the area provides breeding and feeding grounds for *Coilia mystus* and *Hemisalanx prognathus*;
- the area is located along the migration routes of *Coilia ectenes*, *Anguilla japonica* (common eel) and of the protected Chinese Sturgeon;
- Areas shelter complex aquatic communities, in relation to the variability of the water salinity, attracting freshwater and semi-fresh water species plus some low-salinity level and euryhaline species. However, the degradation of aquatic biodiversity and biomass is clearly observed due to water pollution, large scale construction development and climate change.
- 62 phytoplankton species, 38 zooplankton species, and 16 macro benthos species have also been recorded from the surveys.

### 3.4.6 THE YANGTZE STURGEON: PRESENT SITUATION AND ANTICIPATED TRENDS

The Chinese Sturgeon is one of the rare wild aquatic protected species in China, which is found mainly in the Yangtze River Basin and its coastal waters. It is a very old species (left over from the Cretaceous period) with length of 2-5m and weight of 200-500kg, which has been defined as a Class I national-level protected animal, known as the "water panda." The Chinese Sturgeon is a migratory fish of the rare anadromous type, which spends most of its adult life in salt water but spawn and spend the early stage of its life in freshwater.

According to historical records, the Chinese Sturgeon was distributed in Pearl River, Min River, Qiantang River, Yellow River and Yangtze River. But nowadays, it has disappeared in Qiantang River and Yellow River, and become rare in Pearl River and in Yangtze River.

Monitoring results from Shanghai Chinese Sturgeon Nature Reserve show that the population of sturgeon is highly erratic: there were 119 sturgeons in 2004, 150 in 2005. In 2006, the quantity soared to 600, but one year later in 2007, the quantity fell sharply to 29 only.

Mature Chinese sturgeons migrate upstream the Yangtze River from adjacent seas from May through June and spawn in the upper part of the Yangtze River from October to November. The sturgeon fingerlings will move downstream the Yangtze Estuary in May to July of the following year and feed in the brackish water of Chongming Island tidal flats from July to August and move to the sea in September. The sturgeon will not migrate to the river again until its full maturity several years later.
The estuary is an important location in the life cycle of the Acipenser sinensis. Most Chinese Sturgeon (young) are observed in the area around Tuanjesha in the DongTan of Chongming Islands which is between 8 km to 10 km in length and between 3 km to 5 km wide. No Chinese Sturgeon (young) has ever been found in the northern area or in the Pudong New Development Zone (old Chuansha County).

The number of Chinese Sturgeon observed has been drastically decreasing during the last few decades. According to a recent report (co-authored by the Yangtze River Water Resources Commission, WWF, and the Nanjing Institute of Geography and Limnology), the sturgeon once moving upstream from the East China Sea to the upper Yangtze River every spring to spawn, has been blocked on his migration route by the building of the Gezhouba Dam, the Yangtze’s first hydroelectric dam, in the 1980s. Although the government established a special conservation area below the dam for the sturgeon to lay eggs, the number of the fish observed in the river has dropped dramatically. During the 1972~1980 period, the average annual catch of Chinese Sturgeon was 517 individuals all over the Yangtze River. In 1982, the annual catch reached a peak 1163 individuals trapped together under Gezhouba Dam. Based on the statistical records, the sturgeon population was estimated at 2176 individuals in 1983. In 1998, the population of Chinese Sturgeon had already deceased by 50% as a result of the river closure by the Gezhouba Dam.

A large concentration of fertilizer, paper, textile dye, and metal processing manufacturers is located near the conservation area. The facilities’ considerable wastewater discharge contains nitrogen, phosphorous, toxic metals, and organic compounds, depleting oxygen in the water, disrupting the metabolism of the sturgeon, and even leading to malformation and gene mutation of the endangered fish.

The species is presently considered almost extinct in the Yangtze estuary and experts are pinning their hopes on breeding technology as well as on the release of sturgeon fingerlings into the Yangtze River each year to restore the fish population.

Since 2002, the Ministry of Agriculture has imposed a fishing ban in the river basin to prohibit trawlers from operating during the spring spawning period.

As mentioned earlier, the establishment of the Chinese Sturgeon (Young) Nature Reserve at the estuary was approved by the Shanghai Municipal Government in April 2002. The Reserve is located in the DongTan area of Chongming Islands, which is clearly outside the QCS reservoir Project Area. The protected area covers 276 km².
3.5 DEVELOPMENT ACTIVITIES CLOSE TO THE PROJECT AREA

3.5.1 CHANGXING ISLAND DEVELOPMENT-SHIPYARD

The master plan of Changxing Island Development Project covers an area of approximately 124 km$^2$ (including Changxing, Qingcaosha and Zhongyangsha). The three main components are:

- Shipyard project,
- QCS reservoir, and
- Development of Fenghuang town.

At the end of the plan, total constructed land will reach 41.36 km$^2$ (9.37 km$^2$ central town, 16.1 km$^2$ for central industrial park, 7.54 km$^2$ matching industrial park, 3.33 km$^2$ modern service, 0.81 km$^2$ reserved land). The planned land for eco-forest, waters and other constructions will reach about 82.65 km$^2$ (12.6 km$^2$ main water area, 3 km$^2$ for rural residents). The area of Changxing is divided into 5 districts: residential district, core industrial district focusing on ship-building, matching industry district, modern service center and eco-district.

The world’s largest shipyard, along eight kilometres of coastline on Changxing Island, will be fully operational by 2015 with an expected annual capacity of 8 million deadweight tons (DWT). The shipyard, located along the southern part of the island, at the mouth of the Yangtze estuary, will occupy 300 ha. This gigantic shipyard will create the world's largest shipbuilding base by increasing the city's current shipbuilding capacity from the current 3 million DWTs per year to 12 million DWTs by 2015.

According to the Master Plan, Changxing Island, after completion, will have 16.4 km deep-water shoreline used by shipyards, wharfs and other related activities. In addition, Changxing Small Port, together with about 5 km deep-water shoreline will be reserved for future development.

The development plan of Changxing Island is set up to enhance the urban area of Fenghuang Town at Changxing Island. At the completion of the plan, Changxing permanent residents is expected to reach about 130,000, including about 110,000 urban residents (90,000 in Fenghuang Town, 20,000 in Yuansha Community). Railway and other transport facilities are also anticipated.

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3.5.2 CHONGMING ECO-ISLAND PROJECT

Chongming Island is located north to Qingcaosha reservoir and is the largest island in the estuary of Shanghai (approximately the size of Manhattan). The eastern tidal area of Chongming Island (Dongtan) is an important bird protection area. The Chinese Government proclaimed this area part of the Australian wading birds protection zone and had it registered as a RAMSAR site. At present (2008), no wastewater treatment system exists on the island despite 100,000 population. Water quality is degrading, only quality 4 now, because of resulting pollution.

However, the biggest ecological urban planning project is taking place: the Dongtan Ecocity - a demonstration eco-city for China which will eventually houses 500,000 people. The master plan is under design and the first phase is scheduled to be completed by 2010 in due time for Shanghai’s World Expo. The concept of this eco-city is very innovative and should include: collect and purification of water, waste recycling management, landfills minimization, combined heat and power systems, development of new environmental technologies like fuel cell cars, biological farming etc. A preservation zone for the wetland area is part of the Master Plan; nevertheless the size of the wetland will be reduced, and the Eco-city project will certainly impact on the wetland wildlife, especially for the bird breeding area.  

FIGURE 3-12: CHONGMING ISLAND, DONGTAN ECOCITY

The eco-city will initially accommodate between 20,000 and 50,000 people. It will be linked to the mainland by an 19 km long bridge-tunnel which also connects two smaller islands, Changxing and Hengsha.

Articles and websites – related to Dongtan Eco-city project:


“Will The Dongtan Development in China Be The World’s First Eco-City?” by Leonora Oppenheim, treehugger online magazine and BBC Radio, 04.30.06, http://www.treehugger.com
http://www.guardian.co.uk/business/2005/nov/06/china.theobserver
3.5.3 THE TUNNEL AND BRIDGE PROJECT

Shanghai Yangtze River tunnel and bridge project goes across the Yangtze River and through Changxing Island including 8.9 km tunnel in the south, 10.3 km bridge in the north and 6.3 km connection highway between Changxing and Chongming Island.

The main span of the bridge is 730m long. It is the first bridge over the Yangtze River estuary. The construction has been launched on February 28th, 2004 and will take 5 years for completion.
4 ENVIRONMENTAL IMPACT ASSESSMENT

Impacts from the Project on the Environment are related to 3 main causes:

- The Location of the Project, which will directly affect land use and particularly wetland and specific mudflat areas;
- The Construction activities which may result in pollution risk and detrimental effects on biodiversity;
- The Operation period during which the new environmental conditions created by the project implementation will stabilize and the operational activities generate new type of constraints on the environment.

Most probable impacts related to these 3 causes are reviewed in this report section. The results of this impact review are summarized as follows:

The project will result in two major positive impacts:

- the improvement of the water supply safety for Shanghai by adding a new water source to the two already existing, Daoqiao and Chenhang;
- the creation of a new open water reservoir consisting of fresh water, which will attract more water fowl type birds in an area originally sheltering wading birds.

Negative impacts will relate more to the effects of construction activities, particularly dredging and reclamation operations, and to the land use change in the area with related loss of plant and animal biomass, alteration of the existing food chain and future uncertainties regarding the potential for eutrophication in the future reservoir.

All other impacts discussed below are either of limited significance or can be mitigated.

4.1 IMPACTS ON WATER QUALITY

4.1.1 IMPACTS DURING CONSTRUCTION STAGE

During the construction period, significant impacts may be anticipated from the following key activities:

- dredging operation,
- reclamation operation,
- closure of the overflow pass,
- production of drainage water from dredging & reclamation;
- production of oily waste from machinery & heavy equipment;
- production of domestic wastewater from construction camp.

4.1.1.1 IMPACTS FROM DREDGING

Dredging will be carried out within the future reservoir site in order to secure its capacity and along the new dikes to secure their foundations. Large volume of dredged material will be produced during the construction stage, estimated at about 16 Mm3. Sand for construction purpose will be also dredged close to the QCS site.
The main impact on the environment is related to the production of excessive suspended sediment in the water column, which will affect the aquatic habitats. The level of impact depends on 1) the sediment characteristics (the finer, the worse), and 2) on the dredging technology used.

- The sediment

The QCS project area consists mainly in sandy sediments, with limited quantities of silty sediment. This situation will be in favor of a rapid re-deposition of the particles and of a limitation in the quantity of fine particles which could be put durably into suspension and constitute a suspended solid flume.

Areas outside QCS site are also sandy areas as they are dredged specifically for sand production.

Another aspect refers to the level of contamination of the sediment, as the re-suspension of particles may release contaminants in the water and in the food chain. Information available on the sediments concerned do not show significant contamination level, an observation in line with the dominantly sandy composition of the sediment.

- The dredging operation

Three main types of dredge are operational worldwide: 1) the bucket chain dredge, mechanical dredging system, which creates generally large bottom disturbance and generates large volumes of suspended matter with significant impact on the aquatic ecosystems; 2) the trailing suction dredge, hydraulic system, which allows dredging while moving; the system is recommended for linear dredging, and generates some turbidity but locally and in a smaller quantities than the bucket chain system; it is appropriate if the dredged material is dominantly sandy; 3) the cutter suction dredge operates also hydraulically, but on fixed positions, not moving like the previous system; bottom disturbance with the cutter system is minimum and the loosened sediment is immediately sucked by the hydraulic pump system; this is the most recommendable system for the QCS area.

Indeed, this project will use a cutter suction dredger system, which will operate on fixed locations and will generate a limited volume of suspended solids. Associated with the predominantly sandy sediments observed in the area, the impact from turbidity should be reasonably limited to the dredging point proper and re-deposition of particles is anticipated to be quick.

4.1.1.2 IMPACTS FROM RECLAMATION

- Construction of the new dike

Based on the suspended sediment load data from the Datong sampling station, the potential increase in sediment concentration due to the construction work has been estimated in the EIA to only 1.4% of the average natural SS load.

- Construction of the Changxing Island seawall slope

There is a need to reclaim the internal slope when heightening and reinforcing the Changxing Island seawall. The drainage water from the reclamation will be discharged into the Suitang River (located on Changxing Island) through a channel and the suspended solids concentration may be significant with potential impact on water quality if no mitigation is implemented.

- Reclamation within the Qingcaosha area

It is required to backfill the reclamation area of Qingcaosha. The drainage water from the bank gate of the backfilled area may generate SS with risks of impact. However, since the backfill material is sand with low silt percentage and good settlement performance, similar project experience indicates that the water overflow from the reclamation area should not have a significant impact on the water quality.
4.1.1.3 IMPACTS FROM CLOSURE GAP OVERFLOW

Before the closure of the gaps, due to other construction activities, there may be a discharge from the overflow with a significant release of SS. Based on the above dredging and reclamation impact analysis, the closure gap overflow water should only affect the range from upstream 100m to downstream 200m in terms of SS content. Considering data on the water discharge and the sediment concentration rate of the Yangtze River Estuary, the increased SS in such a limited area should not have a significant effect on water quality.

4.1.1.4 IMPACT FROM WASTEWATER FROM CONSTRUCTION SITE

The main construction wastewater source will be from the processes of concrete manufacturing, site washing, container drum washing as well as the concrete maintenance washing. The main pollution factors are the suspended solids, and the pH value (generally 9–12). The total volume of wastewater generated during the entire project construction period has been estimated to approximately 163,000m³, or an average of about 137m³/d. If the wastewater is directly discharged, it will increase the SS concentration in nearby regional water bodies and have an impact on the water quality because of the high alkaline pH. Therefore, the construction wastewater should be discharged only after appropriate treatment in order to meet the discharge standards.

4.1.1.5 BILGE WATERS FROM MACHINERY

The peak volume of bilge water production has been estimated at about 45t/d during the construction period. Since 1980, the Ministry of Transport has stipulated that different wastes from ships must be recycled in harbors and an oil separation on the ship is required to reduce the oil content in the bilge water to less than 10 ppm. Therefore, as long as the construction contractor’s ships have a navigation permit from the relevant Transport Departments, the discharged wastewater should meet the relevant standards. This bilge water should not have any impact on the water environment if complying effectively with the Chinese standards.

4.1.1.6 DOMESTIC WASTEWATER FROM CONSTRUCTION LABOURS

During the peak construction period, the total labor population will be approximately 10,000. The volume of daily domestic wastewater will be approximately 1 000 m³. The domestic wastewater will be collected and treated before being discharged.

4.1.2 IMPACT DURING OPERATING STAGE

4.1.2.1 IMPACTS FROM DOMESTIC EFFLUENTS

The operational staff on site will generate domestic effluents estimated at about 9m³/d. As the project operation is scheduled to start in 2010, it is expected that the Changxing Island wastewater treatment plant will also be operational. The domestic wastewater generated from the reservoir management compound will be transported to the Changxing Island WWTP for disposal. A wastewater storage tank will be installed in the staff compound to collect domestic wastewater and allow for regular transportation to the Changxing WWTP. No impact is expected from this issue.
4.2 IMPACTS ON ECOLOGY AND BIODIVERSITY

4.2.1 IMPACTS DURING CONSTRUCTION STAGE

4.2.1.1 IMPACTS ON LAND BASED FLORA

Terrestrial vegetation may be directly impacted if project facilities are developed on vegetated land.

The embankment construction through dredging and excavating activities will reduce the partial beach elevation and eliminate the existing shallow rooted vegetation. The beach surface elevation will be reduced and the change in water level will affect the water plants such as reeds etc and could occasionally cause the local disappearance of the original vegetation. The excavation of the beach area will change the geomorphologic features (such as the tidal furrows and hollows), reduce the habitat heterogeneity and affect the distribution and diversity of the vegetation.

4.2.1.2 IMPACT ON BIRDS AND OTHER TERRESTRIAL WILDLIFE

Occupation of the habitat area by the project facilities

The earth works associated with the construction of dikes and other auxiliary works will occupy the shoals, bare land and vegetation habitats for the birds, potentially causing changes in the bird population in the area.

During the partial earthwork excavation and piling activities, it is possible that some birds may be encouraged to stop and feed on the freshly returned soil. For example, during the dike construction of Chongming east beach, new soil attracted large numbers of birds to stop and feed. Consequently, the number of birds increased considerably during that year. However, at the end of the construction, along with the start of project operations, the original type and number of birds will decline, even if some bird population, such as the sparrow, is expected to increase.

Noise and night activities during the construction will probably chase away several birds which will take refuge in the surrounding areas. The bird density may possibly decrease during construction activities, but the impact is temporary and the birds should come back as soon as the noisy works are completed. However, this possible reduction in bird population may be compensated by the attractiveness of the fresh sediment explained above.

The project is not anticipated to have impact on any other terrestrial wildlife, as the area around the site is already extensively developed.

4.2.1.3 IMPACTS ON THE AQUATIC ECOLOGY

1). Impact on Chlorophyll A, primary production and phytoplankton

Main potential impact comes from the turbidity created by the dredging and reclamation works, which reduces light penetration in water, thus chlorophyll activity and phytoplankton. As previously explained, nature of sediment and dredging technology used will minimize the suspended sediment load release. Impact will be limited, localized, temporary and reversible, with no significant effect on primary production.

2). Impact on Zooplankton

In accordance with 1), impact anticipated on zooplankton as a direct consequence of the reduction in phytoplankton (which is the food source for zooplankton) will also be very limited, temporary and fully reversible.

3). Impacts on the benthos (tidal zone and sub-littoral zone benthos)
Dredging and reclamation works will evidently have direct impact on benthos communities by a direct destruction of the habitat. Locally, benthos biomass and biodiversity will be destroyed during the construction works. However, the benthic communities in soft sea bottom as observed here mainly consist of mollusks (shells, worms) and crustaceans which can colonize quickly other areas and redevelop on the new reservoir bottom as it will not be lined. The area does not shelter more sensitive and exclusive benthic species as coral which develop generally on hard substrate.

4.2.1.4 IMPACT ON THE FISH RESOURCES

1) Impact on fish population

Fish population should be partly affected during the construction works. Even if no significant impact on water turbidity is anticipated at large scale, the localized dredging or reclamation operation will disturb the local fish communities which may temporary move at a few distance to get quieter conditions. However, as the dredging and reclamation operations will release into the water part of the benthic species trapped with the sediment, it is certain that the works will also attract fishes for the additional food made available. At the location of the works, fish eggs deposited and fish fingerlings may be more sensitive to suspended sediment and be more affected than mature individuals.

(2) Impact on migration and feeding grounds of fish, shrimp and crabs

Mudflats and intertidal zones are generally rich in organic matter and provide feeding grounds for several fish and crustacean species. The shallow and warm waters of such areas provide also favorable spawning grounds for coastal species. It is evident that the dredging of such areas will locally affect the aquatic communities. However, the works will affect only a small portion of the area at the same time and the several shoals located nearby the QCS will provide at least temporary grounds replacement to the affected species.

Regarding impact on migration, 2 main aspects have to be considered: The importance of the migration process and the significance of the channel reduction because of the QCS reservoir.

Regarding migration, since the implementation of dams on the Yangtze river and on several of its major tributaries, the migration process, and particularly that of the Chinese Sturgeon, has drastically reduced. As discussed earlier in this report, because of this situation, the sturgeon has almost vanished from the Yangtze estuary. Mature individuals, those involved in migration, are hardly observed in the region, and even not every year.

The QCS reservoir will not hamper the North Channel on which it is developed, but only delineate by a dike the contour of the existing mudflat. It does not reduce significantly the width of the existing main river flow, which is the one used by the fishes during the migration process. Furthermore, the project does not affect the South Channel, which remains accessible to fish. During the works, the construction activity will be carried out within the QCS area or in the immediate vicinity.

Considering this situation, it is not anticipated any impact of the works on a fish migration event, in the eventuality any significant one occurs during the construction.

4.2.2 IMPACTS DURING OPERATION STAGE

4.2.2.1 GENERAL CONSIDERATIONS

The QCS reservoir area will experience a radical change: from a river and mudflat shallow zone, under freshwater and saline water influence, it will be transformed into a permanent deeper reservoir of fresh water. No doubt that the existing ecosystem will be deeply modified and that fauna and flora will adapt the changes brought to the existing ecological parameters. The major factors affecting flora and fauna will be:
The change of water quality from a variable salinity type to a permanent fresh water type;

The change in water depth, from shallow type to a deep water type.

4.2.2.2 IMPACTS ON VEGETATION

The present shallowness of the water within the QCS area allows the development of an extensive wetland vegetation dominated by reed and grasses. Today’s water level fluctuations, more controlled by the upstream regulation of the Yangtze, have permitted the development of extensive areas characterized by reeds (Phragmites australis), grasses (Zizania aquatica) or sedges (Scirpus mariqueter, Carex tristachya). These species accept different ranges of water level fluctuations, from 5 to 10 cm for the shortest grasses or sedges to 20 to 50 cm for taller reeds.

It is thus anticipated that shortly after the impoundment of the new reservoir, the existing vegetation will be partly destroyed, the surviving parts being mainly located at the peripheral part of the reservoir, where the water depth for most of the year is in accordance with the plant acceptability. Reeds will probably continue to occur around the reservoir until the -50 cm isobath while grasses and sedges will be located more at the periphery where water depth does not exceed about 10 cm. The extent of this future vegetation cover will depend upon the smoothness of the slope around the reservoir. The south-west area which will not be dredged during the first stage of the project may be the main supporting area for vegetation.

Also, the transformation of the reservoir into a purely freshwater body will certainly favour the development (in term of density, strength) of the vegetation, as for these main species, salinity is a constraint to their development. Other new species of grasses or other herbaceous or even shrub species may also develop there after the disappearance of the salinity constraint.

These aspects may be confirmed from observation made at the Beihu (Northern Lake) district on Chongming Island, where the construction of the sea dikes has resulted in an increase in the height, the coverage and the biomass of reeds growing inside of the sea dikes compared to those outside of the dike. This is the result of a reduction in flooding and of the salinity.

4.2.2.3 IMPACTS ON TERRESTRIAL FAUNA

Impacts on terrestrial fauna will mainly concern birds. Impacts on bird communities will directly reflect the changes of natural habitats and of feeding availability.

Impacts on the vegetation distribution and biodiversity after the filling of the reservoir will subsequently alter the bird species composition and distribution. This can be observed presently for snipe or other species (Charadriiformes Order) along the tidal plain in Nanhui district on the south bank of the Yangtze River Estuary.

Bird species identified within project areas are mainly migrant (winter) and passing migrant bird species. Passing migrants birds belong mainly to the Charadriiformes Order, typical wading birds. They need land and shallow water for habitat and food. Migrant birds belong mainly to the Anseriformes Order, typically ducks, geese and swans which prefer open water areas for habitat, shallow water, dry land and the presence of sedge (here, Scirpus mariqueter).

Because of water retention with loss of tidal plains and vegetation cover, wading birds will loose their habitat as well as more common Passeriformes (perching birds, song-birds) species. It is anticipated a possible decrease in bird species diversity and number in spring, summer and autumn. However, the increase of the open water area with the new reservoir will create an additional habitat for the species of the Anseriform group, with an anticipated increase in diversity and number during winter.
During water level fluctuation of the reservoir, the temporary emerged bottom of shallow water areas will provide an excellent feeding ground for the bird groups already mentioned, as well as for the Ciconiiformes group (long-legged wading birds including storks, herons, egrets, ibis, spoonbills etc).

During low water level periods, the development of grass cover on the low emerged areas will also attract species from the Passeriformes group. Diversity and density of birds is expected to increase during the low water level periods in QCS area.

Regarding the five Class II Protected Bird Species identified in the estuary area, among which 4 are Falconiformes (bird of prey), it is not anticipated particular impacts as none was reported from the QCS project area impact, and falconiformes do not feed traditionally in this type of habitat.

Impacts on bird diversity outside the project area: As mentioned in the EIA, the major wetland area of the Yangtze estuary is the Chongming-Dongtan National Nature Reserve, which attracts most of the migratory bird population in the area. The QCS is further upstream in the estuary, with less marine influence, and is considered by the specialists more as a refuge (when a tropical storms makes conditions too difficult in Chongming-Dongtan NR) rather than a migration destination. As already mentioned in this report, the species observed in QCS area refers mainly to passing migratory birds, with short periods of stay, rather than migratory birds installed for the full winter. Considering this limited role of QCS in the bird migratory pattern of the estuary, it is unlikely that the QCS project has a significant impact on bird species distribution and density over the whole estuary region.

Small mammals species already identified inside of the original east sea dike should not be impacted by the QCS project development. New freshwater body should also be favourable to the development of the batrachian species.

4.2.2.4 IMPACTS ON AQUATIC FAUNA

Impacts on Chinese Sturgeon

As discussed previously in this report, it is anticipated that (1) the project will have no direct impact on the Chinese Sturgeon Protection Zone at Dongtan area of Chongming Island due to the long distance between the two concerned areas; (2) upon completion of the water reservoir, juvenile Chinese Sturgeon may enter the water reservoir accidentally between April and August and be trapped without appropriate feeding grounds. Therefore, the installation of a prevention system (as a fine grid) in front of the sluice gates or pumping system will be necessary.

Impacts on Aquatic Biodiversity

The new conditions in the future reservoir, dominantly of freshwater type, will definitely alter the existing community structures and ecological functions typical of a brackish estuary type, and may result in a change in species composition and biomass.

a) Changes of community structures

The salinity level reduction in the reservoir will result in the development of a new aquatic community dominated by fresh water species. However, the change in the structure of the aquatic community will have limited impact on ecological functions of the water reservoir. Fresh water phytoplankton species (blue or green algae) will replace progressively salt water ones as diatoms for example (brown algae).

Similarly for zooplankton, fresh water species as Cladocera or Rotifera will replace salt to brackish species as Schmackeria, Tortanus or Labidocera presently observed in the area.

b) Change in biodiversity
According to monitoring records of phytoplankton and zooplankton species in the Yangtze River estuary, biodiversity is already decreasing, probably because of the changes in river hydrology and because of the water pollution. The construction of the QCS water reservoir, will most probably result in a decrease of biodiversity in the reservoir area, as it will reduce it to the fresh to slightly brackish water species only.

c) Change in biomass

As a result of human activities, the general biomass trend of the Yantze estuary is towards a decrease. The QCS reservoir is not anticipated to have a significant or measurable impact on the estuary biomass. However, the biomass inside the reservoir may even grow higher than observed presently if mitigation measures proposed are implemented.

Impacts on Fishery Resources

According to information gathered during the fishery resources investigation conducted in November 2005 and March 2006, there were 63 types of fish, four types of shell fish and one type of crustacean. The level of impact of the project on the species identified in the project surrounding area is expected to be insignificant. However, within the project area, the change to a fresh water environment will obviously reduce locally the fish diversity.

Most of the rare fauna species at the Yangtze River estuary are considered near extinction, as the Chinese River Dolphin and the Trachidermus fasciatus (cottid fish) which have not been observed since many years. Similarly, the number of Chinese Sturgeon has been drastically decreasing. The QCS is not anticipated to have any effect on these trends. However, protection at the entrance of the reservoir may be required to avoid any of these rare species accidentally enters the reservoir.

Nanzhi (south branch) and Beigang (north port) are both on the migrant paths of commercial fish such as Coilia ectenes, Coilia mystus, and River Crab. As discussed previously, the QCS reservoir should not affect directly the existing fish migration paths. However, the narrowing of the branch near the Beigang area could eventually result in a more easier catch of the fishes during their migration process. But such an impact is still highly questionable considering the remaining large section of river, with a deeper channel and a higher flow velocity.

The Yangtze River estuary is a rich feeding ground for young Chinese Sturgeon, Coilia Ectenes, Coilia Mystus and River Crab. Since the 1970s, industrial developments along the Yangtze River have caused a serious decrease in the feeding ground area. The west and north parts of Changxing Island are both feeding grounds and the construction of the QCS Reservoir will contribute to this decrease.

Coilia Mystus is a short distance migrant () fish species and a major commercial fish in the estuary. It breeds in the upstream estuary and also along the Changxing and Chongming island. The construction of the QCS reservoir will reduce the available area of its breeding grounds.

As described above, the project area and upstream watercourse are both breeding grounds for Coilia mystus. Therefore, the fertilized eggs and the fry are likely to travel with the flow downstream especially during the period of May to August. A small part of it may be eventually trapped in the QCS reservoir when passing close to the sluice gates.

According to biodiversity investigations conducted in November 2005, the benthos species include mainly shell fish with an average biomass of 3.27g/m². Some of it may be transported to the Pudong district together with raw water. The anticipated resulting loss to fisheries has been estimated about 0.28 tons per year in the EIA.
4.3 IMPACTS ON AIR QUALITY AND NOISE

4.3.1 IMPACTS DURING THE CONSTRUCTION STAGE

4.3.1.1 IMPACT FROM FUEL AIR EMISSION

Fugitive air emission from fuel-driven vessels include NO\textsubscript{X}, SO\textsubscript{2}, CO and other kinds of exhaust gases. A model performed during the EIA study concluded that the fugitive emission can reach a distance of 180m from the emission point with a maximum SO\textsubscript{2} concentration is 0.09 mg/m\textsuperscript{3} and a maximum CO concentration of 0.72 mg/m\textsuperscript{3}, both of which meeting the Class II level of the Environmental Air Quality Standards. The construction area is located in the Qingcaosha area and Changxing Island and the open conditions of the area are favorable to the diffusion of the contaminants. There are no residential areas near to the construction area; the closest are some small villages or some residents living 250m away from the south of Changxing Island seawall. Therefore there will be in general no significant impact on the air quality except, occasionally near the Mengsiyuan Holiday Resort which is only 100m away from the northeast of the construction area, and which may be slightly impacted by the air emission when the works are carried out at the closest distance.

4.3.1.2 IMPACTS FROM DUST

Dust production is anticipated from earthworks and material stocks. The site is far from any dense residential area, and may, occasionally have only some impacts on the Mengsiyuan Holiday Resorts (only at 100 m from construction boundary) and on the construction sites proper. In both case, mitigation measures, as regular watering, will be performed on construction sites and near the holiday resorts whenever necessary to keep the dust emission below acceptable levels.

4.3.1.3 IMPACTS FROM NOISE

During the construction period, the main noise sources will include the high-intensity construction machinery, such as the dredgers, mud-blowing boats, hammers, hydraulic dredging units, concrete mixers, dump trucks and other construction and shipping machinery.

Because the project area is far away from the central residential area of Changxing Island and only a scattering of residents are living within a 250m radius of the south seawall of Changxing Island, the construction noise should not have a significant impact on these residents. However, the Mengsiyuan Holiday Resorts located closer may be more affected if no mitigation measure is implemented. Suspending noisy activities close to these residential places during the night should be required.

The noise may also impact on birds and other wildlife in the nearby area and force them find other locations for feeding and sheltering. If considered justified, some noisy works may be carried out in specific areas during the period the least damageable to the breeding activity.

4.3.2 IMPACTS DURING OPERATING STAGE

4.3.2.1 IMPACT ON THE REGIONAL CLIMATE

Due to the location of the project in the middle of the Yangtze estuary, the QCS reservoir is not anticipated to have any impact on regional climate conditions.
4.3.2.2 IMPACT OF AIR EMISSIONS ON THE QINGCAOSHA WATER RESOURCES AREA I

According to the air quality baseline survey, the air quality standard in the Changxing Island area meets the Class I level. Atmospheric pollutants will not be produced during the operations period and there will be no impact from the Qingcaosha reservoir.

4.4 IMPACTS FROM SOLID WASTE AND OTHER POTENTIAL IMPACTS

4.4.1 IMPACTS DURING CONSTRUCTION STAGE

4.4.1.1 IMPACT FROM SOLID WASTE

According to the project feasibility study report, the sand and soil from the excavation and dredging process will be used for the backfilling of the bank and reclamation area and will not generate environmental pollution. The main sources of wastes are the waste soil, solid wastes, construction waste from the dismantling of few buildings and domestic wastes generated by the on-site personnel.

These waste will require appropriate management, from handling to disposal.

4.4.1.2 IMPACT FROM PROJECT LAND OCCUPATION

According to the project design plan, the permanent land occupation only involves the area along the old Changxing Island seawall, and the remaining area located in the high beach of Zhongyangsha in the central Yangtze River Estuary and/or shoals and deep areas in Qingcaosha. During the construction period land will be taken to establish a temporary base on Changxing Island. The temporary area will be confirmed according to the detailed construction plan.

Since the project has a long construction period, long-term occupation of the land will change or disturb the terrain and destroy the original ecology or landscape. According to the Changxing Island land development and control plan, all of the permanent and temporary land taken will be in the planning area of the permanent protection zone. As the permanent protection function is for the Qingcaosha water resources area and surrounding forest, following the construction the area will be ‘greened’ to form the Qingcaosha protection area. Consequently, the project land occupation on Changxing Island will not impact the land-use Plan.

4.4.1.3 IMPACT FROM SHIPPING AND ROAD TRAFFIC

All of the construction materials will be transported by boat through the two large temporary ports at the ends of the embankment and five small temporary access terminals and then transferred to the land-based construction platform or through the existing shipping terminal on the island then transferred to the site. During the construction period, the road traffic will utilize the top of the original bank, of the newly-constructed bank, the top of the embankment and the top of the temporary bank.

The temporary piers are mainly located in the vicinity of the construction area. After shipping goods to the land transportation vehicles, the road traffic will mainly use the roads at the top of the bank and will not impact the traffic system of Changxing Island. Goods transported to the existing island ports will use the Changxing Island road network and are anticipated to have some impact on the volume of traffic. Safety conditions will be established by the contractors to limit risks on public safety (accidents) and the nuisances (noise and dust).
The channels at the south branch and north port are the main fairways in the Yangtze Estuary. There are large container ships, bulk carriers and oil tankers passing through, making the fairway busy. During the construction period, tugs, transport ships, dredgers, mud-blowing boats, and piling boat construction vessels will frequently occupy these routes, which may increase the risk of ship collisions. Safety measures will be implemented to limit the risk.

4.4.1.4 IMPACT ANALYSIS OF CONSTRUCTION WORKERS' HEALTH

A large number of construction workers will be in the construction area, rising to 10,000 during the peak period, and causing a sharp rise in the population density. Construction of worker camps with appropriate water supply and sanitation facilities will be required to avoid any public health problem among the worker population and the resident population.

4.4.2 IMPACTS DURING OPERATION STAGE

4.4.2.1 IMPACT FROM SOLID WASTES

The solid wastes generated during the operation period will be mainly the domestic waste the personnel in charge of operation, and material from the maintenance dredging and later excavation of sediment from the bottom of the reservoir.

Although the volume of domestic waste is relatively small, estimated about 90 kg/d, measures will be implemented for disposal facilities on site and regular collection and transport to the nearest landfill facility.

The mud from sediment dredging and excavation will be transported to the dumping storage area already dedicated to this purpose, and the drainage water from this area will be discharged after sedimentation stage, to avoid suspended sediment release in the river.

4.4.2.2 IMPACT FROM SEDIMENTATION

After the completion of the reservoir construction, suspended sediment from the inflow will deposit at the bottom of the reservoir, from where it will require regular removal by maintenance dredging. In order to reduce the environmental degradation and the impact on the quality of raw water, a dredging boat will be used for the dredging works. The dredged sediment will be disposed into the dedicated dumping site located downstream along the east bank of reservoir.

Additional sediment will be produced at the time of expansion of the QCS reservoir. During rainfall events, run-off water from the sludge disposal site may flow into the Qingcaosha Reservoir or in the Yangtze River with a significant suspended sediment load which may affect the water quality of the aquatic environment.

In order to reduce the risk, the following measures should be taken:

(1) Sediment piles should not exceed 3m to ensure the stability of the pile.

(2) Disposed mud can be compacted to beat the artificial slope, or use an anti-lift truck to beat the slope of the dump heap and compact the mud to ensure the stability of the slope.

(3) Prohibit the random dumping or piling up the mud. The mud should be piled up in separated areas.

(4) According to the rainfall intensity pattern of Shanghai and considering the project type, the rainfall return period will be 0.5 years. Drainage channels will be constructed (to a width of 1.0m, a depth of 0.6 m, and with a 1.0 ‰ slope at the bottom of the channel) around the sediment sludge disposal.
(5) Provide sediment pond facilities designed in accordance with the rainfall pattern to ensure water released outside in the Yangtze meets the Class II level of the Shanghai Wastewater Discharge Standards* (DB31/199-1997) with suspended solids less than or equal to 150 mg / L)

4.5 OTHER ENVIRONMENTAL CONSTRAINTS AND IMPACTS

4.5.1 IMPACT FROM THREE GORGES PROJECT ON THE YANGTZE LOAD TRANSPORT

The sediment load of the Yangtze in the future is expected to decrease as a large part will sediment into the Three Gorges reservoir. At the same time, "returning farmland to forest" at the upper steam of the Yangtze River is one of the important Soil and Water Conservation measures to reduce the amount of sediment transported. Reduced sediment runoff will cause sediment changes at the Yangtze River Estuary and reduce the amount of sediment in the Qingcaosha Reservoir.

4.5.2 IMPACT OF SOUTH-NORTH WATER TRANSFER PROJECT ON THE YANGTZE ESTUARY

The designed capacity of the South to North Water Transportation project is 44.8 billion m³ per year, approximately 0.5% of the average runoff volume of the Yangtze River. It is anticipated that it will have a significant impact on the downstream saline intrusion especially during dry seasons.

4.5.3 PROJECT IMPACT ON THE RIVER TREND EVOLUTION

The river trend evolution rule is complex at Qingcaosha Reservoir project area. The Shanghai Municipal Construction and Investment Company organized a number of institutes to analyze the river trend influence of the Qingcaosha Reservoir project between October 2005 and August 2006 using real monitoring results analysis, river trend evolution analysis and mathematical and physical modeling analysis whether the bank layout and water intake positions are reasonable.

Main Results are:

To date and currently, the river trend of the South-North Branch Diversion point has been in a relatively good condition but some adverse trends have developed. If prompt action is not taken, any favourable opportunity to control the river will be lost, bringing irreversible loss to the river’s stability and the Qingcaosha Reservoir construction. It is a good time to construct the bank and restore the South-North Water diversion point. The project can fix the lower boundary of the Xinqiao channel, prevent the head of Zhongyangsha moving backward and create a good condition for the south-north water separation restoration project implementation.

The calculation results of the mathematical model shows that the impact area of high-low tide is only located at the North Channel area. Implementation of the project will have no obvious impact on flood prevention and drainage in the Yangtze River Estuary;

Project implementation will have no significant influence on the main fairway hole of the North Channels bridge because the dam line of Qingcaosha reservoir will block North Xiaohong of Changxing Island. Meanwhile, the cross section of the water flow will be narrowed and water flow speeded up, but the position of the main axis position will not be changed.

4.5.4 IMPACT OF WATER INTAKE ALONG THE YANGTZE RIVER

Currently, the cumulated volume of water intakes along the Yangtze River has exceeded that of the South to North Water Transportation project which has a significant impact on the saline intrusion downstream. It is estimated that in future decades, the water intakes are likely to increase rather than decrease, which may further intensify saline intrusion in the Yangtze River Estuary areas.
4.6 ENVIRONMENTAL RISKS AND UNCERTAINTIES

4.6.1 EXCESSIVE WATER SALINITY

The North Branch salt tide intrusion is the main constraint to the use of the Yangtze River Estuary freshwater resources.

The reservoir operation is designed to adapt to this constraint:

Before the start of the saline intrusion, the pump located at the upstream gate will pump water into the reservoir to a maximum level of 7.0m. The QCS reservoir has been designed for a maximum storage time of 68 days, which, according to the modelling studies, is sufficient to avoid any pumping requirement during a high salinity situation in the Yangtze.

4.6.2 EUTROPHICATION RISK

Within the framework of the EIA studies, a modelling study using the MIKE21 modelling system was carried out to simulate water quality, water flow and eutrophication in the Qingcaosha Reservoir.

4.6.2.1 WATER FLOW SIMULATION ASSESSMENT

The simulation results show that 1) the water velocity in the QCS reservoir is slow, and 2) that it is irregularly distributed in the reservoir, with 3 areas with limited or no water renewal.

These areas are located in zones with limited depth, and the model shows that deepening of these areas can provide an acceptable improvement of this situation, as presented in the following figures (upper is without deepening, below is with deepening). Static areas are in yellow.
4.6.2.2 ORGANIC CONTAMINATION RISK

A water coupling modeling was used to do the assessment. The transportation of the water body's organic contamination and concentration field distribution rule are predicted on the basis of variables as wind velocity, sunshine, temperature and water treatment measures.

- The self-purification level in QCS reservoir is sufficient due to the long retention time, the wind occurrence and the large surface for re-aeration. Therefore, NH$_3$-N and BOD can be degraded in the reservoir.
- Due to the large grain size of the transported sediment, mainly sand, the attached organic contamination will settle down because of slow velocity in the reservoir.
- The nutrients (nitrogen and phosphorous) reach a critical level favorable to eutrophication if the retention period is too long.
- The water quality at the gates is good even a little above the standard. The annual average data of NH$_3$-N BOD$_5$ and DO comply with or are better than the Class II standard. If the water quality becomes worse and some parameters, such as NH$_3$-N and BOD$_5$,
increase 20 percent compared with the current data, the DO will become lower than 5 mg/L between July and October. The annual average of NH$_3$-N and BOD$_5$ can comply with the Class II standard even under this situation.

4.6.2.3 EUTROPHICATION PREDICTION RISK

- The level of nitrogen and phosphorus concentration in the planned water intake area has already reached the required nutritive salt concentration level for eutrophication. Based on the analysis of nitrogen and phosphorus ratios of water samples, phosphorus is the limiting element of nutritive salt with respect to algae growth within the area.
- The levels of nitrogen and phosphorus concentration in water at the planned water intake area have met the conditions for eutrophication to take place. Therefore, optimizing the operation of the gates and lengthening the water retention period is one of the critical measures to prevent eutrophication within the water reservoir.
- In order to prevent and control the occurrence of eutrophication in the water reservoir, it is recommended that “during flood tide, the upstream gate is opened for water intake and the downstream gate is shut; during the ebb tide period, the upstream gate should be shut and the downstream gate open for water discharge.” On average, the water retention period should be strictly restricted to less than 20 days.
- During dry seasons, the water reservoir will shorten the water intake and extend the water retention periods, which will increase the chances of eutrophication. Appropriate preventative measures should be put in place.
- After a certain period of operation, the silt at the bottom of the water reservoir will release nitrogen and phosphorus elements and increase the TP and TN concentrations (less than 2% of increase). The chlorophyll-a average value is likely to remain steady and is unlikely to change the overall eutrophication level within the water reservoir.
- Once the recommended operational arrangements are implemented, the tranquil flow area will be minimized which will effectively prevent algae growth in the area. However, a partial tranquil flow may exist near the upstream water intake area, which may result in partial eutrophication.

The water eutrophication model provides simulation of input and output of nitrogen, phosphorus and organic contamination, DO, nutrient resources, phytoplankton and plankton changes, phytoplankton sedimentation and concentration distribution. These simulations rely on various environmental variables as wind velocity, sunshine and temperature.

The following observations have been obtained from the simulations:

- The water velocity of the Qingcaosha Reservoir is generally slow;
- The nitrogen and phosphorus concentrations in QCS reach the nutrient levels which may allow the eutrophication process. It is therefore recommended to strictly control the average water retention time so as to abate the excessive development of reservoir algae. The chlorofucine concentration can be monitored at low or middle nutrient levels.
- The water retention time is slightly long during some periods in the year when the flow is slow, which increases the possibility of eutrophication (refer to N and P concentration seasonal change characteristics of the Qingcaosha water body). Therefore appropriate actions need to be taken to prevent the phenomenon.
- Deepening of the reservoir can partly reduce the stagnant areas and prevent algae from blooming. However, limited areas with low renewal of water cannot be avoided, where algae may grow faster and represent a potential for local eutrophication.

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11 Chlorofucine is also called Chlorophyll C, associated to brown algae, diatoms and dinoflagellates. It is a good indicator for the algal development, in complement to chlorophyll A.
The TN and TP concentrations may increase due to nitrogen and phosphorus release from the bottom sediment, but the whole water nutrient level will not be changed after a certain period of operation.

If the concentration of TN and TP of water outside reservoir increase 20 percent compared to the current concentration, the TN and TP concentration of water inside reservoir will increase 17 percent and 10 percent respectively, but the reservoir nutrition grade will not change.

4.6.3 ACCIDENTAL SPILL POLLUTION RISK

A major risk for the QCS reservoir is an accident involving a cargo ship transporting oil or hazardous materials as it already happened on the Huangpu river in July 2003 when a cargo oil spill threatened the water supply pumping stations located along the river branch\(^{12}\).

Due to the location of the QCS reservoir, the establishment or enhancement of safety strategies, prevention policies, emergency planning has to be considered in the feasibility study and operation mode.

There are 8 major incidents identified on the Yangtze River during these last 22 years, most of them being located near the floating lights and anchorage, not in the terminal handling process or near Chenhang Reservoir. Among the eight accidents, five accidents relate to oil transportation, and other three to leakage after collision events.

4.6.4 ASH DISPOSAL RISK

The ash storage area for the Changxing Island power plant is located in the north along the Changxing Island seawall and southeast corner of the reservoir, which is a strip of land measuring 980 m from east to west and 262 m from north to south, and covering an area of about 385 mu. It is divided into two parts, East and West, by a road crossing from north to south. The western part has been developed in a resort (Mengsiyuan Holiday Resort) while the eastern part is kept as the ash storage area. From there, a culvert has been established to discharge drainage water into the north estuary of the Yangtze River. During heavy rainfall, the ash storage area suffers serious erosion and a quantity of toxic and hazardous substances from the ashes may be discharged into the north estuary, posing a threat to the quality of the raw water source of the Qingcaosha Reservoir.

In accordance with the relevant provisions of water pollution prevention and control in the water resource protection area, it is recommended the zone around the reservoir to be changed into a Class II protection zone where "the dumping, digging and burying of coal ash, slag, tailings, waste oil, radioactive materials, toxic and hazardous materials, as well as industrial, construction and other types of solid waste is prohibited". Therefore, it is proposed that concerned administrations change the function of the ash storage area before the Qingcaosha Reservoir is put into operation. It is recommended that effective measures be taken to improve the water and soil protection of the existing disposal area.

4.6.5 WATER CONTAMINATION FROM CHANGXING & CHONGMING ECONOMIC DEVELOPMENT

To date, no wastewater treatment facilities do exist on Chongming Island. Domestic and industrial wastewaters generated from the island are discharged into the adjacent water bodies either directly or via a drainage system. The pollutants discharged into the Yangtze River by tides impact the water bodies.

\(^{12}\) Article from People's Daily, 8th July 2003, "Oil Spill on Huangpu Threatens Water Supply Sources"

15 Environmental Impact Report on Pusteel Relocation Engineering of Baosteel, SAES, March, 2005
The Changxing Wastewater Treatment Plant is already planned for construction in the center of Changxing Island. The treated effluents will be discharged on the south bank of the Yangtze River via sewer or into inland natural streams and rivers when the treated meets stricter discharge standards. The Qingcaosha Headwater is located on the north bank of Changxing Island, hence no significant impact on the headwater anticipated from these treated effluents.

With the increased development of the agriculture, tourism, economy and society of Chongming Island, industrial and domestic wastewater and non-point sources from agriculture will pose potential threats to the water quality in the water source of Qingcaosha. Discharge points installed along the North Channel of the headwaters should be as far away from the water source as possible.

According to the General Plan for Chongming Islands, the construction of wastewater treatment facilities has been planned for Chengqiao, Xinhe, Baozhen and Chongdong in the urban areas on Chongming Island. The wastewater can only be discharged into water bodies after secondary treatment. Any installation of discharge points for treated effluent generated from the WWTPs must take into consideration the protection of the water sources of Qingcaosha. The short-term goal is to achieve a secondary treatment and the long-term goal is the effluent will achieve Class 1B. The wastewater should be discharged into neighboring water bodies in order to avoid impact on the water intake of Qingcaosha Reservoir.
5 ENVIRONMENTAL MANAGEMENT PLAN

5.1 ENVIRONMENTAL MANAGEMENT DURING CONSTRUCTION PERIOD

During the construction period, the project environmental management will involve:

1) Project Implementation Unit (PIU): responsible for overall environmental protection throughout the construction phase, from the commencement of construction till the completion acceptance, strictly in accordance with the requirements from the EPB approval.

2) Construction Supervision Unit (CSU): responsible for supervising the implementation of designed environmental protection measures;

3) The Contractors: construction of designed environmental protection facilities and implementation of environmental protection measures as per the contract terms.

5.1.1 ORGANIZATION AND RESPONSIBILITIES OF PIU

The PIU will establish an Environmental Management Office (EMO) for the Qingcaosha project and for the sub-projects of water intakes and water conveyance, which will be in charge of environmental protection works throughout the cycle of the project construction. The major responsibilities of PIU–EMO are listed below:

(1) Define the composition of the EMO and its responsibilities;

(2) Establish procedures and objectives of environmental protection management during construction period;

(3) Ensure that environmental protection requirements are included into bidding documents and construction work contracts;

(4) Establish annual plan for environmental protection work;

(5) Establish and review annual environment protection budget plan;

(6) Plan and arrange for expenditures of environmental protection works;

(7) Organize annual environmental monitoring and authorization;

(8) Ensure the fulfilment of Contractor's environmental protection measures;

(9) Facilitate communication between management department, environmental monitoring centre and other departments concerned;

(10) Deal with pollution accidents caused by the project construction and report to competent authority;

(11) Prepare and submit environmental protection reports: monthly/quarterly/semi-annually and annually;

(12) Communication, education and training in environmental protection.
5.1.2 ORGANIZATION AND RESPONSIBILITIES OF CONSTRUCTION SUPERVISION UNIT

The construction supervision unit will carry out regular site inspections to ensure the environmental obligations of Contractors are satisfied and impact mitigation measures are in place.

(1) Prepare Environmental Monitoring Plan;
(2) Prevent the Contractor from environmental pollution and appropriate management of turbidity during dredging activities;
(3) Supervise and inspect the process of Contractor’s emergency response plan to accidental spill.
(4) Ensure land occupation by Contractors is in accordance with plan and land compensation is applied in due time and in accordance with agreements signed.
(5) Monitor the quality of water, atmosphere and noise, raising non-compliance when target standards are not respected.
(6) Do the supervision records and reports in the daily work, organizing quality assessment.

Meanwhile construction supervision unit should establish regimes for supervision work, as follows:

(1) Working reported regime: environment supervisor should write down the working process, put emphasis on the situation of project site and point out environmental problems which will be improved. Find out and analyze causes of problems then provide suggestion to deal with them.
(2) Supervision reporting: supervisor will organize team members to compile environment supervision reports every month, every quarter, and each year.
(3) Communication in time: non-compliances will be reported to construction staff for rapid resolution of issues raised.
(4) Attend monthly environmental meeting and prepare minutes of meeting: Contractor review the environmental protection process according to their obligations, then supervisor gives an evaluation and suggestions for achieving these obligations. If serious environmental pollution accidents occur, the investigation should be carried out on the basis of supervision, combined with other related units to deal with, such as the procedure in figure 6.1.
5.1.3 ORGANIZATION AND RESPONSIBILITIES OF CONTRACTOR

The Contractor should specifically carry out the environmental protection measures according to construction work contract under supervision by PIU, Construction Supervision Unit and related management department. Project Environmental Protection office is established when Contractor start to work until the project is completed and pass the completion acceptance procedures. The key responsibilities of Contractor in environmental protection aspect during construction period are as follows:

(1) Establish annual plan of environmental protection;
(2) Check construction progress of the environmental protection facilities and status of mitigation measures, and deal with any problems occurred;
(3) Check annual expenditure on environmental protection;
(4) Report regularly to PIU and construction supervision unit on the performance of environmental protection articles stipulated in the contract.
5.2 ENVIRONMENTAL PROTECTION MEASURES DURING CONSTRUCTION PERIOD

5.2.1 WATER AND SOIL CONSERVATION MEASURES

Both the project proponent and the construction contractors will be responsible for environmental protection during the construction period and detailed environmental protection measures will be implemented by the construction contractors.

The Contractor will particularly prepare a soil and water conservation plan detailing the measures he will implement to control turbidity levels during dredging and reclamation activities.

5.2.2 ECOLOGICAL PROTECTION MEASURES

5.2.2.1 TERRESTRIAL ECOLOGY

(1) Arrange a reasonable construction schedule and construction plan; as far as possible, reduce the construction intensity during the peak migration and flocking seasons of the birds. According to a seasonal characteristic analysis of the regional birds, the number of birds is large in the spring or autumn migration season and in winter. Therefore, it is suggested that construction intensity is reduced during the birds’ migration periods (from the end of March to the beginning of May, and from late September to early November).

(2) Control noise, light and other impacts from human activity during the construction process; minimize the noise generated from transportation vehicles and project machinery during the construction activities. In addition, conduct the construction activities mainly during the daytime so as to avoid lights and machinery activity disturbing the birds’ habitats during the night-time.

(3) Select a reasonable location for the auxiliary facilities; avoid invading the birds’ habitat, or minimize the impact to the birds’ habitat by making only the smallest changes to the landscape pattern.

(4) Strengthen the observation and protection of the birds during the construction period. Since the earthwork excavation and piling is likely to encourage birds to stop in the region, strengthened observation and the protection of birds is needed so as to prevent them being threatened or killed by the construction activities. Meanwhile, as the construction work progresses, the impact on the birds and their habitat will be continually changing such that on-going observation will be needed. Observation points should be established according to project progress. These may be mainly divided between the reserved areas, such as the Qingcaoshha area, the project construction area and the reserved project construction areas, using fixed-point observation and route investigation methods.

5.2.2.2 AQUATIC ECOLOGY

(1) Taking into consideration the anticipated level of destruction and serious loss of benthonic organisms during the project construction period, a propagation experiment should be developed for fish, shellfish and mitten-handed crabs during the construction period as an effort towards compensating for the loss of aquatic biological resources.

(2) Since the Qingcaoshha Reservoir is located on the edges of the return route for the mitten-handed crab, Coilia mystus, knife Coilia nasus and eels, it is suggested that construction intensity should be reduced during the return periods: knife Coilia nasus (March ~ April); spawning and return of Coilia mystus (May ~ August); return to the sea of the mitten-handed crab (December ~ April) and the Chinese Sturgeon (April ~ August) so as to reduce the impact to these rare species, economically-important fish and crabs.
(3) During the construction period, strengthen observations of the Chinese Sturgeon and other protected wildlife in the mudflats and aquatic areas within the project region. In the event of any injury to a protected species, such as the Chinese Sturgeon, due to project construction activities, initiative should be taken in reporting the incident immediately to the Shanghai fisheries administration and promptly conveying the injured fish to an appropriate protection area or to the place designated by the Shanghai fisheries administration.

(4) Establish noticeable warning signs within the construction sea area and notify the construction schedule, indicated scope and times when fishing is prohibited.

(5) Develop ecological environment and fishery resources tracking and monitoring in the nearby waters during the construction period; understand the project construction’s actual impact on the ecological environment and fishery resources.

(6) In considering the project’s impact on fishery production and the livelihood of local fishermen, the PIU should coordinate with the fisheries department and other relevant departments to develop a compensation plan for the losses of fishery production according to the related national provisions so as to guarantee that the fishermen’s livelihood is maintained and that the production level is not reduced due to the project’s impact. Normally the compensation would be either financial compensation or resettlement to other places.

It is recommended that prior to the commencement of the construction work, the PIU and the fisheries administration should conduct specific research on the economic losses and associated compensation measures, and make sure the fishermen compensate arrangements are implemented effectively.
### Table 5-1: Environmental Protection Measures during Construction Stage

<table>
<thead>
<tr>
<th>Principle</th>
<th>WATER PROTECTION</th>
<th>Ships - Vessels</th>
<th>WATER AND SOIL</th>
<th>AIR</th>
<th>NOISE</th>
<th>Solid Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Reduce unnecessary overflow to the Yangtze river; time for overflow is no more than 10 minutes.</td>
<td>The suspension quantity from dredging and reclamation process should be controlled.</td>
<td>Domestic Waste Water (10,000 construction works on-site at peak times) should be treated.</td>
<td>Vessels and transportation ships should obey to the Pollution Prevention and Equipment Standard of Inland River Ships from National Ships Quarantine Bureau.</td>
<td>Water and soil should be protected</td>
<td>develop a dust pollution prevention and control program; according to articles 8, 9,10 and 11 of the “Shanghai Dust Pollution Prevention and Control Management Methods”.</td>
<td>Develop noise pollution control measures according to art. 27, 28, 29 and 30 of Law on Ambient Noise Pollution Control of PRC. China, and Construction Noise Limiting Values (GB12523-90).</td>
</tr>
<tr>
<td><strong>2</strong> Prohibit over-loading of ships with mud, control that no leaching is appearing</td>
<td>Implementing a conventional coagulation sedimentation treatment plant.</td>
<td>At the project area, three large temporary buildings for construction workers temporary are planned, and wastewater collection facilities has to be set up.</td>
<td>Formulate a Prevention and Emergency Plan for and Oil Spill Accidents.</td>
<td>Construction activity should be controlled within the project’s land take area, and farmland and vegetation should be protecting outside the project area.</td>
<td>Harden the ground within the working area; install simple isolation screening around the working areas (barriers height about 2.5-3m).</td>
<td>New low-noise equipments should be selected to strictly control the noise emissions in accordance with the Standard requirements.</td>
</tr>
<tr>
<td><strong>3</strong> During reclamation - WWTP will be set</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Notes:**
- WWTP will be set before construction works.
- Vessels and transportation ships should obey to the Pollution Prevention and Equipment Standard of Inland River Ships from National Ships Quarantine Bureau.
- Domestic Waste Water (10,000 construction works on-site at peak times) should be treated.
- Water and soil should be protected.
- Develop a dust pollution prevention and control program; according to articles 8, 9,10 and 11 of the “Shanghai Dust Pollution Prevention and Control Management Methods”.
- Develop noise pollution control measures according to art. 27, 28, 29 and 30 of Law on Ambient Noise Pollution Control of PRC. China, and Construction Noise Limiting Values (GB12523-90).
- The project construction contractor is responsible for disposing the solid wastes generated from project’s construction activities.
<table>
<thead>
<tr>
<th>WATER PROTECTION</th>
<th>Ships - Vessels</th>
<th>WATER AND SOIL</th>
<th>AIR</th>
<th>NOISE</th>
<th>Solid Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>gates should be closed, silt should be settled down.</td>
<td>up in an appropriate location to treat the collected wastewater after pre-sedimentation and will be treated by adding coagulant (and flocculants) to remove smaller particles of sand.</td>
<td>unrestricted loading and unloading during the loading and unloading activities of the construction materials.</td>
<td>activities should be avoided on rainy day to reduce soil erosion.</td>
<td>construction vehicles which comply with the Motor Vehicle Permitted Noise Standard (GB1495-79) should be used.</td>
<td>and solid should be cleaned up and backfilled into the ground or used as construction materials. Non-recyclable wastes will be disposed by construction contractor.</td>
</tr>
<tr>
<td>4 Sand take area should be at a certain distance from Longkou, water stay time should be increased to reduce silt suspension at Yangtze river.</td>
<td>Oily wastewater should be treated through grease traps before coagulation treatment.</td>
<td>Management Measures for WWTP 2) Mud or wastewater from construction process must be treated before being discharged.</td>
<td>The height of piles of temporary soil, sand, stone materials should be limited, temporary covers, retaining walls and drainage facilities etc provided.</td>
<td>Prohibit mechanical equipment and haulage vehicles from entering the working area, which do not comply with the national noise emissions standard.</td>
<td>When the project is completed, the site must be cleaned up, and solid wastes must be disposed of properly</td>
</tr>
<tr>
<td>5 Earthwork for inner slope of Changxing island seawall: broadening and deepening can be partially conducted at the end of the pre-dug gutter. A settling basin shall be installed for reducing suspension concentration. Clean deposited silt to reduce impact on Suitang river.</td>
<td>The sludge from the sedimentation pond should be transported out periodically after dewatering.</td>
<td>Management Measures for WWTP 3) Use environmentally-friendly construction machinery for cleaning and sand work in the reservoir to minimize the disturbance on the bed of the reservoir</td>
<td>The safety coefficient of construction ships should be enhanced. The vessels should have certain anti-storm performance.</td>
<td>After completed construction, the land occupied by temporary construction should be restored and reclamation and restoration conducted for the farmland and vegetation.</td>
<td>Reasonable transportation routes and times for construction vehicles should be implemented; pay attention to speed restrictions; and prohibit the use of loud horns so as to reduce the traffic noise.</td>
</tr>
<tr>
<td>WATER PROTECTION</td>
<td>Ships - Vessels</td>
<td>WATER AND SOIL</td>
<td>AIR</td>
<td>NOISE</td>
<td>Solid Waste</td>
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</tr>
<tr>
<td><strong>6</strong> Cover the stack and construct a 50cm-high retaining wall around the stacks to prevent at rainy days the loss of temporarily piled construction materials that could affect the water environment.</td>
<td>The sludge generated by the construction wastewater processing system should also be disposed of promptly.</td>
<td>landscape work on the internal slope, internal edges, outside the bank and within the Qingcaosha Reservoir management area.</td>
<td>Vessels should have anti-pollution equipment and containers appropriate for the amount of generated waste.</td>
<td>Prevent transportation between 22:00 and 6:00. In case if night transportation work cannot be avoided, report should be made to EPB, work may only be allowed after obtaining EPB approval.</td>
<td>Make arrangements with the environmental sanitation department to collect and transport the waste regularly.</td>
</tr>
<tr>
<td><strong>7</strong> Training for contractors on construction principles, operate according to construction operation standards, avoid and minimize pollution accidents</td>
<td>During the construction period, WW should be treated for re-use on site, such as for washing working area and roads, vehicles tires etc. WW from cleaning should be discharged into drainage system and conveyed to the WWTP.</td>
<td>Plan inspection activities if the contractors obey to these measures.</td>
<td>Plan inspection activities if the contractors obey to these measures.</td>
<td>Plan inspection activities if the contractors obey to these measures.</td>
<td>Plan inspection activities if the contractors obey to these measures.</td>
</tr>
</tbody>
</table>

- **Shanghai APL Project Management Office**
- **Shanghai Urban Environment Project – APL 3**
- **Strategic Studies and Project Preparation**
- **R3: Summary of QCS Environmental Assessment**

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5.2.3 PUBLIC HEALTH MANAGEMENT

In order to protect the health of construction workers and nearby residents and prevent diseases spreading, the following measures will be implemented:

(1) Attention will be paid to sanitation and epidemic prevention; before entering the working area, construction workers should undergo a recruitment medical examination; during the construction period, an annual medical examination will be carried out for every employee on the construction site.

(2) Ensure drinking water in the working area is potable and complies with the drinking water health standards; food will be supplied to the workers on the basis of 3 meals per day. Food canteen will respect the standards of hygiene applicable to restaurants.

(3) Awareness training on basic principles will be carried out and posters on the subject will be provided as reminders in key areas as canteens, toilet areas, dormitories.

(4) Implement an appropriate sanitation system and solid waste management in the worker camps. The Contractor will submit a plan related to camps facilities and management at the beginning of his contract.

(5) Control the working time of operators and on-site contractors according to the labor regulations, and provide personal protective equipment: safety shoes, helmet, glasses, ear plugs and gloves.

(6) Each construction contractor will carry out awareness training on solid waste management and provide dust bins for waste separation at source (organic, plastic, metal and paper).

5.3 ENVIRONMENTAL MANAGEMENT DURING OPERATION PERIOD

When the reservoir will be operated, the PIU should set up a full-time EMO to be responsible for the effective implementation of environmental protection legislations in order to protect the environment of Qingcaosha water reservoir area. The basic functions of the EMO cover the following four aspects:

(1) Organize a work team in charge of establishing annual plans of environmental protection and the objectives for Qingcaosha reservoir.

(2) Carry out the environmental protection for the operation and maintenance of Qingcaosha reservoir.

(3) Organize the research and development on the Qingcaosha WQ monitoring, early warning and emergency response system.

(4) Organize the research and studies on ecological restoration, review ecological restoration engineering plans, and coordinate the supervision of ecological compensation activities.

5.4 ENVIRONMENTAL MONITORING DURING CONSTRUCTION AND OPERATION PERIODS

Environmental monitoring should be carried out in order to know the environmental and ecological status and to assess the project impacts.
5.4.1 WATER QUALITY MONITORING PLAN

a) Construction period

Surface water monitoring: water temperature, pH, BOD₅, COD₅, SS, NH₃-N, TP, petroleum, volatile phenol compounds.

Construction effluents monitoring: pH, COD₅, SS, petroleum

Monitoring locations: According to the process of engineering construction, located on the discharge outlet of wastewater treatment upstream and downstream the river.

Monitoring frequency: bimestrial for the Construction effluents, one time monitoring per year high-water, normal-water, low water period and on the spring and neap tide desperately for the surface water.

Monitoring methods: Based on the principles of environment monitoring technical regulations.

b) Operating period

Methodology: Applying the automatic monitoring analysis technology, experimental analysis for meeting an emergency.

Monitoring range and site location: to address outside and inside parts of Qingcaoshan reservoir, the number and location of sites depends on the detailed environmental condition.

Monitoring parameters: some useful parameters need to be monitored by two kinds of methods, which are automatic monitoring and routine monitoring.

Monitoring frequency: The automatic monitoring and routine monitoring have the different monitoring frequency, the former can utilize on line monitoring on the basis of actual need.

Monitoring methods: standard methods defined by the Ministry of Environmental Protection of the PRC and SEPA.

<table>
<thead>
<tr>
<th>TABLE 5-2: AUTOMATIC MONITORING PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Priority</strong></td>
</tr>
<tr>
<td>Compulsory</td>
</tr>
<tr>
<td>Optional</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 5-3: REGULAR MONITORING PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cross Section</strong></td>
</tr>
<tr>
<td>Upstream Pump and Gate</td>
</tr>
<tr>
<td>Pump Station</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>Inside of reservoir</td>
</tr>
</tbody>
</table>

**TABLE 5-4: MONITORING FREQUENCY**

<table>
<thead>
<tr>
<th>Water body</th>
<th>Main cross section</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal monitoring cross section inside reservoir</td>
<td>12 times per year</td>
<td>The frequency will increase according to the actual condition; but should not be less than 12 times every year.</td>
</tr>
<tr>
<td>Normal monitoring sites outside reservoir</td>
<td>12 times per year</td>
<td>Outside monitoring should be operated by Shanghai Environment Monitoring center.</td>
</tr>
</tbody>
</table>
5.4.2 AQUATIC ECOLOGY- MONITORING PLAN

Ecological characteristics of the aquatic ecosystem have to be monitored to have an accurate idea of the environmental conditions in the water body of the reservoir, as aquatic animals and plants are very sensitive to pollution and can indicate in a comprehensive way the actual water quality. This includes also the time and spatial distribution of ecological dynamics.

Monitoring subjects:

(a) Aquatic organisms: biomass, biodiversity, community structure, number distribution, specific composition of chlorophyll, phytoplankton, zooplankton, benthos.

(b) Fishing resource: specific composition, number distribution of fish spawn and dominant species, specific composition of local economic fishery.

(c) Benthos and fish: monitoring: quarterly, in Feb, May, Aug, Nov, meanwhile according to the condition of the fishing season.

Monitoring methods: adopt Shannon Diversity Index, Margalef Index and Algae density standard on aquatic organisms.
5.4.3 **MONITORING BIRDS AND THEIR HABITATS**

The main monitoring sites include Biandansha, Baimaosha, Chongming Dongtan, as well as regions between outside and inside of water reservoir. During the first five years of water reservoir operation, bird monitoring should be carried out four times per year in different seasons. The monitoring parameters are community composition, diversity, distribution and vegetation characteristics, without neglecting bird habitats.

![Figure 5-3: Birds Monitoring Sites in Qingcaoshu Reservoir](image)

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5.4.4 **POST MONITORING AND MANAGEMENT MEASURES FOR ECOLOGICAL IMPACT**

5.4.4.1 **ARRANGEMENTS OF MONITORING STATIONS AND THE SYSTEMIC MONITORING AND CONTROL NET**

Given the characteristics of the regional environment, long-term monitoring stations should be installed to form a system monitoring and control network. On-line monitoring of the physical and chemical parameters; surveys of vegetation, of birds and of various aquatic resources (including chlorophyll a, phytoplankton, zooplankton, benthic organisms and fisheries resources) will be conducted at specific monitoring points.

Wintering migratory birds, for instance a flock of geese and ducks will spend winter at the reservoir, which might pose a threat of bird flu and further influence the safety of water usages of the reservoirs. Therefore, the monitoring of geese and ducks should be reinforced.

5.4.4.2 **ESTABLISHMENT OF AN INFORMATION INTEGRATION AND INFORMATION MANAGEMENT BASE**

An information management base will be established on the basis of the monitoring and control network, integrated with GIS and computer technologies, and aimed at achieving an integrated process function and analysis of monitoring data and to provide support for effective management and decision-making.

5.4.4.3 **INTER-RELATIONS BETWEEN NATURE RESERVES**

Long term inter-relations should be built between the existing nature reserves in order to conduct the monitoring of birds, compensation for habitats and follow-up monitoring of the effects post-compensation measures.
5.4.5 NOISE MONITORING

Due to the dispersion of monitoring locations, mobile noise monitoring equipment has to be used, and applied based on the processes and engineering conditions of water reservoir. The monitoring times will be 10:00, 14:00 in daytime and 22:00 in night. Every sample time will cover 15 minutes at least.

5.4.6 MONITORING OF WORKER POPULATION HEALTH

In order to guarantee the public health among construction workers and maintenance staff, several monitoring parameters will be followed including various infections such as diarrhea, hepatitis and malaria. Health condition of workers will be examined regularly, treatment will be provided when required and awareness information and dissemination will be carried out.

5.5 MITIGATION PLAN FOR ENVIRONMENTAL AND ECOLOGICAL IMPACTS

5.5.1 SHANGHAI WETLAND PROTECTION (DATA SOURCE: SHANGHAI WETLAND, 2004)

5.5.1.1 ISSUES

In order to meet the needs of urban development and population growth, the wetlands of the Yangtze Estuary have been reclaimed for urban land use, this has drawn the serious concern of Shanghai government on the utilization and protection of tidal wetlands. According to historical data over the past 40 years, there has been some dozens of tideland reclamation actions, and by 1997 the area of enclosed tideland for cultivation was 785.33km².

5.5.1.2 PROTECTION EFFORTS AND ACHIEVEMENTS

To control the scale and speed of tideland reclamation, the Exploitation and Protection Plan of Tidal Flat Resources in Shanghai has been formulated in an effort to ensure the tideland reclamation will be under strict control of wetland management institution. Meanwhile, ecological compensation measures have been taken as compensation for the lost enclosed tidal flat due to large scale reclamation activities.

As of 2004, the total area of Shanghai wetland is 3197.14 km², accounting for 40% of the total area of Shanghai, which distribute widely with different types (see table below). There are 5 key wetlands: Jinshan Three Islands, Chongming Dongtan, Jiuduansha, South Branch of Yangtze estuary and Huangpu River.

### TABLE 5-5: AREAS AND TYPES OF SHANGHAI WETLAND (DATA SOURCE: SHANGHAI WETLAND, 2004)

<table>
<thead>
<tr>
<th>Type of Wetland</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offshore and coastal wetlands</td>
<td>3054.21</td>
</tr>
<tr>
<td>River wetlands</td>
<td>71.90</td>
</tr>
<tr>
<td>Lake wetlands</td>
<td>68.03</td>
</tr>
<tr>
<td>Reservoir and pond wetlands</td>
<td>2.99</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3197.14</strong></td>
</tr>
</tbody>
</table>
5.5.2 PRESENT ORGANIZATION AND MANAGEMENT OF WETLANDS AND NATURE RESERVES IN SHANGHAI MUNICIPALITY

The management and regular monitoring should be strengthened for the protection and operation of nature reserves, meanwhile the disturbance coming from human activities should be controlled, which will be beneficial to the wildlife and their habitats protection. Furthermore, according to the wildlife’s characteristics, natural reserves should be better protected by means of habitat restoration and reconstruction.

The local government document (code number: HFB [2004]44) is the most relevant document in this context and is the basis for wetland protection and management in Shanghai area.

Main functional responsibilities of government agencies mentioned in HFB[2004]44 are listed below.

<table>
<thead>
<tr>
<th>Government Agencies</th>
<th>Functional responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanghai Municipal Development &amp; Reform Commission</td>
<td>coordination of funds and planning</td>
</tr>
<tr>
<td>Shanghai Agriculture Committee</td>
<td>wild animal protection</td>
</tr>
<tr>
<td>Shanghai Municipal Tourism Administrative Commission</td>
<td>related eco-tourism</td>
</tr>
<tr>
<td>Shanghai Forestry Bureau</td>
<td>protection of wild animal and its habitants</td>
</tr>
<tr>
<td>Shanghai Municipal Housing, Land And Resource Administration Bureau</td>
<td>usage of land reserve</td>
</tr>
<tr>
<td>Shanghai Finance Bureau</td>
<td>financial input</td>
</tr>
<tr>
<td>Shanghai Municipal Environmental Protection Bureau</td>
<td>supervision of environmental affairs</td>
</tr>
<tr>
<td>Shanghai Municipal City Planning Administration</td>
<td>balance plan</td>
</tr>
<tr>
<td>Shanghai Municipal Water Affairs Bureau</td>
<td>plan and governing tidal flat resource</td>
</tr>
<tr>
<td>Shanghai Municipal Ocean Bureau</td>
<td>governing coastal wetland</td>
</tr>
</tbody>
</table>

To better control human activities and preserve the natural area, 3 levels of protections status have been defined:

- 1st protection status level: Dongtan (Wetland - Birds and marine area – for Chinese Sturgeon) and Jiuduansha are the priority protection of wetland.
- 2nd protection status level: Nanhui Marginal Bank and Hengsha Intertidal Flat,
3rd protection status level: other wetlands belonging to the third rank.

Furthermore, the three Jinshan Island wetlands and Huangpu River wetland have been identified as important coastal wetlands in Shanghai by the municipal government.

A detailed description of the species and legal boundary are given in the previous chapter in table 3.5. Figure 3-2 presents a detailed map concerning the boundary of important coastal wetlands and protected wetlands. All existing wetlands in Shanghai city are shown in figure 3.7. The table 3-5 and 3.6 list detailed information concerning the characteristics, and species abundance of the 1st Protection status level nature reserves in Shanghai.

A specific ecological field survey was carried out for the EIA of QCS reservoir on Zhongyangsha, Qingcaosha and the Xinqiao Channel between these two islands (see table 3-1 and figure 3-4 and results in table 3.7).

Fishing restriction plan in the Yangtze Estuary: Due to the absence of a general fishing restriction plan before, eel and crab larvae were caught the whole year long, day and night. This has during the breeding season exerted a great influence on the fish population. At present, some measures have been carried out to improve the situation for example: annual fishing plan for different fishes according to its amount in different water areas; restrict the amount of fishing nets in Yangtze estuary and inland waters and enlarge the net mesh to protect the younger fish resource. The season when fishes accumulate for egg reproduction has been set as a closed fishing seasons and the feeding area of rare or endangered fingerling has been set as forbidden zone for fishing.

5.5.3 CONSERVATION PLAN FOR NATURAL RESERVES IN SHANGHAI ESTUARY

On November 16, 2006, SWA/DRC jointly issued the 11th Five-Year Planning document for the development of intertidal zones (Hu Shui Wu [2006]1240), in which the dynamic balance between wetland exploitation and utilization of Chongming Dongtan and Jiuduansha beach has been addressed. At present, in Chongming Dongtan and Jiuduansha, the mudflat areas which are 3 meters higher than sea-level are 24.79km² and 31.49 km² respectively. According to the principle of “keeping wetland area slightly increasing”, considered that 107.2 km² should be artificially nourished and 40.2 km² may be implemented by land enclosure. A specific plan will be carried out when the wetland dynamic balance research is finished.

<table>
<thead>
<tr>
<th>Classification</th>
<th>S/N</th>
<th>Project Area</th>
<th>Nourishment (km²)</th>
<th>Land Enclosure (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamental Project</td>
<td>1</td>
<td>Chongming north longshore</td>
<td>46.9</td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>North channel Beisha</td>
<td>46.9</td>
<td>14.74</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Zhongyangsha</td>
<td></td>
<td>15.41</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Hengsha Dongtan</td>
<td>80.4</td>
<td>34.84</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Pudong airport outward</td>
<td></td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Nanhui Dongtan</td>
<td>113.9</td>
<td>40.2</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Bao steel outward</td>
<td></td>
<td>1.206</td>
</tr>
</tbody>
</table>

Reference: article of Zhao Bin (2005)
<table>
<thead>
<tr>
<th>Classification</th>
<th>S/N</th>
<th>Project Area</th>
<th>Nourishment (km²)</th>
<th>Land Enclosure (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
<td>Fengxian Nantan</td>
<td>6.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Chongming new village north</td>
<td>2.68</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Changxing north longshore</td>
<td>1.34</td>
<td></td>
</tr>
<tr>
<td>subtotal</td>
<td></td>
<td></td>
<td>288.1</td>
<td>143.25</td>
</tr>
<tr>
<td>Project Seek To</td>
<td>1</td>
<td>Chongming Dongtan</td>
<td>67</td>
<td>20.1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Jiuduansha</td>
<td>40.2</td>
<td>20.1</td>
</tr>
<tr>
<td>subtotal</td>
<td></td>
<td></td>
<td>107.2</td>
<td>40.2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>395.3</td>
<td>183.45</td>
</tr>
</tbody>
</table>

### 5.5.4 FINANCIAL ARRANGEMENTS

According to information from Shanghai Financial Bureau14, “SMG relevant agencies arrange about 8 million RMB each year for wetland protection during the 11th five year plan (2006-2010)” period.

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14 Email from DFV, 20080925
5.5.5 PRINCIPLES OF RESTORATION AND COMPENSATION MEASURES FOR ECOLOGICAL IMPACTS

Ecological compensation should be based on the existing China’s laws and regulations
Ecological compensation must be based on scientific approach; China is still in the initial research stages of ecological compensation and, as yet, no national standards for scientific and analytical methods have been developed in terms of ecological compensation. Given the current situation, the scientific appraisal of ecological loss will be conducted by applying appropriate methodologies and experienced scientific judgment.

Standardization of ecological compensation - ecological compensation should be compatible with ecological policies, legislation, regulations and management measures.

Market mechanism - ecological compensation should be market oriented.

In conclusion, more applications and modifications to the principles of ecological compensation are needed in the future.

Systematic, integrity and feasibility: The restoration and compensation for ecological impacts must comply with the following:

- the principles of "human-orientation" and "ecological preference";
- regional social and economic development;
- using man-made or self–restoration means and
- promotion of sustainable development of the region.

5.5.6 ECOLOGICAL RESTORATION PLAN AND COMPENSATION MEASURES

According to national regulations and laws, an ecological restoration and compensation plan has to be developed. Ecological engineering measures were deployed for ecological restoration and compensation. Off-site compensation is the main method to ecological engineering construction. Biandansha and Baimaosha can be considered as chief compensation areas which cooperated with peripheral nature reserves.

The requirements stated in the Guideline, and the details of ecological restoration and compensation measures as related to construction projects are described in the following sections.

5.5.6.1 ECOLOGICAL RESTORATION TARGETS

Targets are the followings:

- maintaining good water quality in the reservoir,
- protecting and propagating the biological resources in the neighboring aquatic area outside of the reservoir.
- compensating for the losses of aquatic vegetation and of areas inhabited by birds, and improving the quality of the neighboring land which is also inhabited by birds.

5.5.6.2 CONTROL AND COMPENSATION MEASURES FOR THE FIELD’S ECOLOGICAL IMPACT

Measures for ecological impact on the field

- Control of human activities in the region: human activities in the region have to be controlled in order to provide better habitat conditions for the aquatic plants and animals;
- Monitoring of birds’ population changes (monitoring the species, numbers, distribution) and their related habitats;
- Bird Flu: flocking of ducks and geese should be monitored, inspection and quarantine analysis must be undertaken immediately for dead and sick birds in order to prevent any impact on water heads from biological pollution.
Location: 3 sections, reclaimed area of Qingcaosha, water area in Qingcaosha and the Zhongyangsha Reservoir. (see figure above)

Frequency: On a quarterly basis for one year.

Duration: Monitoring will be conducted over a period of five years. Further monitoring activities will be dependent on the amended monitoring and research plan based on the five-year monitoring results.

Ecological compensation measures

- Ecological engineering measures.

Sedimentation on the tidelands will be increased if vegetation (Bulrushe is an ideal choice of plant for tidelands) can be initiated on the area. Biandansha and Baomaosha are middle and high tidelands and are considered as a potential wetland compensation area. The growth of vegetation will also compensate for the loss of organisms and the water's self-purification ability. The project plays an important role in the stabilization of the river regime and smooth transportation of river ways in the Estuary.

- Stronger protection of Nature Reserves

Nature reserves, recognized as an important compensation area. Stricter management measures need to be taken in the existing nature reserves to control the impact of human activities and enhance the effects of protection for birds and their habitats. More comfortable living conditions should be created to attract the birds. This can be done through renovations and further construction of the nature reserves after studying the characteristics of the birds and other wild animals.

- Protection of the reclaimed area in Qingcaosha

Qingcaosha reclaimed area will be able to provide an habitat for birds and compensate for the loss of the birds’ previous habitats. Contribution to the protection of the reclaimed area in Qingcaosha will depend on the appreciation of the concerned Departments.

5.5.6.3 CONTROL AND COMPENSATION MEASURES FOR AQUATIC ECOLOGICAL IMPACT

Significant ecological and economic benefits will be gained through effective ecological restoration projects.

5.5.6.3.1 GENERAL PRINCIPLES

1) Aquatic ecological system restoration of reservoir

Biological restoration and biological purification measures: Silver Carp, Bighead Carp and Xenocypris microlepis are able to consume large quantities of algae in the water bodies. Micro-organisms, such as algae and other aquatic organisms are the main food source for Silver Carp and Bighead Carp. At least 100 kg of various types of algae can be eaten by a Silver Carp or Bighead Carp which has grown to 1 kg. This can have significant effects on the purification of the water system.

Corbicula fluminea and Potamocorbula ustulata which belong to the family of Bivalve Molluscs, are fast-growing and have strong reproduction abilities (several generations per year). They eat various types of algae. In the propagation season, Trochophora and Veliger larva from these mussels, are an appreciated food for Coilia mystus, Silver Fish and other aquatic organisms; therefore eutrophication risk will be reduced. There is also great economic value in breeding pearls from these Mussels and other shellfish.
Bellamya purificata, river snail and other aquatic organisms, which belong to the gastropod family in the category of mollusk, can live on the sand and rock. They are known as “scavengers” because they sweep up organisms from around the rock and sand, biological debris and a large number of benthic algae. The gastropod plays an important role in purifying the water and improving the environmental quality.

2) Aquatic organisms resource cultivation and compensation

The compensation breeding in and out of the reservoir is planned to last for five years.

The following changes can be achieved through ecological compensation breeding:

- improvements in generating biological resources and ecological effects;
- enhancements in biological diversity at the Yangtze River Estuary;
- supplements to biological resources;
- improve environmental conditions.

3) Enhancing the protection of endangered species and commercial aquatic organisms.

In order to protect Chinese Sturgeon and other endangered species and commercial aquatic organisms, grids to cover the inlets and outlets of pumping stations must be installed at all water in and out let gate to prevent the entry of Chinese Sturgeon, other commercial fish and other items into the reservoir. Professional suppliers can be commissioned to designs and install such grids.

5.5.6.3.2 FEASIBILITY FOR APPLICATION TO QCS

Natural conditions

Due to sand accumulation, tidelands at the Yangtze River Estuary are naturally increasing. No development activities have been considered at the reclamation area in the Qingcaoshui Reservoir so that natural conditions can be preserved. Since the Eastern Tideland of Chongming Islands, Jiuduansha and the Chinese Sturgeon (young) Nature Reserves have been declared as natural protection areas, the environmental conditions were well preserved. The current status provides basic conditions to the ecological impact restoration and compensation in the region.

Economy and technology

The implementation of ecological restoration projects in Qingcaoshui, especially ecological restoration and resources compensation measures, such as man-made breeding, will accelerate the ecological restoration process, generate considerable ecological and economic benefits and minimize the impacts to the ecological environment.

In the past ten years, there have been considerable developments in ecological restoration and compensation technologies, especially for wetlands. Experience can be gained from successful cases in China and abroad. For instance, the research results of the project entitled “vegetation growth – silt accumulation acceleration – attracting birds” conducted in Jiuduansha can be referenced for the establishment of ecological impact restoration and compensation. Technically speaking, the recommended ecological restoration and compensation measures can be fully implemented.

Huge benefits and high efficiencies can be gained through combinations of man-made design and system self-design, complying with the natural development of the ecological system and providing considerable contributory efforts to restoration and compensation projects.

Social support
The eco-index has become an important indicator of competitiveness and the image of the metropolis, which will also directly influence the regional environmental conditions, industrial development and daily lives of the people. Therefore, the proposed ecological restoration and compensation measures will be supported by the society and the general public.

5.6 COMPENSATION MEASURES FOR FISHERIES, FISHERMEN AND LOCAL RESIDENTS

5.6.1 MEASURES FOR FISHERIES AND LOCAL FISHERMEN

Impacts may be posed on the fishing industry and fishermen during the operating period. Therefore Contractors should work closely with the fisheries departments, local departments and affected fishermen. Compensation measures to cover fishermen’s losses must be developed based on relevant national requirements to ensure that the fishermen’s quality of life will not be worsened due to the construction of the project.

During the implementation of the project, the proposed improvements to fishermen include:

- Encouraging fishermen to change their productivity and occupation, supported and guided by the relevant policies and finances;
- Reducing the fishing pressure to protect fish resources;
- Adjusting the strategic plan of the marine fisheries structure; and
- Protecting the legal rights of the fishermen.

It is recommended in the report that the potential economic losses to the fishing industry during the construction and operation periods should be paid by the PIU in a single payment. The Chongming Government and the Shanghai Administrative Fisheries Department will be responsible for the compensation and/ or resettlement of the affected fishermen.

5.6.2 MEASURES FOR PROJECT LAND ACQUISITION

These aspects are developed in the Resettlement Action Plan prepared for the QCS Reservoir project.

5.7 EMERGENCY PREPAREDNESS AND RESPONSE

5.7.1 IMPACT ANALYSIS OF CONTAMINATION ACCIDENTS ON WATER HEAD SITE

Industries and discharge points along the river are mostly located in the south bank, away from the Qingcaosha area which is at the central area. Also, the Yangtze River main stream works as a natural barrier to prevent potential contamination from spreading towards the central areas, and minimizes the potential impacts of contamination incidents on the planned water reservoir.

In cases of emergency response, the management of the Qingcaosha water reservoir must be notified immediately. The water intake gates must be immediately shut to stop water inflow; the water retention level should be able to continue to supply water for at least 12 days. At the same time, pumps should be used to abstract uncontaminated water to increase the water retention level and reduce the impacts of the contamination on the water supply.
5.7.2 IMPACT OF SHIP ACCIDENTS

Shipping accidents near the water intake area could generate acute contamination and pose a serious threat to water quality. Without prompt emergency response and due to the unpredictable and random characteristics of boating accidents, any contamination may spread and cause larger scale contamination. It is necessary to develop an emergency plan to react appropriately to ship accidents.

5.7.3 IMPACT OF REGIONAL INCIDENTS

Saline intrusion will be one of the main impacts on water quality at the Qingcaosha area. During the high salt intrusion period, water abstraction from the river must be suspended. If the period lasts longer than the designed capacity of the water reservoir, it may have serious implications for the Shanghai water supply. Typhoons and earthquakes may also have impacts on the structures of the water reservoir. Therefore, these impacts should be considered during the design and construction stages.

5.7.4 PREVENTION MEASURES FOR CONTAMINATION INCIDENTS

Improve boat traffic supervision, which covers management, inspection, maintenance and operation of pollution control facilities.

Enhance navigation management at the North Passage area, upgrade boat models, and prohibit boats carrying hazardous materials from entering the area. The IFC Guidelines for: Environmental, Health, and Safety Guidelines for Shipping should be referred to.

Install filtration facilities at the water intake area to prevent oil or other pollutants from entering the water reservoir; implement 24-hour security and real-time incident reporting.

Arrange a comprehensive investigation of discharge points and industrial practices (chemical, petrochemical, and mechanical and refinery industries) which are potential threats to water quality and safety, and develop corrective action plans.

Establish a real-time water quality monitoring system at the Qingcaosha water reservoir.

5.7.5 DEVELOPMENT OF EMERGENCY RESPONSE PLANS

Considering the characteristics of the project and the related laws and regulations, it is suggested that the Qingcaosha water reservoir emergency response planning should include: an emergency response organizational chart and responsibilities; an emergency response network (warning and contacts); emergency response and actions; determination of emergency status and shut-down; emergency response capacity and competency building; and trainings, practices and public participation.

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5.8 **BUDGET**

The total project investment is approximately RMB 4.922 billion, including tentative 2.92% investment for environmental protection, which is about RMB 143.53 million. In addition, the SMG will allocate about 8 million per year for wetland protection during the 11th five-year period (2006-2010) (see 5.5.4).

**TABLE 5-8: INVESTMENT ESTIMATE FOR ENVIRONMENTAL PROTECTION**

<table>
<thead>
<tr>
<th>S/N</th>
<th>Items</th>
<th>costs (\text{ten thousand} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Environment protection measures</td>
<td>6670.7</td>
</tr>
<tr>
<td>1</td>
<td>Fishery compensation</td>
<td>Need to be defined by further discussion and consultation with relative fields</td>
</tr>
<tr>
<td>2</td>
<td>Aquatic biological resource compensation</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Birds' habitats restoration</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Environment monitoring</td>
<td>1884.0</td>
</tr>
<tr>
<td>1</td>
<td>Environment monitoring during construction period</td>
<td>984.0</td>
</tr>
<tr>
<td>1 1</td>
<td>Noise monitoring during construction period</td>
<td>12.0</td>
</tr>
<tr>
<td>2 1</td>
<td>Assanation monitoring during construction period</td>
<td>200.0</td>
</tr>
<tr>
<td>3 1</td>
<td>Industrial and domestic wastewater monitoring</td>
<td>12.0</td>
</tr>
<tr>
<td>4 1</td>
<td>Surface water quality monitoring (include chartering costs)</td>
<td>60.0</td>
</tr>
<tr>
<td>5 1</td>
<td>Ecological fishery monitoring (include chartering costs)</td>
<td>460.0</td>
</tr>
<tr>
<td>6 1</td>
<td>Birds and habitats observation and research</td>
<td>240.0</td>
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<tr>
<td>2</td>
<td>Ecological monitoring in the first 5 years of operating period</td>
<td>900.0</td>
</tr>
<tr>
<td>1 1</td>
<td>Birds and habitats observation and research</td>
<td>300.0</td>
</tr>
<tr>
<td>2 1</td>
<td>Aquatic organisms monitoring (include chartering costs)</td>
<td>300.0</td>
</tr>
<tr>
<td>3 1</td>
<td>fishery resource monitoring (include chartering costs)</td>
<td>300.0</td>
</tr>
<tr>
<td>III</td>
<td>Environment protection instruments and their installation</td>
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</tr>
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<td>1</td>
<td>Automatic water quality monitoring system</td>
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</tr>
<tr>
<td>2</td>
<td>Routine test instruments in lab</td>
<td>200.0</td>
</tr>
<tr>
<td>3</td>
<td>Water quality monitoring ships for reservoir (include monitoring facilities)</td>
<td>200.0</td>
</tr>
<tr>
<td>4</td>
<td>Emergency facilities and supplies of reservoir</td>
<td>1000.0</td>
</tr>
<tr>
<td>5</td>
<td>Fish barrier</td>
<td>150.0</td>
</tr>
<tr>
<td>6</td>
<td>Domestic wastewater and garbage gathering and processing equipments</td>
<td>20.0</td>
</tr>
<tr>
<td>IV</td>
<td>Temporary measures of environment protection during construction period</td>
<td>970.8</td>
</tr>
<tr>
<td>1</td>
<td>Industrial and domestic wastewater treatment</td>
<td>482.8</td>
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<td>Industrial wastewater treatment equipments</td>
<td>48.0</td>
</tr>
<tr>
<td>2 1</td>
<td>Operating costs of industrial wastewater treatment equipments</td>
<td>9.2</td>
</tr>
<tr>
<td>3 1</td>
<td>Domestic wastewater treatment equipments</td>
<td>247.5</td>
</tr>
<tr>
<td>4 1</td>
<td>Operating costs of domestic wastewater treatment equipments</td>
<td>178.1</td>
</tr>
<tr>
<td>2</td>
<td>Measures of air impacts remediation</td>
<td>23.2</td>
</tr>
<tr>
<td>3</td>
<td>Measures of noise impacts remediation</td>
<td>18.6</td>
</tr>
<tr>
<td>4</td>
<td>Measures of solid waste impacts remediation</td>
<td>227.2</td>
</tr>
<tr>
<td>1 1</td>
<td>Building rubble</td>
<td>78.8</td>
</tr>
<tr>
<td>2 1</td>
<td>Domestic garbage</td>
<td>148.4</td>
</tr>
<tr>
<td>5</td>
<td>Population health protection measures</td>
<td>200.0</td>
</tr>
<tr>
<td>6</td>
<td>Other temporary engineering projects</td>
<td>19.0</td>
</tr>
<tr>
<td>S/N</td>
<td>Items</td>
<td>costs [ten thousand]</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td>Independent costs of environment protection</td>
<td>1905.8</td>
</tr>
<tr>
<td>1</td>
<td>Engineering environment management costs</td>
<td>349.0</td>
</tr>
<tr>
<td>2</td>
<td>Inspection costs for completion of environment protection equipments</td>
<td>100.0</td>
</tr>
<tr>
<td>3</td>
<td>Supervision costs of Engineering environment</td>
<td>80.0</td>
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<tr>
<td>4</td>
<td>Scientific research costs of environment protection</td>
<td>1000.0</td>
</tr>
<tr>
<td>5</td>
<td>Costs of EIA and environment monitoring</td>
<td>345.0</td>
</tr>
<tr>
<td>6</td>
<td>Costs of engineering quality supervising</td>
<td>31.8</td>
</tr>
<tr>
<td>VI</td>
<td>Fundamental preparation costs</td>
<td>812.4</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>14353.0</strong></td>
</tr>
</tbody>
</table>

5.9 IMPLEMENTATION ARRANGEMENTS

The environmental management work during construction period shall be borne by the three parties together: PIU, CSU and the construction contractor(s).

5.10 IN-DEPTH RISK/UNCERTAINTY ANALYSIS

5.10.1 A LIST OF STUDIES ON WATER QUALITY

To be provided

5.10.2 MECHANISMS TO REVIEW THESE STUDIES, AND TO INCORPORATE THE RESULTS OF THE STUDIES INTO OPERATIONS OF THE RESERVOIR.

To be provided
6 PUBLIC CONSULTATION

6.1 CONSULTATION ACTIVITIES FOR PROJECT APPROVAL

The major consultation activities undertaken include expert consultation, questionnaire/interview, and information on internet and questionnaires on website. These activities were used to better understand and control the conditions of project’s water region, aquatic ecology, and water using and mudflat planning.

The expert panel provided important suggestions in the production of the EIA, and their inputs have been incorporated into this report. Public consultation by collecting public’s opinion via internet questionnaires was carried out on the QCS reservoir project and its environmental impacts. The questionnaire was classified into two types which are group questionnaires (for collective attitudes of organizations and associations etc.) and individual questionnaire (for individual views, including information of age, gender, educational history, address.)

The results obtained from the internet survey showed that the public concern was focused on water quality and the project’s impacts on the aquatic ecological environment. Furthermore a public survey undertaken around the project areas showed concerns over the impacts on fishery.

Besides, as per the opinion of Shanghai Municipal Forestation Administration, protection and management of Changxing Island itself should be considered as top priority, followed by the protection of neighbouring areas (Dongtan, Jiuduansha, etc.) as compensation

6.2 CONSULTATION FOR IMPACT ASSESSMENT

According to the results of group and individual questionnaire, most of the participants care, understand and support the project. Suggestions and advices should have reference value for the project. Experts gave vital regional and environmental advice that can guide the project to a beneficial development: concerning the water quantity, water quality, impacts on the saltwater intrusion and eutrophication, losses of fishing resource and biological habitats. Environmental protection issues and compensation measures should be integrated in the planning, design, construction and operating period of the QCS reservoir.

<table>
<thead>
<tr>
<th>Table 6:1 TYPES &amp; METHODS FOR PUBLIC CONSULTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>Expert consultation</td>
</tr>
<tr>
<td>Questionnaire/interview</td>
</tr>
<tr>
<td>Information disclosure on internet</td>
</tr>
<tr>
<td>Questionnaire on website</td>
</tr>
</tbody>
</table>
6.3 RESULTS ANALYSIS

TABLE 6-2: RESULTS OF PUBLIC CONSULTATION

<table>
<thead>
<tr>
<th>S/N</th>
<th>Feedback from</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Expert</td>
<td>The water quantity, quality and river regime are stable. The coordination between river and navigation project should be strengthened. Put emphasis on the saltwater intrusion and eutrophication. Suitable measures for fisherman compensation. Implement biodiversity protection and ecological compensation. Make plans for water reservoir management and protection.</td>
</tr>
<tr>
<td>2</td>
<td>Business units/institutes</td>
<td>The project plays an important role on urban water supply, promoting regional economic development. Most of units have known the project clearly.</td>
</tr>
<tr>
<td>3</td>
<td>General public</td>
<td>Need to do integrated environment impact assessment, proposing reasonable policies aiming at preventing local people and environment from noise and other pollutions impacts.</td>
</tr>
<tr>
<td>4</td>
<td>Fishermen</td>
<td>Expect to care about the problems of fisherman’s living, considering the fishing destruction caused by the project and providing economic compensation.</td>
</tr>
<tr>
<td>5</td>
<td>Internet</td>
<td>Construct the project as soon as possible, in order to supply safe and clean water resource but a healthy natural environment should be considered in the planning. It’s necessary to do efficient management that guarantees good water quality.</td>
</tr>
<tr>
<td>6</td>
<td>Information Disclosure</td>
<td>No comments or feedback received, which means the general public has no critical disagreements against this construction project.</td>
</tr>
</tbody>
</table>

6.4 FUTURE CONSULTATION PLAN

These four types of consultation reflect current public attitudes concerning this project and have provided objective, reasonable and operational suggestions that should be considered in the project plan. During construction and operating periods suitable environmental protection measures should be implemented. On the basis of these consultations, combining with the project process, some further consultation plan are proposed.

- Investigate if compensation for fishing resource losses was satisfactory
- Investigate if compensation for biological habitats was satisfactory
- Inquire environmental destruction degree in views of the general public.
- Pay attention to fisherman’s living conditions especially in Chongming and Changxing
Through the continuous consultation environmental impacts should be detected. Based on the further consultation, the Contractor should notify that they adopt the suggestions and advices from public consultation and implement all measures which can help for reducing negative environmental impacts.
CONCLUSIONS

The QCS reservoir will improve the water supply safety of the Shanghai Municipality. This objective constitutes the major positive impact of the Project.

The QCS reservoir area is located in an area of the Yangtze which provides water in compliance with Class II of the Surface Water Quality Standard (GB3838-2002), and is thus suitable for water supply of Shanghai Municipality. However, the area is periodically under the influence of saline water intrusions, which occur during high tides along the dry season, when the discharge in the estuary is reduced.

The area, which consists of partly vegetated mudflats (reeds, sedges) is a shelter for migratory birds (wading birds). Because of its location in the midstream of the estuary, rather far from the seashore and of the direct marine influence, the QCS is not a major wintering site for migratory birds in the region as Chongming Dongtan and the Jiuduansha Nature Reserves are. As a result, the QCS may be considered as a wetland of secondary ecological value, where birds take mainly temporary shelter in case of severe weather conditions on the seashore.

The design of the reservoir has used detailed hydraulic and water quality modeling, which has been performed to assess the risk of salt intrusion and the risk of eutrophication of the reservoir water body. The reservoir capacity was defined considering a maximum duration of 68 successive days during which the salinity level above the standard of 250 mg Chlorides/l in the Yangtze does not allow abstraction of water from the river.

Because of the nutrient levels in the Yangtze river, the risk of water eutrophication is a reality with potential of algal bloom (including of toxic algae) and consequences on treatment complexity. The design of the reservoir, in terms of shape and depth, optimizes the water circulation within the whole water body and reduces the residence time of the water, resulting in a strong reduction in the eutrophication risk. The reservoir management is based on an average residence time not exceeding 20 days, a threshold below which eutrophication should not develop.

The area is also a corridor along which rare or endangered species such as the Chinese Sturgeon used to move seasonally during their migration towards the Yangtze headwaters. The construction of dams across the Yangtze in the 1980's has seriously affected the process, and mature sturgeons have rarely been observed since several years. Nevertheless, the QCS project will not affect the traditional route of the fish, and the North Channel, even if slightly reduced in width, will provide a deeper water depth and a higher velocity of water compared to the present situation, favorable to fish movement.

The present shallow water and temporarily brackish conditions of the QCS will be transformed by the Project into a deeper water body with permanent freshwater conditions. This alteration from the initial situation will of course involve a change in habitat and thereafter related biodiversity. The ecosystem will shift from a diversified type (because of various levels of salinity observed as well as various water depth and vegetation cover) to a less diversified habitat shelter of dominantly freshwater species. This change in habitat will also induce probable changes in bird communities, shifting from wading bird types, typical of mudflats and shallow waters to waterfowl type (ducks, geese, swans).

The QCS project will slightly reduce the width of the Beigang (North Channel) stream and increase the vertical velocity of the flow. However, studies show that the axes of the main stream are likely to remain steady with little erosion threat and no significant impact on the navigation channel of the Beigang Bridge. Both mathematical and physical modeling studies concluded that the QCS Project will not affect the tidal regime in the Beigang.
During the construction stage, the major potential impacts relate to dredging and reclamation activities. However, the sandy type of the concerned sediments and the selection of cutter suction dredges will significantly reduce the release of fine sediment in the river and the risk of impact on the aquatic ecosystem because of the turbidity. The dredged sediment will be disposed into a dedicated area, isolated by a dike from the Yangtze river and from the future QCS reservoir. The drainage water from this disposal area will be diverted towards sedimentation facilities before being discharged into the Yangtze.

All other typical impacts resulting from construction activities will be mitigated through obligations made to the Contractors: noise, dust, construction and domestic waste, public health and sanitation in worker camps, hazardous products management (particularly used engine oil, bilge waters).

During the operation period, water quality will be closely monitored upstream of the intake for early detection of pollution hazard of the water resource and in the QCS reservoir to anticipate any eutrophication trend.

Protection areas will be set-up around the QCS reservoir following the Protected Water Resource regulation for Class I (200 m distance from the QCS reservoir perimeter and 500 m radius around the water intake) and Class II (2500 m upstream and 1500 m downstream the water intake) and a Qincaosha Water Source Protection Regulation will be implemented. This requirement will make compulsory the treatment prior to discharge of any urban or industrial wastewater from Chongming and Changxing islands in proximity to the QCS Reservoir.

The Project Owner will develop an Emergency Preparedness and Response Plan in order to deal efficiently with any accidental situation threatening the water quality and supply: accidental chemical spill in the Yangtze, ship collision near or upstream the reservoir intake.

In order to avoid accidental trapping in the reservoir of rare or endangered species as the Chinese Sturgeon, a protection system will be installed at the sluice gate entrance and the pump intake of the QCS reservoir.

In order to limit the eutrophication risk, ecosystem restoration works will be carried out within the reservoir area, including the introduction of selected algae feeding fish species and the organization of fishery activities.
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