

Environmental Assessment Report

Summary Initial Environmental Examination
Project Number: 29466
August 2006

India: Kolkata Environmental Improvement Project (Supplementary Financing)

Prepared by the Kolkata Municipal Corporation for the Asian Development Bank (ADB).

The summary initial environmental examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

CURRENCY EQUIVALENTS

(as of 2 August 2006)

Currency Unit	–	Indian rupee/s (Re/Rs)
Re1.00	=	\$0.0215
\$1.00	=	Rs46.59

ABBREVIATIONS

ADB	–	Asian Development Bank
BOD	–	biochemical oxygen demand (a measure of organic pollution)
CBO	–	community-based organization
CO	–	carbon monoxide
DWF	–	dry weather flow
EA	–	executing agency
EIA	–	environmental impact assessment
EKW	–	East Kolkata Wetlands
EMP	–	environmental management plan
GDP	–	gross domestic product
GOI	–	Government of India
GoWB	–	government of West Bengal
IEE	–	initial environmental examination
I&WD	–	Irrigation and Waterways Department
KMC	–	Kolkata Municipal Corporation
MSW	–	municipal solid waste
NGO	–	nongovernment organization
PIU	–	project implementation unit
PMU	–	project management unit
S&D	–	sewerage and drainage
SDU	–	social development unit
SLF	–	sanitary landfill
SOP	–	standard operating procedures
STP	–	sewage treatment plant
SWF	–	storm water flow
TA	–	technical assistance
TSS	–	total suspended solids
WBPCB	–	West Bengal Pollution Control Board

WEIGHTS AND MEASURES

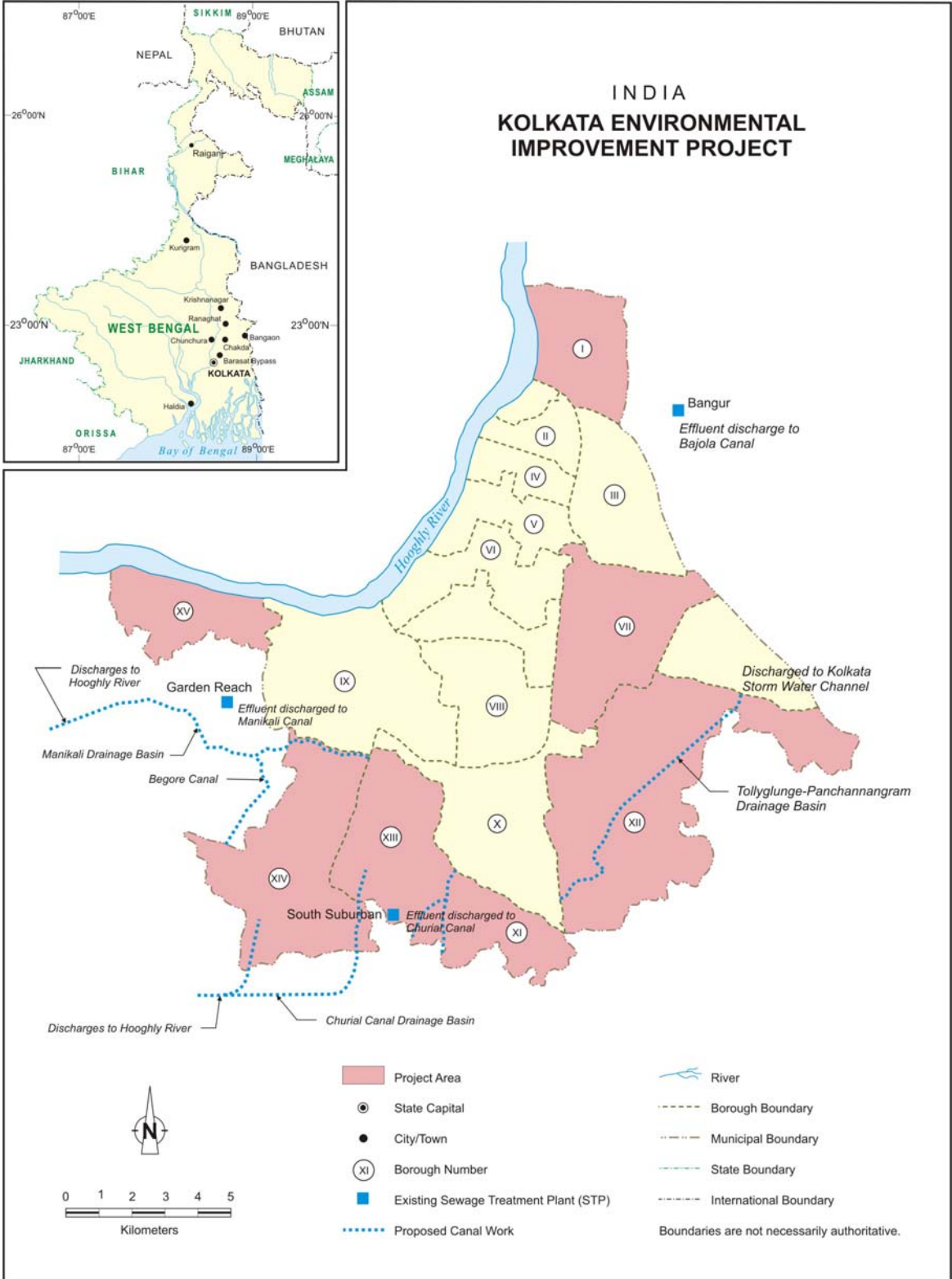
cm/sec	–	centimeter per second
dBA	–	A-weighted decibels
kg/ha/yr	–	kilogram per hectare per year
lps	–	liters per second
mg/l	–	milligram per liter
mg/m ³	–	milligram per cubic meter
MLD	–	million liters per day

NOTE

In this report, "\$" refers to US dollars.

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I. INTRODUCTION

A. Background and Purpose

1. The Asian Development Bank (ADB) approved the Calcutta Environmental Improvement Project in December 2000¹ for \$250 million to assist the government of West Bengal (GoWB) to improve sanitation in the outer areas of Kolkata municipality. The Project was made effective on 16 April 2002 and has a closing date of 31 December 2007.

2. The project preparatory technical assistance (PPTA) prepared a comprehensive initial environmental examination (IEE) report for the Project.² While the IEE complied with ADB's *Environment Policy (2002)* and *Environmental Assessment Guidelines (2003)*, some changes were made to the physical scope and project design during detailed design and project implementation. A supplementary loan, the Kolkata Environmental Improvement Project (Supplementary Financing), is being processed. The IEE was revised to assess environmental impacts of the Project in its current scope and design, and to propose appropriate environmental mitigation and monitoring measures along with the required environmental management plan.

3. The revised IEE was prepared in accordance with ADB's environment policy and guidelines and was designed to identify potential environmental impacts and monitoring and mitigation measures.

B. Extent of the Revised IEE

4. The revised IEE was based largely on existing information on general environmental conditions in Kolkata. It analyzed the information in published and unpublished documents, a limited amount of primary data generated during the design and implementation of the Project, and secondary data collected from projects and research papers on East Kolkata Wetlands (EKW). This was supplemented by field reconnaissance and primary investigations of the project area during preparation of the original IEE, detailed investigations by the scientists and engineers of the design and supervision consultants of the Project, and preliminary analysis by the School of Water Resources Engineering of Jadavpur University.

5. Information was also collected through consultations with scientists and staff of the West Bengal Pollution Control Board (WBPCB); EKW Management Authority, Department of Environment, GoWB; Department of Fisheries, GoWB; Department of Science & Technology, GoWB; Institute of Environmental Studies and Wetland Management (IESWD); and fisheries cooperatives in the EKW area. Environmental issues related to the EKW were also discussed with (i) Dr. Dhruvajyoti Ghosh; (ii) Professor S. C. Santra, Department of Ecology, Kalyani University; (iii) Professor Prodip Sikdar, Institute of Social Welfare and Business Management; (iv) Mr. Protap Chakraborty, Center for Study of Man and Environment; and (v) Dr. S.P. Sinha Roy, formerly of the Central Ground Water Board. The School of Water Resources Engineering (SWRE), Jadavpur University has recently been engaged under the Project to carry out further scientific research on various aspects of environmental issues related to the proposed wastewater discharge into the dry weather flow (DWF) channel, which is tapped by the fisheries located within the EKW area.

¹ ADB. 2000. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to India for the Calcutta Environmental Improvement Project*. Manila (Loan 1813-IND, approved on 19 December 2000). For this report Calcutta is replaced with Kolkata.

² Under ADB. 1998. *Technical Assistance to India for Preparing the Calcutta Environmental Improvement Project*. Manila (TA 3089-IND, approved on 16 October 1998), by Egis Consultants Australia Pty. Ltd. in association with Consulting Engineering Services (India) Ltd. and Sinclair Knight Merz Pty. Ltd.

II. DESCRIPTION OF THE PROJECT

A. Project Type and Rationale

6. The Project's environmental assessment was category B when it was approved in 2000. However, in August 2002, the EKW—into which some of the treated wastewater from the Project (from Borough VII, Borough XII, and parts of Borough XI) will discharge—was included in a list maintained by the Ramsar Bureau. This is in accordance with Article 8 (site number 1208) of the Ramsar Convention, which recognizes EKW as a “wetland of international importance.” This designation of the receiving water body has resulted in the environmental assessment of the Project (the ongoing loan and the supplementary loan) being reclassified as category B sensitive.

7. The Executing Agency (EA) is currently studying the potential environmental impacts on the EKW of its proposal to drop two sewage treatment plants (STPs) from the Project and to discharge sewage effluent (from Borough VII, and parts of Borough XI and Borough XII) into the DWF channel to be treated using the fisheries in the EKW. The DWF channel is an artificial channel which carries dry weather flow from almost the entire core of the city. After traveling a distance of over 30 kilometers (km), it ultimately discharges into the Kulti river, where it undergoes a process of natural treatment through fisheries and agriculture in the EKW area.

8. A draft environmental management plan (EMP) has been prepared as part of the revised IEE for the management and monitoring of environmental impacts arising from the Project in its existing scope and design. The revised IEE and the draft EMP take into consideration potential impacts and proposed mitigation measures. The environmental monitoring program allows for the most sensitive case scenario for potential environmental impact purposes, i.e., the sewage from boroughs concerned being treated through the fisheries in the EKW. The authorities responsible for implementing mitigation measures and for monitoring requirements have been identified. Responsibilities for reporting and review, cost estimates, and mechanisms for feedback and adjustment have also been identified.

9. The EKW is situated about 5 km from the eastern edge of Kolkata. It lies within latitudes 22° 25' to 22° 40' north and longitudes 88° 20' to 88° 35' east. The average elevation is 2–5 meters (m) above mean sea level. It has an area of about 12,500 ha. The Ramsar Bureau has selected EKW to demonstrate “wise use” of a wetland near a city. The EKW is well known internationally for its many uses. The wetland area traps nutrients (through an aquatic food chain) which are richly available in wastewater and converts them to edible protein in the form of fish. It is a resource-recovery activity, mastered by the local farmers, that has saved the city from the need to construct and maintain wastewater treatment plants. The Ramsar fact sheet,³ prepared by the World Wide Fund for Nature, cites the EKW as “a perfect example of wise-use wetland ecosystem where usage of city sewage for traditional practices of fisheries and agriculture is practiced.” It further acknowledges that EKW is “one of the rare examples of combination of environmental protection and development management where a complex ecological process has been adopted by local farmers by mastering the resource recovery activities,” and that “it is the largest ensemble of sewage-fed fish ponds in the world in one place.”

³ World Wide Fund for Nature and Government of India Ministry of Environment and Forests. *A Fact File on India's Wetlands of International Importance*.

10. The EKW area was originally designated as a conservation area by an order of the Kolkata High Court in 1992, and the Government accordingly introduced development controls to conserve the water bodies. Subsequently, GoWB constituted a management committee that produced an outline management plan for the EKW in 2004. In March 2006, the EKW (Conservation and Management) Act⁴ became law. The act divided the EKW area into four land use classes: (i) mainly water body; (ii) agricultural area; (iii) productive farming area; and (iv) urban or rural settlement. Activities that may be allowed or promoted for the wise use of the wetland have been listed under each land use class. Sewage-fed fish cultivation is extensively carried out in the water body areas and provides a livelihood for a large population. The east Kolkata peri-urban area is regarded as a unique example of utilization of city waste that is essential for the upkeep of the ecosystem and an appropriate example of wise use of wetlands. Under the act mentioned above, GoWB has set up a statutory EKW management authority that will prepare a management plan for the conservation and wise use of the EKW. WBPCB, the Department of Environment, and the Department of Fisheries of GoWB have already approved the proposal to discharge additional sewage (from the boroughs listed in para. 7) into the DWF channel as a measure that is consistent with the wise use of the EKW.

11. Six local nongovernment organizations (NGOs) active in EKW protection—Public, Bharat Sevashram Sangha, Jayprakash Institute of Social Change, *Jalabhumii Bachhao Samity* (Save the Wetlands), Purba Kolkata Fish Producing Association, and Centre for Environmental Management and Participatory Development—have been consulted by the Project. Consultations with these NGOs showed that the present practice of sewage-fed fisheries was considered by NGOs to be a wise use of the EKW. NGOs not only support and promote sewage-fed fisheries, they consider them to be an important component of the EKW, making a substantial contribution to the sustenance of the EKW ecosystem, and providing a livelihood for more than 20,000 people.

B. Component Description

12. The project components are: (i) part A, a stakeholder consultation program; (ii) part B, sewerage and drainage (S&D) improvements; (iii) part C, solid waste management; (iv) part D, slum improvements; (v) part E, canal improvements; and (vi) part F, implementation assistance and capacity building. In parallel, a \$42 million grant from the Department for International Development (DFID) of the United Kingdom is supporting modernization and capacity building of the Kolkata Municipal Corporation (KMC). The project area covers Boroughs I, XI, XII, XIII, XIV, VII and XV for part B, while physical works under parts A, C, D, E, and F cover different boroughs of KMC.

1. Stakeholder Consultation Program

13. The stakeholder consultation program (SCP) consists of promoting stakeholder involvement in the Project through (i) education programs for communities about links between environmental sanitation and health; (ii) and consultations with project beneficiaries about project operations and community benefits and responsibilities as a result of the Project, including its design, implementation, and operation and maintenance. The SCP is designed to ensure stakeholder awareness, participation, and education with respect to the implementation and management of the project facilities. No physical works will be carried out under this component.

⁴ West Bengal Act VII of 2006. The East Kolkata Wetlands (Conservation and Management) Act, 2006.

2. Sewerage and Drainage Improvements

14. This component includes (i) the installation of about 424 km of new lines where the drainage and sewerage network does not exist; (ii) renovation and desilting of approximately 364 km of existing sewers and drains; (iii) construction of new pumping stations for channeling the additional flow; (iv) construction of 18 new pumping stations and augmentation or rehabilitation of 17 existing pumping stations for channeling the DWF and storm water flow (SWF); and (v) disposal of wastewater into specific STPs for all project boroughs, or possible disposal of wastewater from Borough VII, parts of Borough XI and Borough XII, into the DWF channel. The S&D network will be a combined system, with DWF separated using a suitably designed overflow arrangement. The total DWF discharge into the three existing STPs South Suburban (East), Bangur, and Garden Reach to be augmented under the Project will be of the order of 170 million liters per day (MLD) by 2035. The total discharge into the two new STPs to be constructed under the Project, or to be discharged into the DWF channel has been estimated at 112 MLD by 2035.

15. The component also includes rehabilitation works in 15 small water bodies and parks. These works are minor and mainly consist of beautification and upgrading of environmental quality (including fencing and paving of play areas). These parks and water bodies are in various stages of decay due to inadequate upkeep.

16. **Process of Sewage Treatment in the EKW.** The DWF channel is about 36 km long with a varying bed width of about 6 m. The canal flows parallel to the SWF canal until it joins the SWF canal at Ghushighata, about 1 km ahead of the confluence point with the Kulti River. From Topsisia point A through the EKW from west to east, the DWF channel is used by fisheries at several points for sewage-fed fish cultivation. The sewage water is fed into the shallow fisheries and passes through ponds before it is finally returned to the combined SWF and DWF channel near Ghushighata.

17. The EKW sewage-fed fisheries are the largest example of wastewater-based fish cultivation in the world. The system can accommodate up to about 18,800 liters per second (lps) of wastewater for the existing 4,440 ha of sewage-fed fisheries. The total area of the water bodies in the EKW is 5,800 hectares (ha). The increased discharge into the DWF channel can also help bring more water bodies into the sewage-fed fishery and to increase its productivity. In this system, the sewage undergoes partial treatment, as it takes several hours to flow from city outfalls along the DWF to the fish ponds. As it flows into the ponds, it is rapidly diluted with pond water. Nutrients in the wastewater stimulate aquatic food webs of phytoplankton and zooplankton in the water column and organisms such as midge larvae and tubifex worms in the pond sediments, providing natural food for fish. The ponds simultaneously act as waste stabilization ponds for natural degradation of wastewater. Studies show that the average efficiency for reducing biochemical oxygen demand (BOD) in wastewater is above 80%, and for reducing coliform bacteria it is 99.99%.⁵ Solar radiation is adequate for photosynthesis to take place. Solar energy is tapped by a dense plankton population which the fish consume. While the plankton play a highly significant role in degrading organic matter in the wastewater, the fish, the highest trophic level, play an equally important role by grazing on the plankton. The twofold role played by the fish is crucial: they maintain a balance of the plankton population in the pond and convert the available nutrients in the wastewater into a readily consumable form (fish) for human consumption. This is a complex ecological process perfected in the EKW by fishers. Further

⁵ Ghosh, D. and Sen, S. 1987. Ecological History of Calcutta's Wetland Conservation. *Environmental Conservation*. 14(3):219-226.

details on the sewage treatment process through the fisheries are in the revised IEE and the draft EMP.

3. Solid Waste Management

18. This component will support procurement of primary collection and segregation equipment for solid waste management, as well as vehicles to transport and help in the collection of municipal solid waste, including trucks, tipper trucks, dumper placer vehicles, tractor trailers, refuse collectors, and pay loaders. The component will also support construction of a sanitary landfill (SLF) to receive to take municipal solid waste from Kolkata city. The SLF will have a design capacity of 1,200 metric tons (t) per day and a design life of about 20 years. An area of approximately 60 ha will be required for the proposed SLF facility.

4. Slum Improvements

19. This component aims to improve the living conditions and productivity of low-income communities throughout the KMC area. It supports the improvement of infrastructure and the enhancement of environmental services, including water supply, sewerage and wastewater management, drainage, and solid waste management. Under this component the following will be carried out: (i) construction of 8,600 water stand posts; (ii) construction or upgrading of 4,200 sanitary latrines; (iii) construction or upgrading of 700 community latrines; (iv) construction of 280 washing or bathing platforms; (v) realignment or widening of 28 km of drains; (vi) provision of 222 solid waste containers; and (vii) improvement and/or paving of 178,000 square meters (m²) of open public space.

5. Canal Improvements

20. Canal improvement works have been proposed in parts of the T-P Basin, Keorapukur Basin, Churial Basin, and Monikhali Basin, including desilting and lining of canals. The component includes construction of 53 bridges over these rehabilitated canals, and resettlement of 3,626 households (canal bank dwellers) in colonies or flats being built under the VAMBAY scheme.⁶ This component will also include the construction of four pumping stations to handle the additional SWF flow at Chowbhaga, Keorapukur, Manikhali, and Gushighata.

6. Institutional Development and Capacity Building

21. The Project will provide assistance to KMC, under the Capacity Building Program funded by DFID, in developing the institutional capacity of KMC. This involves mainstreaming management and geographical information systems, computerization of accounts and records, training of line department staff, and assisting in project implementation.

C. Description of the Environment

1. Physical Resources

22. Kolkata lies within the tidal reaches of the Hooghly, an area that is mostly flat and sloping in general from north to south and from west to east. The center of the city is at latitude 22° 34' north and longitude 88° 24' east. Elevations range from 1.5 to 9.0 m above sea level.

⁶ Valmiki Ambedkar Shari Awaz Yojna (VAMBAY) is the Government's housing scheme for the urban poor.

23. The city is underlain by quaternary sediments consisting of clay, silt, and various grades of sand, gravel, and pebbles. Lithological logs show the presence of a clay bed at the top, with a thickness of 10–40 m. There is a further clay bed 250–650 m below ground level. There is a group of granular aquifers between these layers, and these are being tapped as a groundwater resource. The area is seismically stable and lies in the part of Zone III that borders on Zone IV. Regional subsoil data covering a large area in and around Kolkata reveal six levels of strata up to a depth of about 50 m below ground level. These are intercepted at several locations by deposits of the recent river system, parts of which are now dry.

24. The climate is hot and humid and temperatures in Kolkata are high throughout the year. The average temperature is between 22.7 °C and 31.5°C. There are three distinct seasons: summer, monsoon, and winter.

25. The primary surface water resource for Kolkata is the Hooghly River. In addition, the city has a large number of water bodies and canals that are heavily used for everything from water supply, bathing, washing, aquaculture, and recreation to waste disposal. A large quantity of water is drawn from the Hooghly River for various uses and returns as wastewater to the river without treatment. Industrial and domestic pollution along with run-off from adjoining areas has led to a deterioration in river water quality. National Environmental Engineering Research Institute conducted a study of Hooghly river water quality in 1976/1977. A more recent study in 1996/1997 by the WBPCB showed no discernible improvement in water quality.

26. The predominance of impervious clay in the near surface strata of Kolkata region and its immediate neighborhood inhibits local recharge to the deeper aquifers in the Kolkata area. The recharge area for Kolkata lies in the north and western part of the contiguous greater Kolkata region. The intrusion of brackish water in the southern part of the city is increasing because of the over-pumping of water from the aquifers. The groundwater in deep tube wells showed high concentrations of chlorides and other chemical pollutants, but the groundwater was free of bacterial contamination. Hardness and concentrations of Iron (Fe), Chlorine (Cl), and sulfates SO_4 increase from north to south. Recent studies show that the groundwater in some KMC wards contains arsenic, lead, and cadmium in excess of the levels prescribed by the World Health Organization (WHO) for drinking water.

27. The concentrations of air pollutants in Kolkata are at their highest during winter and at their lowest during the monsoon months. Seasonal variations in temperature, wind, rainfall, and other factors account for this. In Kolkata, there are frequent thermal inversions at low elevations (50 m) during winter. Although there has been some improvement over the peaks of the early to mid-1980s, some standards are still being violated, specifically that for suspended particulate matter (SPM). Moreover, these figures represent annual averages; the maximum 24-hour values still regularly exceed standards. Carbon monoxide (CO) concentrations in Kolkata have not been measured systematically or regularly. However, surveys undertaken at traffic junctions from time to time since 1972 show traffic site CO mean values ranging from 3.7 to 7.3 milligrams per cubic meter (mg/m^3). These values are considerably higher than available ambient CO values, indicating a high contribution from transport sources. According to a Calcutta Environmental Management Strategy and Action Plan report, transport is the greatest source of CO in Kolkata, accounting for 48% of the total, followed by industry at 34%.

28. Noise levels in the city during both day and night times are higher than the permissible limit. The excessive noise levels are caused by increasing vehicular traffic, and the presence of small enterprises. The night-time noise levels in many sensitive zones exceed 100 A-weighted decibels (dBA) against a prescribed standard of 40 dBA by the Bureau of Indian Standards.

2. Ecological Resources

29. The project area is in a region of moist tropical deciduous vegetation, with fresh water aquatic plants. Because of the continuous expansion of human habitation and heavy population pressure, the nature of the vegetation is rapidly changing and there are fewer herbaceous plants in some parts of the area. The few undisturbed areas along canal banks, roadsides and small orchards within the residential area offer more varied vegetation. There is no demarcated forest. Common jungle cats, foxes, house rats, and mice are present. Of the reptiles, garden lizards, snakes, and kraits are common. The birdlife includes house crows, house sparrows, and pigeons. Amphibians such as Indian bullfrogs, annelids such as earthworms, and arthropods such as cockroaches, butterflies, and ants are common.

30. Anchored and free floating and submerged hydrophytes can be seen in the many open water bodies, which often contain such fish as rohu (*Labeo rohita*), Catla (*Catla catla*), and Bata (*Labeo bata*).

31. In and around the EKW area there are about 34 families, 68 genera and 104 species of plants. These include *Sagittaria montivindensis*, *Cryptocoryne ciliata*, *Cyperus spp.*, *Acrostichum aureum*, and *Ipomoea aquatica*. Studies⁷ indicate three zones of vegetation in the Salt Lake area: vegetation of embankments and bunds are mostly dominated by *Fimbristylis ferruginea*, *Suaeda maritima*, *Acanthus ilicifolius*, *Excoecaria agallocha*, and *Avicennia officinalis*. Salt Lake proper is dominated by numerous algal flora, bushes of *Phragmites karka*, *Aegiceras magus*, and *Typha elephantine*. In the core fishing area, farmers prefer *Eichhornia crassipes* and naturally developed plankton like algae (about 20 species). *Sagittaria sagittifolia*, *Rumex dentatus*, *Panicum spp.*, *Brachiara mutica*, and *Colocasia esculenta* are the dominant flora of the wastewater canals. *Cryptocoryne ciliata* and several species of sedges are predominant in wastewater canals receiving tidal flushes. *Eichhornia crassipes* and *S. sagittifolia* may be considered the indicator species of these wetlands. Among the rare mammals, marsh mongoose, small Indian mongoose, palm civet, and small Indian civet are significant in and around the EKW area. About 20 mammals have been reported in this region. Threatened reptiles such as the Indian mud turtle (*Lissemys punctata*) are also reported occasionally from the adjacent locality. Significant species of reptiles include *Xenochorphis sp.*, *Enhydrus enhydrus*, *Veramus salvator*, and *Cerberus rhynchops*. Among amphibians, *Rana hexadactyla*, *Rana cyanophlctis*, *Rana tigenna*, and *Rana limnocharis* are significant. More than 40 bird species are present, including grebe, coot, darter, shag, cormorant, teals, egrets, jacanas, snipes, eagle sand piper, gulls, rails, and kingfishers.

32. Kolkata has a number of man-made lakes within its municipal boundary. These provide a habitat for a number of aquatic and avian species and are the site of various recreation activities. The waste and storm water of the KMC area is carried by a system of natural and man-made canal systems flowing mostly eastward through an elaborate network of canal systems, while a narrow strip along the Hooghly drains to the river. The DWF channel is the most important man-made channel (from Topsisia Point A through EKW from west to east).

3. Socioeconomic and Cultural Resources

33. The total urban population of the Kolkata Metropolitan Area (KMA) was 12.8 million in 2001. The population of the KMC area is close to 5 million. About one third of the KMC population lives in substandard housing.

⁷ Ghosh, A. K. 1990. *Biological Resources of Wetlands of East Calcutta, Landscape & Ecological Studies*. India: Department of Geography, Calcutta University.

34. Kolkata is a service center rather than an industrial center, although industrial growth has been accelerating in West Bengal. In the 7 years before the introduction of the New Economic Policy (1984/1985 to 1990/1991), West Bengal's industrial production grew at an average annual rate of 2.67% (government of West Bengal, 1999).⁸ In the 7 years after the introduction of the New Economic Policy (1991/92–1997/98), the average annual growth of industrial production increased to 5.05%.⁹

35. A number of institutions in the KMC area may have a role in the Project's development, including government administration and services, police and security, urban development, and environmental protection. The agency with the most important role is the KMC, which is primarily responsible for operation and maintenance of basic urban services. Urban development is covered by a variety of government departments and NGOs. WBPCB has overall responsibility for setting policy and standards for the protection of the environment, following the lead of the Central Pollution Control Board. The West Bengal Department of Environment has set out proposed conservation measures for the EKW, primarily the control of further development in areas deemed vital for wastewater treatment. The EKW Management Authority is also a key agency, which is responsible for preparing a management plan for conservation and wise use of the EKW.

36. The Kolkata transportation system is multi-modal and highly heterogeneous. Public transportation ranges from cycle rickshaws to a subway system. Main thoroughfares in Kolkata are crowded with taxis, cars, buses, two-wheelers, three-wheelers, hawkers, and pedestrians. Trams run in some thoroughfares. Calcutta Electric Supply Corporation is responsible for generation, transmission, and distribution of electric energy in and around the city, with West Bengal State Electricity Board (WBSEB) serving a small portion of the city. The power supply situation in Kolkata has significantly improved in last few years.

37. A socioeconomic survey of 17,000 households in the EKW area is currently being carried out. The KMC area, which includes the project area, has fairly high rates of literacy (88% for males and 92% for females). Most of the residents in the project area are Hindu (79%) and most belong to general castes (84%). There are significant concentrations of Muslims in the substandard housing areas. The mother tongue reported by 74% of the population is Bengali, with 14% speaking Hindi, and 12% Urdu. Average household size ranges from 4.3 to 6.2 persons, according to the survey, with an average of 5.6. About 6% of households surveyed reported unemployment: 5% for those living in standard residential areas and 7% for those in substandard housing and refugee colonies.

38. Public health varies according to socioeconomic level and location. As of 1997, there were 50 government hospitals (central, state, and local) with 15,441 hospital beds; 27 private hospitals with 3,050 beds; and 126 clinics and dispensaries with 95 beds in the KMC area. As of 1993, West Bengal had one doctor per 2,045 people, compared with the national average of one doctor per 2,600 people. Malaria is seasonally prevalent. Cardio-vascular diseases are increasingly prevalent among people over 40, while waterborne diseases such as gastrointestinal diseases are common among children less than 15 years of age. Skin ailments have been reported from people living and working in the EKW areas.

⁸ Government of West Bengal. 1999. *Review of Economic Policy*. India.

⁹ Most tanneries within the city have been relocated to an integral leather complex downstream of EKW. Adequate treatment facilities are available within the complex.

D. Forecasting Environmental Impacts and Mitigation Measures

39. Although the Project is expected to have overall positive impacts on environmental conditions and the livelihood of local communities, potential adverse environmental impacts from the planning, construction, and operation phases of the Project have been identified and mitigation measures recommended. The draft EMP, included in the revised IEE, presents these potential impacts and mitigation measures in detail, and they are summarized in this section.

40. The potential adverse impacts of the Project include a deterioration in the water quality of the EKW, an environmentally sensitive area; stress on ecological resources of EKW; pollution in the receiving waters; and resettlement of canal bank dwellers. The environmental impacts on a fragile ecosystem such as the EKW of the disposal of a large volume of wastewater into the DWF channel and the discharge of pollution on the inland surface water that receives the DWF discharge need to be carefully evaluated. The public health implication of the consumption of sewage-fed fish and the health of the fishers practicing fish cultivation also need careful assessment and mitigation if necessary.

1. General Potential Impacts and Mitigation Measures

41. **Location and Design Phase.** Since all the land required for the Project has been acquired, and detailed design of most of the work packages has been completed, the potential location and design impacts from the Project are not significant. Detailed hydrological modeling has been carried out to ensure the capacities of the sewerage and drainage network and pumping stations are adequate. Features to mitigate adverse impacts on the environment, such as overloading and flooding, have been built into the designs for both the new STPs and the STP upgrades. Proper procedures will be put in place to ensure quality assurance and quality control of all works under the Project.

42. Sewage from Boroughs VII, XII, and parts of XI that may be discharged into the DWF will ultimately be treated in the EKW, which is a Ramsar-protected wetland. Sewage treatment through the fisheries in the EKW is in line with the "wise use" guideline of the Ramsar Convention and was sanctioned by the Ramsar secretariat during the process of designating EKW as a Ramsar-protected wetland. Regular interaction with the Ramsar secretariat will be carried out by the EKW Wetland Management Authority.

43. The sanitary landfill will be not be sited in environmentally sensitive areas, such as wetlands, culturally sensitive areas, or close to densely populated areas. The design of the sanitary landfill will be carried out in accordance with the Municipal Solid Waste 2000 Rules, including adequate collection and treatment of leachate and gas-venting facilities in order to avoid surface and groundwater pollution, as well as local explosion hazard conditions and damage to the soil.

44. **Involuntary Resettlement Impacts on the Canal Bank Dwellers.** The Project will affect 3,626 households along the canal banks and resettlement impacts are addressed in a revised resettlement plan. These impacts will be fully addressed before beginning any civil works.

45. **Construction Phase.** Temporary environmental impacts on air quality, noise, soils, land use and transportation, institutions, aesthetics, public health and safety, and cultural resources are likely to arise during the construction phase. Contract documentation will include the following mitigation measures.

- (i) During dry or windy periods, fugitive dust generation on exposed construction surfaces will be suppressed by spraying water or other suitable means. Workers in dust-prone areas will be provided with masks and goggles. Excavated material transported by trucks will be covered and/or wetted to prevent dust nuisance.
- (ii) Construction will be scheduled so that large areas of soil are not laid bare during the monsoon season. Ground disturbances will be phased and exposed surfaces will be resurfaced and stabilized as soon as possible. Trenches will have adequate backfill to prevent subsequent settlement. Upon completion of backfill, the surface will be restored to its original condition.
- (iii) Spoil will be appropriately disposed of, following testing and monitoring as agreed. Non-hazardous spoil and silt will be disposed of in low-lying areas within the KMC. After dewatering, silt will immediately be disposed of in approved disposal sites. Any hazardous material discovered during testing will be disposed of in the existing hazardous waste treatment facility in Kolkata.
- (iv) All construction vehicles will be properly maintained and will have a valid "pollution under control certificate." Noisy construction activities will be carried out only during normal working hours and local residents will be advised of any unusual or unavoidable noise. Where feasible, a sound barrier will be provided in inhabited areas. Measures will be in place for the safe passage of traffic, including temporary diversions, and/or separation of motor vehicle traffic from non-motorized and pedestrian traffic where necessary. Measures will also be taken to ensure safety of traffic passing through the construction area, including signs, marking flags, lights and flagmen as required.
- (v) Proper planning will be carried out to minimize disruption to traffic, and adequate prior notification will be given to residents. Traffic management will be carried out in coordination with Kolkata Police. A committee has been formed within the project management unit (PMU) which will be responsible for coordinating with utility operators to facilitate the works.
- (vi) Dewatering during trenching and water testing of new lines will be regulated so it does not lead to water logging of the nearby area.
- (vii) All necessary precautions will be taken to prevent accidents and/or damage to property. Measures taken by the contractor will include but not be limited to safe execution of construction work; provision of adequate health and safety protection to workers; sufficient insurance coverage for all risks, including property damage; third party liability; workmen compensation; and transit insurance.
- (viii) All occupational and health and safety requirements for the workforce will be adhered to. Periodic health check ups for workers will be provided. A physician will be retained to handle emergencies. During sewer line cleaning, the line will be adequately vented to ensure that no toxic or hazardous gases are present. Gases in the sewer line will be analyzed for the hazardous and toxic nature before cleaning begins, if it is needed. Workers engaged in cleaning sewer lines will be provided with proper protective cover, including gumboots, rubber gloves, and gas masks.
- (ix) All construction campsites and worksites will be located so that they do not interfere with the existing drainage system. Camps and compounds will be

contained by surrounding the site with an earth mound with controlled drainage outlets. Campsites will have adequate shelter, water supply, and excreta and solid waste management. The construction work-site will be properly barricaded and have adequate drinking water, toilets, and dispensing of first aid. Appropriate control measures will be taken to prevent insect- or vector-borne diseases, especially malaria, by measures such as spraying and/or preventing stagnant pools of water.

- (x) During desilting and lining works in the canals, there is potential for pollution of surface waters and groundwater. In order to mitigate this risk, preventive measures will be enforced during the temporary storage of silt on the banks. The interstitial water will be drained back into the canal, preventing water pollution of nearby areas. Silt will be transported only when it is dry. At the time of temporary stacking and final transportation of the dry silt, especially during the dry seasons, enough water to suppress dust emission will be light sprayed. Analysis has shown the silt to be non-hazardous and it will be transported to pre-approved low-lying sites in Kolkata for filling. Silt will not be washed back again into the canals during any construction stage. The floating debris that is removed during the initial steps will be disposed of in the solid waste disposal ground of KMC. Water hyacinths will be burnt before disposal.

46. **Operational Phase.** During the operational phase, the potential environmental impacts are expected to be mostly positive. Improvements in sewerage and drainage as a result of the Project will minimize water logging and/or flooding in the service area and ensure better sanitation practices. However, there is potential contamination of local ponds and canals as a result of sewage overflow and flooding, which will be prevented or minimized by adhering to standard operating procedures developed by the KMC for the proper operation and regular maintenance of the S&D network.

47. There is a risk of a discharge of hazardous industrial effluents into the sewer, which could damage the sewer system, or interfere with the downstream treatment process and damage the environment. Regulatory activities being carried out by the WBPCB, such as mandatory relocation of all tanneries to an industrial site, strict enforcement of existing industrial discharge treatment regulations, and regular monitoring by the WBPCB will ensure that untreated effluent from industry is not discharged into the proposed sewer system.

48. Workers engaged in sewer maintenance face potential health hazards. They are likely to be exposed to toxic gases and any hazardous materials in the sewage and therefore risk contracting communicable diseases from exposure to pathogens. The KMC will ensure that the proper health and safety precautions are adhered to during sewer cleaning.

49. Lack of proper operation and maintenance of the system could cause siltation and thus overflow of sewage and water logging, which would be a nuisance and health hazard for the public. Regular preventive maintenance by KMC will be needed to prevent flooding or water logging caused by clogged drains.

2. Potential Adverse Impacts in Environmentally Sensitive Areas and Mitigation Measures

50. Significant potential impacts and their proposed mitigation measures are discussed below under the relevant project subcomponent.

a. Sewage Discharge to DWF channel for Treatment in the EKW

51. **Impacts on Surface Water Quality of the Receiving Water Bodies.** The Project may discharge an additional 1,300 lps to the DWF channel (approximately 10% of the current wastewater load), through the pumping stations in Borough VII, Borough XII and parts of Borough XI. Currently, the total suspended solids (TSS) and BOD level of DWF channel water at the outfall point at Kulti River is much less than WBPCB limiting standard of 100 milligrams per liter (mg/l) for TSS and 30 mg/l for the BOD level (based on monthly monitoring results conducted by WBPCB for the past 6 years), and currently meets the Government standards for discharge into inland surface water. Additional wastewater load (based on BOD load calculations) will be absorbed, so current discharge standards are met. Preliminary projection and analysis has been carried out to ensure that the additional load can be effectively treated by the EKW system. However, this is not conclusive and needs to be confirmed by detailed analysis. A study will be carried out, under technical assistance funded by ADB, to establish that the sewage currently received by the DWF channel from the core area of Kolkata, and the additional/proposed load from Boroughs VII, XII and parts of Borough XI, is being or will be effectively treated by the sewage-fed fisheries in the EKW. This study will feed into the EKW management plan and will assist in developing long-term management practices for the entire EKW system to ensure its sustainability.

52. To mitigate potential impacts on water quality from improper solid waste dumping into the DWF channel, strict control will be enforced and monitored by KMC. Before disposal of discharge from the Project boroughs, fencing along the DWF channel will be provided, checked, and repaired. Subsequently, periodic checking and repair of the fencing will be carried out by the Irrigation and Waterways Department (I&WD) to prevent and minimize solid waste dumping into the DWF channel. The water quality monitoring currently being undertaken by the WBPCB should be continued for both DWF and SWF.

53. **Impacts on Water Quality (Groundwater and Surface Water) through Overflow and Seepage from the DWF Channel.** The DWF channel has been designed to convey about 14,150 lps of wastewater. The anticipated discharge of wastewater through the channel after additional discharge of about 1,300 lps will be about 13,000 lps. Therefore, no over-bank flooding of the DWF channel is expected even after the additional flow begins. However, there is a potential risk of surface water and groundwater contamination through damage in the lining or cracks in the lining of the DWF channel and overflow of the DWF channel. Therefore, it is important that adequate operational management practices be adhered to in order to prevent and minimize the seepage and over-bank flooding of the DWF channel. It is proposed that the DWF channel be cleaned and the lining repaired before additional sewage from the Project boroughs is discharged into it. Subsequently, the channel will be periodically cleaned, at least every 3 years, and the lining checked and repaired as necessary every 6 years by the I&WD.

54. **Flood Impacts and Management of SWF and DWF Channels.** Proper gate operations will be carried out at Bantola. I&WD will explore how to improve the gate operation, for example through the introduction of sensors and an automated system, and will develop appropriate rapid response strategies for flood risks. The detailed study being carried out by the Project, which will feed into the EKW Management Plan, will use a hydraulic model based on the most recent historical data on water levels in order to determine the optimal level(s) at different stages of the monsoon season. Minimum discharge into the SWF will ensure that as little untreated sewage as possible reaches the Kulti River. The gate at Ghushighata will be repaired under the Project, and subsequent maintenance of this gate by I&WD will ensure minimum discharge of raw sewage into the Kulti River.

55. An emergency pumping station will also be constructed by the Project at Gushighata, where the SWF and DWF channels meet before they discharge into the Kulti River. This pumping station will be operated by I&WD in case of emergency to reduce the potential for flooding.

56. **Impacts on Groundwater from the EKW Area.** Hydrogeological sampling in the EKW area revealed a highly impermeable clay layer (hydraulic conductivity in the range of 10^{-5} to 10^{-7} centimeter per second [cm/sec]) with a thickness of at least 15 m below the soil surface of the EKW area. This clay layer is followed by an aquifer (which is not being used for water supply), then by more impermeable clay layers, and eventually by another aquifer at 90 m, which is being used for drinking water extraction. While there is an extremely low risk of contamination in the deeper aquifer, there is a potential risk of contamination of the shallow aquifer through the fish ponds in the EKW area. The shallow aquifer should not, therefore, be used to supply drinking water, and KMC should provide alternative taps if contamination of shallow tube well or water supply is either reported or determined through the groundwater monitoring program.

57. **Impacts on Ecological Resources.** There are no endangered species in the EKW area, but the rare mammals, reptiles, fish and bird species in the EKW need to be protected. Preliminary projections of wastewater load projections and analysis of data on the efficiency of treatment in the EKW area and preliminary data collected by the local fisheries cooperatives and the Fisheries Department show that there will be no significant ecological impact on the fish population. The additional discharge from the Project is not expected to have a significant impact on the habitat of the flora and fauna in the EKW area. However, detailed sampling and ecotoxicity analysis being carried out as part of the detailed EMP preparation supported by the Project will recommend measures to mitigate any potential impact. Fish pond operators follow requirements in the Government's *Handbook on Sewage-fed Fisheries*, which include the recommended BOD level in fish ponds (45 mg/l of BOD). Efforts need to be made to disseminate information about this level and to ensure it is adhered to.

58. **Impact on Biodiversity of Species.** EKW's overall ecological health is dependent on there being many species and an ecological balance of invertebrates, bacterial colonies, and algae. In general, a large number of fauna and flora will increase an ecosystem's resilience and capacity to adapt to changes. Greater awareness and understanding of these issues, particularly among cooperatives and unions, must be developed, as decision-making is usually exclusively influenced by labor demand, fish seed costs, and market demand for fish. The ecological balance is also important when considering a shift from rain-fed fisheries to sewage-fed fisheries, as some species may not adapt easily.

59. There is potential for eutrophication, but the operation and management process of the fish ponds in drawing sewage from the DWF is well managed, with proper inlets and outlets (normally sluice valves) for sewage flow, and farmers have been trained to operate the system to ensure that the system is not overloaded. Dissolved oxygen levels are monitored and the health of fish is promoted through the oxygenation of ponds using pumps or manual aeration. Further training and capacity building of fishers will be provided under the Project.

60. To mitigate the potential impacts from hazardous industrial effluent entering into the DWF channel and thus into the EKW, strict regulatory activities being carried out by WBPCB, such as mandatory relocation of all tanneries to an industrial site and strict enforcement of existing industrial treatment requirements, and regular monitoring activities, need to be continued. Regular monitoring of sewage discharge at the pumping stations in Boroughs VII and XII discharging into the DWF channel will be carried out and will include indicators of industrial

effluent. The standard operating procedures developed by the KMC for these pumping stations will contain emergency procedures to stop discharging and to alert the WBPCB should industrial effluent be detected in the samples.

61. **Habitat Change Impact.** Land use in the EKW includes fisheries (5,852 ha), agriculture (4,718 ha), garbage dumping and farming (603 ha) and human settlements (1,326 ha), although urban expansion may have reduced the land area for these activities. The EKW Management Authority will monitor land use and planning and ensure it complies with the EKW Management Act. Under the act, no building and construction activities are allowed within the sensitive areas of the EKW.

62. **Siltation of the DWF Channel, Fish Feeding Canals and EKW Area.** Based on experiments carried out by the Fisheries Department, average siltation in the EKW area is about 14–20 kilograms per hectare per year (kg/ha/yr). Since the additional discharge from the Project boroughs is mainly settled sewerage (since all Borough XII households and 80% of Borough VII households have septic tanks), siltation from the Project will be minimal. Nonetheless, in order to promote the sustainability of the system and to minimize siltation in the area, a one-off cleaning of the DWF channel and a one-off desilting of the four fisheries feeder canals will be carried out under the Project. Subsequently, regular maintenance of the DWF channel will be carried out by I&WD and of the fisheries feeder canals by the fisheries cooperatives. Although de-silting of fish ponds and secondary canals is regularly undertaken by fish operators, individually or through organized fishery subcommittees, desilting of feed and primary canals should be systematically undertaken as a way of maximizing the amount of sewage to be treated in the EKW.

63. **Impacts on Air Quality.** Sewage water passing through the DWF channel emits a bad odor in and around the area through which the channel passes, principally because of the dissolved hydrogen sulphide in the sewage. However, this odor will not travel far beyond the channel corridor. The area around the DWF channel is sparsely populated.

64. **Livelihood and Socioeconomic Impacts.** There are 264 fish farms in the EKW and these produce 69,000 quintals of fish per year. Recent field surveys show that 8,500 people are directly engaged in sewage-fed fisheries, of which 90% are from local villages falling within the EKW. The Social Development Unit (SDU) of the Project began a socioeconomic study of the EKW area titled “Awareness Generation and Community Mobilization in EKW Area” in March 2006, which will be completed by October 2006.

65. A household survey covering 11,000 households is now being carried out. Field investigators meet each member of the household and discuss with them the objectives of the study and the importance of the EKW ecosystem and record their views. The survey will be an important part of awareness building and will document the socioeconomic background of the people living within the EKW area, their economic activities, and emerging problems relating to their livelihood. The survey will examine the role of the EKW with regard to waste management in general and sewage treatment in particular and also the stability of the social structure.

66. Subsequent to the completion of this survey, a capacity building program for the fishers will be developed. The capacity program will focus on improved wetland efficiency, a better understanding of public health, an appreciation of the overall environmental significance of the wetland, and management according to the *Handbook on Sewage-fed Fisheries*.

67. **Occupational Health and Safety Impacts.** There may be occupational health and safety impacts on (i) fishers and crop handlers, and (ii) workers involved in maintaining the DWF

channel. Though the fishponds are well managed by the fishers, in order to minimize potential risks, occupational health and safety (OH&S) training will be included in the capacity building program for the fishers and a separate OH&S training session will be conducted for I&WD workers and contractors engaged in cleaning the DWF and SWF channels.

68. Ensuring the health and safety of employees engaged in sewage-fed fish farming practices is an essential component of managing the risks associated with these practices. Providing protective clothing and, where appropriate, regular treatment of the workers for intestinal helminths need to be institutionalized in order to limit the transmission of parasites and bacteria. This is particularly important for workers who are exposed to raw sewage. The key to implementing these safeguards will be to encourage behavioral change through the education of employers and employees. People handling and processing products that are cultured using waste-reuse practices also need to be educated about health risks and the desirability of wearing gloves and paying close attention to personal hygiene. Local residents may be exposed to the transmission of pathogenic infections and health services and treatment should be available in nearby locations.

69. **Community Health Impacts.** The analysis of the metal and bacterial presence (in fish muscles) carried out the Fisheries Department shows that toxic accumulation in the fish is below the permissible limit for consumption and hence does not pose significant public health threats. The potential health and safety impact of people falling into the DWF channel will be minimized by the provision and maintenance of adequate fencing along the DWF channel.

70. **Capacity Building for Overall Protection of EKW.** Studies currently being conducted with assistance from the Project will help the EKW Management Authority to build its capacity to implement long-term mitigation measures and carry out monitoring to ensure that the ecological character of the EKW is preserved. The Project will also help the fisheries department to carry out capacity building programs for the fishers to improve the management of sewage-fed fisheries and thus promote the sustainability of the EKW.

III. INSTITUTIONAL REQUIREMENTS, AND ENVIRONMENTAL MANAGEMENT AND MONITORING PLANS

A. Responsible Authorities

71. Having well defined implementation arrangements, with specific assigned responsibilities, and adequate monitoring of the implementation and performance of mitigation measures, are critical to environmental management. The presence of a good institutional framework and monitoring entities, with reporting responsibilities, ensures that mitigation measures are an important and integral part of these arrangements.

72. Monitoring becomes part of the development process as mitigation measures are included and their performance monitored. Feedback in the event of poor performance of a mitigation measure will allow appropriate corrective actions to be taken.

73. **Overall Institutional Arrangement for Implementation.** The implementation and monitoring requirements of environmental impact mitigation and monitoring measures will be met jointly by the institutions identified below. The PMUs in KMC and I&WD will take overall responsibility for undertaking and coordinating the mitigation and monitoring measures identified during the preconstruction and construction phases. The PMUs, in consultation with the other institutional partners of the EMP and the state government, will ensure that the mitigation and

monitoring measures for the operation and maintenance phases are adequately transferred and subsequently institutionalized within the relevant departments and agencies of GoWB, KMC and I&WD.

74. **KMC.** KMC is the principal body entrusted to provide essential services to the citizens of Kolkata, under the 74th Constitutional Amendment Act of India.¹⁰ Operation and maintenance of bulk services such as water supply, sewerage and drainage, and solid waste management are entrusted with KMC. KMC is also responsible for the maintenance of heritage buildings, parks, water bodies, and other public spaces or aspects of the city. It is also oversees the granting of development work within the Kolkata Metropolitan Area. KMC will be responsible for operating and maintaining all S&D facilities created under the Project.

75. **I&WD.** The I&WD of GoWB is the principal authority for the operation and maintenance of the canals and channels flowing through the state, as well as for the provision and implementation of infrastructure such as pumping stations and outfalls. Its other primary responsibilities include design, execution, operation, and maintenance of flood control measures and provision of irrigation facilities for agriculture, one of the principal income generating activities in West Bengal. The I&WD will be responsible for operating and maintaining the canals and the Gushighata pumping station constructed under the Project.

76. **WBPCB.** The WBPCB is an independent regulatory agency responsible for pollution control and overall environmental improvement of the State of West Bengal, under the principal guidelines set by the Central Pollution Control Board, New Delhi. Improvement of air and water quality, regular monitoring and addressing environmental pollution from industries and urban wastes are an integral part of the WBPCB's responsibilities. Management of hazardous wastes and substances also fall within the jurisdiction of the WBPCB.

77. **Fisheries Department.** The Department of Fisheries of GoWB is the principal authority responsible for the promotion and development of fish cultivation in different types of water bodies across the state of West Bengal. Fish is a major product of this state and the department has the mandate to manage and regulate the sector, and facilitate its enhancement.

78. **EKW Management Authority.** Following the declaration of the EKW as a Ramsar-protected site in 2002, the GoWB formed the EKW Management Authority, chaired by the Chief Secretary of GoWB, under the East Kolkata Wetlands (Conservation and Management) Act 2006,¹¹ to conserve and manage the EKW. This authority is also mandated to formulate a "wise use" management plan for the protection of the EKW. An outline management plan has been prepared and the detailed management plan is under preparation by the Authority. Any proposed development in the EKW has to seek prior permission from this authority, and overall management and monitoring responsibilities of the EKW lie with EKW Management Authority.

79. **Fisheries Cooperatives and Associations.** There are a large number of sewage-fed fisheries in the EKW area operated by the following groups.

- (i) Fishermen cooperative societies (FCS)—for large water bodies (constituted under the West Bengal Cooperative Act 1973,¹² and overseen by the Department of Fisheries, GoWB). The membership varies from 100 to 300.

¹⁰ 74th Constitutional Amendment Act of India, 1991.

¹¹ West Bengal Act VII of 2006: The East Kolkata Wetlands (Conservation and Management) Act, 2006.

¹² West Bengal Cooperative Act, 1973.

- (ii) Fish production groups (FPG)—for smaller water bodies (constituted under the West Bengal Inland Fisheries Act 1984, and overseen by the Department of Fisheries, GoWB).
- (iii) Private individuals—both large and small sized water bodies.

80. The FCS and FPG manage and facilitate fishing practices, and the main and secondary fish feeding canals under their jurisdiction. The West Bengal State Fisheries Corporation, an enterprise of Fisheries Department of GoWB, also controls two big fisheries in the EKW area. Officials of the Fisheries Department provide technical support to them on these and related aspects.

B. Environmental Management Plan

81. To ensure mitigation measures and monitoring requirements are undertaken in subsequent stages of the Project, an environmental management plan (EMP) has been prepared as part of the revised IEE. The revised IEE and the draft EMP take into consideration potential impacts, proposed mitigation measures, and an environmental monitoring program.

82. The EMP summarizes project impacts and describes proposed mitigation measures, monitoring programs and parameters, and public consultation activities. It identifies the authorities responsible for implementing mitigation measures and monitoring requirements. It also assigns responsibilities for reporting and review, cost estimates, and mechanisms for feedback and adjustment. The EMP will be finalized before discharges begin being treated through fisheries in the EKW. The final EMP will be revised if necessary if the project design or scope is modified.

C. Environmental Monitoring Program

83. A comprehensive environmental monitoring program has been prepared as part of the draft EMP for all project components or subcomponents, to ensure that environmental impacts are monitored and mitigated effectively. The monitoring program provides details of the monitoring parameters, sampling and testing program, methodology, institutional responsibility, and preliminary costs. It will enable the PMUs to evaluate the scope of environmental impacts and to compare them with anticipated impacts. The PMUs will also monitor results of environmental protection measures and compliance with regulations. The program will indicate the overall effectiveness of the EMP. Environmental monitoring reports will be prepared monthly and complete records will be maintained at the site office.

84. An excerpt from the environmental monitoring plan, identifying significant potential impacts and their mitigation measures is presented in Table 1.

Table 1: Monitoring Plan of Potential Environmental Impacts in Environmentally-Sensitive Areas and Mitigation Measures

Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Preliminary Costing
Sewage Discharge to DWF channel for Treatment in the EKW						
Adequate surface water quality meeting discharge standards	Adherence to Government of India Inland Water Standards	Discharge point, pumping station, DWF channel (4 locations) and 3 pond systems – 96 points	BOD ₅ , COD, pH, oil and grease, TSS, TDS, dissolved oxygen, chloride, nitrite, total/faecal coliform, sulphate, cadmium, arsenic, lead, chromium, phytoplankton/ zooplankton	Monthly	WBPCB	Rs500,000 per annum
Adequate ground water quality meeting discharge standards	Water quality (i.e., is it within WHO safe drinking water levels)	20 boreholes around the site	pH, hardness, chloride, dissolved oxygen, nitrite, sodium, Potassium, phosphates, arsenic, cadmium, lead, mercury, chromium, total faecal coliform	Monthly	WBPCB	Rs1,200,000 per annum
Biodiversity preservation in the EKW area	Biodiversity conservation, in line with Ramsar Convention	EKW 20 fish ponds	Biodiversity mapping Fish polyculture records from fishery committees and market surveys	6-monthly	EKWMA	Rs500,000 per annum
All tannery effluent (integrated leather complex) to be discharged into SWF after treatment	Adherence to pipeline with no digression for use in fishing ponds. SWF discharge adherence to Government of India Inland Water Standards	Discharge point, SWF channel (2 locations) and 3 pond systems – 20 points	BOD ₅ , COD, pH, oil and grease, TSS, TDS, dissolved oxygen, chloride, nitrite, total faecal coliform, sulphate, cadmium, arsenic, lead, chromium, phytoplankton/ zooplankton	Monthly	WBPCB	Rs500,000 per annum

Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Preliminary Costing
Desiltation of DWF channel, fish feeding canals and EKW fish ponds	(i) A one-off cleaning of DWF and SWF channels; one-off desilting of the four fisheries feeder canals; (ii) regular maintenance of DWF channel carried out by the I&WD, and fisheries feeder canals by the fisheries cooperatives; and (iii) silt testing and disposal at agreed sites	DWF and SWF fisheries feeder canals	Total mass, Testing for cadmium, arsenic, lead, chromium,	Regular maintenance	I&WD fisheries department and fisheries cooperatives	Rs73 million for (i)
Air quality monitoring	To meet BIS 5182	3 stations and the project site (72 samples)	SPM, RPM, sulfur dioxide, oxides of nitrogen, carbon monoxide	Once a week for 12 weeks (4 weeks each in pre- monsoon, post- monsoon and winter season)	WBPCB	Rs200,000 per annum
Preserving health and hygiene of fishers through improved occupational health and safety	Support to fisheries cooperatives in developing OHSPs, and provide awareness and education programs	Entire EKW	OHSPs and number of education sessions delivered	40 sessions to be programmed	Fisheries Department and EKWMA	Rs300,000 per annum

BIS = Bureau of Indian Standards, BOD₅ = biological oxygen demand 5, CO = carbon monoxide, COD = chemical oxygen demand, DWF = dry weather flow, EKW = East Kolkata Wetlands, EKWMA = East Kolkata Wetlands Management Authority, I&WD = Irrigation and Waterways Department, KMC = Kolkata Municipal Corporation, NO_x = oxides of nitrogen, OHSP = occupational health and safety plan, pH = potential of hydrogen, RPM = respirable particulate matter, SO₂ = sulfur dioxide, SPM = suspended particulate matter, SWF = storm water flow, TDS = total dissolved solids, TSS = total suspended solids, WBPCB = West Bengal Pollution Control Board, WHO = World Health Organization.

Sources: Bureau of Indian Standards; project documents and estimates; and West Bengal Control Pollution Board Reports.

IV. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

85. The revision of the IEE has involved consulting with a range of public stakeholders, through the ongoing stakeholder consultation process. There have also been more focused interactions in connection with the environmental issues related to solid waste management, the functioning of the DWF channel, the discharge of wastewater into the EKW, and other environment improvement measures under the Project.

86. Since the initiation of the Project in 2002, the general public, elected representatives, local councilors, KMC engineers, and community leaders, including members of NGOs and women's groups, have been consulted under the following project components: sewerage and drainage, solid waste, slum improvement, and canal improvement. The detailed design and physical construction process has responded to the feedback, perceptions and priorities of the intended beneficiaries.

87. Details of slum improvement schemes in boroughs have been worked out after extensive interactions with residents, especially with women in selected slums and with local councilors. The dates, venues and the participants for these consultations have been included in the revised IEE. As for the solid waste management subcomponent, public consultations included meetings at the borough level, presided over by a borough chairman. These meetings assessed the equipment needs for primary collection and transportation of MSW. A preliminary survey of the vegetable farmers cultivating the proposed landfill site has also been undertaken through the local farmers' organization. Extensive interactions with canal bank dwellers have assessed the number and socioeconomic status of affected families and prepared them for relocation. Public consultation and disclosure meetings have been conducted before commencement of works in each borough.

88. The SDU of the Project has been managing and facilitating the public consultation, participatory appraisal, and disclosure processes, with assistance from local NGOs and community-based organizations (CBOs).

89. Six local NGOs active in EKW protection—Public, Bharat Sevashram Sangha, Jayprakash Institute of Social Change, *Jalabhumi Bachao Samity* (Save the Wetlands), Purba Kolkata Fish Producing Association, and Centre for Environmental Management and Participatory Development—have been consulted by the Project. The consultations with these NGOs showed that the present practice of sewage-fed fisheries is considered a “wise use” of the EKW by them. These NGOs not only supported and promoted the sewage-fed fisheries; they considered them to be an important component of the EKW, which contributed substantially to sustaining the ecosystem.

90. Details of consultations on potential sewage discharge into the EKW area are shown in Table 2.

Table 2: Public Consultations on Potential Sewage Discharge into the East Kolkata Wetlands

Date	Participants	Issues Identified
04.01.06	Representatives of Jay Prakash Institute of Social Change, <i>Bharat Sevashram Sangha</i> , and community representatives from the EKW area	<ul style="list-style-type: none"> • Existing EKW livelihood practices • Sustenance of ecosystem in EKW
10.01.06	Representatives of the public, Jayprakash Institute of Social Change, <i>Bharat Sevashram Sangha</i> , <i>Jalabhoomi Bachao Samity</i> and community representatives from EKW area	<ul style="list-style-type: none"> • Existing EKW livelihood practices • Sustenance of ecosystem in EKW
06.02.06	Representatives of the public, Jayprakash Institute of Social Change, <i>Bharat Sevashram Sangha</i> , <i>Jalabhoomi Bachao Samity</i> , Purba Kolkata Fish Producing Association, Centre for Environmental Management and Participatory Development, and community representatives from the EKW area	<ul style="list-style-type: none"> • Need for additional sewage for fisheries in EKW area • Whether environmental balance will be disturbed if the existing system continues and additional sewage is fed
27.02.06	Representatives of the public, Jayprakash Institute of Social Change, <i>Bharat Sevashram Sangha</i> , <i>Jalabhoomi Bachao Samity</i> , Purba Kolkata Fish Producing Association, Centre for Environmental Management And Participatory Development, and community representatives from the EKW area	<ul style="list-style-type: none"> • Occupational health hazards • Mitigation of these hazards
07.03.06	Representatives of the public, Jayprakash Institute of Social Change, <i>Bharat Sevashram Sangha</i> , <i>Jalabhoomi Bachao Samity</i> , Purba Kolkata Fish Producing Association, Centre for Environmental Management and Participatory Development, and community representatives from the EKW area	<ul style="list-style-type: none"> • Capacity-building support required for sustaining ecological balance in the community • Effective participation of community members for conservation of ecological balance

EKW = East Kolkata Wetlands.

Sources: Project consultation records and minutes.

91. On the issue of the potential sewage discharge into the EKW, consultations were also held with representatives of fishing cooperatives managing the sewage-fed fisheries in the EKW. As mentioned earlier, the SDU has begun a socioeconomic study of the EKW area titled "Awareness Generation and Community Mobilization in EKW Area" which will be completed by the end of 2006.

92. Consultations undertaken so far indicate that the people in the study area understand the significance of wetlands, although they may not have heard of the Ramsar Convention. Their main concern is possible eviction under the guise of conservation of wetland. The local people understand that the conservation measures being initiated by the Government are not only in the best interests of the local people but are also enhancing their livelihoods. During the consultations, people associated with fisheries identified siltation of the canal and lack of adequate sewage as the main hindrances to their economic activities. Sewage quality is another problem. Water logging is the main hindrance to the development of agriculture and only vegetables are grown in the area.

93. Detailed discussions were held with the Department of Fisheries, EKW Management Authority, Institute of Environmental Studies and Wetland Management, WBPCB, and the Department of Environment.

94. Information about the proposed works has been publicized on billboards and pamphlets. IEEs on the project subcomponents have been posted on the project website for the benefit of stakeholders and interested parties. The general public and stake holders have been informed and their views have been given due weight in determining the schemes under the Project.

V. FINDINGS AND RECOMMENDATIONS

95. The Project will improve the physical environment of the city of Kolkata significantly. It will support ecological resources, strengthen human and economic development, and improve the quality of life of its citizens. The rehabilitation and expansion of sewers and drains will considerably reduce flooding in the city, improve the public health of beneficiary communities, and protect surface water and groundwater quality. Sewage treatment plants will reduce the pollution load on the city's environment. Rehabilitating the canals will reduce flooding in the city and enhance the quality of life in low-lying flood-prone areas. Improved solid waste measures will reduce adverse health impacts on citizens, garbage sorters, and people working throughout the solid waste cycle. The Project will help to preserve the EKW area. It will support the livelihood of over 20,000 people producing crops and fish in the area. The quality of life of relocated canal bank dwellers will improve significantly when they move into flats under the VAMBAY scheme. They will receive other socioeconomic benefits as outlined in the revised resettlement plan for the Project. There is an urgent need for improved urban infrastructure in the project areas, and the Project will provide this in an efficient and environmentally sound manner.

96. Detailed screening and assessment of potential adverse impacts from the various stages of the Project indicated that the Project will not cause significant environmental impacts, provided the recommended mitigation and monitoring measures are carried out.

97. These findings and recommendations are based on the assumption that mitigation measures will be carried out. Key measures include:

- (i) development and implementation of resettlement and relocation plans for people involuntarily displaced by the Project, especially by canal rehabilitation works;
- (ii) appropriate siting and design of solid waste disposal and treatment sites, sewage treatment plants, sewerage, and drainage works;
- (iii) treatment of sewage to appropriate standards to protect receiving waters and community health; and
- (iv) careful management and monitoring of the EKW area to ensure that the ecological character of the area is not changed, and that the receiving waters and fauna and flora in the EKW area are not subjected to additional pollution load.

98. A draft EMP has been prepared, outlining the recommended mitigation measures, monitoring plan, roles and responsibilities of the entities in implementing the mitigation measures, and the implementation timelines. A broader EMP for the EKW is also being prepared with support from the Project. This will form part of the comprehensive wetlands management plan currently being prepared by the EKW Management Authority.

99. Given the above, a full environmental impact assessment (EIA) is not required.
100. The draft EMP should be finalized on the basis of the detailed final project design, the results of the surveys, the comprehensive wetlands management plan, proposed public consultations, and various plans recommended in the revised IEE. ADB should review and approve the final EMP.
101. During the detailed engineering design of the project subcomponents, the location and design mitigation measures, including those outlined above, must be incorporated.
102. Mitigation measures at the construction stage for each subcomponent (as identified in the IEE) should be included in the bid and contract documents. Mitigation measures at the operation stage should be included in the operating procedures and plans for the subcomponents and institutionalized through appropriate regulations wherever possible.
103. However, the IEE needs to be supplemented by a detailed study of potential impacts of sewage discharge from the Project into the EKW. The study must provide scientific and quantitative evidence that (i) all types of sewage-receiving environments within the EKW will be capable of treating the current and proposed sewage discharge to the required levels; (ii) effluent discharged into receiving waters will meet inland surface water standards, as prescribed by the local statutory and government regulations and requirements, and the *Pollution Prevention and Abatement Handbook*¹³ of the World Bank, as referred to in ADB's *Environment Policy*; (iii) current and proposed sewage discharge into the EKW will not have potential adverse impacts on ecological resources in the EKW and other receiving environments throughout the Project's design life; and (iv) the EKW and associated channels can absorb the present and additional pollution load without posing significant environmental threats of any kind. Provided the outcome of this study is satisfactory and acceptable to ADB, the EA may propose the replacement of subcomponents pertaining to the construction of sewage treatment plants for treating sewage effluent from Boroughs VII, XII, and parts of Borough XI with treatment through sewage-fed fisheries and natural treatment processes in the EKW.

VI. CONCLUSIONS

104. The Project is categorized as environmental category B. An overall IEE was undertaken as a part of the revised engineering design to assess the impact of each project scheme. The overall IEE shows that the Project will have a positive impact on the environment of the project area, particularly on terrestrial habitats, by improving flood control capacity, reducing flood damage, and improving the local environment and institutional capacity for flood control. The potential negative impacts on the environment are localized, short-term, not significant, and can generally be mitigated.
105. An EMP has been prepared. This outlines the recommended mitigation measures, monitoring plan, roles and responsibilities of the entities in implementing them, and the implementation timelines. A broader EMP for the EKW is also being prepared with support from the Project. This will form part of the comprehensive wetlands management plan currently being prepared by the EKW Management Authority. Given the above, a full EIA is not required. However, the IEE needs to be supplemented by a special and detailed study on potential impacts of sewage discharge from the Project into the EKW.

¹³ The World Bank. 1999. *Pollution Prevention and Abatement Handbook*. Washington, D.C.:The World Bank.