Initial Environmental Examination

May 2012

IND: Kolkata Environmental Improvement Investment Program (Tranche 1) - Sewerage and Drainage Subproject

Prepared by the Kolkata Municipal Corporation for Asian Development Bank

WEIGHTS AND MEASURES

CFU	-	Colony Forming Unit
cum/hr	-	cubic meter per hour
cum/m^3	-	cubic meter
dB(A)	-	Decibal in A network
Ft	-	feet
Ha	-	hectare
Km	-	kilometer
km^2 or sq km	-	square kilometer
KVA	-	Kilovolt ampere
lpcd	-	liter per capita per day
M	-	meter
m/yr	-	meter per year
mg/l	-	milligram per liter
MGD	-	million gallon per day
MGH	-	million gallon per hour
MPN	-	Most Probable Number
MT	-	Metric Ton
ML	-	million liter
MLD	-	million liter per day
mm	-	Millimeter
NTU	-	Nephelometric turbidity Unit

ABBREVIATIONS

AAS	-	Atomic Absorption Spectroscopy
ADB		Asian Development Bank
APHA	-	American Public Health Association
ASI	-	Archaeological Survey of India
BIS	-	Bureau of Indian Standards
BOD	-	Biochemical Oxygen Demand
CBO	-	Community Based Organization
COD	-	Chemical Oxygen Demand
CESC	-	Calutta Electric Supply Corporation'
CHWTSDF	-	Common Hazardous Waste Treatment Storage & Disposal Facility
CPCB	-	Central Pollution Control Board
CPHEEO	-	Central Public Health and Environmental Engineering Organisation
CTE	-	Consent to Establish
CTO	-	Consent to Operate
CRZ	-	Coastal Regulation Zone
CW	-	Canal Water
DG	-	Diesel Generator
DO	-	Dissolved Oxygen
DPR	-	Detailed Project Report
DSC	-	Design and Supervision Consultants
DWF		Dry Weather Flow
DVC	-	Damodar Valley Corporation
KMC	-	Kolkata Municipal Corporation
EARF	-	Environmental Assessment and Review Framework
EIA	-	Environmental Impact Assessment
EKW	-	East Kolkata Wetlands
EKWMA	-	East Kolkata Wetland Management Authority
EMP	-	Environmental Management Plan
GC	-	Gas Chromatography
GRC	-	Grievance Redressal Committee
GRM	-	Grievance Redress Mechanism
GW	-	Groundwater
HC	-	Hydrocarbons
HPLC	-	High Pressure Liquid Chromatography
ICP	-	Inductively Coupled Plasma Chromatograph
IEE	-	Initial Environmental Examination
INR	-	Indian National Rupee
KEIP	-	Kolkata Environmental Improvement Project
KMC	-	Kolkata Municipal Corporation
KMDA	-	Kolkata Metropolitan Development Authority
LPG	-	Liquefied Petroleum Gas
MoEF	-	Ministry of Environment and Forest, Government of India
MSDS	-	Material Data Safety Sheet
MTBM	-	Micro Tunnel Boring Machine
NEERI		National Environmental Engineering Research Institute
NIOSH	-	National Institute of Occupational Health
NGO	-	Non Government Organization
O and M	-	Operation and Maintenance
PAH	-	Polynuclear Aromatic Hydrocarbon
PBPS	-	Palmer Bazar Pumping Station
PMC	-	Project Management Consultant
PMU	-	Project Management Unit
PS	-	Pumping Station
REA	-	Rapid Environmental Assessment
ROW	-	Right of Way
RP	-	Resettlement Plan
S&D	-	Sewage & Drainage

SEIAA	-	State Level Environmental Impact Assessment Authority
SPM	-	Suspended Particulate Matter
SPS	-	Safeguard Policy Statement
STP	-	Sewage Treatment Plant
SWF	-	Storm Water Flow
SW	-	Surface Water
TDS	-	Total Dissolved Solids
TMP	-	Traffic Management Plan
TP	-	Tollygunge-Panchanangram
TSS	-	Total Suspended Solids
TVS	-	Total Volatile Solids
UFW	-	Unaccounted For Water
USD	-	US Dollar
WBPCB	-	West Bengal Pollution Control Board
WBSEB		West Bengal State Electricity Board
WBWML	-	West Bengal Waste Management Ltd.
WTP	-	Water Treatment Plant

TABLE OF CONTENTS

List of Tables

Appendixes

EXECUTIVE SUMMARY

1. The city of Kolkata is the seventh largest metropolis in India, and had 4.5 million residents in 2011. The city's continuous improvement in the urban environment is necessary to continuously increase the labor productivity through better health status of the urban population, especially when it has been experiencing lower population growth. There have been, however, geographical disparities in access and quality of the water supply and sewerage services, because the Kolkata Municipal Corporation (KMC), an urban local body having a mandate to provide these services under the KMC Act (1980), has an aging water supply system, and has inadequate sewer coverage in the city's peripheral areas. The Asian Development Bank (ADB) loans have assisted KMC in expansion of the sewerage coverage through the Kolkata Environmental Improvement Project (KEIP) since 2000. The Kolkata Environmental Improvement Investment Program (the investment program) will help KMC not only continue sewer network expansion at a larger scale, but also gradually improve efficiency in water supply operations which enable KMC to generate operating surplus for capital investment in water supply and sewerage.

2. The investment program is a continuation of the KEIP. It is envisaged that KMC will implement the investment program in three projects in phases. It considers that the first project under the investment program will be the second phase of the KEIP. Likewise, the second and the third projects under the investment program will be the third and forth phases of the KEIP. The proposed investment activities under the investment program will include: (i) water supply including pumping and transmission system and (ii) sewerage and drainage (S&D) including dry weather flow (DWF) and storm water flow (SWF) pumping stations and sewage treatment plants (STPs).

3. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for environmental assessment are described in ADB's Safeguard Policy Statement (SPS), 2009. This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, and loans involving financial intermediaries, and private sector loans.

4. This IEE has been prepared for the Tranche 1 sewerage and drainage (S&D) subproject, which includes (i) construction of combined sewerage and drainage pipe along Diamond Harbour Road by micro-tunneling; (ii) Construction of S&D network within Diamond Harbour Road catchment (1st stage) (iii) construction of Churial pumping station within the compound of Joka Tram depot; (iv) construction of Begore pumping station and (v) Laying of pressure main between Santoshpur Main Pumping Station and Garden Reach Sewage Treatment Plant by micro-tunnelling. Construction work is likely to commence in 2012 and will be completed in 48 months for the total S&D subproject. However individual components will be taken phase-wise in an average of 18 months construction period.

5. This IEE aims to (i) provide critical facts, significant finding, and recommended actions; (ii) present the national and local legal and institutional framework within which the environmental assessment has been carried out; (iii) provide information on existing geographic, ecological, social and temporal context including associated facilities within the subproject's area of influence; (iv) assess the subproject's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic, and physical cultural resources in the subproject's area of influence; (v) identify mitigation measures and any residual negative impacts that cannot be mitigated; (vi) describe the process undertaken during project design to engage stakeholders and the planned information disclosure measures and the process for carrying out consultation with affected people and facilitating their participation during project implementation; (vii) describe the subproject's grievance redress mechanism for resolving complaints about environmental performance; (viii) present the set of mitigation measures to be undertaken to avoid, reduce, mitigate, or compensate for

adverse environmental impacts; (ix) to describe the monitoring measures and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures; and (x) identify who is responsible for carrying out the mitigation and monitoring measures.

6. Potential negative impacts were identified in relation to pre- , construction and operation of the improved infrastructure, but no permanent environmental impacts were identified as being due to either the subproject design or location. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the designs for the infrastructure. This means that the number of impacts and their significance have already been reduced by amending the design.

7. The public participation processes to be undertaken during project detailed design will ensure stakeholders are engaged during the preparation/finalisation of the IEE. The planned information disclosure measures and process for carrying out consultation with affected people will facilitate their participation during project implementation.

8. The subproject's Grievance Redress Mechanism will provide the citizens with a platform for redress of their grievances and describes the informal and formal channels, time frame and mechanisms for resolving complaints about environmental performance.

9. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between KMC, PMU, DSC and the contractors. The EMP will (i) ensure that the activities are undertaken in a responsible non-detrimental manner; (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (ii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (iv) ensure that safety recommendations are complied with.

10. A copy of the EMP will be kept on site during the construction period at all times. The EMP will be made binding on all contractors operating on the site and will be included within the Contractual Clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

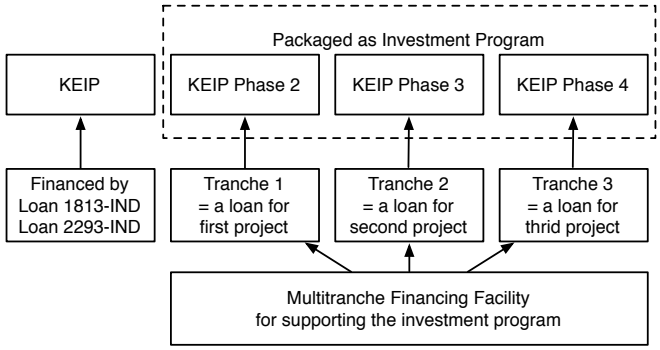
11. The subproject is unlikely to cause significant adverse impacts because: (i) most of the individual components involve straightforward construction and operation, so impacts will be mainly localized; (ii) in most cases the predicted impacts are localized and likely to be associated with the construction process at isolated locations and are produced because the process is invasive, involving excavation, obstruction at specific construction locations, and earth movements; and (iii) being located mainly along roads and built-up area will not cause direct impact on terrestrial biodiversity values. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures.

12. Therefore as per ADB SPS, the subproject is classified as environmental Category B and does not require further Environmental Impact Assessment.

I. INTRODUCTION

1. The city of Kolkata is the seventh largest metropolis in India, and had 4.5 million residents in 2011. It is the largest city in the state of West Bengal, and has been the biggest contributor to West Bengal's gross state domestic product, which was ranked at the sixth largest among all state in India in 2010. The city's continuous improvement in the urban environment is necessary to continuously increase the labor productivity through better health status of the urban population, especially when it has been experiencing lower population growth. There have been, however, geographical disparities in access and quality of the water supply and sewerage services, because the Kolkata Municipal Corporation (KMC), an urban local body having a mandate to provide these services under the KMC Act (1980), has an aging water supply system, and has inadequate sewer coverage in the city's peripheral areas.[1] The Asian Development Bank (ADB) loans have assisted KMC in expansion of the sewerage coverage through the Kolkata Environmental Improvement Project[2] (KEIP) since 2000. The Kolkata Environmental Improvement Investment Program[3] will help KMC not only continue sewer network expansion at a larger scale, but also gradually improve efficiency in water supply operations which enable KMC to generate operating surplus for capital investment in water supply and sewerage.

2. The investment program is a continuation of the KEIP. It is envisaged that the Kolkata Municipal Corporation (KMC) will implement the investment program in three projects in phases. It considers that the first project under the investment program will be the second phase of KEIP. Likewise, the second and the third projects under the investment program will be the third and forth phases of KEIP. The proposed investment activities under the investment program will include: (i) water supply including pumping and transmission system and (ii) sewerage and drainage (S&D) including dry weather flow (DWF) and storm water flow (SWF) pumping stations and sewage treatment plants (STPs).



[1] The 1899 Calcutta Municipal Act defined the administrative domain of the municipal authority as covering 25 wards and 48.5 square kilometers. Many boundary changes followed, the latest one in January 1984 when Boroughs XI, XII, XIII, XIV and XV were annexed to KMC. These boroughs are popularly known as the "added areas".

[2] ADB. 2000. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to India for the Calcutta Environmental Improvement Project.* Manila (Loan 1813-IND, $250 million, approved on 15 November 2000). The project completion date is 30 June 2012.

ADB 2006. *Report and Recommendation of the President to the Board of Directors: Proposed Supplementary Loan to India for the Kolkata Environmental Improvement Project.* Manila (Loan 2293-IND: $80 million, approved on 20 November 2006). The project completion date is 30 June 2012.

[3] ADB provided project preparatory technical assistance. ADB. 2009. *Technical Assistance to India for Preparing for Kolkata Environmental Improvement Project II*. Manila.

3. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for environmental assessment are described in ADB's Safeguard Policy Statement (SPS), 2009. This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, and loans involving financial intermediaries, and private sector loans.

4. ADB classified the investment program as environment Category B and accordingly initial environmental examination (IEE) is required for all subprojects. This IEE has been prepared for the Tranche 1 sewerage and drainage (S&D) subproject which includes (i) construction of combined sewerage and drainage pipe along Diamond Harbour Road by micro-tunneling; (ii) Construction of S&D network within Diamond Harbour Road catchment (1st stage) (iii) construction of Churial pumping station within the compound of Joka Tram depot; (iv) construction of Begore pumping station and (v) Laying of pressure main between Santoshpur Main Pumping Station and Garden Reach Sewage Treatment Plant by micro-tunnelling. Construction work is likely to commence in 2012 and will be completed in 48 months for the total S&D subproject. However individual components will be taken phase-wise in an average of 18 months construction period..

5. This IEE aims to (i) provide critical facts, significant finding, and recommended actions; (ii) present the national and local legal and institutional framework within which the environmental assessment has been carried out; (iii) provide information on existing geographic, ecological, social and temporal context including associated facilities within the subproject's area of influence; (iv) assess the subproject's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic, and physical cultural resources in the subproject's area of influence; (v) identify mitigation measures and any residual negative impacts that cannot be mitigated; (vi) describe the process undertaken during project design to engage stakeholders and the planned information disclosure measures and the process for carrying out consultation with affected people and facilitating their participation during project implementation; (vii) describe the subproject's grievance redress mechanism for resolving complaints about environmental performance; (viii) present the set of mitigation measures to be undertaken to avoid, reduce, mitigate, or compensate for adverse environmental impacts; (ix) to describe the monitoring measures and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures; and (x) identify who is responsible for carrying out the mitigation and monitoring measures.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. ADB Policy

6. ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB SPS, 2009. This states that ADB requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, and loans involving financial intermediaries, and private sector loans.

7. **Screening and Categorization.** The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project, the sensitivity, scale, nature and magnitude of its potential impacts, and the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impact and are assigned to one of the following four categories:

(i) **Category A.** Projects could have significant adverse environmental impacts. An EIA is required to address significant impacts.

(ii) **Category B.** Projects could have some adverse environmental impacts, but of lesser degree or significance than those in category A. An IEE is required to determine whether significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.
(iii) **Category C.** Projects are unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are reviewed.
(iv) **Category FI.** Projects involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all Projects will result in insignificant impacts.

8. **Environmental Management Plan.** An EMP which addresses the potential impacts and risks identified by the environmental assessment shall be prepared. The level of detail and complexity of the EMP and the priority of the identified measures and actions will be commensurate with the Project's impact and risks.

9. **Public Disclosure.** The IEE will be put in an accessible place (e.g., local government offices, libraries, community centers, etc.), and a summary translated into Bengali/Hindi for the project affected people and other stakeholders. The following safeguard documents will be put up in ADB,s website so that the affected people, other stakeholders, and the general public can provide meaningful inputs into the project design and implementation:

(i) For environmental category A projects, a draft EIA report at least 120 days before Board consideration;
(ii) Final or updated EIA and/or IEE upon receipt; and
(iii) Environmental monitoring reports submitted by the Project Management Unit (PMU) during project implementation upon receipt.

B. National and State Laws

10. Implementation of the subproject will be governed by the national and State of West Bengal environmental acts, rules, regulations, and standards. These regulations impose restrictions on activities to minimize/mitigate likely impacts on the environment. It is the responsibility of the project executing and implementing agencies to ensure subprojects are consistent with the legal framework, whether national, state or municipal/local. Compliance is required in all stages of the subproject including design, construction, and operation and maintenance.

11. The following legislations are applicable to the subproject:

(i) Environmental (Protection) Act of 1986, its rules and amendments;
(ii) Environmental Impact Assessment (EIA) Notification of 2006 and 2009;
(iii) Water (Prevention and Control of Pollution) Act of 1974, its Rules, and amendments;
(iv) Air (Prevention and Control of Pollution) Act of 1981, its Rules and amendments;
(v) Central Pollution Control Board (CPCB) Environmental Standards;
(vi) Ancient Monuments and Archaeological Sites and Remains Rules of 1959;
(vii) Land Acquisition Act of 1894 and as amended in 1985;
(viii) Wetlands (Conservation and Management) Rules, 2010;
(ix) Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules 2008

(x) Noise Pollution (Regulation and Control) Rules of 2000 as amended up to 2011.
(xi) National Institute of Occupational Safety and Health Criteria for a recommended standard: occupational noise exposure, NIOSH Publication No. 98-126
(xii) West Bengal Trees (Protection and Conservation in Non-Forest Areas) Act, 2006;
(xiii) East Kolkata Wetlands (Conservation and Management) Act, 2006

12. The summary of environmental regulations and mandatory requirements for the subproject is shown in Table 1.

Table 1: Applicable Environmental Regulations for S&D subproject

Law	Description	Requirement
EIA Notification	The EIA Notification of 2006 and 2009 (replacing the EIA Notification of 1994), set out the requirement for environmental assessment in India. This states that Environmental Clearance is required for certain defined activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorized as A or B depending on the scale of the project and the nature of its impacts. Category A projects require Environmental Clearance from the National Ministry of Environment and Forest (MoEF). Category B projects require Environmental Clearance from the State Environmental Impact Assessment Authority (SEIAA).	The proposed components of this sewerage and drainage subproject are not listed in the EIA Notification's "Schedule of Projects Requiring Prior Environmental Clearance" and thus Environmental Clearance is not required.
Water (Prevention and Control of Pollution) Act of 1974, Rules of 1975, and amendments	Control of water pollution is achieved through administering conditions imposed in consent issued under provision of the Water (Prevention and Control of Pollution) Act of 1974. These conditions regulate the quality and quantity of effluent, the location of discharge and the frequency of monitoring of effluents. Any component of the Project having the potential to generate sewage or trade effluent will come under the purview of this Act, its rules and amendments. Such projects have to obtain Consent to Establish (CTE) under Section 25 of the Act from West Bengal Pollution Control Board (WBPCB) before starting implementation and Consent to Operate (CTO) before commissioning. The Water Act also requires the occupier of such subprojects to take measures for abating the possible pollution of receiving water bodies.	No work components of the S&DS&D subproject under will require CTE and CTO from WBPCB. The construction of the pumping stations and pipelaying do not attract the provisions of the Act[4]. All relevant forms, prescribed fees and procedures to obtain the CTE and CTO can be found in the WBPCB website (www.wbpcb.gov.in).
Air (Prevention and Control of Pollution) Act of 1981, Rules of 1982 and amendments.	The subprojects having potential to emit air pollutants into the atmosphere have to obtain CTE under Section 21 of the Air (Prevention and Control of Pollution) Act of 1981 from WBPCB before starting implementation and CTO before commissioning the project. The occupier of the project/facility has the responsibility to adopt necessary air pollution control measures for abating air pollution.	For the subproject, the following will require CTE and CTO from WBPCB: (i) diesel generators; and (ii) hot mix plants, wet mix plants, stone crushers, etc. if installed for construction. All relevant forms, prescribed fees and procedures to obtain the CTE and CTO can be found in the WBPCB website (www.wbpcb.gov.in).

[4] WBPCB has a common CTE and CTO form (Form L) for Local Authorities covering all aspects of municipal constructional and operation activities. All proposed interventions under the S & D subproject will be covered under one CTE and CTO if required.

Law	Description	Requirement
Environment (Protection) Act, 1986 and CPCB Environmental Standards.	Emissions and discharges from the facilities to be created or refurbished or augmented shall comply with the notified standards notified.	Appendix 1 provides applicable standards for ambient air, air emission, effluents, receiving water bodies, and drinking water at the consumer end.
Noise Pollution (Regulation and Control) Rules, 2002 amended up to 2010.	Rule 3 of the Act specifies ambient air quality standards in respect of noise for different areas/zones.	Appendix 2 provides applicable noise standards.
National Institute of Occupational Safety and Health (NIOSH) Publication No. 98-126	NIOSH has laid down criteria for a recommended standard: occupational noise exposure. The standard is a combination of noise exposure levels and duration that no worker exposure shall equal or exceed.	Appendix 3 provides applicable NIOSH occupational noise standards.
Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008.	According to the Rules, hazardous wastes are wastes having constituents specified in Schedule II of the Rules if their concentration is equal to or more than the limit indicated in the said schedule (Appendix 4).	If during excavation works, the excavated material is analyzed to be hazardous, they are to be stored and disposed of only in such facilities as may be authorized by the WBPCB for the purpose
Forest (Conservation) Act, 1980 and Forest Conservation Rules, 2003 as amended	As per Rule 6, every user agency, who wants to use any forest land for non-forest purposes shall seek approval of the Central Government.	No notified forest land within the subproject area.
Wetlands (Conservation and Management) Rules, 2010	The Rules specify activities which are harmful and prohibited in the wetlands such as industrialization, construction, dumping of untreated waste and effluents, and reclamation. The Central Government may permit any of the prohibited activities on the recommendation of Central Wetlands Regulatory Authority.	The subproject is not within the East Kolkata Wetlands thus no permission from the Central Government is required.
Ancient Monuments and Archaeological Sites and Remains Rules of 1959	The Rules designate areas within a radius of 100 meters (m) and 300 m from the “protected property” as “protected area” and “controlled area” respectively. No development activity (including mining operations and construction) is permitted in the “protected area” and all development activities likely to damage the protected property are not permitted in the “controlled area” without prior permission of the Archaeological Survey of India (ASI). Protected property includes the site, remains, and monuments protected by ASI or the State Department of Archaeology.	There are no protected properties in the subproject area. However, in case of chance finds, the contractors will be required to follow a protocol as defined in the Environmental Management Plan (EMP).
Land Acquisition Act of 1894	Private land acquisition is guided by the provisions and procedures in this Act. The District Collector or any other officer designated will function as the Land Acquisition Officer on behalf of the Government. There is a provision for consent award to reduce the time for processing if the land owners are willing to agree on the price fixed by the Land Acquisition Officer.	For the subproject, there will be no land acquisition. Temporary resettlement of shops and establishment will not be involved during pipe laying work. A Resettlement Plan has been prepared in accordance with the ADB SPS, 2009.
West Bengal Trees (Protection and Conservation in Non-Forest Areas) Act, 2006	The Act states that those who want to fell trees will have to obtain permission from the Forest Directorate, Government of West Bengal . Violators (means whoever fells or causes to be felled any tree or cuts, uproots or otherwise disposes of any fallen tree or contravenes the permission granted) shall be punished with imprisonment up to one year or with fine of Rs.5000/- or both. Also, until plantation of	Permission from the Divisional Forest Officer (Utilisation Division), Forest Directorate, Government of West Bengal will be required if trees, particularly those looked upon as sacred groves, identifies as belonging to an endangered species, or given the status of heritage, will be cut/felled.

Law	Description	Requirement
	requisite number of trees is undertaken, the violators will be fined for each day of default of Rs.50/-. In case the development agency or entrepreneur fails to implement the plantation plan, the defaulter might have to face an imprisonment up to two years or fine that may extend to Rs.10,000/- or with both.	Promoters/developers will have to submit a 'Tree Plantation Plan' while they seek approval for a residential/ commercial/ industrial project.
East Kolkata Wetlands (Conservation and Management) Act, 2006	In August 2002, 12,500 hectares (ha) of the East Kolkata Wetland area was included in the 'Ramsar List' making it a 'wetland of International Importance'. The Ramsar convention is playing a vital role by providing certain basic guidelines to draw up suitable plans for the maintenance and sustenance of the wetlands. Among these, the three most important guiding principles are: (i) maintenance of the special characteristics of the ecosystem; (ii) wise use of its resources with an eye towards sustainability; and (iii) economic development for the wetland community. The East Kolkata Wetlands Management Authority (EKWMA) has the power to enforce land use control in the substantially waterbody-oriented areas and other areas in the East Kolkata wetlands.	The subproject is not within the East Kolkata Wetlands thus no permission from the Central Government is required.
The Child Labour (Prohibition and Regulation) Act, 1986	No child below 14 years of age will be employed or permitted to work in any of the occupations set forth in the Act's Part A of the Schedule or in any workshop wherein any of the processes set forth in Part B of the Schedule.	No children between the age of 14 to 18 years will be engaged in hazardous working conditions.

III. DESCRIPTION OF THE SUBPROJECT

A. Existing Situation

13. Though Kolkata was provided with organised sewerage and drainage system years ago and the system has been expanded with the growth of the city several times, the city is afflicted with water logging and inadequate sanitary conditions in many areas. The core city comprising wards 1 to 100 are provided with the organised S&D system though improvements are still needed to make it comprehensive and complete. The areas added to the KMC in 1984 have grossly inadequate S&D infrastructure posing severe problems to the citizens living in these areas till 2003.

14. Following the master plan recommendations and detailed studies under KEIP, several improvement works have been taken up under the KEIP through two loans from the Asian Development Bank (1813-IND and 2293-IND) by KEIP/KMC. These works are taken up in both "Core City Area" as well as "Added Areas" to KMC. And the works include construction/refurbishment of major sewers, canals, pumping stations and treatment plants.

15. Most part of the added areas falls with in the Monikhali and Churial Basins. These basins are located in the southern and southwestern part of Kolkata. Churial basin is moderately populated but currently growing very fast. While Monikhali is a developed area and has higher population densities compared to Churial Basin. Since metro is routed through these basins, which is currently under implementation coupled with the recent improvements in road connectivity to the core city, these two basins are expected to grow at a rapid pace. This rapid growth in population with grossly inadequate sewerage and drainage infrastructure will definitely put the citizens to great risk and discomfort. Hence, a

need is felt to provide further organised sewerage and drainage system in these areas in line with the existing system in the core city areas.

B. Components of the Subproject

16. In order to mitigate in part the above deficiencies Sewerage and Drainage Subproject of KEIP Phase2 has been designed (**Table 2**). The locations of the subproject components are shown in Figure 1.

Table 2. Tranche 1 proposals 2012-2016

	Sewerage and Drainage	**Costs in INR millions**
1	Construction of Beghore Khal Pumping Station	200
2	Construction of new combined pumping station within Joka Tram Depot	340
3	Micro-tunnelling work along Diamond Harbour Road from Behala Chowrasta to Joka Tram Depot pumping station	1150
4	Construction of S&D network within Diamond Harbour Road Catchment (first stage)	200
5	Laying of pressure main between Santoshpur MPS and Garden Reach sewerage treatment plant (STP) by micro tunnelling (spill-over KEIP I)	350
	Sub-total S&D	**2240**

17. The Begore Khal pumping station is the last remaining missing link in the sewerage and drainage network constructed under the KEIP in Monikhali Basin. Construction of this pumping station will ensure that the S&D system constructed under the KEIP in this area will become fully operational and all anticipated benefits will be achieved. Routine construction technology will be used.

18. Churial Basin in the southern part of the KMC is almost devoid of an organized sewerage and drainage system and has not been covered under the KEIP. S&D Subproject under Tranche 1 will concentrate on the primary and secondary sewer/drainage system development. This includes construction of downstream sewer mains and pumping station as a first step in creating a comprehensive system, i.e. the trunk sewers along Diamond Harbour Road from Sakher Bazaar in the north to Churial Canal in the south, main sewers of 600 mm diameter and above in a part of the Diamond Harbour road catchment area that is mostly affected by flooding, and construction of a new combined Churial S&D pumping station at Joka Tram Depot. Considering the difficulties associated with laying of large diameter circular sewers by open cut method and based on experience gained in the KEIP, it has been decided that the construction of trunk sewers along Diamond Harbour road from Sakher Bazar to Churial khal will be done by advanced technology, i.e. micro-tunnelling having entry pits at regular intervals. The locations of these pits have not yet been finalized. However, main sewers in the Diamond Harbour road catchment will be constructed by open trench method.

19. The pressure main between between Santoshpur main pumping station and Garden Reach sewerage treatment plant was planned to be constructed as part of the KEIP project, but could not be taken up. It is the only missing link in a system that is otherwise completely operational after completion of the KEIP. Construction of this sewer main will ensure that the S&D system constructed by the KEIP in this area will become fully operational and all anticipated benefits would be achieved. In view of the difficult site conditions the construction will be by micro-tunneling with only two entry pits – one within the premises of Santoshpur pumping station

C. Salient Features of the Subproject

20. Begore Pumping Station. The main civil structural components of the combined flow pumping station are as follows (Table 3):

Table 3: Salient Features of Begore Pumping Station

SN	Parameters	Value	Remarks from environmental point of view
1	Type	Combined flow	Routine construction work; No land acquisition is involved; Land under transfer from another government agency, the present owner
2	Flow	DWF and SWF	
3	Design period for Civil structural units	2042	
4	Design period for E&M equipments.	2027	
5	DWF (in lps)	300	
6	SWF (in lps)	4500	
7	Screen	Dual Manual Screen	
8	Wet well dia (m)	14.5	
9	DWF pumps	3 W + 1 SB *	
10	SWF pumps	6 W + 2 SB	
11	DWF pump discharge capacity (Cu.m/hr) and Head (m)	360/23*	
12	SWF pump discharge capacity (Cum/hr) / Head (m)	2700/7.5	
13	DWF pump motor rating (KW)	38*	
14	SWF pump motor rating (KW)	75	
15	DWF transmission main dia (mm) / length (m)	600/680	
16	SWF transmission main dia (mm) / length (m)	2100/ 300	

21. Churial Pumping Station. The civil structural and electro-mechanical components of the Churial Pumping Station will be same as given for the Begore Khal Pumping Station above. The sizes, specification and capacities for the major components are given in the Table 4:

Table 4: Salient features of Churial pumping station

SN	Parameters	Value	Remarks from environmental point of view
1	Type	Combined flow	Routine construction work; No land acquisition is involved; Land under transfer from another government agency, the present owner
2	Flow	DWF and SWF	
3	Design period for Civil structural units	2042	
4	Design period for E&M equipments.	2027	
5	DWF (in lps)	616	
6	SWF (in lps)	3000	
7	Screen	Dual Manual Screen	
8	Wet well dia (m)	11.5	
9	DWF pumps	4 W + 2 SB	
10	SWF pumps	4 W + 2 SB	
11	DWF pump discharge capacity (Cu.m/hr) and Head (m)	556 / 23.0	
12	SWF pump discharge capacity (Cu.m/hr) / Head (m)	2700 / 7.5	
13	DWF pump motor rating (KW)	55	
14	SWF pump motor rating (KW)	75	
15	DWF transmission main dia (mm) / length (m)	800/1500	
16	SWF transmission main dia (mm) and length (m)	1800/270	

22. Trunk Sewers and Pipelines. Salient features of installation of gravity trunk sewers and pressure main works are summarized in Table 5.

Table 5: Salient features of Trunk Sewers and Laterals in Diamond Harbour Road Catchment

Description of subproject component	Diameter of trunk sewer, mm	Length of the trunk sewer, km.	Remarks from environmental point of view
Circular trunk sewer along Diamond Harbour Road	1800, 2000, 2200	3.9 km. (app)	Construction by micro-tunneling with partial blocking of entry pits at intervals; No land acquisition
Circular gravity outfall along Diamond Harbour Road	2400	0.3 km. (app)	

Description of subproject component	Diameter of trunk sewer, mm	Length of the trunk sewer, km.	Remarks from environmental point of view
Laying of SWF pumping main along Diamond Harbour Road	1800	0.3 km. (app)	
Laying of DWF pumping main to Kalagachia STP	Only yard piping inside Churial PS site for DWF pressure main will be included in this project; balance work to be included in later Phase		Routine construction work within Churial pumping station and therefore no land acquisition
Laterals in Diamond Harbour Road Catchment (Western side only)	600 to 1400	7.0 km. (app)	Construction job involving open trenching in narrow roads; No land acquisition as civil works will be on public roads in stretches at a time

23. **Santoshpur-Garden Reach Pumping Main.** As per earlier design, the HDPE transmission pipe (of 800 mm OD) will be encased inside a RCC casing pipe (1500- 1800 mm ID) as per requirement of the railway authority. This stretch is about 0.5 km long and will be constructed by a single long drive of about 525 m with jacking/ receiving shafts at both ends. One of the receiving shafts will be within Santoshpur PS premises owned by KMC. The location of the other jacking shaft will be in a water-logged area on KMDA land that is under transfer to KMC. The shaft area is low lying with water during most part of the year and is to be adequately dewatered to serve the purpose.

24. Excess solid waste from construction sites will be disposed at pre-approved sites after samples are tested for selected hazardous metals. Water from pits will be disposed in nearest drains or in pre-approved nearby water bodies. Supernatant liquid from waste slurry of micro-tunneling will be similarly disposed.

25. Estimated solid wastes to be handled and disposed under the S&D subproject are given in the following Table 6.

Table 6. Estimate of Solid Wastes to be Generated Under Tranche 1S&D Subproject

Component	Begore PS construction and allied works	Churial PS construction and other allied works	Micro-tunneling along D-H road	Laterals along D-H road catchment	Micro tunneling of Santoshpur/ Garden Reach Pumping Main
Estimated approx. volume of soil to be excavated (m^3)	7760	74460			
Estimated approx. volume of excess excavated soil to be disposed (m^3)	7030	52380			
Estimated approx. volume of road crust to be removed and disposed (m^3)	1060	6770			

D. Implementation Schedule

26. Construction work is likely to commence in 2012 and will be completed in 48 months for the total Tranche 1 S&D subproject. However, individual components will be taken up phase-wise in an average of 18 months construction period.

IV. DESCRIPTION OF THE ENVIRONMENT (BASELINE DATA)

A. Physical Resources

27. **Topography, drainage, and natural hazards**. Regionally KMC area is mostly flat and sloping in general from north to south and from west to east. The southern portion of the

subproject area within Boroughs XI, XIII and XIV are low lying and marshy. Similarly, the southwestern part of Borough XV and different parts of Borough XII are low lying. The broad topographical features of the subproject area are given in Table 7.

Table 7: Topographical information of Boroughs XI-XV, KMC

Basin	Ground level	General slope
XI	Varying from 6.34 m to 2.16 m	Generally in north to south direction
XII	Varying from 5.69 m to 1.02 m	Topography of the area is generally flat with a ridge along EM bypass. A portion of northern part of the area slopes towards Tolly's nullah and the balance area slopes towards north east direction.
XIII	Varying from 7.09 m to 1.15 m	Generally in north to south and east to west direction
XIV	Varying from 5.79 m to 1.04 m	Generally in north to south and east to west direction
XV	Varying from 5.50 m to 1.50m	Generally in north to south and west to east direction

28. 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. Hooghly river forms the western boundary of the KMC area. Bidyadhari and Kulti rivers meander along the eastern boundaries of KMC and discharge directly in to the Bay of Bengal. These rivers, along with an elaborate network of canal systems connected to these rivers are the recipients of entire drainage from KMC and its adjacent areas. Drainage of KMC area is generally divided in to the following drainage basins according to the topography and land use: Kolkata Basin; Bagjola Basin; Tollys Nullah Basin; Manicktala Basin; Tollygunge – Panchanagram (T-P) Basin; Keorapukur Basin; Monikhali Basin; and Churial Basin

29. The KMC area, with its generally flat terrain condition, receives more than 1,582 mm of rainfall yearly mainly spread over a 4 months period and comprised of mainly medium density – high frequency long duration storms. Due to the absence of an efficient drainage system to cater such an adverse condition, large areas of KMC suffer from prolonged inundation during monsoon causing severe health and economic hazards to the inhabitants.

30. The waste and storm water of the KMC area is carried by a system of natural and man-made canal system as follows:

(i) Bagjola Canal system – flowing in easterly direction
(ii) Kestopur Canal system – flowing in southerly direction
(iii) Beliaghata (Circular) Canal system
(iv) Storm Water Flow (SWF) – Dry Weather Flow (DWF) canal system flowing in easterly direction towards East Kolkata Wetlands carrying the pumped storm and sewage water of Kolkata
(v) Tolly's nala system
(vi) T-P system
(vii) Monikhali system
(viii) Churial system

31. Natural hazards in Kolkata include water logging and flooding during monsoon months. Sample socio-economic survey conducted in Borough XI-XV during preparation of DPR of KEIP II revealed that streets in the vicinity of households remained under water four times on an average during the year 2008. In areas like Behala, Tollygunge and Garden Reach a medium to heavy shower causes water logging in some localities which takes considerable period to evacuate. Some pockets remain partially inundated for even 3 to 4 months in a year. All these result due to inadequate drainage facility in such selected areas.

In many cases, newly constructed roads are in embankment and higher than the built-up areas causing stagnation of water in pockets. However, with the completion of the KEIP's S&D subprojects situations have improved to a great extent.

32. Duration of flooding varies from hours to days, depending on the facility available, nature of topography and outfall conditions in and around different localities. However, July is the worst month, followed by June and August.

33. In revised seismic zones map of India (IS 1893; Part 1, 2002) eastern part of Kolkata falls in Zone IV while the area to the west falls in Zone III. No seismic micro-zonation map has yet been prepared for the KMC area.

34. **Geology and Mineral Resources.** The subproject area 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 to 40m. There is a further clay bed 250 to 650 m below ground level. There is a group of granular aquifers between these layers, and these are being tapped as a ground water resource. Regional subsoil data covering a large area in subproject area reveal six levels of strata up to a depth of about 50 m below ground level. Near surface stratigraphy of Kolkata Region is given in Table 8.

Table 8: Near Surface Stratigraphy of Kolkata Region

Horizon I	Stratum I	Brownish grey/ light brown, silty clay/ clayey silt/ sandy silt with occasional lenses of silty fine sand; encountered from the top ground surface to a depth of about 3 to 4 m; occasionally only fill material of widely varying characteristics (about 4 m).
	Stratum II	Grey/ dark gray silty clay with semi-decomposed timber pieces, having lenses of silt and peaty clay; encountered between depths 3-4m and approximately 15m below ground level (about 10m).
Horizon II	Stratum III	Bluish grey and mottled brown/ grey, silty clay with kankar nodules and minute pockets of silt and sand (about 5.5m).
	Stratum IV	Brown/ yellowish brown, sandy silt/ silty fine sand/ clayey silt with lenses and pockets of brown/ grey silty clay (about 6m).
	Stratum V	Mottled brown/ grey, grey silty clay and brown silty clay frequently showing laminar character (about 18m).
	Stratum VI	Brown/ light brown, silty fine to medium sand (9m +).

35. The Horizon I comprising Strata I and II represents generally soft sediments. The second horizon comprising Strata III to VI have two clay layers (Stratum III and V) separated by a predominantly cohesionless layer (Stratum IV). Stratum VI is definitely water bearing and shallow tube wells in Kolkata region draw water from this stratum. The sediments of the second horizon are oxidized and are consolidated. The sequence is intercepted at several locations by deposits of the recent river system, parts of which are now dry.

36. There is no mineral occurrence in the area.

37. **Soil.** The Kolkata area may be divided into two groups based on the soil types : Entisols and Alfisols. The Entisols are present at the western part of the area and the other part is represented by Alfisols. These soils are typically deltaic alluvial soils. The agro-climatic zone characterization of the area is Gangetic alluvium group of soils rich in calcium. Free calcium carbonate occurs in surface soils and the soil profile shows low to medium levels of organic matter and medium levels of available phosphate and potash. Kolkata0 and the neighboring areas are represented predominantly by clayey soils. Table 9 lists the physical and chemical characteristics of soil sampled and analyzed from the five selected Boroughs of KMC in the southern part of the city.

Table 9: Soil Quality in Five Boroughs of Kolkata Municipal Council

Sl.No.	Parameters	Sample (S1)	Sample (S2)	Sample (S3)	Sample (S4)	Sample (S5)
1	Sand (%)	14.0	15	20	22.0	24.0
2	Silt (%)	32.0	30	40	44.0	30.0
3	Clay (%)	54.0	65.0	60.0	34.0	46.0
4	pH	8.5	9.3	6.9	9.7	9.47
5	Available nitrogen (mg/kg)	1250	1428.0	1071.0	2356.2	904.4
6	Available phosphorus (mg./kg)	180	230	190	280	210
7	Available potassium (mg./kg)	58	80	62.5	90	52.0
8	Iron (mg/kg)	326.0	266.9	250.0	5433.57	3125.87
9	Zinc (mg/kg)	29.1	25.0	28.5	31.1	31.48
10	Copper (mg/kg)	5.81	7.69	8.5	21.94	<0.4
11	Hexavalent chromium (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
12	Trivalent chromium (mg/kg)	11.67	8.33	5	28.33	25.0
13	Nickel (mg/kg)	10.0	13.2	8	14.8	14.0
14	Arsenic (mg/kg)	<0.1	<0.1	<0.1	<0.1	<0.1
15	Lead (mg./kg)	12.35	12.8	8.5	25.19	13.33
16	Cadmium (mg./kg)	<0.4	<0.4	<0.4	<0.4	<0.4

Notes: S1 - HL Sarkar Road, Borough XI, Ward 113; S2 - Near Chowbagha, Borough XII, Ward 108; S3 - Motilal Gupta Road, Borough XIII, Ward 122; S4 - Near Kalitala Market, Borough XIV, Ward 125; and S5 - Near Badartala, Borough XV, Ward 141

38. **Climate.** The climate is hot and humid from March to October. It is somewhat cool from November to February. Rains are received principally from June to September with frequent pre-monsoon showers and nor'westers during April and May. The winter season begins in November and continues to February, followed by the summer season which continues until mid-June. The monsoon starts in mid-June and goes up to mid-September, sometimes extending up to October.

39. April and May are the hottest months with monthly mean maximum temperature above 35 degree Celcius (deg C). Mean maximum temperature is above 30 deg C from March to October. Relatively low monthly mean minimum temperatures occur during December (15.2 deg C), January (14.1 deg C) and February (18.1 deg C). Mean monthly minimum temperature is relatively high and is between 26 deg C and 27 deg C during the months of May, June, July and August.

40. The average annual rainfall is about 1919 mm with the four monsoon months (June to September). Rainfall peaks in July. Average number of rainy days is about 146 days per annum. During monsoon months it is not uncommon to receive 75 mm to 100 mm of rainfall in a 24 hour period. Such heavy rainfall may occur from 4 to 10 times in a year.
Wind is light to gentle with maximum monthly average speed 7.22 kilometer per hour (km/hr). The post-monsoon and winter months (October-February) experience very light wind. The average monthly wind speed during pre-monsoon and monsoon are 6.10 and 5.03 km/hr respectively. The mean annual wind speed is 4.28 km/hr. The prevalent wind direction was from southwestduring most of the time in the year, except during winter when the northerly wind became significant. However, during cyclonic storms and depressions especially those occurring in September to October, high wind speed reaching around 100 km/hour is not uncommon.

41. **Air Quality.** The concentrations of air pollutants in Kolkata are highly variable over the seasons. They are at their highest during winter months (November to February) and at their lowest during monsoon months (June to September). 24-hourly suspended particulate matter (SPM) concentration in the winter months generally ranges between 300 and 400 microgram per cubic metre ($\mu g/m^3$), sometimes reaching values in excess of 500 $\mu g/m^3$. 24-hourly respirable particulate matter (RPM) concentration in those months is mostly in the range of 150 to 200 $\mu g/m^3$ but often exceeds 200 $\mu g/m^3$. During monsoon months, the 24-hourly SPM and RPM concentrations come down to around 100 $\mu g/m^3$ and around 50 $\mu g/m^3$ respectively. Similarly, 24-hourly nitrogen oxides (NO_X) concentrations are around 50 $\mu g/m^3$

during the monsoon months but rises to around 90 µg/m^3, sometime exceeding 100 µg/m^3, during the winter months. Except for a slight build-up during the winter months, 24-hourly sulphur dioxide (SO_2) concentrations are mostly around 5 to 7 µg/m^3 during most months of the year. The month of October generally shows a rapid transition from low concentrations of all pollutants to the succeeding high concentration months. But the transition from high concentration in winter months to that of low in monsoon months is rather gradual through the months of March, April and May. Seasonal variations in temperature, wind, rainfall, and other factors account for this.

42. Table 10 presents the monthly average ambient air quality of Kolkata for the year 2008 calculated from daily measurement data as reported by WBPCB. When compared with national air quality standard for residential areas the ambient air quality of Kolkata does not meet the national standard in respect of RPM and NO_X in terms of both arithmetic annual average and also percent of time the daily concentration exceeding the prescribed standard. However, the concentration of SO_2 adequately meets the national standard on both counts.

Table 10 : Monthly average ambient air quality of Kolkata in 2008

Month	SPM		RPM		SO2		NOX	
	A	B	A	B	A	B	A	B
January	352	27/31	178	27/31	9	0/31	91	24/31
February	287	25/29	140	25/29	7	0/29	81	16/29
March	189	10/31	85	10/31	6	0/31	69	1/31
April	139	0/30	55	0/30	5	0/30	62	0/30
May	126	0/31	45	0/31	5	0/31	52	0/31
June	104	0/30	39	0/30	5	0/30	44	0/30
July	107	0/31	37	0/31	5	0/31	47	0/31
August	88	0/31	32	0/31	5	0/31	43	0/31
September	99	0/30	39	0/30	6	0/30	43	0/30
October	177	8/31	81	4/31	7	0/31	62	1/31
November	250	25/30	123	25/30	8	0/30	85	24/30
December	329	31/31	173	31/31	11	0/31	93	25/31
Whole Year	187	126/366	86	122/366	7	0/366	64	91/366
		34.40%		33.30%		0%		24.90%

Source: WBPCB, www.wbpcb.gov.in

Notes: SPM = Suspended Particulate Matter ; RPM = Respirable Particulate Matter; SO_2 = Sulphur dioxide; NOX = Nitrogen Oxides

A = Arithmetic mean concentration in microgram/cum from 24-hourly data

B = Number of days the daily value exceeded the standard out of total days monitored based on 24-hourly data

43. Ambient air quality at Behala Chowrasta close to the subproject sites showed the same pattern from October 2010 to September 2011 as given in Table 11.

Table 11: Month-Wise Average Ambient Air Quality at Behala Chowrasta

October, 2010 to September, 2011

(Arithmetic Mean Concentration in µg/m^3 from 24-Hourly Data)

	NO_2	PM_{10}	SO_2
September, 2011	45.71	52.00	7.06
August, 2011	36.15	39.52	5.43
July, 2011	39.02	40.37	5.84
June, 2011	42.66	44.8	5.48
May, 2011	45.69	50.75	6.21
April, 2011	48.18	71.04	5.82
March, 2011	64.01	99.42	6.39
February, 2011	94.93	193,55	9.66
January, 2011	111.11	221.13	10.28
December, 2010	91.75	170.5	11.75
November, 2010	76.78	148.11	9.67
October, 2010	59.25	73.25	7.5
Yearly Mean	62.73	99.59	7.65

Source: WBPCB, www.wbpcb.gov.in

Notes: NO_2 = Nitrogen oxides; PM_{10} = Particulate Matter with diameter of 10 micron or less; SO_2 = Sulphur dioxide

44. Results of limited time air quality monitoring carried out for the subproject near Joka tram depot are reproduced in Table 12. The values are comparable with the general air quality level of Kolkata and surrounding areas.

Table 12. Ambient Air Quality at Diamond Park Club, near Joka tram depot

Date	Shift wise sample no.	Pollutants level in µg/m^3				
		PM_{10}	SPM	SO_2	NO_2	CO
21.10.2011	1/1	139.2	268.5	6.8	38.5	<125
to	1/2	126.0	237.2	5.2	26.5	<125
22.10.2011	1/3	137.2	241.8	5.8	30.0	<125
24.10.2011	2/1	143.8	278.2	7.2	40.0	<125
to	2/2	130.8	236.5	5.6	26.5	<125
25.10.2011	2/3	136.8	247.2	6.5	35.0	<125
31.10.2011	3/1	136.8	260.1	6.7	36.5	<125
to	3/2	120.8	228.5	5.8	28.7	<125
01.11.2011	3/3	128.3	237.2	6.1	32.8	<125
03.11.2011	4/1	130.8	256.2	6.5	35.0	<125
to	4/2	112.9	218.5	5.6	25.0	<125
04.11.2011	4/3	120.5	224.8	5.8	31.6	<125
07.11.2011	5/1	143.8	280.5	7.2	42.5	<125
to	5/2	132.5	256.7	6.2	32.5	<125
08.11.2011	5/3	123.7	238.2	6.0	31.2	<125
10.11.2011	6/1	123.5	237.2	5.9	32.8	<125
to	6/2	116.3	210.5	5.6	25.0	<125
11.11.2011	6/3	126.5	228.1	5.6	31.5	<125
14.11.2011	7/1	168.2	273.5	7.8	45.0	<125
to	7/2	130.8	236.2	7.0	35.0	<125
15.11.2011	7/3	162.5	258.7	7.0	38.2	<125
18.11.2011	8/1	162.5	261.8	6.8	38.2	<125
to	8/2	123.8	232.5	5.8	26.5	<125
19.11.2011	8/3	138.5	248.2	6.2	32.8	<125

Source: Primary data generated under Tranche 1the investment program
Notes: NO_2 = Nitrogen oxides; PM_{10} = Particulate Matter with diameter of 10 micron or less; SO_2 = Sulphur dioxide, SPM = Suspended Particulate Matter, CO = Carbon Monoxide

45. Surface Water Quality. The primary surface water resource for Kolkata is the Hooghly River that skirts the western margin of Kolkata. In addition, the project area has a large number of waterbodies and canals that are heavily used for everything : from bathing, washing, aquaculture and waste disposal. A large quantity of water is drawn from the Hooghly River for various uses and returns as wastewater to the river without little treatment. Industrial and domestic pollution along with runoff from adjoining areas has led to deterioration in river water quality. Summary chemical analysis Hooghly river water at Garden reach are given below in Table 13.

Table 13. Water quality of Hooghly river at Garden Reach

Sl No.	Parameter	Unit	Test result (dated 11.01.11)	Test result (dated 07.04.11)	Test result (dated 08.07.10)
1	Conductivity	µs/cm	336	371	214
2	Dissolved O2(DO)	mg/l	12.2	4.4	5.7
3	pH	Unit	8.27	8.03	7.4
4	Temperature	^{0}C	16	29	27
5	BOD	mg/l	5.55	3.8	5.9
6	Nitrate-N	mg/l	0.04	1	0.31
7	Fecal Coliform	MPN/100ml	250000	8000	22000
8	Total Coliform	MPN/100ml	350000	11000	33000
9	Ammonia-N	mg/l	BDL	0.164	0.225
10	Phosphate - P	mg/l		0.25	0.04
11	Chloride	mg/l		29.14	14.56
12	Lead	microgram/l		7.48	

Source: WBPCB, www.wbpcb.gov.in
Notes: us/cm = micro siemen per centimetr; mg/l = milligram per litre; MPN/100 mL = Most Probable Number per one hundred millilitre; BDL = Below Detection Limit; ug/l = Microgram per litre; There are no government standards for (tidal) river water

46. The drainage canals in the southern part of the city are Kalagachia, Suti, Churial, Manikhali, Begore, Keorapukur, Western channel joining Keorapukur, Rania, TP Main canal, Intercepting channel, Suti khal (eastern part), different Lead canals to TP Main, Mundapara khal etc. Chemical analysis of water of Suti, TP Main, Churial, Kalagachia and Keorapukur canals shows the following characteristics : Total Suspended Solid (30.0-38.5 mg/l), Total Dissolved Solid (650.0-1580 mg/l), Dissolved Oxygen (4.6-5.2 mg/l), Biochemical Oxygen Demand $_{3days}$ (18.0-35.0 mg/l), Chemical Oxygen Demand (50.0-109.92 mg/l), Chloride (123.1-487.9 mg/l), Total nitrogen (6.41-35.0 mg/l), Total coliform (3.2-4.5x10^3 CFU/ml). Concentrations of heavy metals [Pb, Cd, Hg, As, Cr (III) & Cr (VI)] were always below their respective detection limits (ref Table 14). Water of these canals does not meet the primary water quality criteria for even bathing water.

Table 14. Quality of canal water from five selected boroughs of KMC

Sl. No.	Parameters	Sample (CW 1)	Sample (CW 2)	Sample (CW 3)	Sample (CW 4)	Sample (CW 5)
1	pH	7.27	7.1	7.23	7.35	7.12
2	Total suspended solid (mg/l)	34.0	38.5	30.0	34.0	32.5
3	Total dissolved solid (mg/l)	1735.0	1580.0	741.0	725.0	650.0
4	**DO (mg/l)**	**4.6**	**4.6**	**4.6**	**5.2**	**5.2**
5	COD (mg/l)	56.64	50.0	109.92	82.44	67.96
6	**BOD_3 days, 27^0C (mg/l)**	**20.0**	**23.0**	**35.0**	**20.0**	**18.0**
7	Chloride (mg/l)	487.93	450.0	131.87	123.08	138.0
8	Sulphate (mg/l)	14.35	20.0	12.0	23.52	26.5
9	Nitrate (mg/l)	23.5	20.0	25.0	18.5	19.0
10	Sodium (mg/l)	250.0	230.0	80.5	62.5	70.0
11	Potassium (mg/l)	20.0	18.5	20.0	15.0	18.5
12	Calcium (mg/l)	137.47	130	66.77	58.92	51.06
13	Magnesium (mg/l)	58.8	50	28.22	35.28	23.52
14	Phosphorus (mg/l)	2.66	2.5	8.54	7.53	4.5
15	Lead (mg/l)	<0.3	<0.3	<0.3	<0.3	<0.3
16	Cadmium (mg/l)	<0.04	<0.04	<0.04	<0.04	<0.04
17	Mercury (mg/l)	<0.9	<0.9	<0.9	<0.9	<0.9
18	Arsenic (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01
19	Trivalent Chromium (mg/l)	<0.2	<0.2	<0.2	<0.2	<0.2
20	Hexavalent Chromium (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1
21	Zinc (mg/l)	0.13	0.2	0.04	0.5	0.8
22	Phenolic Compound (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1
23	Cyanide (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05
24	Ammoniacal Nitrogen (mg/l)	4.28	5.3	6.8	3.5	3.0
25	Kjeldahl Nitrogen (mg/l)	20.77	15	23.5	9.34	8.5
26	Total Nitrogen (mg/l)	29.5	23.8	35	15.8	15.0
27	Total Ammonia (mg/l)	5.17	6.41	8.22	4.23	3.63
28	**Total Coliform (CFU/100 ml)**	**4.2 x 10^3**	**3.6 x 10^3**	**4.5 x 10^3**	**3.5 x 10^3**	**3.2 x 10^3**

CW 1	Suti khal (Borough XII, Ward 109)	CW 4	Kalagachia canal (Borough XIV, Ward 126)
CW 2	TP Main canal (Borough XII, Ward 108)	CW 5	Keorapukur canal (Borough XIII, Ward 122)
CW 3	Churial canal (Borough XIV, Ward 124)		

Source: KEIP
Notes: DO = Dissolved Oxygen, BOD = Biochemical Oxygen Demand, mg/l = milligram per litre, CFU = Colony Forming Unit

47. Chemical analysis of water of surface waterbodies (ponds/ jheels/ lakes) from the from southern parts of the city generally shows the following characteristics : Total Dissolved Solid (345-977 mg/l), Dissolved Oxygen (5.0-8.0 mg/l), Chemical Oxygen Demand (18.88-79.04 mg/l), Biochemical Oxygen Demand $_{3\ days}$ (4.0-18.0 mg/l), Chloride (61.54-325.29 mg/l), Total Nitrogen (4.1-19.5 mg/l), Total coliform (1.1-4.5x10^3 CFU/ml). Concentrations of heavy metals like Lead (Pb), Cadmium (Cd), Mercury (Hg), Arsenic (As), Chromium (Cr) (III) & Chromium (Cr) (VI) were always below their respective detection limits. Water of these waterbodies may not always meet the primary water quality criteria for bathing.

48. Chemical analysis of Begore and Churial canal water were analysed for the subproject, which shows high BOD, TVS, Odour threshold and coliform pollution (**Table 15**).

Table 15. Chemical analysis of canal water

Date	Parameters	SW-9 Begore Khal near Rabindra Nagar	SW-10 Churial Khal near Diamond Harbour Road Crossing
02.11.11	Temperature(^{0}C)	23.5	21.50
	Colour unit	2.0	2.0
	Turbidity(NTU)	12.5	11.50
	Odour (TON)	4.0	8.0
	pH	7.67	7.47
	Total solids(mg./l)	512.0	582.0
	TDS(mg./l)	360.0	365.0
	TSS(mg./l)	63.0	67.0
	TVS(mg./l)	72.0	128.0
	DO(mg./l)	5.0	3.8
	B.O.D. (mg./l)	23.0	45.0
	C.O.D. (mg./l)	90.0	160.0
	Oil & Grease(mg./l)	4.6	5.0
	Lead(mg./l)	<0.03	<0.03
	Chromium (III) (mg./l)	<0.20	<0.20
	Chromium (VI) (mg./l)	<0.05	<0.05
	Arsenic(mg./l)	<0.01	<0.01
	Cadmium(mg./l)	<0.01	<0.01
	Nickel(mg./l)	<0.20	<0.20
	Copper(mg./l)	<0.05	<0.05
	Zinc(mg./l)	0.19	0.24
	Iron(mg./l)	1.20	1.8
	Ammoniacal Nitrogen(mg./l)	10.5	16.5
	Kjeldahl Nitrogen(mg./l)	18.6	30.0
	Total Nitrogen(mg./l)	42.5	58.5
	Total Ammonia(mg./l)	12.7	19.96
	Free Ammonia(mg./l)	0.99	0.75
	Sulphide(mg./l)	2.50	3.60
	Mercury(mg./l)	<0.0001	<0.0001
	Salinity (ppt)	0.023	0.025
	Faecal coliform (MPN/100ml)	2.8 X 10^6	3.2 X 10^6

Source:: Primary data generated during present IEE preparation

Notes: NTU = Nephelometric Turbidity Units; TON = Threshold Odor Number; mg/l = milligram/litre; ppt = parts per thousand; MPN/100 ml = Most Probable Number per one hundred millilitre; BOD = Biochemical Oxygen Demand COD = Chemical Oxygen Demand

49. **Groundwater.** The aquifers that are tapped for ground water in Kolkata are under confined condition because of the presence of a thick clay layer near the surface. Such aquifers occur at various depths separated by other clay layers. Generally the first aquifer is encountered at a depth of about 15 m followed by other aquifers with a principal one at about 90 m depth. The shallow aquifer is not used for bulk water tapping purposes, and is generally only tapped for spot supply of through hand pumps. A further deep aquifer occurs at depths approximately between 150 to 200m, and majority of deep tube wells for organized

supply of drinking water tap this aquifer. The earliest geohydrological data for the configuration of the piezometric surface beneath Kolkata are available for the post-monsoon period of 1956. It shows that in the northern part of the city, the piezometric surface was about 0.5-1.0 m above sea level and progressively declined below mean sea level towards the south. There was a drastic change in the pattern in the pre-monsoon of 1958 when a small depression in the piezometric surface was created with the center near Park Street lying at 5 m below mean sea level. The piezometric surface contour plan therefore defined a centripetal ground water flow pattern changing from an open north to south to a closed one. This ovoid ground water trough with long axis trending northwest-southeast persisted since then progressively going down with the central part having piezometric surface lying at (-) 13 m below the mean sea level in the pre-monsoon of 1998. The fall in elevation of the piezometric surface over a period of 40 years is of the order of at least 5 m at the extreme eastern part of Kolkata. The fall of piezometric surface in Command Hospital (Alipore), Kudghat and Tiljala area are 2.08, 3.06 and 3.24 m respectively. The area of depression is roughly bounded by the triangle formed by Narkeldanga, Park Circus and Alipore National Library.

50. As part of KEIP II DPR preparation geohydrological investigations were carried out in January, 2009 in seventeen wards distributed in Borough XI to XV. In these areas, ground water occurs mainly under confined to semi-confined conditions in 13 wards (108, 109, 111, 115, 122, 123, 124, 125, 126, 127, 139, 140 & 141). Depths of piezometric surface from ground level in these wards varied between 9.3m to 14.11m. In wards 110, 112, 113 & 114, due to presence of near surface aquifers under water table conditions the depths to water level in the tube wells in these wards are between 1.3m to 2.9m. An aquitard occurs near surface over the entire studied area and ground water from this aquitard is tapped by dug wells. The depths to water table varied between 0.50m to 7.95m in these dug wells. With most areas reporting water levels within 1 to 2m from the ground surface.

51. **Taratala – Garden Reach Sector :** The depth to piezometric surface or depth to water levels in dug wells is very close to the land surface. The depth ranges between 0.42 to 0.9 m bgl. The depth to water level is low at the Gardenreach site than the Taratola region. During the same period the piezometric surface in the deeper aquifer zones (>40 m bgl) rested at a deeper level – generally above 15 m bgl.

52. **Taratala – Thakurpukur Sector:** The depth to piezometric surface or depth to water levels in dug is very close to the land surface. The depth ranges between 0.27 to 1.0 m bgl. During the same period the piezometric surface in the deeper aquifer zones (>40 m bgl) rested at a deeper levels ranging between 12.07 m bgl and 14.85 m bgl.

53. **Begore Khal Pumping Station sector:** The depth to water levels in dug is close to the land surface. The depth ranges between 1.34 to 2.4 m bgl in the upper most aquifer. As presence of Tube well in this area is very negligible, depth to water level of deep aquifer can not be visualized in this area.

54. The relevant ground water level data are given in the following Table 16.

Table 16. Ground water level data as measured during December, 2011

Sl. No.	Location	Type of Structure	Sector	SWL (m bgl)
7.	Sri Ram Janki Mandir, 1 no. Gate, CPT Colony, Taratola Road	Dug Well	Gardenreach	0.9
8.	Zinzira Bazar, Budge Budge Road Crossing	Dug Well	Gardenreach	0.42
9.	Paharpur, Bidhangarh, Kolkata-66	Dug Well	Gardenreach	0.45
10.	Trenching Ground Road, Moila Depo, Kolkata-24	Dug Well	Gardenreach	0.43

11.	1 No. Gate, CPT Colony, Taratola Road	Tube Well	Gardenreach	15.15
12.	Trenching Ground Road, Moila Depo, Opposite to Siva Mandir, Kolkata-24	Tube Well	Gardenreach	15.3
13.	57/6/2, Santosh Roy Road, Kolkata-8	Dug Well	Behala	0.85
14.	210, James Long Sarani, Opposite to Fire Brigade Depo, Kolkata-63	Dug Well	Behala	0.6
15.	46, A. J. C. Bose Road, Barabagan, Kolkata-63	Dug Well	Behala	0.27
16.	P-21, J. L. Sarani, Majher Para, Thakurpukur, Kolkata-63	Dug Well	Behala	1.0
17.	Diamond Park, behind Vaishnawi Garden, 444, J. L. Sarani, Kolkata-104	Dug Well	Behala	0.5
18.	12/1A, Roy Bahadur Roy, Kolkata-34	Tube Well	Behala	13.85
19.	N/214, Biren Roy Road (E), Kolkata-8	Tube Well	Behala	14.85
20.	Primary School, Barisha Purba Para, Kolkata-63	Tube Well	Behala	13.32
21.	Thakurpukur, Maheshtola, J. L. Sarani, Kolkata-108	Tube Well	Behala	12.07
22.	Beside Begaur Khal Pumping Station	Dug Well	Rabindranagar	2.40
23.	Beside the Behal Flying Station	Dug Well	Rabindranagar	1.70
24.	At 2/121 rabindranagar, near Goyalapara More	Dug Well	Rabindranagar	1.34

Notes: SWL = Static Water Level, m bgl = Meter Below Ground Level

55. Ground water quality was monitored around the project sites during November, 2011 and the results are reproduced in Table 17 below. Water quality is rather high in TDS but within acceptable limit. Fe concentration is also high. No heavy metal pollution especially that of arsenic has been detected.

Table 17. Ground water quality around Tranche 1 S&D subproject sites (date of sampling – 4.11.2011)

Parameters	**GW – 1 Near Taratala More, Garden Reach (Tube Well)**	**GW – 2 Diamond Park, Joka (Tube Well)**	**GW – 3 Near Puspashree, Behala (Tube Well)**	**GW – 4 Janakalyan Vidyapit, James Long Sarani**	**GW – 5 Krishnayan Cooperative Housing, Behala (Tube Well)**	**GW – 6 Thakurpukur, James Long Sarani (Tube Well)**	**National drinking water standard Permissible limit**
Temperature(^{0}C)	20.5	19.50	19.5	18.5	18.0	18.5	-
Colour unit	1.0	1.0	1.0	1.0	1.0	1.0	5
Turbidity(NTU)	2.8	2.65	2.45	5.2	4.8	6.8	1
Odour	No odour observed	No odour observed	No odour observed	No odour observed	No odour observed	No odour observed	Agreeable
pH	7.57	7.78	7.73	7.87	7.71	7.8	6.5-8.5
TSS (mg./l)	<10	<10	<10	<10	<10	<10	-
TDS(mg./l)	560.0	556.0	623.0	559.0	879.0	580.0	500
Total hardness(mg./l)	240.0	228.0	248.0	252.0	232.0	240.0	200
Chloride(mg./l)	72.53	79.12	105.5	70.33	219.79	76.93	250
Sulphate(mg./l)	5.5	5.0	6.0	6.0	9.75	3.5	200
Nitrate(mg./l)	10.5	12.5	15.0	21.5	35.80	25.0	45
Sodium(mg./l)	120.5	138.5	156.0	138.5	212.0	180.0	-
Potassium(mg./l)	35.0	30.0	25.0	26.5	42.10	25.0	-
Calcium(mg./l)	59.32	56.11	56.11	54.51	72.14	60.92	75
Magnesium(mg./l)	22.08	21.12	25.92	27.84	12.48	21.12	30
Iron(mg./l)	0.62	0.64	0.51	1.57	1.61	2.34	0.3
Zinc(mg./l)	0.82	0.65	0.10	0.82	0.65	0.28	5.0
Phosphorus(mg./l)	0.08	0.14	0.10	0.08	0.04	0.06	-
Fluoride(mg./l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	1.0
Lead(mg./l)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.01
Cadmium(mg./l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.003
Arsenic(mg./l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01

Parameters	GW – 1 Near Taratala More, Garden Reach (Tube Well)	GW – 2 Diamond Park, Joka (Tube Well)	GW – 3 Near Puspashree, Behala (Tube Well)	GW – 4 Janakalyan Vidyapit, James Long Sarani	GW – 5 Krishnayan Cooperative Housing, Behala (Tube Well)	GW – 6 Thakurpukur, James Long Sarani (Tube Well)	National drinking water standard Permissible limit
Chromium (III) (mg./l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
Chromium(VI) (mg./l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
Phenolic compound(mg./l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Cyanide(mg./l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Mercury(mg./l)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Total coliform (MPN/100 ml)	<2	<2	<2	<2	<2	<2	Not detectable

Parameters	GW – 7 Near Begore Khal, near Rabindra Nagar (Tube Well)	GW – 8 Near Moyla Depot, Garden Reach (Tube Well)	GW – 9 Near Moyla Depot, Garden Reach (Well)	National drinking water standard Permissible limit
Temperature(^{0}C)	19.5	18.5	18.0	-
Colour unit	1.0	1.0	1.0	5
Turbidity(NTU)	2.8	5.1	6.8	1
Odour	No odour observed	No odour observed	No odour observed	Agreeable
pH	7.67	7.45	7.76	6.5-8.5
TSS (mg./l)	<10	<10	<10	-
TDS(mg./l)	564.0	617.0	615.0	500
Total hardness(mg./l)	240.0	380.0	388.0	200
Chloride(mg./l)	74.73	79.12	74.73	250
Sulphate(mg./l)	5.0	36.5	44.5	200
Nitrate(mg./l)	26.5	31.6	32.5	45
Sodium(mg./l)	210.0	228.67	238.5	-
Potassium(mg./l)	31.5	36.8	30.0	-
Calcium(mg./l)	56.11	99.4	96.19	75
Magnesium(mg./l)	24.0	31.68	35.52	30
Iron(mg./l)	0.71	2.12	2.27	0.3
Zinc(mg./l)	0.73	0.05	0.12	5.0
Phosphorus(mg./l)	0.05	0.55	0.92	-
Fluoride(mg./l)	<0.02	<0.02	<0.02	1.0
Lead(mg./l)	<0.03	<0.03	<0.03	0.01
Cadmium(mg./l)	<0.01	<0.01	<0.01	0.003
Arsenic(mg./l)	<0.01	<0.01	<0.01	0.01
Chromium (III) (mg./l)	<0.20	<0.20	<0.20	-
Chromium(VI) (mg./l)	<0.01	<0.01	<0.01	0.05
Phenolic compound(mg./l)	<0.001	<0.001	<0.001	0.001
Cyanide(mg./l)	<0.05	<0.05	<0.05	0.05
Mercury(mg./l)	<0.0001	<0.0001	<0.0001	0.001
Total coliform (MPN/100 ml)	<2	<2	<2	Not detectable

Source: Primary data generated during preparation of this IEE

Notes: NTU = Nephelometric Turbidity Units; TON = Threshold Odor Number; mg/l = milligram/litre; MPN/100 ml = Most Probable Number per one hundred millilitre; TSS = Total Suspended Solid TDS = Total Dissolved Solid

56. **Noise.** Noise level in Kolkata high and exceeds the national standard. As part of DPR preparation of KEIP II a noise level survey was carried out in the seventeen wards during day time (Table 18). Average noise level in typical residential areas away from the

busy streets varies between 47.9 to 66.9 dBA with only 22% of the measurement sites have noise level conforming to the prescribed noise level of 55 dBA (residential area; day time). Noise level near busy roads of the area expectedly have relatively high but variable noise level depending on the density of vehicle moving on the roads at the time of measurements. The range of measured noise levels was between 58.7 and 88.7 with more than 85% of the measurements show a value above 70 dBA. The measurement sites included some roads in front of school/college/hospital.

Table 18: Noise level measurement within seventeen wards in Borough XI-XV

Sl. No.	Ward	Location	Landuse	Mean noise level in db(A)
1	108	Martin Para	Residential area	58.1
			Busy road	83.3
		Dr B R Ambedkar School	Busy road near school	78.0
2	109	R N Tagore Hospital	Busy road near hospital	71.5
		Netaji Nagar	Busy road side	81.8
			Residential area	56.1
3	110	Andrews College	Busy road near college	77.8
		BRWS Hospital	Busy road near hospital	61.2
		Sreerampur road	Busy road	82.4
			Residential area	66.7
4	111	Satindra Palli	Residential area	56.2
			Busy road	74.3
5	112	Rishi Rajnarayan Road	Residential area	63.0
			Busy road	81.6
6	113	Niranjan Palli	Residential area	59.7
			Busy road	72.9
7	114	Purba Putiary	Busy road near school	73.3
			Busy road	88.7
			Residential area	62.5
8	115	Paschim Putiary Road	Busy road	70.3
			Residential area	51.4
				55.2
9	122	Ustad Amir Khan Sarani	Residential area	61.3
			Busy road	79.5
10	123	Santal Palli	Busy road	74.2
			Residential area	57.0
11	124	Purba Para Road	Residential area	66.9
			Busy road	77.7
12	125	Subodh Kr Mukherjee Road	Busy road	58.7
			Residential area	49.8
13	126	Sabarna {ara Road	Busy road	81.9
			Residential area	47.9
14	127	Nanda Gopal Mukherjee Road	Busy road	80.3
			Residential area	62.5
15	139	Halder Para	Busy road	79.3
			Residential area	61.3
		Parchur College	Inside college	78.0
			Busy road in front of college	80.9
16	140	Mullick Para Lane	Residential area	56.4
			Busy road	70.8
17	141	Bagdi Para	Residential area	52.7
			Road side	61.9

Source : KEIP data

Notes: dBA = decibal in A network

57. Ambient noise level monitoring was carried out in the two subproject area and the results are reproduced in Tables 19 and 20. The day and night Leq level is around 70 dBA in Garden Reach area in most monitoring sites whereas it is generally generally above 70 to above 80 dBA along the two roads during day and night because of heavy traffic.

Table 19: Noise level in Garden Reach area

Station No.	Location	Date and time	Minimum dB(A)	Maximum dB(A)	Leq dB(A)
N1	Santoshpur new road 1 No. railway gate	20.10.2011 (day time)	68.5	73.9	71.89
		20.10.2011 (Night time)	63.7	70.2	67.89
N2	Santoshpur Panchadeep Market	20.10.2011 (day time)	67.9	78.5	74.26
		20.10.2011 (Night time)	64.2	72.1	70.18
N3	Near Brace Bridge Railway Station	20.10.2011 (day time)	78.5	85.3	80.16
		20.10.2011 (Night time)	61.2	73.8	69.18
N4	Near State Bus Terminal	20.10.2011 (day time)	78.3	85.4	81.10
		20.10.2011 (Night time)	63.8	78.9	70.18
N5	Near Water Works Main Gate	20.10.2011 (day time)	68.3	75.3	72.36
		20.10.2011 (Night time)	58.7	68.5	65.89
N6	Near Philips Main Gate	20.10.2011 (day time)	72.1	84.2	79.89
		20.10.2011 (Night time)	61.8	70.2	67.89
N7	Near Nature Park	20.10.2011 (day time)	69.9	84.3	80.68
		20.10.2011 (Night time)	58.7	67.8	64.18
N8	Garden Reach Water Works Pump Room	20.10.2011 (day time)	64.3	75.5	71.30
		20.10.2011 (Night time)	62.7	72.8	69.50
N9	Near Gas Factory Main Gate	20.10.2011 (day time)	70.4	76.8	74.78
		20.10.2011 (Night time)	63.7	69.2	66.18
N10	Near Garden Reach Pumping Station	20.10.2011 (day time)	58.1	68.5	63.78
		20.10.2011 (Night time)	53.2	67.5	62.89

Source: Primary data generated during preparation of this IEE
Notes: dBA = decibal in A network; Leq = Equivalent noise level

Table 20: Noise along Diamond Harbour Road & James Long Sarani

Station No.	Location	Date & time	Minimum dB(A)	Maximum dB(A)	L_{eq} dB(A)
N11	Kankhuli Ghosh Para Telephone Exchange	24.10.2011 (day time)	68.2	78.3	74.21
		24.10.2011 (Night time)	61.2	72.8	68.78
N12	Near Pathak Para Bus Stop	24.10.2011 (day time)	75.2	79.5	77.29
		24.10.2011 (Night time)	64.7	72.5	68.23
N13	Near Begore Khal Pumping Station	24.10.2011 (day time)	61.5	67.2	64.29
		24.10.2011 (Night time)	56.2	65.8	62.78
N14	Paharpur Kalinagar Play Ground	24.10.2011 (day time)	61.9	68.2	65.27
		24.10.2011 (Night time)	57.1	63.2	60.20
	Parnasree Bus Stand	24.10.2011	71.5	78.9	76.29

Station No.	Location	Date & time	Minimum dB(A)	Maximum dB(A)	L_{eq} dB(A)
N15		(day time)			
		24.10.2011 (Night time)	64.1	72.3	67.18
N16	Behala Airport	24.10.2011 (day time)	65.2	72.9	68.49
		24.10.2011 (Night time)	63.1	70.8	67.89
N17	Diamond Park	24.10.2011 (day time)	55.3	61.5	58.79
		24.10.2011 (Night time)	51.2	60.8	56.18
N18	ESIC Hospital	24.10.2011 (day time)	79.8	85.3	82.56
		24.10.2011 (Night time)	64.2	69.8	67.20
N19	Kolkata Model School. James Long Sarani	24.10.2011 (day time)	74.2	83.5	77.87
		24.10.2011 (Night time)	62.8	71.5	67.89
N20	Thakurpukur Police Station	24.10.2011 (day time)	80.9	89.5	83.69
		24.10.2011 (Night time)	64.8	72.5	70.67
N21	Birsha High School (Sakher Bazar)	24.10.2011 (day time)	79.2	88.9	82.45
		24.10.2011 (Night time)	63.8	72.5	70.67
N22	Joka Tram Depot	24.10.2011 (day time)	78.3	85.2	82.47
		24.10.2011 (Night time)	67.2	74.8	72.50
N23	Thakurpukur Bus Stand	24.10.2011 (day time)	80.1	89.3	86.36
		24.10.2011 (Night time)	68.2	76.8	72.68
N24	Thakurpurkur Bazar	24.10.2011 (day time)	79.4	85.2	82.41
		24.10.2011 (Night time)	62.8	76.2	71.67

Source: Primary data generated during preparation of this IEE
Notes: dBA = decibal in A network; Leq = Equivalent noise level

B. Ecological Resources

58. **East Kolkata Wetlands**. The East Kolkata Wetlands (EKW), located on the eastern fringes of Kolkata city, is a part of the extensive inter-distributory wetland regimes formed by the Gangetic delta. The total area is 12,500 ha. Only a small part of KMC area falls within the limits of EKW. The EKW area includes one of the largest assemblages of sewage fed fish ponds. The importance of this wetland lies in the fact that these sustain the world's largest and oldest integrated resource recovery practice based on a combination of agriculture and aquaculture, and provide livelihood support to a large, economically underprivileged population of around 27,000 families which depend upon various wetland products, primarily fish and vegetables for sustenance. Based on its immense ecological and socio cultural importance, the Government of India, declared East Kolkata Wetlands as Wetland of International Importance under Ramsar Convention in 2002. EKW is a classical example of harnessing natural resources of the wetland system for fisheries and agriculture through ingenuity of local communities with their traditional knowledge. The wetland has been included by the Ramsar Convention as one of the 17 case studies on wise use of wetlands at the global level. The wetland provides strong arguments for integration of traditional knowledge of local communities into conservation and management practices.

More than 1000 MLD of untreated sewage from Kolkata are discharged in to the fisheries of EKW for natural treatment in the fishponds.

59. The ecology of the EKW area has undergone a dramatic change since the beginning of the 19th century due to cessation of tidal (brackish water) influx from Bidyadhari and Matla rivers in to the then saline marshy area with brackish water fisheries. The change is not only due to natural causes like siltation but also due to developmental activities and hydrological interventions. The brackish water fisheries of earlier years were converted in to sewage fed fisheries bringing in a changed ecosystem and establishing a new biodiversity in the EKW areas.

60. There is no forest patch within EKW. There are no endangered species but there are a number of rare mammals, reptiles, fish and bird species. According to the Ramsar information database, there are rare mammals such as Marsh mongoose, small Indian mongoose, Palm civet and small Indian civet, which are significant in and around the EKW.

61. The representative aquatic flora and fauna of the EKW are listed in Table 21 and Table 22 respectively.

Table 21: Representative Aquatic Flora of the EKW

Type of flora	Species
Free floating forms	*Eichhornia sp., Spirodella sp., Pistia sp.,Ceratophyllum/Utricularia sp.,Axolla sp.,*
Fixed anchored forms	*Vallisneria sp., Hydrilla sp., Najas sp., Nymphea sp.,Nymphoides sp*
Emergent amphibious forms	*Marsilea sp., Impomoea sp., Enhydra sp., Colocasia sp.,*
Facultative forms	*Typha sp., Cyperus sp.,*
Algal forms	*Synandra sp., Spirogyra sp., Zygnema sp., Nitelea sp.,*

Source: Utilization scenario of Kolkata Wetlands (1996) 2. Urban Ecology, Ghosh A.K 1988.

Table 22: Representative Fauna of the EKW

Type of Fauna	Species
Waterfowl	*Phalacrocdax niger, Ardeola gravii; Babulcus ibis; Egretta garzatta*
Waders	*Tringa hypoleucos; Calibris minuta*
Kingfisher	*Ceryle rudies; Alcedo athhis; Pelargopsis capensis; Halcyon Smyrnesis*
Aquatic reptiles	*Lissemys punctata, Enhydris enhydris, xenochrophis piscator*
Amphibians	*Rana cyanophyctis; Rana tigerina, Rana limnocharis, Microphyla ornata; Bufo melanostictus*
Fish	*Catla catla; Labeo rohita; L.calbasu; L.bata; Cirrhinus mrigala, Hypophthalmich thysmolitrix, Microvertebrates Puntius sarana, P.ticto, Amblypharygodon mola; etc.*
Mollusca	*Bellamya bengalensis; Pila globosa; Diagnostoma sp., Lymnea sp., Gyrulus sp., Thiara sp., etc.*
Annelida	*Oligochaeta; Brachuria; Limno drilus sp., Hirudines – Glassophonia sp.,*
Insecta	*Hemiptera : Anisops sp., Limnogonus sp., Plea sp., Hydrometra sp., Micronecta sp.,*

Source: Utilization scenario of Kolkata Wetlands (1996) 2. Urban Ecology, Ghosh A.K 1988.

62. **Vegetation.** The Kolkata region, except a small part that is falling in East Kolkata Wetlands to the east 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, road sides and small orchards within the residential area offer more varied vegetation. There is no demarcated forest.

63. A field survey in November 2011 was organised to record tree species present along major roads of the subproject area and the results of the survey is given in the following Tables 23, 24, 25 and 26.

Table 23: List of trees along James Long Sarani having more than 1 % occurrence

No.	Name of Plant	Percentage (%)
1	Krishnachura	17.34
2	Kadam	15.15
3	Chatim	10.91
4	Debdaru	8.27
5	Bot	6.77
6	Radhachura	5.51
7	Asathwa	5.40
8	Bokul	4.36
9	Sirish	3.67
10	Neem	2.76
11	Kathbadam	2.07
12	Mango	1.72
13	Mahogani	1.61
14	Sajne	1.61
15	Jum	1.49
16	Jarul	1.26
17	Kanchan	1.15

Table 24: List of trees along Diamond Harbour Road (Joka to Taratala) Having more than 1 % occurrence

No.	Name of Plant	Percentage (%)
1	Krishnachura	14.60
2	Bot	14.60
3	Kadam	11.45
4	Chatim	8.68
5	Asathwa	8.49
6	Sirish	5.53
7	Bokul	5.34
8	Radhachura	5.25
9	Mahogani	4.19
10	Kathbadam	4.10
11	Debdaru	3.91
12	Neem	3.15
13	Subabul	1.53
14	Mayna	1.05
15	Arjuna	1.05

Table 25: List of trees along Taratala More to Santoshpur Road Crossing Having more than 1 % occurrence

No.	Name of Plant	Percentage (%)
1	Krishnachura	22.60
2	Debdaru	11.78
3	Kadam	10.82
4	Radhachura	10.34
5	Bot	9.62
6	Bilaiti babul	6.01
7	Arjun	4.81
8	Ashwattha	4.33
9	Sirish	3.37
10	Akashmani	2.88
11	Chatim	1.92
12	Coconut	1.92
13	Eucalyptus	1.68
14	Bottle Palm	1.44
15	Mahogany	1.44
16	Jarul	1.44

No.	Name of Plant	Percentage (%)
17	Dumur	1.20

Table 26: List of trees along Mahendra Banerjee road from Behala thana (Diamond Harbour Road) to Begor Khal

No.	Name of Plant	Percentage (%)
1	Krishnachura	16.08
2	Kadam	10.49
3	Bilaiti babul	9.79
4	Radhachura	9.09
5	Kathbadam	4.20
6	Guava	3.50
7	Arjun	2.80
8	Bot	2.80
9	Chatim	2.80
10	Mayna	2.80
11	Sirish	2.80
12	Debdaru	2.38
13	Mango	2.10
14	Jum	2.10
15	Date	1.40
16	Akashmani	0.70
17	Mahogany	0.70
18	Dumur	0.70
19	Neem	0.70
20	Rubber	0.70

64. **Wildlife.** Common jungle cats, foxes (Vulpes bengalensis), house rats (Rattus rattus), and mice (Mus muscatus), kingfisher (Alcedo sp.) are present. Of the reptiles, garden lizards (Calotes versicolor), snakes (Natrix sp., Viper sp.), and kraits (Bungarus caeruleus) are common. The bird life includes house crows (Acridotheres tristis), house sparrows (Paser domesticus), and pigeons (Coluamba livia). Amphibians such as Indian bullfrogs (Rana tigrina), annelids such as earthworms (Eisenia foetida), and arthropods such as cockroaches (Periplanata americana), butterflies and ants (Tapinoma sessile) are common. There are no endangered faunal species in the subproject area.

65. **Aquatic Flora and Fauna.** Anchored and free floating and submerged hydrophytes like Kachuri pana (*Eichhornia crassipes*), Azolla (*Azolla pinnata*), Sagittaria (*Sagittaria sp.*), Hogla (*Typha angustifolia*) etc can be seen in the many open water bodies other than Hooghly river. Such water bodies often contain fishes such as Rohu (*Labeo rohita*), Catla (*Catla catla*), and Bata (*Labeo bata*). Phytoplankton like *Spirogyra sp.*, *Zygnema sp.*, *Navicula sp.*, *Nostoc sp., Hydrodistyom sp.*, etc and zooplankton like *Cyclops sp., Paramecium sp., Euglena sp., Diaptomus sp.*, larvae of *culex sp.* etc are ubiquitous.

66. The aquatic ecology of Hooghly river is not known adequately. However, it is known that pollution-resistant species of phytoplankton and zooplankton dominates. The fish resources include the ubiquitous Hilsa.

67. Limited aquatic ecological survey was carried out in Hooghly river near Garden Reach areas during November-December, 2011 at the following locations:

(i) Budge Budge Ferry Ghat (Near Budge Budge Station) (AW3)
(ii) Charial Bazar Ghat (Near Budge Budge Police Station) (AW4)
(iii) Pujali Ferry Ghat (Near Pujali Guest House) (AW5)
(iv) New Raw Water intake jetty (Near CESC Southern Generating Station)(AW6)
(v) Old Raw Water intake jetty (Near CESC Southern Generating Station)(AW7)
(vi) Bichali Ghat (Near CESC Southern Generating Station) (AW8)

68. The data are given in the Tables 27, 28, 29 and 30.

Table 27: Phytoplankton Spectrum In Water Bodies During High Tide

		Sampling Station [plankton count x $10^3/m^3$]					
	Phytoplankton Species	AW3	AW4	AW5	AW6	AW7	AW8
1.	*Melosira sp.*	1.2	1.4	1.6	1.3	1.8	1.1
2.	*Spirogyra sp.*	1.6	1.5	1.3	1.9	1.2	0.8
3.	*Microcystis sp.*	1.8	1.7	1.4	1.1	1.4	1.3
4.	*Anabaena sp.*	0.9	1.1	1.6	0.8	1.5	0.9
5.	*Nitzschia sp.*	1.7	2.1	2.3	1.7	2.2	1.9
6.	*Tetraedron sp.*	1.6	1.9	1.8	1.9	1.8	2.3
7.	*Oscillatoria sp.,*	2.1	2.5	2.7	1.8	2.8	2.1
8.	*Spirulina sp.*	2.6	2.1	2.4	0.8	2.5	1.6
9.	*Euglena sp.*	1.4	1.8	1.7	0.6	1.8	0.8
10.	*Eudorina sp.*	1.7	1.9	2.0	1.2	2.0	1.8
N = Total Plankton Count X $10^3/m^3$		16.6	18.0	18.8	13.10	19.00	14.60
H = Shannon-Weaver Index		2.27	2.28	2.28	2.23	2.27	2.30

Table – 28 :Phytoplankton Spectrum In Water Bodies During Low Tide

		Sampling Station [plankton count x $10^3/m^3$]					
	Phytoplankton Species	AW3	AW4	AW5	AW6	AW7	AW8
1.	*Melosira sp.*	1.0	0.9	1.5	1.5	1.9	1.6
2.	*Spirogyra sp.*	0.9	0.8	1.1	1.0	0.8	1.1
3.	*Microcystis sp.*	1.2	1.1	0.8	0.8	0.9	1.0
4.	*Anabaena sp.*	0.3	0.3	0.2	0.2	0.2	0.3
5.	*Nitzschia sp.*	1.2	1.3	0.4	0.5	1.5	0.6
6.	*Tetraedron sp.*	0.9	1.7	1.8	1.7	1.7	1.8
7.	*Oscillatoria sp.,*	1.2	1.8	2.1	2.0	2.2	2.1
8.	*Spirulina sp.*	1.3	1.6	1.9	1.8	1.0	1.7
9.	*Euglena sp.*	1.1	1.3	1.5	1.5	1.2	1.4
10.	*Eudorina sp.*	1.3	1.2	1.3	1.4	1.2	1.3
N = Total Plankton Count X $10^3/m^3$		10.4	12.0	12.6	12.40	12.60	12.90
H = Shannon-Weaver Index		2.25	2.23	2.17	2.18	2.19	2.20

Table – 29: Zooplankton Spectrum In Water Bodies (Number/M^3) During High Tide

	Zooplankton species		Sampling Station [plankton count x $10^3/m^3$]					
I	**Cladocera**		AW3	AW4	AW5	AW6	AW7	AW8
	1	*Diaphanosoma sp.*	210	190	320	125	80	215
	2	*Moina.sp*	470	380	480	350	380	412
II	**Copepoda**							
	3	*Acartiella sp*	280	470	480	225	223	260
	4	Diaptomus	430	550	580	320	280	318

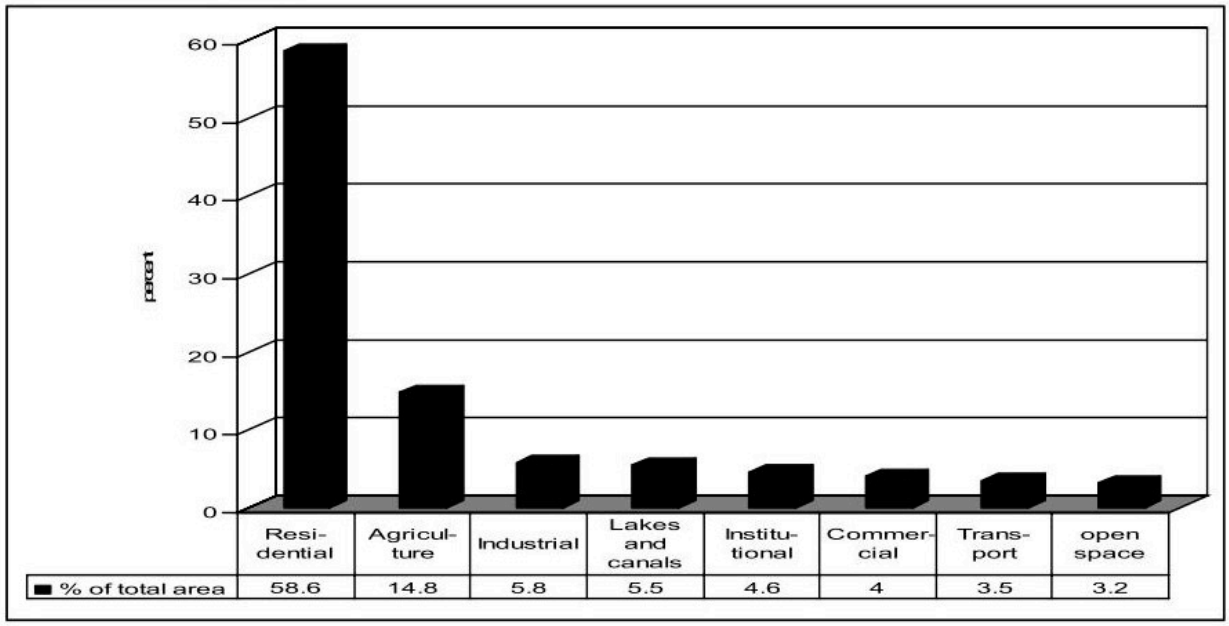
	5	*Pseudodiaptomus sp*	150	140	270	65	72	120
	6	*Cyclopina sp*	130	180	140	90	315	135
III	**Nauplia**							
	7	*Lamellibranchs*	450	480	370	326	290	415
IV	**Miscellaneous**							
	8	*Lucifer sp*	370	310	280	290	310	350
N = Total Plankton Count X $10^3/m^3$			2490	2700	2920	1791	1950	2225
H = Shannon-Weaver Index			1.99	1.98	2.00	1.94	1.96	1.99

Table 30: Zooplankton Spectrum In Water Bodies (Number/M^3) During Low Tide

		Zooplankton species	**Sampling Station [plankton count x $10^3/m^3$]**					
			AW3	AW4	AW5	AW6	AW7	AW8
	I	**Cladocera**						
	1	*Diaphanosoma sp.*	130	90	120	90	72	185
	2	*Moina.sp*	370	240	340	310	352	240
II	**Copepoda**							
	3	*Acartiella sp*	180	260	260	212	180	235
	4	Diaptomus	300	310	380	285	260	280
	5	*Pseudodiaptomus sp*	120	90	190	52	60	112
	6	*Cyclopina sp*	80	110	80	81	280	120
III	**Nauplia**							
	7	*Lamellibranchs*	350	260	350	280	265	370
IV	**Miscellaneous**							
	8	*Lucifer sp*	170	310	170	260	290	326
N = Total Plankton Count X $10^3/m^3$			1700	1670	1890	1570	1759	1868
H = Shannon-Weaver Index			1.95	1.97	1.97	1.93	1.95	2.00

C. Economic Development

69. **Land use.** The metropolitan area of Kolkata has grown from a few small villages to its present status as India's most populous city. The predominant land use in KMC is residential, as shown in Figure below. However, for most residential areas a more exact description will be mixed use. There are industrial sites throughout the city, in all 15 Boroughs and in 71 of the 141 wards. Urban planning is one of the responsibilities of KMC. KMDA also has a role in land planning, with a broader geographic scope than KMC.



70. Land use 3 km around proposed Begore khal and Churial Khal pumping stations area reveals the following as in Tables 31 and 32 (present subproject data):

Table 31: Land use statistics around Begore khal pumping station

	Land use/Land cover	Land use type	Area in ha	Percentage
1	Settlement	Urban	835	47.9695.04
2	Plantation and habitation	Plantation around habitation	587	33.72
3	Grassland/barren	Grassland/barren	26334	15.11
4	Water bodies	Pond/tank/river	3	0.17
5	Canal	Water body	3	0.17
9	Fying Club area	Infrastructure	50	2.87
			1714	100.00

Source: Kolkata Municipal Corporation

Table 32: Land use statistics around Churial khal pumping station

Sl. No.	Land use/land cover	Land use type	Mapping symbol	Area in ha	Percentage
01.	Settlements	**Urban**	1	288	28.8
02.	Industrial / Commercial area	Industrial / Commercial Activities	2	25	2.5
03.	Plantation and Habitation	Plantation around Habitation	3	352	35.2
04.	Agriculture	Cultivated land	4	306	30.6
05.	Fallow Land	Grass /Barren land	5	25	2.5
06.	Water bodies	Pond/tank/River	6	4	0.4
				1000	**100.0**

Source: Kolkata Municipal Corporation

71. **Commerce and industry.** Kolkata is a service center rather than an industrial center. As shown on Figure below, the proportion of the population working in industry is similar to the India urban average, but below that of the rest of urban West Bengal.

72. Industrial growth has been accelerating in West Bengal the introduction of the New Economic Policy (1992), the average annual growth of industrial production has moved up to 5.05%. While the organized industries are located in Cossipore area (Borough I), small scale industries as lead recycling, tanneries etc. are located in the Tiljala/Topsia area (Borough VII). It may be noted that all the tanneries are being relocated to a specially designated site at Karaidanga about 25 km away with all environmental safeguards. Only green i.e. non-polluting industries are permitted to be set up in KMC area. Permission from WBPCB is mandatory for discharging of waste in to municipal sewer or land or inland surface water body. For discharge to municipal sewer, industries must treat the effluent to the acceptable discharge limit as prescribed. Port related industries such as oil handling facilities etc. are found in the Garden Reach area viz Borough XV.

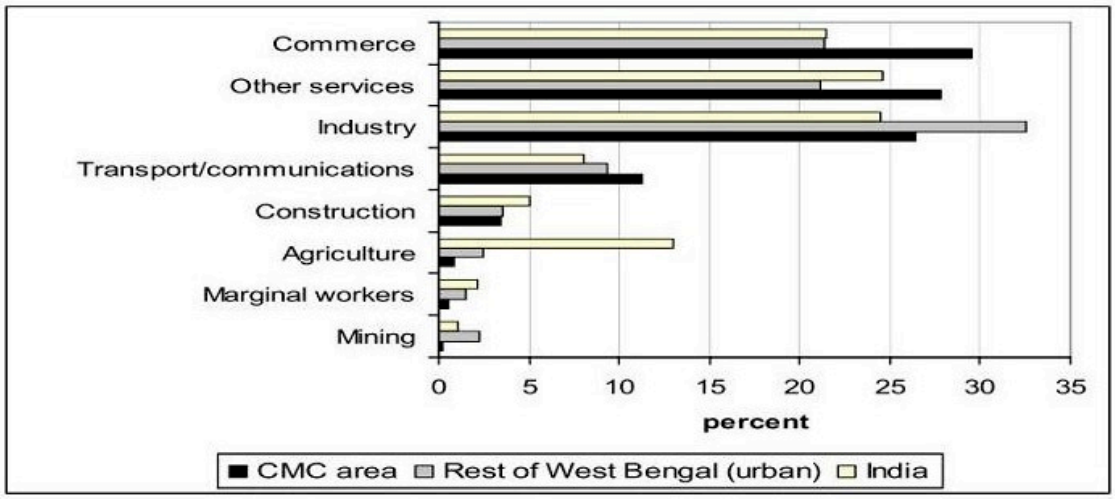


Figure 3.8

73. **Water supply.** The water supply system of Kolkata is very old, operated from 1865. Present average per capita supply is 134 lpcd, which is very near to desired supply of 150 lpcd (for metropolitan cities). But the supply is very uneven, ranging from 310 lpcd to 40 lpcd. Unaccounted for water (UFW) is 40%. Average supply period is 8 hours a day. Residual pressure is very low. The average terminal pressure at consumer end is around 2.5 m of water head. In some areas it ranges around 0.5 m-1.0 m of water head. About 10% of supply in Kolkata is from ground water. The source is affected by arsenic in some locations and TDS and Fe values are often above permissible values. From quality and health point of view the ground water source needs to be replaced. Coverage by piped water supply is 92% which is nearing 100%. But the rest 8% is near the periphery of the study area, and far from surface water source. Hence the service is far from desired level. The two main water works are Palta and Garden Reach.

74. **Transportation.** The Kolkata's transportation system is multi-modal and highly heterogeneous. Public transportation comprises everything from human-powered rickshaws to a subway system. Main thoroughfares in Kolkata are crowded with taxis, buses, two-wheelers, three-wheelers, hawkers, and a myriad of pedestrians all vying for limited space on the streets.

75. **Electrical Power.** Power supply in Kolkata dates back to 1898, when Calcutta Electric Supply Corporation was formed for generation, transmission and distribution of

electrical energy in and around the city of Kolkata. From about 100 kw demand in 1898, the system has grown to about 1200 MW in 1998. Apart from its own generation, CESC Limited, presently a licensee of WBSEB, purchases power from the latter and also from Damodar Valley Corporation (DVC). The generating stations that operate in Kolkata area are: Mulajore, capacity 150 MW, New Cossipore 160 MW, Titagarh 240 MW, Southern 135 MW, and Budge-budge 250 MW. In addition, 300-400 MW of power is supplied by West Bengal State Power Development Corporation and Damodar Valley Corporation. All these power plants are coal-based.

76. **Sanitation and Sewerage**. In the core city area all properties, except the slums, are directly connected to the underground sewer network, meaning a total number of 358,750 households directly connected which is equivalent to 75% of all households in the core city area. The slum areas are in general served by communal toilets connected to septic tanks. In the outer areas served by KEIP a total number of 70,000 house connections would be constructed once the project is finalized in June 2012. This means a coverage of 22% of the total population in the KEIP areas. In the outer areas not yet served house connections to underground sewers don't exist by lack of any underground sewer system, meaning 0% coverage. This brings the average total for the entire KMC area at 44% as compared to the national target level of 100% but nevertheless it is way above the national average of 28%.

77. According to the 2001 Census 96% of the KMC population has access to individual or community toilets within walking distance in the service area. This compares favorably with the national average of 82% and is near the national benchmark of 100%. Most of the KMC slum areas are provided with communal toilet facilities within walking distance. Only 4% of the KMC population has no sanitation facilities and uses gutters, open drains, channels or vacant land for sanitation. This is mostly in the urban fringe areas where population densities are still relatively low. The 2011 Census results in this respect are not yet available but it is likely that the percentage of the population without toilets would further decrease over the years.

78. The collection efficiency of sewage is 71%, which is higher than the percentage of people with direct sewer connections because it also includes sewage collected through the interceptor sewer system. The collection efficiency is around 90% in the core city area as well as in the KEIP areas. The remaining outer areas have no formal sewer system yet and collection is zero.

79. The treatment capacity of the existing treatment plants and the East Kolkata Wetlands (EKW) is sufficient to serve the entire central city (100%) and the KEIP areas (100%). The total average for KMC is 88% because the outer areas not yet served by KEIP generate 12% of the waste water for the entire KMC. The effluent quality at the outlets of the East Kolkata Wetlands and the existing treatment plants fully comply with national norms.

80. The extent of re-use is very high because 90% of all sewage from KMC ends up in the fisheries of the EKW where it serves as quality food for the fisheries. Effluent from other treatment facilities is partially re-used for agricultural purposes before it finally discharges into the Hooghly River. On average 93% of waste water generated in KMC is re-used, comparing very favourable to the national target of 20%.

81. **Solid Waste Management**. The solid waste management system consists of three main components: Collection, Transportation and Disposal.

82. The majority (90%) of collection is done by KMC and 10% is contracted out to private contractors. House-to-house (doorstep) collection has been introduced in 75% of the KMC area. Other areas are served by street sweepers who operate manually. Many roads are too narrow to allow access for motorized collection vehicles. Primary collection is mostly by open

hand carts and delivery at secondary collection sites (vats). There are 694 such collection points – 392 open vats and 302 bulk containers or direct loading. Open vats are generally poorly managed with spillage of disposed waste from the bulk containers or from open vat boundaries creating in most cases an unhygienic environment. In 2011 source segregation has been introduced as a pilot project in 7 wards.

83. In 2011 75% of the KMC area is served by a door-to-door collection system and 25% by street sweeping. This compares favorably to the national average of 51% but is still far below the 100% benchmark target. In the core city area 80% of the population is served by door-to-door collection. In the outer areas this is less (60% - 70%). Collection frequency also differs. The central city and most of the surrounding outer areas are served daily, but some of the lower density fringe areas are only served once or twice per week.

84. KMC estimates that only 3% of waste generated is not collected but (illegally) disposed in channels, vacant land and used for infill, meaning that collection efficiency is close to the national benchmark target of 100%.

85. In 2011 source segregation has been introduced as a pilot project in 7 wards (33, 47, 64, 103, 110, 115 and 130) covering only 4.4 % of the KMC population. Informal segregation takes place at all stages of waste processing. Status baseline 2011 is 13% recycling and 7% composting making a total of 20%. Compared to the national target benchmark of 80% KMC still has a long way to go. In the central city area the level of waste recovery is higher (22%) than in the outer urban areas (15%). Recycling is mainly practiced informally by rag pickers. The privately operated composting plant at Dhapa processes 300 tonnes of biodegradable waste per day, mainly collected from markets.

86. From secondary collection sites the waste is transported in trucks to the final disposal site. KMC transports 30% of waste, while 70% of solid waste transportation is contracted out to the private sector. Private contractors mostly use open trucks with a tarpaulin covering the waste. They make about 600 trips per day carrying an average of about 5.5 MT per trip. The remaining 30% of the total collected waste is transported by municipal vehicles making about 315 daily trips carrying on average about 3.5-4.9 MT per trip. KMC has 125 tipper trucks and 137 dumper placers, 15 tractor trailers, 17 wheel loaders and 12 mechanical sweepers, 32 street sweeping/washing vehicles and 8 wrecker vans daily in operation. KMC has eight garages where transportation vehicles are stationed. Major vat points that accommodate garbage more than 30 MT are serviced from Dhapa garage with Pay loaders and 11 m3 capacity Tipper Trucks. Other vats are serviced by manual loading vehicles and Dumper placers. The street washing vehicles clean major thoroughfares every day. Three of the refuse collector vehicles are engaged for cleaning wastes from 300 trash bins along sixteen major roads.

87. KMC has two waste disposal sites. The Garden Reach dumping ground is a small facility with little remaining capacity. It receives currently about 10 MT/day of waste mainly from borough XV nearby. The main dumping ground is at Dhapa in the east of KMC at approximately 8 km from the city centre. This dump site is nearing its maximum capacity and has been authorized by West Bengal Pollution Control Board to operate for one more year only. It received an average of 4286 MT/day solid waste in 2011 out of which 300 MT/day was diverted to the privately operated Dhapa composting plant.

88. The extent of scientific disposal of solid waste is currently zero and should become 100% in accordance with the national benchmark target. Both the Dhapa and the Garden Reach dump site are not operated as sanitary landfill in accordance with national standards. There is no formal leachate treatment, no proper soil cover and informal, unorganized rag pickers operate at the sites. KMC has an interim permit from WBPCB to operate the Dhapa landfill facility for one year.

89. West Bengal has one Common Hazardous Waste Treatment, Storage and Disposal Facility (CHWTSDF) at Haldia (about 100 km south of Kolkata) that commenced operations in 2005. The facility was jointly developed by the Haldia Development Authority and the Hyderabad based private company, M/s Ramky Enviro Engineers Ltd. who formed a joint venture company named M/s West Bengal Waste Management limited (WBWML) for the development and operation of the facility. The CHWTSDF at Haldia operated by M/s WBWML has completed almost four years of successful operation. The facility caters to units in the entire state of West Bengal. As on March 2009, the membership strength of the unit was 466 and it increased to 528 in March 2010. The first cell of the landfill which was initially built over 1.99 acres was later extended over 2.92 acre. Further expansion by construction of another cell over 2.64 acres has been undertaken recently. Till March 2009, 64594.431 MT of hazardous waste had been disposed in the landfill and the quantity rose to 93215.059 MT in March 2010.

D. Social and Cultural Resources

90. **Communities and Population.** The population of the KMC area is 4.45 million with a growth rate -1.93% (2001 to 2011). Approximately one third (32%) of the KMC population lives in bustees and substandard housing. The Project team prepared population projections to 2022 based on the using previous census data of 2001, 1991 and 1981. These projections show a declining population trend for the KMC area, increasing from 4.38 million in 1991 to 4.56 million in 2022. This hike will indicate a general growth of population in the south and south-eastern part of Kolkata which has a tremendous growth potential. The average household no. for the total KMC area is 972,264 and the average household size of Kolkata Municipal Corporation is 4.61 in 2011. Population density of KMC is very high 24,783 persons/sq.km. in 2011. Household numbers are 972,264 and average household size is 4.61 in 2011.

91. **Institutions.** A number of institutions are present in the KMC area and may have a role in the Project's development. These can be classified in to several categories, as follows: government administration and services, police and security, urban development, and environmental protection.

92. **Government administration and services. .** The agency with the most important role in the Project is KMC. Municipal administration in Kolkata dates from 1727. The functions of the first Corporation were then limited to provision of local roads and drainage and conservancy service. The present system of municipal government has come through an evolutionary process over a long period, resulting in KMC being assigned the responsibility for the following services: regulation of land use; regulation of construction of buildings; planning for economic and social development; roads and bridges; water supply; public health, sanitation, conservancy and solid waste management; urban forestry, protection of the environment and promotion of ecological aspects; safeguarding interests of weaker sections of society, including the handicapped; slum improvement; urban poverty alleviation; provision of urban amenities such as parks gardens, playgrounds; promotion of cultural, educational and aesthetic aspects; burials and burial grounds, cremation and cremation grounds; cattle grounds, prevention of cruelty to animals; vital statistics including registration of births and deaths; public amenities including street lighting, parking lots, bus stops and public conveyance; and regulation of slaughterhouses and tanneries.

93. **Environmental protection.** The WBPCB has the overall responsibility to set policy and standards for the protection of the environment, following the lead of the Central Pollution Control Board. This includes air, noise, hazardous waste, and water quality standards, and the requirement for the preparation of EIAs. The WBPCB also carries out water and air quality monitoring, and might be involved in the environmental quality

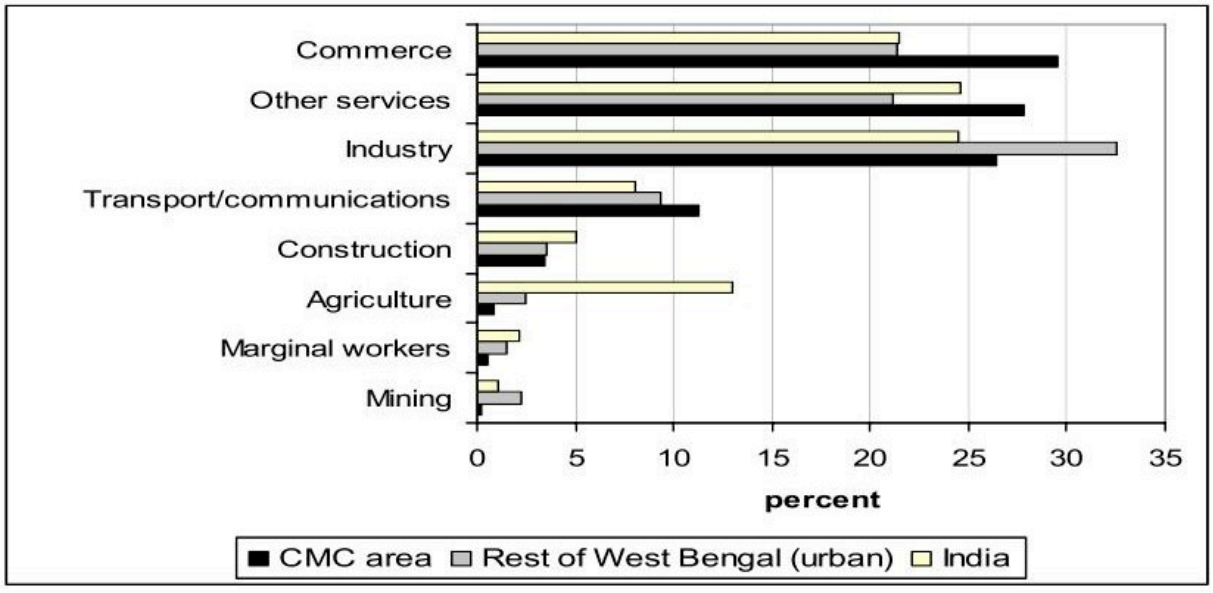
monitoring program that will be a part of this project. No designated protected area lies within 10 km radius of the subproject sites. Kolkata does not fall under the Coastal Regulation Zone (CRZ).

94. **Education.** The population of is fairly literate, around 90% of males and females being literate. School enrollment is moderately for all segments of the population. 85% of males and 80% of females report at least a primary school education. 27% of the population has completed secondary school and 9% have graduated from college.

95. **Religion.** About 80% of the residents of KMC are Hindus. Most belong to general castes (84%), with the balance belonging to scheduled caste or scheduled tribes. There are significant concentrations of Muslims in the bustees.

96. **Languages.** The mother tongue reported by 74% of the population is Bengali, with Hindi and Urdu represented by 14% and 12% of the population respectively. Interestingly, those living in standard residential housing report 91% Bengali, while those in sub-standard housing reporting only 58% Bengali and 25% Hindi.

97. **Occupation.** About 6% of households report unemployment: 5% for those living in standard residential areas and 7% for those in bustees and refugee colonies. Of those employed, there is a broad variety of employment types, with no single category predominating over others.



98. **Education, Health and Health Care Facilities**. A listing in 2009 in Boroughs XI-XV indicated that there are more than 150 government and private educational institutes within the Boroughs. The list includes primary, secondary and higher secondary schools, degree colleges, technical and professional institutes. A number of reputed institutions has recently been established in ward 108. Public health varies according to socio-economic level and location. As of 2008, there are more than forty health centers, government hospitals/dispensaries, private hospitals and nursing homes within the study area. Mention may be made of Ruby General Hospital (ward 108), Manovikash Kendra (ward 108), R N Tagore International Institute for Cardiac Sciences (ward 109), Peerless Hospital and B K Roy Research Centre (ward 109) and Thakurpukur Cancer Hospital (ward 124). Health care facilities appear to be on the low side in wards 112, 113 and 122. 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.

99. **Aesthetic Resources.** The main aesthetic resources of Kolkata as a whole consist of historic buildings and many small lakes and other water bodies. Both of these resources are recognized as being in need of restoration, and a number of efforts are under way to accomplish this. Foreign tourism is not yet a well-developed industry in Kolkata, and there are opportunities for making tourism a profitable industry while still conserving the urban beauty of the area.

100. **Cultural Resources.** The buildings of north Kolkata reflect the traditional culture of the zamindar and rajas, whereas the structures in central Kolkata reflect the British colonial style. The buildings and churches in this area are around 50 to 100 years old. Most of the archaeological monuments are maintained either by the Department of Archaeology or by private concerns like Rama Krishna Mission or Trusts. Some of the valuable monuments are: Metcalfe Hall, Gwalior Monument, Victoria Memorial, Shahid Minar, Indian Museum, Cossipore, Club, Town Hall, Tagore's Baitak Khana, Fort William, Vivekananda's house, and Roy's Naroial – Cossipore. There are also a few monuments at Tollygunge and Kalighat areas

101. As the subproject is concentrated primarily in the added areas of KMC, the project will not hamper any precincts of cultural or historical significance.

102. **Recreational and other facilities.** More than twenty large play grounds are present in Boroughs XI to XV area. There are innumerable temples, maths, mosques and a few churches scattered over the area. Housing complexes with their own recreational areas have come up especially in wards, 108, 109 and 110.

IV. ANTICIPATED IMPACTS AND MITIGATION MEASURES

103. **Methodology.** Issues for consideration have been raised by the following means: (i) input from interested and affected people; (ii) desktop research of information relevant to the proposed subproject; (iii) site visit, limited measurements by specialized agency and professional assessment by environment specialist engaged by the implementing agency; and (iv) evaluation of proposed design scope and potential impacts based on the environment specialist's past experience.

104. The methodology used to rate the impacts was qualitative. Each category was divided into a number of different levels. These levels were then assigned various criteria as indicated in Table 33:

Table 33: Summary of Quantifiers and Qualifiers Used for Assessment Purposes

Duration (time-scale)	Short-term	Impact restricted to construction (0-18 months).
	Medium-term	Impact will continue throughout operation (after construction 30 years).
	Long-term	Impacts will exist beyond the life of the S&D works (>50 years)
	Permanent	Impacts will have permanent potential
Geographic spatial scale	Site	The impact will be limited to within the site boundaries.
	Local	The impact will affect surrounding areas.
	Regional	The impact will affect areas far beyond the site boundary but limited to the State of West Bengal.
Significance rating before mitigation (positive / negative)	Low	The impact will have a minimal effect on the environment.
	Medium	The impact will result in a measurable deterioration in the environment.
	High	The impact will cause a significant deterioration in the environment.

Mitigation	n/a	No mitigation necessary.
	Full	Full mitigation/reversal of the impact is possible.
	Partial	Only partial mitigation/reversal of the impact is possible
	None	No mitigation or reversal of the impact is possible
Degree of Certainty	Definite	(>90%)
	Possible	(50%)
	Unsure	(<40%)

Source: Kolkata Municipal Corporation

105. Categorization of the subproject has been undertaken using ADB's REA Checklist for Sewerage & Drainage (Pumping Station) (Appendix 5)

A. Planning and Design Phase

106. The subproject will be located in properties held by KMC and through public ROWs and existing roads. Hence land acquisition and encroachment on private property will not be required.

107. The plan and technical design of the S&D subproject are based on the specifications of the Manual on Water Supply and Treatment developed by the Ministry of Urban Development's Central Public Health and Environmental Engineering Organization. Engineering decisions considered the results of the population to be served, design period, the nature and location of facilities to be provided, the optimum utilization of the existing network and wastewater disposal. S&D management aims at improving the S&D system.

108. The salient design features are presented in Table 34.

Table 34. Salient design considerations of S&D works

Parameter	Design Consideration
Design Period	The subproject is designed to meet the requirements over 2012 to 2042.
Design Population	The forecasted beneficiary population of 217,051 is estimated with due regard to all the factors governing the future growth and development of KMC until year 2042
Design to meet S&D bench mark provision	100% toilet coverage, 100% sewerage coverage, 100% sewage collection efficiency, and 100% sewage treatment.
Other technical Pressure requirements	Gravity system, pressure main to be designed for PN 1.0
Quality standards	pH = 5.5 to 9.0, SS = 100 mg/L, BOD = 30 mg/L (effluent to inland surface water)
Pumping stations	Circular sump with submersible pumps and pump house constructed at ground level.
Design of pumping stations	Sump, inlet channel, screen chamber, etc. to be designed as per computed flow.
Design of pumps and accessoriesAlignment of transmission mains	Alignment of the S&D lines is guided by public ROWs and existing road alignment.
Design of the pipe work	Trunk sewer to be designed as gravity system, SWF and DWF pipes to be designed as pressure mains
Pipe materials	RCC for gravity main, MS and DI for SWF and DWF mains, respectively.
Pipe laying	The pipe will be laid for trunk sewers using micro-tunneling. Micro-tunneling is a process that uses a remotely controlled Micro-tunnel Boring Machine (MTBM) combined with the pipe jacking technique to directly install the pipelines underground in a single pass. This process avoids the need to have long stretches of open trench for pipe laying. The pipe will be laid for laterals by conventional open trenching in stretches along the ROW
DWF Management	The subproject does not include ant treatment facility for the present
SWF Management	SWF mixed with sewage to be disposed off in Churial canal. Dilution of sewage would not pose any health issue.
Sanitation systems	100% coverage of sewer connection from household is targeted and to be provided by KMC

Parameter	Design Consideration
Drainage and hydrology	The subproject has been designed to drain freely to the pumping station in order to prevent water logging in streets, roads, and open places. Pollutants settling on the road surface and litter will be washed off during rain. Runoff from the subproject will produce a highly variable discharge in terms of volume and quality and in most instances will have no discernable environmental impact.
Ecological diversity	The subproject is situated within an existing built up area and no areas of ecological diversity occur within the subproject. Due to the nature and locality of the subproject there is unlikely to any impacts on biodiversity within the area. However the subproject may affect existing roadside trees. Permission will be obtained from the Forest Directorate for felling trees if required prior to start of civil works. Any landscaping to be undertaken will be done with locally indigenous species and low maintenance requirements.
Land use and livelihoods	The key efforts undertaken to minimize impacts are: (i) before the preparation of engineering design, a survey of the properties of the pipe laying alignment was conducted with regard to their ownership with the objective that minimum proprietary land is utilized for the subproject; (ii) diverting the alignment towards the available government land and ROWs to avoid land acquisition; and (iv) use of micro-tunneling, as it is particularly suited for the urban environment where the disruption of business, traffic and other utilities is not acceptable for commercial, political and safety reasons. A Resettlement Plan has been prepared to address involuntary resettlement impacts.
Traffic flow and access	Due to the location and nature of the subproject, there will be interference with accesses along the isolated spots along Diamond Harbour road and in stretches in the lateral roads branching off from Diamond Harbour road towards west. A Traffic Management Plan will be developed to provide vehicle and pedestrian access and maintain community linkages. Local communities along the alignment will be continuously consulted regarding location of construction camps, access and hauling routes and other likely disturbances during construction. The road closure together with the proposed detours will be communicated via advertising, pamphlets, radio broadcasts, road signages, etc. The implementation of the road detours will also be dependent on advance road signages indicating the road detour and alternative routes. KMC will coordinate with the traffic police for the implementation of the Traffic Management Plan.
Infrastructure and services	There are a number of existing infrastructure (roads, telecommunication lines, power lines and various pipelines along the alignment of the transmission mains. To mitigate the adverse impacts due to relocation of the utilities, PMU will (i) identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; and (ii) require construction contractors to prepare a contingency plan
Environmental Monitoring	The environmental laws place a responsibility on KMC not to pump untreated DWF in the canal and the DWF pumping will commence only when the monitor outflows from the STP is constructed and transmit the results of such monitoring to WBPCB. The regulations also specify the parameters to be monitored, the frequency of monitoring and the method of sampling. The WBPCB can independently sample the quality of the receiving waters, and this data can be used to assess whether the STPs are discharging effluents of acceptable quality.

109. The design considerations were discussed with the specialists responsible for the engineering aspects, and as a result measures have already been included in the subproject design for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design. Alternatives of project components in respect to location, technology and design are discussed in Tables 35.

Table 35: Design Considerations for the Pipe laying Methodology

	Parameters	Micro-Tunneling	Open Trenching
1	Construction methodology	Modern; boring with pipe jacking technique	Primitive; manual
2	Accidental damage to utilities	Below utility lines	Invasive through or avoiding the utility lines; often utility lines are required to be shifted
3	Waste (solid and liquid)	Solid waste handling	Handling volume is more; some part of the

	Parameters	Micro-Tunneling	Open Trenching
	handling and disposal during construction	volume is less; disposal of waste is somewhat complicated	excavated material need to be put back again to fill up the trench after pipe is placed; construction method is hazardous
4	Pollution potential (air, noise, vibration, surface water, etc) during construction	Less severe as operation is below the ground without disturbing the surface	Open trenching gives rise air, water and noise pollution
5	Relative hazards during construction	Same degree	Same degree
6	Relative loss of business due to construction	Loss of business is minimal	Loss of business is likely to be more if the roads are narrow and traffic is heavy
7	Inconvenience to people using ROW	Less likely	More likely
8	Cost	More compared to trenching	Much less
9	Construction time	Less	More
10	Maintenance	Same effort is required	Same effort is required
	Recommendation	Micro-tunneling	

B. Construction Phase

110. **Construction of Pumping Stations.** The civil works, except construction of the micro-tunneling, will involve earth-moving and excavation; mostly those involved in common and simple construction works. Materials will be brought in on trucks and offloaded by hand. Excavation, if necessary will be by manual digging. Excess spoils generated will be loaded into trucks for disposal.

111. **Micro-tunneling for the pipe laying .** The works will be along or adjacent to roads' un-used ROWs below the level of utilities avoiding properties. Intermittent shafts of access will be dug using a backhoe digger, supplemented by manual digging where necessary. Excavated soil will be placed alongside and also the pipes (brought to site on trucks and stored on unused land nearby).

112. Table 36 presents an indication of what activities and facilities are likely to be undertaken during construction of the subproject, including the associated inputs and outputs.

Table 36: Summary of activities and facilities, resource use, and produced outputs during Construction Phase

Activities and Facilities	Inputs/Resource Use	Outputs/Waste Production
Construction camp and its associated facilities (including lay-down areas) Storage camps and lay-down areas Materials and equipment stockpiles Handling and storage of hazardous materials including chemicals additives, gravel, cement, concrete and lubricants Source of water Vegetation clearance Bulk earthworks, grading and contouring. Drilling and blasting	Cement Chemical additives used in concrete / asphalt (i.e. retarders) Paving blocks/bricks Aggregate (sand and stone) Gravel Water Drinking, cooking and sanitation at construction camps Water for dust suppression Water applied to base and sub-base layers during compaction Water for application to sub-base	Old asphalt (removed from road carriageway during road restoration)[5] Waste concrete and other construction rubble Used fuels, lubricants, solvents and other hazardous waste General waste Contaminated soil Soil contaminated with petrochemicals (i.e. oils and lubricants) and other chemicals Sewage and grey water

[5] The opening of small portions of the roads for micro-tunnelling may involve the stripping and demolition of old asphalt layers. Ideally, old asphalt shall be reused during restoration of the road in order to avoid large quantities of waste being produced. However, depending on the availability and cost of virgin aggregate in the area through which the road is aligned, reusing the old asphalt may be more costly than using virgin aggregate.

Activities and Facilities	Inputs/Resource Use	Outputs/Waste Production
Movement of construction staff, equipment and materials Importation of selected materials Temporary detours Noise and vibrations Dust suppression Waste production and temporary storage/disposal i.e. used fuels, waste concrete and bitumen, spoil materials and general waste Use of asphalt/bitumen (and associated storage and mixing areas, chemicals) Concrete batching plan (and associated storage and mixing areas, chemicals) Rehabilitation of disturbed areas Interaction between construction workforce and local communities Management of the passing pedestrians and points of congestion Implementation of the Resettlement Plan prior to start of construction Reminders to affected people of construction with timeframes	and base layers prior to compaction Petrochemicals Other chemicals/lubricants/paints Construction vehicles, machinery and equipment Temporary energy supply to construction camps Topsoil used during revegetation and rehabilitation Plant material for re-vegetation (seeds, sods, plant specimens) Labor Recruitment of construction workforce Skills training Public movement control need barriers (not just danger tape) to protect people from trenches during construction	(temporary construction camp sanitation) Spoil material (excess soil removed during excavations) Noise and vibrations (construction vehicles and machinery) Lighting at construction camps, equipment yards and lay-down areas Plant material removed from servitude/right-of-way during vegetation clearance Smoke and fumes Burning of waste Burning of vegetation cover Fires used for cooking and space heating (construction camps) Vehicle exhaust emissions

113. The following table (Table 37) outlines potential impacts during the construction phase gathered from a process that included a review of available documentation, verified during the site visit, i.e. how, where and when the proposed development can interact and affect the environment significantly, and details what mitigation measures may be taken to counteract these impacts.

Table 37: Summary of anticipated potential environmental impacts during Construction Phase

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
Climate	The nature and intensity of rainfall events in an area, has implications for storm water management. Smoke from burning activities could be wider spread on windy days especially when dust could be blown off site.	Consider seasonal climatic variations during scheduling of construction activities in the area. Do excavations and other clearing activities only during agreed working times and permitted weather conditions. Implement storm water control as per method approved by PMU. No open fires permitted on site	Low (negative)	Site	Short-term	Full Mitigation Possible
Air Quality	Sensitive receptors (e.g. hospitals, schools, churches) may be affected temporarily by increased traffic and related impacts during the construction phase (from the proposed detour). Fugitive dust can also impact on roadside air quality during construction. Exhaust fumes from construction machinery, and potential smoke from cooking fires. Burning of waste and cleared vegetation Odors from use of toilet 'facilities' other than provided facilities.	Guidelines that deal with the control of air pollution and dusts on site have been outlined in the Environmental Management Plan (EMP) Ensure compliance with the Air Act. Ensure compliance with emission standards Undertake monitoring of air pollution levels in potential problem areas. Manage (including storage, transport, handling and disposal) hazardous substances used. Avoid dust generating construction activities during strong winds. Cover soil loads in transit. Cover stockpiles of soil or apply suitable dust palliative such as water or commercial dust suppressants. Regularly service vehicles off-site in order to limit gaseous emissions. No open fires permitted on site Place portable toilets on-site and maintain on a daily basis.	Medium (negative)	Local	Short-term	Partial Mitigation Possible
Geology and soil	Strong water flows into open excavations below the water table will occur, causing micro-tunnel collapse. Layers of mixed fill cover natural ground surface in many places. Contamination from spillage of petroleum products, spent engine oil and oil leaks from construction vehicle maintenance taking place on site.	The design of the site drainage system is adequate to control runoff from the micro-tunnels and open areas in line with topographical features of the site. Rehabilitate all sites during construction including construction camps, stockpile area, temporary access and hauling routes, as soon as possible after the disturbance has ceased. Contractor to exercise strict care in the disposal of construction waste, with proof of disposal at an approved site provided after offloading each waste	Medium (negative)	Site	Short-term	Full Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
		load and this logged/registered. Contain contaminated water and dispose off site at an approved disposal site in consultation with WBPCB. Dispose of waste from the oil interceptors only through suitable waste-handling contractor and request for safe disposal certificates. Mix cement, concrete and chemicals on a concrete plinth and contain spillages or overflows into the soil. Do not allow vehicle maintenance on site. If oil spills occur, dispose contaminated soil at a disposal site in consultation with WBPCB. Stockpile subsoil and overburden in all construction and lay down areas. Protect topsoil and subsoil from contamination. Return for backfilling in the correct soil horizon order.				
Drainage and hydrology	The proposed development is situated within an existing built up area. Due to the nature and locality of the subproject there is unlikely any significant impacts on water resources within the immediate area.	The site surface has been engineered and shaped in such a way that rapid and efficient evacuation of runoff is achieved. Provide containment areas for potential pollutants at construction camps, refueling, depots, asphalt plants and concrete batching plants. Implement waste management practices. Control and manage transport, storage, handling and disposal of hazardous substances.	Medium (negative)	Site	Short-term	Full Mitigation Possible
Biodiversity Fauna and Flora	The proposed development is situated within an existing built up area. No areas of ecological diversity occur within the subproject location. Due to the nature and locality of the subproject there is unlikely to any significant impacts on biodiversity within the area The pipe laying for the transmission mains may however affect existing roadside trees.	Permission will be obtained from the CMC for the cutting/felling of trees prior to start of civil works. Ensure any landscaping to be undertaken will be done with locally indigenous species and low maintenance requirements.	Low (negative)	Site	Short-term	Full Mitigation Possible
Land Uses	Due to the location and nature of the subproject, there will be interference with access	KMC has consulted with various organizations, departments, etc within the area and will be continued during the construction phase.	Medium (negative)	Local	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
	Existing public transport facilities and operations will be affected by the road closure and detours. Shops and establishments are located along the transmission mains alignment therefore will need to be relocated during construction. This may impact on livelihoods. There will be disruptions to health services, education services, local businesses, transport services, pedestrian movements, due to traffic and construction related noise, visual, and air pollution.	Put a sign of "Keep Clear" near critical roads (e.g. in front of fire and police stations and hospitals). Consult with local departments, organizations, etc regarding location of construction camps, access and hauling routes, and other likely disturbances during construction. Provide clear and realistic information regarding detours and alternative accesses for local communities and businesses in order to prevent unrealistic expectations. Provide clear and realistic information regarding employment opportunities and other benefits for local communities in order to prevent unrealistic expectations. Make use of local labor, materials, goods and services as far as possible Provide walkways and metal sheets where required to maintain access across for people and vehicles. Increase workforce in front of critical areas such as institutions, place of worship, business establishment, hospitals, and schools. Consult businesses and institutions regarding operating hours and factoring this in work schedules. Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.				
Infrastructure and Services	There is likely to have temporary disruption of infrastructure and services during the pipe laying of the transmission mains. There are a number of existing infrastructure and services (roads, railway lines, telecommunication lines, power lines and various pipelines within the vicinity of the subproject.	Undertake utility shifting prior to commencing pipe laying/micro-tunneling. Keep construction-related disturbances to a minimum. Consult with affected service providers regarding impacts on access to infrastructure and services and alternatives. Consult with affected communities or businesses prior to foreseeable disruptions, for example notifying residents of a temporary severance of water supply.	Low (negative)	Local	Short-term	Full Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
		Provide backup or alternative services during construction-related disruptions, for example by providing generators for power supply. Provide access points to infrastructure and services. Monitor complaints by the public.				
Traffic	Increased volume of construction vehicles on the roads may lead to increased wear and tear of roads in the vicinity of the subproject site. Road safety concerns due to slow moving construction vehicles. Traffic flow within the vicinity will be affected. The temporary road closure will result in a decrease in overall network performance in terms of queuing delay, travel times/speeds. The road closure will impact on a public transport operations and routing. On street parking and loading bays will be affected by the proposed road closure. Pedestrian movements will be affected by the road closure.	Reroute traffic and close roads according the Traffic Management Plan (TMP). The objective of the TMP is to ensure safety of all the road-users along the work zone and to address: (i) protection of work crews from hazards associated with moving traffic; (ii) mitigation of the adverse impact to the road capacity and delays to the road-users; (iii) maintenance of access to adjoining properties; and (iv) issues that may delay the subproject works. Negotiate with privately-owned public transport operators regarding the affected public transport facilities and routing. Negotiate with business owners and social service operations regarding the loss of parking and loading bays. Clear roads signs will be erected for the full length of the construction period. Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints. Ensure the City Traffic Police will be available on site. Communicate road closure together with the proposed detour via advertising, pamphlets, radio broadcasts, road signage, etc. The implementation of the road detour is also dependent on advance road signage indicating the road detour and alternative routes. Define clearly construction routes. Strictly control access of all construction and material delivery vehicles. Enforce speed limits.	High (negative)	Regional	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
		Do not allow deliveries during peak traffic hours				
Health and Safety	Danger of construction related injuries. Open fires in construction camp can result in accidents Safety of workers and general public must be ensured. Poor waste management practices and unhygienic conditions at temporary ablution facilities can breed diseases. Standing water due to inadequate storm water drainage systems, inadequate waste management practices, pose a health hazard to providing breeding grounds for disease vectors such as mosquitoes, flies and snails. The use of hazardous chemicals in the micro-tunneling and restoration of roads can pose potential environmental, health and safety risks. Road safety may be affected during construction, especially when traffic is detoured.	Implement good housekeeping practices at the construction camp. Strictly implement health and safety measures and audit on a regular basis. Secure enclosed construction site. Use reputable contractors. Provide warning signs of hazardous working areas. Clearly demarcate excavations and provide barriers (not just danger tape) to protect pedestrians from open trenches. Thoroughly train workers assigned to dangerous equipment. Workers have the right to refuse work in unsafe conditions. Undertake waste management practices. Control speed and movement of construction vehicles Exclude public from the site Ensure all workers are provided with and use Personal Protective Equipment. Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas Ensure that qualified first-aid can be provided at all times. Ensure equipped first-aid stations are easily accessible throughout the site; Provide medical insurance coverage for workers. Provide clean eating areas where workers are not exposed to hazardous or noxious substances; Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; Ensure moving equipment is outfitted with audible back-up alarms; Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment,	High (negative)	Site and Local	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
		and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate.				
Noise and Vibrations	Sensitive receptors (hospitals, schools, churches) may be affected temporarily by increased traffic and related impacts Use of heavy vehicles and equipment may generate high levels of noise. Vibrations resulting from bulk earthworks, micro-tunneling and compaction may create significant disturbances to nearby people and businesses. Disturbance from afterhours work.	Locate concrete batching, asphalt, crushing plants, lay down areas and construction camps away from sensitive receptors. Restrict construction activities to reasonable working hours where near sensitive receptors. Keep adjacent landowners informed of unusually noisy activities planned. Regulate roadworthiness of vehicles. Ensure that machinery in a good state of maintenance. Fit and maintain silencers to all machinery on site. Monitor noise levels in potential problem areas.	High (negative)	Local	Short-term	Partial Mitigation Possible
Aesthetics, Landscape Character, and Sense of Place	The presence of heavy duty vehicles and equipment, temporary structures at construction camps, stockpiles, may result in impacts on aesthetics and landscape character	Properly fence off storage areas. Collect all domestic solid waste central point of disposal and feed into the city waste collection system. Contractor to exercise strict care in disposing construction waste, with proof of disposal at the approved site provided after offloading each waste load and this logged/registered. Identify suitable waste disposal site with enough capacity to hold additional waste to be generated by the construction activities. Retain mature trees on and around the site where possible. Remove unwanted material and litter on a frequent basis.	Medium (negative)	Local	Short-term	Partial Mitigation Definite
Workers Conduct	Construction workers on site disrupting adjacent land uses by creating noise, generating litter, and possible loitering.	Ensure strict control of laborers Minimize working hours to normal working times Control littering Ensure no overnight accommodation is provided.	Low (negative)	Local	Short-term	Full Mitigation Definite
Employment Generation	The subproject will provide employment opportunities for local people during construction.	Employ local (unskilled) labor if possible Training of labor to benefit individuals beyond completion of the subproject.	Medium (positive)	Local	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	Mitigation	Significance before Mitigation	Geographic Spatial Scale	Duration	Mitigation
	Expectations regarding new employment will be high especially among the unemployed individuals in the area. Labor gathering at the site for work can be a safety and security issue, and must be avoided. The training of unskilled or previously unemployed persons will add to the skills base of the area.	Ensure recruitment of labors will take place offsite. Ensure at least 50% of all labor is from surrounding communities in the contractual documentation.				
Archaeological and Cultural Characteristics	The proposed development will not require demolition of ASI- or state-protected monuments and buildings	Ensure that construction staff members are aware of the likelihood of heritage resources being unearthed and of the scientific importance of such discoveries. Contact ASI or the State Department of Archaeology if any graves be discovered and all activities will be ceased until further notice. Contact ASI or the State Department of Archaeology if any heritage resources or objects, defined in the Act, be discovered and all activities will be ceased until further notice. Cease all activities immediately and do not move any heritage object found without prior consultation with ASI or the State Department of Archaeology No structures older than 100 years will be allowed to be demolished, altered or destructed without a permit from ASI or the State Department of Archaeology.				

C. Operation and Maintenance Phase

114. The system have a design life of 30 years, during which shall not require major repairs or refurbishments and shall operate with little maintenance beyond routine actions required to keep the pumps and other equipment in working order. The stability and integrity of the system will be monitored periodically to detect problems and allow remedial action if required. Repairs will be small-scale involving manual, temporary, and short-term works involving regular checking and recording of performance for signs of deterioration, servicing and replacement of parts.

115. The main requirement for maintenance of the S&D conveyance system will be for the detection and repair of leaks. The generally flat topography and the usage of good quality pipes shall mean that pipeline breaks are very rare, and that leaks are mainly limited to joints between pipes.

116. Table 38 presents an indication of what activities and facilities are likely to be undertaken during operation and maintenance of the subproject, including the associated inputs and outputs.

Table 38: Summary of Activities and Facilities, Resource Use, and Produced Outputs during Operation and Maintenance Phase

Activities and Facilities	Inputs/Resource Use	Outputs/Waste Production
Operation activities Wastewater flow and pumping Storm water flow and pumping Maintenance activities Upkeep and repair of pumps Sludge removal from pumping stations and sewer lines	Labor Vehicles and equipment used for inspections and maintenance Fuels and lubricants Electricity	Wastewater Storm water Sludge Potential for water source contamination

117. The following Table 39 outlines potential impacts during the operation and maintenance phase gathered from a process that included a review of available documentation, verified during the site visit, i.e. how, where and when the proposed development can interact and affect the environment significantly, and details what mitigation measures may be taken to counteract these impacts.

Table 39: Summary of Anticipated Potential Environmental Impacts During Operation and Maintenance Phase

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	**Mitigation**	**Significance before Mitigation**	**Geographic Spatial Scale**	**Duration**	**Mitigation**
Air Quality	Sensitive receptors (e.g. hospitals, schools, churches) may be affected temporarily by increased traffic and related impacts during S&D network maintenance.	Ensure compliance with the Air Act. Ensure compliance with emission standards Regularly service vehicles off-site in order to limit gaseous emissions.	Low (negative)	Local	Short-term	Partial Mitigation Possible
Biodiversity Fauna and Flora	The proposed development is situated within an existing built up locality. No areas of ecological diversity occur within the subproject location. Due to the nature and locality of the subproject there is unlikely to any significant impacts on biodiversity within the area during maintenance works	Ensure no accidental damage to local flora and fauna.	Low (negative)	Site	Short-term	Full Mitigation Possible
Land Uses	Due to the location and nature of the subproject, there will be interference with access during maintenance works Existing public transport facilities and operations will be affected by the road closure and detours. There will be disruptions to health services, education services, local businesses, transport services, pedestrian movements, due to traffic and maintenance-related noise, visual, and air pollution.	Put a sign of “Keep Clear” near critical roads (e.g. in front of fire and police stations and hospitals). Consult with local departments, organizations, etc regarding location of construction camps, access and hauling routes, and other likely disturbances. Provide clear and realistic information regarding detours and alternative accesses for local communities and businesses in order to prevent unrealistic expectations. Provide walkways and metal sheets where required to maintain access across for people and vehicles. Increase workforce in front of critical areas such as institutions, place of worship, business establishment, hospitals, and schools. Consult businesses and institutions regarding operating hours and factoring this in work schedules. Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.	Low (negative)	Local	Short-term	Partial Mitigation Possible
Health and Safety	Danger of operations and maintenance-related injuries. Safety of workers and general public	Implement good housekeeping practices at all pumping stations . Strictly implement health and safety measures and	Low (negative)	Site and Local	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	**Mitigation**	**Significance before Mitigation**	**Geographic Spatial Scale**	**Duration**	**Mitigation**
	must be ensured. Poor waste management practices and unhygienic conditions at the improved facilities can breed diseases. Standing water due to inadequate storm water drainage systems, inadequate waste management practices, pose a health hazard to providing breeding grounds for disease vectors such as mosquitoes, flies and snails. Fire and electrocution hazards in the pumping sations.	audit on a regular basis. Provide warning signs of hazardous working areas. Clearly demarcate excavations and provide barriers (not just danger tape) to protect pedestrians from open trenches. Thoroughly train workers assigned to dangerous equipment. Workers have the right to refuse work in unsafe conditions. Undertake waste management practices. Ensure all workers are provided with Personal Protective Equipment. Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas Ensure that qualified first-aid can be provided at all times. Ensure equipped first-aid stations are easily accessible throughout the site; Provide medical insurance coverage for workers. Provide clean eating areas where workers are not exposed to hazardous or noxious substances; Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; Ensure moving equipment is outfitted with audible back-up alarms; Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate.				
Noise and Vibrations	Sensitive receptors (hospitals, schools, churches) may be affected temporarily by increased traffic and related impacts	Restrict maintenance activities to reasonable working hours where near sensitive receptors. Keep adjacent landowners informed of unusually	Low (negative)	Local	Short-term	Partial Mitigation Possible

Environmental Aspect	Summary of Implications and Mitigation		Assessment of Impacts			
	Potential Impacts	**Mitigation**	**Significance before Mitigation**	**Geographic Spatial Scale**	**Duration**	**Mitigation**
	Disturbance from after hours work.	noisy activities planned. Fit and maintain silencers to all machinery on site. Monitor noise levels in potential problem areas.				
Workers Conduct	Maintenance workers on site disrupting adjacent land uses by creating noise, generating litter, and possible loitering.	Ensure strict control of laborers Minimize working hours to normal working times Control littering	Low (negative)	Local	Short-term	Full Mitigation Definite
Solid Waste	Solid waste from screens in the pump house.	Regular removal through municipal system	High (negative)	Local	Medium-term to Long-term	Partial Mitigation Possible
Wastewater	Excess accumulation of sewage due to various reasons Excess accumulation of storm water	Ensure adequate pumping	High (negative)	Local	Medium-term to Long-term	Partial Mitigation Possible

D. Summary of Site Specific Mitigation Measures

118. The important site specific required mitigation/safeguard measures are summarized as in table (Table 40) below:

Table 40. Site Specific Mitigation Measures for the S&D Subproject

Work Component	Mitigation measures
Micro tunneling along Diamond Harbour road	1. Entry shaft for the micro-tunnels are to be located at places on the road where there are least encroachments on the ROW and least chances inconveniences to pedestrians and people living in the neighborhood. 2. The locations of the entry shafts are to be concurred by Metro railway authorities and Kolkata Police 3. A traffic management plan as approved by the above two authorities should in place before construction work commences 3. Suitable bill boards are to be put up at strategic points on the Diamond Harbour road giving salient information on the work component, time schedule and name & contact numbers of responsible persons of PMU and Contractor 4. Required security fencing is to be in place throughout the construction period of the shafts 5. Excess solid waste is to be disposed at sites pre-approved by PMU 6. First aid boxes is to be available in the construction locations 7. Safety gears are to be provided to workmen
Construction of Churial pumping station within Joka tram depot	1. Construction is to commence only after receiving written land transfer document from the present owner, the Calcutta Tramways Company 2. Excess solid waste from civil constructions is to be disposed at sites pre-approved by PMU 3. Pumps/motors are to comply with the prescribed noise standard and manufacturers' specification of noise level is to be checked when installed. 4. The pumping station is to be provided with fire extinguishers, first aid box and rubber mattings around the control panels and ear muffs for the operators 5. No untreated sewage is to be pumped in to the Churial canal; treated sewage, if any, received in the pumping station and is to be disposed, necessary authority from the WBPCB is to be obtained before hand.
Construction of Begore pumping station	1. Construction is to commence only after receiving written land transfer document from the present owner, the Airport Authority of India 2. Excess solid waste from civil constructions is to be disposed at sites pre-approved by PMU; waste water from dewatering of construction site will be disposed in water bodies/drains pre-approved by PMU 3, Diesel gene set, if used during the construction activities, is to comply with prescribed emission and noise standards 3. Pumps/motors are to comply with the prescribed noise standard and manufacturers' specification of noise level is to be checked when installed. 4. The pumping station is to be provided with fire extinguishers, first aid box, rubber mattings around the control panels and ear muffs for the operators 5. The untreated sewage is to be pumped to the Behala Flying Club P.S. from where it will be pumped to Garden Reach STP for treatment. The treated Sewage will then go to Monikhali Canal.
Construction of Santoshpur-Garden Reach STP DWF sewer line by micro-tunneling	1. Construction of entry pit at the Garden Reach STP end is to commence only after receiving written land transfer document from the present owner, the KMDA. As he micro tunneling will go below the railway line, the construction is to commence only after the receipt of written permission from the Railway authorities. 2. The proposed entry pit at the Garden Reach end is located in a low lying area, water logged as observed on 1 March, 2012. It is reported that the site becomes dry at the peak of summer and is being used as play ground during dry period. Taking this information in to consideration, the site may be free from water logging only during 3 months in a year at the maximum. As it has been estimated that the construction period of the entry pit will not be less than 6 months, pumping out of accumulated water will be required during the construction period. The disposal of the pumped water has been proposed in water logged ditches and/or low-lying areas in and around the STP. Contract clauses are to specifically include that the construction cost of the entry pit will include cost of pumping out of accumulated water by the contractor to water bodies approved in writing by the DSC Engineer. The DSC Engineer will identify the suitable disposal site for pumped water. 3. It has been proposed that part of the pathway on one side of the entry pit at STP end recently widened for a length about 30 m by KEIP, will be used as material

Work Component	Mitigation measures
	storage area leaving space for people to move in to and out of their residences connected to this path way and therefore there is no anticipated impact on access. Space will be left in the pathway by the side of entry pit for movement of residents to gain easy access to their houses 4. As the entry pit at STP end will be within a predominantly residential area construction noise should be kept at a minimum avoiding work during night time 5. Approved security fencing is to be in place throughout the construction period of the shafts 6. Excess solid waste is to be disposed at sites pre-approved by PMU 7. First aid boxes is to be available at the construction sites 8. Safety gears are to be provided to workmen 9. There are no site specific environmental issues connected with construction of entry pit at the Santoshpur PS end.

E. Cumulative Impact Assessment

119. The Begore pumping station will be an isolated civil construction work. No other major civil construction activities are known to be taking place in the area. The Churial pumping station on Diamond Harbour road will be close to currently ongoing Metro rail construction along the road. Construction of S&D lines along Diamond Harbour road will be through areas where Metro contruction is under way and may be used in future by agencies for construction of water supply, electric supply and tele-communication lines. If such construction activities are undertaken simultaneously with the KEIP construction period, such work may give rise to cumulative impact during the construction stage only. Such cumulative impact is likely to be in the nature of transient elevation in the level of air pollution and noise and inconveniences to people using the same space.

120. Table 41 summarizes the cumulative impacts resulting from the subproject when added to other present, and reasonably future actions reasonably foreseeable (30-year) period. During this time period, it is expected that many other actions will be implemented that will affect the environmental conditions.

Table 41 : Cumulative Impact Assessment of S&D subproject

	Summary of Implications and Mitigation		**Assessment of Environmental Impacts**			
Environmental Aspect	**Potential Impacts**	**Mitigation**	**Significance before Mitigation**	**Geographic Spatial Scale**	**Duration**	**Mitigation**
Improvement in S&D infrastructure	Increase in amount of pumping and treatment	KMC undertaking sewerage and drainage improvement subproject	High (negative)	Site/Local	Long-term	Full Mitigation Definite
Cumulative land use and growth-inducing impacts	With sufficient S&D facilities, development can proceed to the degree that sewerage and drainage is not a constraint	KMC to develop additional facilies beyond the design year to accommodate growth if it is to occur	High (negative)	Site/Local	Long-term	Full Mitigation Possible
Growth and development will result in the replacement of open space areas with residential and commercial development.	This development will substantially change the visual character of the area from existing conditions. This will be a	KMC to implement City Land Use plan and Zoning	High (negative)	Site/Local	Long-term	Full Mitigation Possible

	Summary of Implications and Mitigation		Assessment of Environmental Impacts			
Environmental Aspect	**Potential Impacts**	**Mitigation**	**Significance before Mitigation**	**Geographic Spatial Scale**	**Duration**	**Mitigation**
	significant and unavoidable cumulative aesthetic impact.					
Cumulative Air Quality Impacts	The subproject can collectively generate construction-related air emissions.	See mitigation measures in the EMP	Low (negative)	Site/Local	Short-term	Partial Mitigation Possible
Cumulative Noise Impacts	Noise is a localized issue that diminishes in intensity with distance from the source. Construction of the proposed facilities along with construction activities of other development in the subproject area can potentially increase construction-related noise impacts on land uses directly adjacent to the construction sites.	Such cumulative noise impacts will be temporary and will not likely occur during sensitive nighttime hours. See mitigation measures in the EMP	Low (negative)	Site/Local	Short-term	Partial Mitigation Possible
Cumulative Transportation Impacts	The subproject in combination with future growth and development could result in potentially significant construction-related traffic impacts. These include adding traffic to local roadways and lane closures when facilities (pipelines) are being installed in roadways. Minor amount of employee trips will be generated	The impacts will be temporary in nature, and standard traffic controls and notifications will be implemented during project construction Minor employee trips will not contribute substantially to cumulative long-term operational traffic impacts	Low (negative)	Site/Local	Short-term	Partial Mitigation Possible

V. ANALYSIS OF ALTERNATIVES

121. In the preceding paragraph/section a discussion was made on existing environment scenario of the "Project Influenced Areas" of proposed Begore and Churial pumping stations as well as of the proposed S&D works along Diamond Harbour road & Diamond Harbour road catchment laterals and of the Santoshpur Garden Reach Pumping main. Technical and locational details of the subproject components were also examined. It is assessed from the impact study that majority of the impacts will be caused during construction phase of the project and are temporary in nature. Substantial positive impacts on socio-economic status in the form of increased sanitation and drainage facilities are expected during operation phase. Negative impacts can be mitigated through adoption of appropriate mitigation measures and appropriate engineering designs.

122. Practically in all the isolated subproject locations government land and ROWs are considered and therefore displacement of any community will not arise. Laying of pipeline will be within ROW with no encroachment on any private land and with no eviction of squatters. In the screening exercise, areas of concern - congested market place on the sides of the road, existence of sensitive area, extent of physical displacement if any, etc. was studied. The findings have been used as inputs for engineering design within the technical requirements and cost effectiveness. A Comparative analysis of "with project" and "no project" scenario is given in Table 42.

Table 42. Comparative analysis of With Project and No Project scenario

Sl. No.	Parameter	'With-Project' Scenario	'No-Project' scenario
	Services		
1	Water logging/flooding – extent and duration	Substantially reduced	Suffering from long duration water-logging/flooding
2	Sanitation	Organized management of sewage including scientific treatment	Spot management through individual septic tanks with possible overflow of untreated sewage from septic tanks during rains
3	Maintenance of sewage and drainage system	Organised and better maintenance and therefore efficient operation of the created system	Individual maintenance of the system at source
	Environment		
4	Public health	Clean surroundings eliminating bad odour and mosquito breeding from open drains	Mosquito menace due to presence of open drains with low flow velocity
5	Effect on aquatic ecology of discharging canal	No effect	Polluted waste water draining in to the canal
	Social		
6	Inconveniences to people	During construction phase only	Inconvenience especially during rains
7	Quality of life	Improvement with availability of organized S&D system	No change; negative with increase of population
	Economic		
8	Economic development	Increase in property value	No effect
9	Business	Attract more business due to improved infra structure	No change
10	Roads	With elimination of side open drains roads will become wide	No effect
11	Risks	Wide roads means safe transport and pedestrian movement	No change (narrow roads) will continue to pose transport hazards and risk of accident to pedestrians
	Recommendation	Present level of S&D service will improve after implementation of the project. No permanent impact on environmental parameters is envisaged in case of "with project" scenario, only short term negative impact and long term positive impact may result. Hence "With Project" scenario is much more preferable than "No-Project" scenario.	

-

VI. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Public participation during the preparation of the IEE

123. The public participation process included identifying interested and affected people (stakeholders); informing and providing the stakeholders with sufficient background and technical information regarding the proposed development; creating opportunities and mechanisms whereby they can participate and raise their viewpoints (issues, comments and concerns) with regard to the proposed development; giving the stakeholders feedback on process findings and recommendations; and ensuring compliance to process requirements with regards to the environmental and related legislation.

124. The primary stakeholders are: (i) local residents, shopkeepers and business people who live and work along side the roads where pipeline will be laid and facilities will be provided; and (ii) custodians and users of socially- and culturally-important buildings in affected areas.

125. The secondary stakeholders are: (i) KMC as the executing agency; (ii) KEIP officials as implementation agency; (iii) WBPCB, government department (like Environment department, Government of West Bengal, Forest Directorate, Government of West Bengal, Ministry of Environment & Forests, Government of India) and relevant government agencies (like CPCB, NEERI), including state and local authorities responsible for land acquisition, ,(iv) non-government organizations, university professors, and community-based organizations (CBOs) working in the affected communities; (v) other community representatives (prominent citizens, religious leaders, elders, women's groups); (vi) beneficiary community in general; and (vii) ADB, the government, and Ministry of Finance.

126. The following methodologies will be used for carrying out public consultation:

(i) Local communities, Individuals affected, traders and local shopkeepers who may be directly affected to be given priority while conducting public consultation.
(ii) Walk-through informal group consultations along the proposed S&D pipe laying stretch.
(iii) The local communities to be informed through public consultation with briefing on project interventions including its benefits.
(iv) The environmental concerns and suggestions made by the participants to be listed out, discussed and suggestions to be noted for consideration during implementation.

127. Formal consultations have been carried out with Mayor and engineers of KMC on 5.8.2011 and 18.11.2011 to prioritise and finalise items of work to be taken under the Proect. These were supplemented by series of informal discussions by the PMC engineering Consultants with Chief Engineers of KMC and Director General (Projects), PMU mainly on understanding current situation and optimum design to be adopted in order to attain the objectives of taking up the work items. On specific environmental fronts Team Leader, Deputy Team Leader and Environmental Expert, PMC arranged a meeting at the WBPCB office on 13 September, 2011 in which Chairman, Member Secretary, Chief Engineer (Planning), Chief Scientist and other engineers of WBPCB were present, The officials of WBPCB were appraised about the proposed work programme of KEIP at it stood on that date.

B. Future Consultation and Disclosure

128. The public consultation and disclosure program will remain a continuous process throughout the subproject implementation and shall include the following:

i. Consultation during detailed design

129. Focus-group discussions with affected persons and other stakeholders to hear their views and concerns, so that these can be addressed in subproject design wherever necessary. Regular updates on the environmental component of the subproject will kept available at the PMU office of KMC.

130. KMC will conduct information dissemination sessions at major intersections and solicit the help of the local community leaders/prominent citizens to encourage the participation of the people to discuss various environmental issues.

131. The PMU, with assistance of DSC will conduct information dissemination sessions in the subproject area. During EMP implementation PMU and DSC will organize public meetings and will apprise the communities about the progress on the implementation of EMP in the subproject works.

ii. Consultation during construction:

132. Public meetings with affected communities (if any) to discuss and plan work programs and allow issues to be raised and addressed once construction has started; and

133. Smaller-scale meetings to discuss and plan construction work with local communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation;

A summary of the proposed Consultations is given in Appendix 6. Some of the scheduled consultations may be combined in to a single composite consultation if the situation so demands.

iii. Project disclosure

134. A communications strategy is of vital importance in terms of accommodating traffic during road closure. Local communities will be continuously consulted regarding location of construction camps, access and hauling routes and other likely disturbances during construction. The road closure together with the proposed detours will be communicated via advertising, pamphlets, road signage, etc.

135. One public information campaigns via newspaper/radio/TV is proposed to explain the subproject details to a wider population. Public disclosure meetings at key project stages will be organized to inform the public of progress and future plans.

136. For the benefit of the community a summary of the IEE will be translated in the local language and made available at the offices of KMC, the PMU and the DSC. Hard copies of the English version of the IEE will be accessible to citizens as a means to disclose the document and at the same time creating wider public awareness. Electronic version of the IEE will be placed in the official website of the KEIP and the official website of ADB after approval of the IEE by the Government and ADB. The PMU will issue Notification on the start date of implementation of the S&D subproject in the KEIP web site ahead of the implementation works.

VII. GRIEVANCE REDRESS MECHANISM

137. **Common Grievance Redress Mechanism:** A common grievance redress mechanism (GRM) will be in place for social, environmental or any other subproject related grievances.

138. **Grievance Redress Process**. PMU will maintain a Complaint Cell headed by a designated Grievance Officer at its office. The Grievance Registration/Suggestion Form (Appendix 7) will be available at the Complaints Cell and in Borough Offices and will also be downloadable from the KEIP website.

139. Grievances/suggestions of affected persons can be dropped in suggestion boxes or conveyed through phone or mail. Affected Persons will also be able to register grievances - social, environmental or other, personally at the Complaint Cell and at Borough offices of KMC. The Grievance Officer and designated official at the Boroughs will be able to correctly interpret/record verbal grievances of non-literate persons and those received over telephone. The Complaint Cell will also serve as Public Information Centers, where, apart from grievance registration, information on the Project, subprojects, social and environmental safeguards can be provided.

140. The Grievance Officer will resolve simple issues and in case of complicated issues, consult/seek the assistance of the Environment/Social Coordinator of the PMU. Grievances not redressed through this process within one month of registration will be brought to the notice of the Project Director, KEIP. The draft Grievance Redress Process will be discussed with the stakeholders at the proposed disclosure workshop.

141. Periodic community meetings with affected communities to understand their concerns and help them through the process of grievance redress (including translation from local dialect/language, recording and registering grievances of non-literate affected persons and explaining the process of grievance redress) will be conducted if required.

142. **Grievance Redressal Committee (GRC):** An apex GRC will be considered, if required, to address grievances pertaining to broader concerns related to the program/subproject. The membership of the Committee wil be decided by Commisioner, KMC later on.

143. **Consultation Arrangements.** This will include (i) group meetings and discussions with affected persons, to be announced in advance and conducted at the time of day agreed on with affected persons (based on their availability) and conducted to address general/common grievances; and (ii) availability of Environment/Social Coordinator of PMU on a fixed day as required for one-to-one consultations. Non-literate affected persons/ vulnerable affected persons will be assisted to understand the grievance redress process, to register complaints and with follow-up actions at different stages in the process.

144. **Record-keeping.** Records will be kept by PMU of all grievances received including contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were in effect, and final outcome.

145. **Information Dissemination Methods of the GRM.** Grievances received and responses provided will be documented and reported back to the affected persons. (Appendix 6) has the Sample Grievance Registration Form). The number of grievances recorded and resolved and the outcomes will be displayed/disclosed in the offices of the different Boroughs of KMC and web. The phone number where grievances are to be recorded will be prominently displayed at the construction sites.

146. **Periodic Review and Documentation of Lessons Learned.** The PMU will periodically review the functioning of the GRM and effectiveness of the mechanism, especially on the Project's ability to prevent and address grievances.

147. **Costs.** All costs involved in resolving the complaints (meetings, consultations, communication and reporting / information dissemination) will be borne by the PMU.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

148. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between the PMU, the DSC, and the contractors. The EMP identifies activities according to the following three phases of development: (i) Site Establishment and Preliminary Activities; (ii) Construction Phase; and (iii) Post Construction/Operational Phase.

149. The purpose of the EMP is to ensure that the activities are undertaken in a responsible non-detrimental manner with the objectives of: (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (ii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (iv) ensure that safety recommendations are complied with.

150. A copy of the EMP must be kept on site during the construction period at all times. The EMP will be made binding on all contractors operating on the site and will be included within the Contractual Clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance. It shall be noted that the Supreme Court of India[6] mandates those responsible for environmental damage must pay the repair costs both to the environment and human health and the preventative measures to reduce or prevent further pollution and/or environmental damage. (The polluter pays principle).

151. The Contractor is deemed not to have complied with the EMP if:

(i) Within the boundaries of the site, site extensions and haul/ access roads there is evidence of contravention of clauses.
(ii) If environmental damage ensues due to negligence.
(iii) The contractor fails to comply with corrective or other instructions issued by the PMU/DSC within a specified time.
(iv) The Contractor fails to respond adequately to complaints from the public.

A. Institutional Arrangement

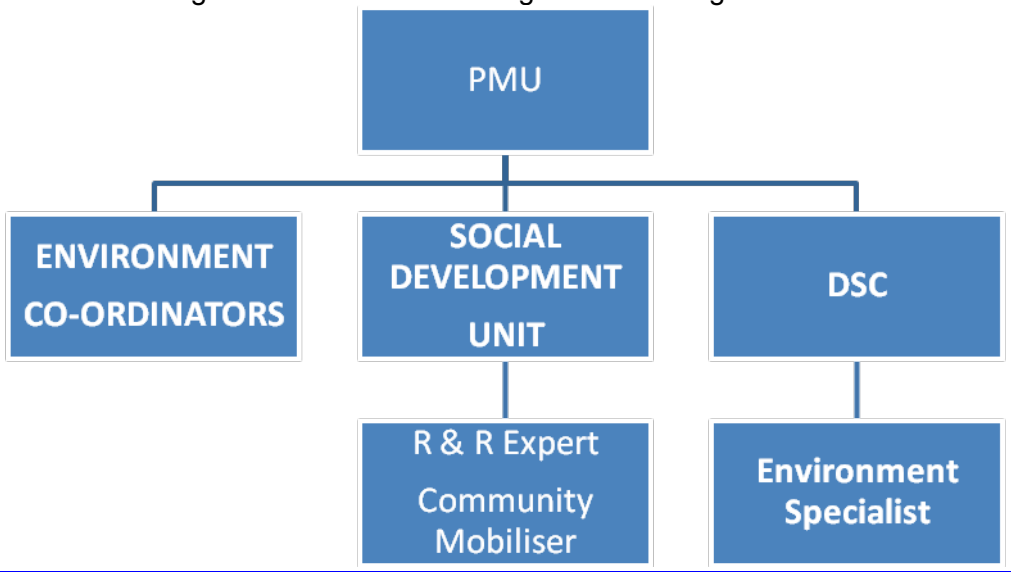
152. The existing institutional arrangement for implementation of the KEIP, which has been functioning satisfactorily, will continue (Figure 2). The subproject will be implemented and monitored by the Project Management Unit (PMU). The KEIP Special Officer (Co-ordination) and Deputy Chief Engineer I will be PMU's Environmental Coordinators. The responsibilities of the Environmental Coordinators will ensure that (i) environmental and social safeguard issues are addressed; (ii) EMP is implemented; (iii) physical and non-

[6] Writ Petition No. 657 of 1995. The Supreme Court, in its order dated Feb.4, 2005, that "The Polluter Pays Principle means that absolute liability of harm to the environment extends not only to compensate the victims of pollution, but also to the cost of restoring environmental degradation. Remediation of damaged environment is part of the process of sustainable development."

physical activities under the subproject are monitored; and (iv) monitoring reports are prepared on time and submitted to ADB.

PMU will be supported by the Design and Supervision Consultants (DSC). An Environment Specialist will be engaged to ensure: (i) EMP is implemented; (ii) surveys and measurements are undertaken; (iii) inspections and observations throughout the construction period are recorded to ensure that safeguards and mitigation measures are provided as intended; and . (iv) statutory clearances and permits from government agencies/other entities are obtained prior to start of civil works.

Figure 2: Institutional Arrangement – Safeguards



Notes: PMU = Project Management Unit; DSC = Design and Supervision Consultants; R & R = Relocation and Rehabilitation

153. Table 43 gives the institutional roles and responsibilities in all phases of the subproject.

Table 43: Institutional Roles and Responsibilities: Environmental Safeguard

Phase	PMU	DSC	ADB
Subproject identification stage		• DSC to screen subprojects with inputs based on the EARF subproject selection guidelines	
Subproject appraisal stage	• PMU to review the REA checklists and draft IEE. • PMU to disclose on its website the approved IEE. • PMU to ensure disclosure of information throughout the duration of the subproject.	• DSC to conduct REA for each subproject using checklists and to prepare IEE	• ADB to review the REA checklists and reconfirm the categorization. • ADB will review and approve EIA reports (Category A) and IEE reports (Category B) subprojects. • ADB to disclose on its website the submitted EIA/IEE report.
Detailed Design	• PMU with the assistance	• DSC to revise the	• ADB will

Phase	PMU	DSC	ADB
Phase	of DSC to incorporate the EMP, environmental mitigation and monitoring measures into contract documents.	IEE and EMP in accordance with detailed design changes if warranted. • DSC to ensure incorporation of EMP in bid documents and contracts. • DSC to prepare inventory of utilities to be affected by the subproject. • DSC to conduct baseline environmental conditions and inventory of affected trees	review and approve updated EIA reports (Category A) and IEE reports (Category B) subprojects. • ADB to disclose on its website updated EIA/IEE report.
Pre-construction Phase	• PMC and DSC to conduct public consultation and disclosure during IEE process and comments will be reflected in the IEE report. • PMU to monitor the disclosure and public consultation. • PMU and DSC to approve contractor's proposed locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes	• DSC to ensure statutory clearances and permits from government agencies/other entities are obtained prior to start of civil works. • DSC to consult affected people and ensure RP is implemented prior to start of civil works. • DSC to ensure disclosure of information prior to start of civil works and throughout the duration of the construction period. DSC to approve contractor's site-specific environmental plan (such as traffic management plan, waste management plan, locations for camp sites, storage areas, lay down areas, and other sites/plans specified in the EMP).	
Construction Phase	• PMU will review 6-monthly monitoring and EMP implementation report including the status of Project compliance with statutory clearances and with relevant loan covenants and submit the 6-monthly report to ADB and seek permission to disclose the same in the Project web site.	DSC to monitor the implementation of mitigation measures by Contractor. • DSC to prepare monthly progress reports including a section on implementation of the mitigation measures (application of EMP and monitoring plan) • DSC (as per EMP) will conduct environmental quality monitoring during construction stage (ambient air and noise, and water quality). • DSC to prepare the 6 monthly monitoring report on environment by focusing on the progress in implementation of the EMP and issues encountered and measures adopted, follow-up actions required, if any.	ADB to review the 6 monthly report, provide necessary advice if needed to the PMU and approve the same. • ADB to disclose on its website environmental monitoring reports.
Pre-operation Phase (Commissioning	• _ PMU to review monitoring report of DSC on post-construction activities by the	• DSC to monitor post-construction activities by the contractors as	

Phase	PMU	DSC	ADB
and Defect Liability Period)	contractors as specified in the EMP ____	specified in the EMP.	
Operation Phase	• KMC to conduct monitoring, as specified in the environmental monitoring plan. • WBPCB to monitor the compliance of the standards regarding drinking water quality, ground water, ambient air, effluent quality from treatment plant, as applicable.		

Notes: WBPCB = West Bengal State Pollution Control Board, KMC = Kolkata Municipal Corporation, CTE = Consent to Establish, CTO = Consent to Operate, DSC = Design and Supervision Consultant, EIA = Environmental Impact Assessment, EMP = Environmental Management Plan, IEE = Initial Environmental Examination, PMU = Project Management Unit; REA = Rapid Environmental Assessment, WTP = water treatment plant

154. The Contractor will be required to:

(i) Comply with all applicable legislation, is conversant with the requirements of the EMP;
(ii) Brief his staff, employees, and laborer about the requirements of the EMP;
(iii) Ensure any sub-contractors/ suppliers who are utilized within the context of the contract comply with the environmental requirements of the EMP. The Contractor will be held responsible for non-compliance on their behalf;
(iv) Supply method statements for all activities requiring special attention as specified and/or requested by the DSC Environment Specialist during the duration of the Contract;
(v) Provide environmental awareness training to staff, employees, and laborers;
(vi) Bear the costs of any damages/compensation resulting from non-adherence to the EMP or written site instructions;
(vii) Conduct all activities in a manner that minimizes disturbance to directly affected residents and the public in general, and foreseeable impacts on the environment.
(viii) Ensure that the PMU Environment Coordinators are timely informed of any foreseeable activities that will require input from the DSC Environment Specialist.

B. Environmental Management and Mitigation Measures

155. Table 44 outlines the site establishment and preliminary activities.

Table 44: Site Establishment and Preliminary Activities

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
1.	Legislation, Permits and Agreements	In all instances, KMC, service providers, contractors and consultants must remain in compliance with relevant local and national legislation.	PMU and DSC	Prior to moving onto site and during construction
		DSC to obtain statutory clearances and permits from government agencies/other entities	PMU	Prior to start of civil works
		Contractor to submit proof of compliance to Air Act (in relation to hot mixing, stone crushers, diesel generators)	DSC Environment Specialist	Prior to moving onto site and during construction
		A copy of the EMP must be kept on site during the construction period	PMU Environment Coordinator and DSC Environment	At all times

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
			Specialist	
2.	Access to Site	Access to site will be via existing roads. The Contractor will need to ascertain the existing condition of the roads and repair damage shall not occur due to construction.	DSC Environment Specialist	Prior to moving onto site and during construction
		The Local Traffic Department shall be involved in the planning stages of the road closure and detour and available on site in the monitoring of traffic in the early stages of the operations during road closure	DSC Environment Specialist	Prior to moving onto site
		The Local Traffic Department must be informed at least a week in advance if the traffic in the area will be affected.	DSC Environment Specialist	Prior to moving onto site
		The location of all affected services and servitudes must be identified and confirmed.	DSC Environment Specialist	Prior to moving onto site
		All roads for construction access must be planned and approved ahead of construction activities. They shall not be created on an ad-hoc basis.	PMU Environment Coordinator and DSC Environment Specialist	Prior to moving onto site and during construction.
		No trees/shrubs/groundcover may be removed or vegetation stripped without the prior permission.	PMU Environment Coordinator and DSC Environment Specialist	Before and during construction.
		Contractors shall construct formal drainage on all temporary haulage roads in the form of side drains and mitre drains to prevent erosion and point source discharge of run-off.	DSC Environment Specialist	Prior to moving onto site.
3.	Setting up of Construction Camp[7]	Choice of site for the contractor's camp requires the DSC Environment Specialist's permission and must take into account location of local residents, businesses and existing land uses, including flood zones and slip / unstable zones. A site plan must be submitted to the DSC Environment Specialist for approval.	DSC Environment Specialist and PMU Environment Coordinator	During surveys and preliminary investigation s and prior to moving onto the site
		The construction camp may not be situated on a floodplain or on slopes greater than 1:3.	PMU Environment Coordinator and DSC Environment Specialist	During surveys and preliminary investigation s and prior to moving onto the site
		If the Contractor chooses to locate the camp site on private land, he must get prior permission from both the DSC Environment Specialist and the landowner.	PMU Environment Coordinator and DSC Environment Specialist	During site establishment and ongoing – weekly inspections
		In most cases, on-site accommodation will not be required. The construction camp can thus be comprised of: • site office • toilet facilities • designated first aid area • eating areas • staff lockers and showers (where water and waterborne sewers are available)	DSC Environment Specialist	During set-up

[7] Careful planning of the construction camp can ensure that time and costs associated with environmental management and rehabilitation are reduced.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		• storage areas • batching plant (if required) • refuelling areas (if required) • maintenance areas (if required) • crushers (if required)		
		Cut and fill must be avoided where possible during the set up of the construction camp.	DSC Environment Specialist	During site set-up
		The contractor shall make adequate provision for temporary toilets for the use of their employees during the construction phase. Such facilities, which shall comply with local authority regulations, shall be maintained in a clean and hygienic condition. Their use shall be strictly enforced.	DSC Environment Specialist	During site establishment and ongoing – weekly inspections
		Under no circumstances may open areas or the surrounding bush be used as a toilet facility.	DSC Environment Specialist	Ongoing
		Bins and/or skips shall be provided at convenient intervals for disposal of waste within the construction camp.	DSC Environment Specialist	During site set-up and ongoing
		Bins shall have liner bags for efficient control and safe disposal of waste	DSC Environment Specialist	Ongoing
		Recycling and the provision of separate waste receptacles for different types of waste shall be encouraged.	DSC Environment Specialist	During site set-up and ongoing
4.	Establishing Equipment Lay-down and Storage Area[8]	Choice of location for equipment lay-down and storage areas must take into account prevailing winds, distances to adjacent land uses, general on – site topography and water erosion potential of the soil. Impervious surfaces must be provided where necessary	PMU Environment Coordinator and DSC Environment Specialist	During site set-up
		Storage areas shall be secure so as to minimize the risk of crime. They shall also be safe from access by children / animals etc.	DSC Environment Specialist	During site set-up
		It is very important that the proximity of residents, businesses, schools etc is taken into account when deciding on storage areas for hazardous substances or materials. Residents living adjacent to the construction site must be notified of the existence of the hazardous storage are	PMU Environment Coordinator and DSC Environment Specialist	During site set-up
		Equipment lay-down and storage areas must be designated, demarcated and fenced if necessary.	DSC Environment Specialist	During site set-up
		Fire prevention facilities must be present at all storage facilities	DSC Environment Specialist	During site set-up
		Proper storage facilities for the storage of oils, paints, grease, fuels, chemicals and any hazardous materials to be used must be provided to prevent the migration of spillage into the ground and groundwater regime around the temporary storage area(s). These pollution prevention measures for storage shall include a bund wall high enough to contain at least 110% of any	DSC Environment Specialist	During site set-up and ongoing

[8] Storage areas can be hazardous, unsightly and can cause environmental pollution if not designed and managed carefully

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		stored volume. The contractor shall submit a method statement for approval		
		These storage facilities (including any tanks) must be on an impermeable surface that is protected from the ingress of storm water from surrounding areas in order to ensure that accidental spillage does not pollute local soil or water resources	DSC Environment Specialist	During site set-up and ongoing
		Fuel tanks must meet relevant specifications and be elevated so that leaks may be easily detected.	DSC Environment Specialist	During site setup and monitored
		Material Safety Data Sheets (MSDSs) shall be readily available on site for all chemicals and hazardous substances to be used on site. Where possible the available, MSDSs shall additionally include information on ecological impacts and measures to minimize negative environmental impacts during accidental releases or escapes	DSC Environment Specialist and Contractor	Ongoing
		Staff dealing with these materials/substances must be aware of their potential impacts and follow the appropriate safety measures. The contractor must ensure that its staff is made aware of the health risks associated with any hazardous substances used and has been provided with the appropriate protective clothing/equipment in case of spillages or accidents and have received the necessary training	DSC Environment Specialist and Contractor	Ongoing
		Contractors shall submit a method statement and plans for the storage of hazardous materials and emergency procedures.	DSC Environment Specialist	Prior to establishment of storage area
5.	Materials Management – Sourcing[9]	Contractors shall prepare a source statement indicating the sources of all materials (including topsoil, sands, natural gravels, crushed stone, asphalt, clay liners etc), and submit these to the DSC Environment Specialist for approval prior to commencement of any work.	PMU Environment Coordinator and DSC Environment Specialist	On award of contract
		Where possible, a signed document from the supplier of natural materials shall be obtained confirming that they have been obtained in a sustainable manner and in compliance with relevant legislation	PMU Environment Coordinator and DSC Environment Specialist	On receipt of natural materials
		Where materials are borrowed (mined), proof must be provided of authorization to utilize these materials from the landowner/material rights owner and the Department of Minerals	DSC Environment Specialist	On receipt of borrowed (mined) materials
6.	Education of site staff on general and Environmental Conduct[10]	Ensure that all site personnel have a basic level of environmental awareness training	PMU Environment Coordinator, DSC Environment Specialist and Contractor	During staff induction and ongoing

[9] Materials must be sourced in a legal and sustainable way to prevent offsite environmental degradation.
[10] These points need to be made clear to all staff on site before the subproject begin.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		Staff operating equipment (such as excavators, loaders, etc.) shall be adequately trained and sensitized to any potential hazards associated with their task	DSC Environment Specialist and Contractor	During staff induction, followed by ongoing monitoring
		No operator shall be permitted to operate critical items of mechanical equipment without having been trained by the Contractor and certified competent by DSC	DSC Environment Specialist and Contractor	During staff induction, followed by ongoing monitoring
		All employees must undergo safety training and wear the necessary protective clothing	DSC Environment Specialist and Contractor	During staff induction, followed by ongoing monitoring
		A general regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. Workers need to be made aware of the following general rules: • No alcohol / drugs to be present on site; • Prevent excessive noise • Construction staff are to make use of the facilities provided for them, as opposed to ad-hoc alternatives (e.g. fires for cooking, the use of surrounding bus as a toilet facility are forbidden) • No fires to be permitted on site • Trespassing on private / commercial properties adjoining the site is forbidden • Other than pre-approved security staff, no workers shall be permitted to live on the construction site • No worker may be forced to do work that is potentially dangerous or for what he / she is not trained to do	DSC Environment Specialist and Contractor	During staff induction, followed by ongoing monitoring
6.	Social Impacts[11]	Open liaison channels shall be established between the site owner, the developer, operator, the contractors and interested and affected people such that any queries, complaints or suggestions can be dealt with quickly and by the appropriate person(s).	PMU Environment Coordinator and DSC Environment Specialist	Prior to moving onto site and ongoing
		A communications strategy is of vital importance in terms of accommodating traffic during road closure. The road closure together with the proposed detour needs to be communicated via advertising, pamphlets, radio broadcasts, road signage, etc	PMU Environment Coordinator	Prior to moving onto site and ongoing
		Advance road signage indicating the road detour and alternative routes. Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.	PMU Environment Coordinator	Prior to moving onto site and ongoing
		Storage facilities, elevated tanks and	DSC Environment	During surveys

[11] It is important to take notice of the needs and wishes of those living or working adjacent to the site. Failure to do so can cause disruption to work.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		other temporary structures on site shall be located such that they have as little visual impact on local residents as possible.	Specialist and PMU Environment Coordinator	and preliminary investigations and site set-up.
		In areas where the visual environment is particularly important or privacy concerns for surrounding buildings exist, the site may require screening. This could be in the form of shade cloth , temporary walls, or other suitable materials prior to the beginning of construction.	DSC Environment Specialist and PMU Environment Coordinator	During surveys and preliminary investigations and site set-up.
		Special attention shall be given to the screening of highly reflective materials on site.	PMU Environment Coordinator	During site set-up
7.	Noise Impacts	Construction vehicles are be to fitted with standard silencers prior to the beginning of construction		
		Equipment that is fitted with noise reduction facilities (e.g. side flaps, silencers, etc) will be used as per operating instructions and maintained properly during site operations		
8.	Dust/Air Pollution[12]	Vehicles travelling along the access roads must adhere to speed limits to avoid creating excessive dust.	PMU Environment Coordinator	Ongoing.
		Camp construction / haulage road construction – areas that have been stripped of vegetation must be dampened periodically to avoid excessive dust.	PMU Environment Coordinator	Ongoing – more frequently during dry and windy conditions
		The Contractor must make alternative arrangements (other than fires) for cooking and / or heating requirements. LPG gas cookers may be used provided that all safety regulations are followed.	DSC Environment Specialist	Ongoing.
9.	Soil Erosion	The time that stripped areas are left open to exposure shall be minimised wherever possible. Care shall be taken to ensure that lead times are not excessive.	DSC Environment Specialist and PMU Environment Coordinator	Throughout the duration of the subproject.
		Wind screening and stormwater control shall be undertaken to prevent soil loss from the site.	DSC Environment Specialist and PMU Environment Coordinator	During site set-up
		Procedures that are in place to conserve topsoil during the construction phase of the subproject are to be applied to the set up phase. i.e. topsoil is to be conserved while providing access to the site and setting up the camp.	DSC Environment Specialist and PMU Environment Coordinator	Ongoing monitoring. during site set-up
10.	Stormwater[13]	To prevent stormwater damage, the increase in storm water run-off resulting from construction activities must be estimated and the drainage system assessed accordingly. A drainage plan must be submitted to the DSC Environment Specialist for approval and must include the location and design criteria of any temporary stream	DSC Environment Specialist	During surveys and preliminary Investigations.

[12] Establishment of the camp site, and related temporary works can reduce air quality.
[13] Serious financial and environmental impacts can be caused by unmanaged stormwater.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		crossings (siting and return period etc).		
		During site establishment, stormwater culverts and drains are to be located and covered with metal grids to prevent blockages if deemed necessary by the DSC Environment Specialist. (e.g. due to demolition work).	DSC Environment Specialist	During site setup.
		Temporary cut off drains and berms may be required to capture stormwater and promote infiltration.	PMU Environment Coordinator	During site setup.
11.	Water Quality[14].	Storage areas that contain hazardous substances must be bunded with an approved impermeable liner	DSC Environment Specialist	During site setup.
		Spills in bunded areas must be cleaned up, removed and disposed of safely from the bunded area as soon after detection as possible to minimise pollution risk and reduced bunding capacity.	DSC Environment Specialist and PMU Environment Coordinator	During site setup.
		A designated, bunded area is to be set aside for vehicle washing and maintenance. Materials caught in this bunded area must be disposed of to a suitable waste site or as directed by the DSC Environment Specialist	DSC Environment Specialist and PMU Environment Coordinator	During site setup.
		Provision shall be made during set up for all polluted run off to be treated to the DSC Environment Specialist's approval before being discharged into the stormwater system. (This will be required for the duration of the project.)	DSC Environment Specialist and PMU Environment Coordinator	During site setup and to be monitored weekly
12.	Conseravtion of the Natural Environment[15]	No vegetation may be cleared without prior permission from the DSC Environment Specialist.	DSC Environment Specialist and PMU Environment Coordinator	During site setup and ongoing.
		Trees that are not to be cleared shall be marked beforehand with danger tape. The PMU Environment Coordinator must be given a chance to mark vegetation that is to be conserved before the Contractor begins clearing the site	DSC Environment Specialist and PMU Environment Coordinator	During site set-up
		Care must be taken to avoid the introduction of alien plant species to the site and surrounding areas. (Particular attention must be paid to imported material)	PMU Environment Coordinator	Ongoing in camp Site, haulage Areas
13.	Set-up of Waste Management Procedure	The excavation and use of rubbish pits on site is forbidden	PMU Environment Coordinator	Ongoing
		Burning of waste is forbidden.	PMU Environment Coordinator	Ongoing
14.	Cultural Environment	Prior to the commencement of construction, all staff need to know what possible archaeological or historical objects of value may look like, and to notify the DSC Environment Specialist/Contractor shall such an item	PMU Environment Coordinator	During site set-up And ongoing.

[14] Incorrect disposal of substances and materials and polluted run-off can have serious negative effects on groundwater quality

[15] Alien plant encroachment is particularly damaging to natural habitats and is often associated with disturbance to the soil during construction activities. Care must be taken to conserve existing plant and animal life on and surrounding the site.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		be uncovered.		
15.	Security and Safety	Lighting on site is to be set out to provide maximum security and to enable easier policing of the site, without creating a visual nuisance to local residents or businesses.	DSC Environment Specialist	During site set-up
		Material stockpiles or stacks, such as, pipes must be stable and well secured to avoid collapse and possible injury to site workers / local residents.	PMU Environment Coordinator	Ongoing
		Flammable materials shall be stored as far as possible from adjacent residents / businesses.	PMU Environment Coordinator	Ongoing
		All interested and affected persons shall be notified in advance of any known potential risks associated with the construction site and the activities on it. Examples are: • stringing of power lines • excavation for the micro-tunnel equipment • earthworks/earthmoving machinery on beside houses/infrastructure/sensitive receptors • risk to residences/sensitive receptors along haulage roads / access routes	PMU Environment Coordinator and DSC Environment	24 hours prior to activity in question

156. Table 45 outlines management of construction activities and workforce..

Table 45: Management of Construction and Workforce Activities

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
1.	Access to Site	Contractor shall ensure that all side and mitre drains and scour check walls on access and haul roads are functioning properly and are well maintained.	DSC Environment Specialist	Weekly and after heavy rains.
		Contractor shall ensure that access roads are maintained in good condition by attending to potholes, corrugations and stormwater damage as soon as these develop.	DSC Environment Specialist	Weekly inspection.
		If necessary, contractor to employ a staff to clean surface roads adjacent to construction sites where materials have been spilt.	DSC Environment Specialist	When necessary
		Contractor to avoid unnecessary compaction of soils by heavy vehicles.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to restrict construction vehicles to demarcated access, haulage routes and turning areas.	DSC Environment Specialist	Ongoing monitoring.
2.	Maintenance of Construction Camp	Contractor to monitor and manage drainage of the camp site to avoid standing water and soil erosion.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure run-off from the camp site must not discharge into neighbors' properties.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to maintain toilets in a clean state and shall be moved to ensure that they adequately service the work areas	DSC Environment Specialist	Weekly inspection

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		Contractor to ensure that open areas or the surrounding bush are not being used as a toilet facility.	DSC Environment Specialist	Weekly inspection
		Contractor to ensure all litter is collected from the work and camp areas daily.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to empty bins and/or skips regularly, dispose wastes at the pre-approved sites, keep all disposal waybills for review.	DSC Environment Specialist	Weekly inspection
		Contractor to ensure eating areas are regularly serviced and cleaned to the highest possible standards of hygiene and cleanliness.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure that his camp and working areas are kept clean and tidy at all times.	DSC Environment Specialist	Weekly monitoring
3.	Staff Conduct	Contractor to monitor performance of construction workers, ensure points relayed during their induction have been properly understood and are being followed. If necessary, the DSC Environment Specialist and/or a translator shall be called to the site to further explain aspects of environmental or social behavior that are unclear.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure rules that are explained in the worker conduct section,[16] must be followed at all times	DSC Environment Specialist	Ongoing monitoring.
4.	Dust and Air Pollution[17]	Contractor to ensure vehicles travelling to and from the construction site adhere to speed limits so as to avoid producing excessive dust.	DSC Environment Specialist	Ongoing monitoring.
		A speed limit of 30km/hr must be adhered to on all dirt roads.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to dampen access and other cleared surfaces whenever possible and especially in dry and windy conditions to avoid excessive dust.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to utilize screening using wooden supports and shade cloth where dust is unavoidable in residential/commercial/sensitive receptors areas	DSC Environment Specialist	As directed by the DSC Environment Specialist.
		Contractor to keep vehicles and machinery in good working order and meet manufacturers specifications for safety, fuel consumption etc.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to check and repair equipment as soon as possible if excessive emissions are observed.	DSC Environment Specialist	As directed by the DSC Environment Specialist.
		No fires are allowed on site except for the burning of firebreaks.	DSC Environment Specialist	Ongoing monitoring.

[16] (i) no alcohol / drugs to be present on site; (ii) prevent excessive noise; (iii) construction staff are to make use of the facilities provided for them, as opposed to ad-hoc alternatives (e.g. fires for cooking, the use of surrounding bus as a toilet facility are forbidden); (iv) no fires to be permitted on site; (v) trespassing on private / commercial properties adjoining the site is forbidden; (vi) other than pre-approved security staff, no workers shall be permitted to live on the construction site; (vii) no worker may be forced to do work that is potentially dangerous or for what he / she is not trained to do

[17] Main causes of air pollution during construction are dust from vehicle movements and stockpiles, vehicle emissions and fires.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
5.	Soil Erosion	Once an area has been cleared of vegetation, the top layer (nominally 150mm) of soil shall be removed and contractor to stockpile in the designated area.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to commence top soiling and revegetation immediately after completion of an activity and at an agreed distance behind any particular work front.	DSC Environment Specialist	As each activity is completed.
		Contractor to ensure stormwater control and wind screening to prevent soil loss from the site.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to dispose unusable soils and spoils to pre-approved disposal sites[18].	DSC Environment Specialist	Ongoing monitoring.
		Contractor to protect all embankments, unless otherwise directed by the DSC Environment Specialist, by a cut off drain to prevent water from cascading down the face of the embankment and causing erosion.	DSC Environment Specialist	Immediately after the creation of the embankment/stripping of vegetation.
6.	Stormwater	Contractor shall not in any way modify nor damage the banks or bed of streams, rivers, wetlands, other open water bodies and drainage lines adjacent to or within the designated area, unless required as part of the construction project specification. Where such disturbance is unavoidable, modification of water bodies shall be kept to a minimum in terms of: (i) removal of riparian vegetation; and (ii) opening up of the stream channel	PMU Environment Coordinator and DSC Environment Specialist	Ongoing monitoring.
		Contractor to dispose earth, stones, and rubbles and prevent obstruction of natural water pathway, i.e.: these materials must not be placed in stormwater channels, drainage lines or rivers.	DSC Environment Specialist	Monitoring throughout the duration of the subproject.
		Contractor to check periodically sites' drainage system to ensure that the water flow is unobstructed.	DSC Environment Specialist	Monthly inspection.
		Contractor to control un-channeled flows. Where large areas of soil are left exposed, rows of straw/ hay or bundles of cut vegetation shall be dug into the soil in contours to slow surface wash and capture eroded soil.	DSC Environment Specialist	As surfaces become exposed.
		Contractor to slow down flows where surface run-off is concentrated (e.g. along exposed roadways/tracks by contouring with hay bales or bundled vegetation generated during site clearance operation. If the area must be used for construction vehicles, berms may be used instead. The berms must be at least 30 cm high and well compacted. The berms shall channel concentrated flow into	DSC Environment Specialist	Ongoing monitoring.

[18] Estimated total volume of unused excavated material to be disposed is 36200 cubic meters and 18800 cubic metres of road crust.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		detention ponds or areas protected with hay bales for flow reduction and sediment capture		
7.	Water Quality[19]	Contractor to ensure mixing/decanting of all chemicals and hazardous substances take place either on a tray or on an impermeable surface and dispose waste from these to pre-approved disposal sites.	DSC Environment Specialist	Regular monitoring (refer to the environmental monitoring program)
		Contractor to ensure every effort is made that any chemicals or hazardous substances do not contaminate the soil, Hooghly river, or groundwater on site.	DSC Environment Specialist	Regular monitoring (refer to the environmental monitoring program)
		Contractor to ensure run-off from vehicle or plant washing does not enter Hooghly river or the groundwater and ensure wash water passes through an oil-grease trap prior to discharge.	DSC Environment Specialist	Regular monitoring (refer to the environmental monitoring program)
		Contractor to prohibit site staff in using any stream, river, other open water body or natural water source adjacent to or within the designated site for the purposes of bathing, washing of clothing or for any construction or related activities. Municipal water (or another source approved by the DSC Environment Specialist) shall instead be used for all activities such as washing of equipment or disposal of any type of waste, dust suppression, concrete mixing, compacting etc.	DSC Environment Specialist	Regular monitoring (refer to the environmental monitoring program)
		Contractor shall refer to emergency contact numbers of WBPCB in order to deal with spillages and contamination of aquatic environments.	PMU Environment Coordinator and DSC Environment Specialist	As necessary
8.	Conservation of Natural Environment	Contractor is to check vegetation clearing and tree-felling have prior permission as the work front progresses.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure only trees that have been marked beforehand are to be removed.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to prohibit site staff from gathering firewood, fruits, plants, crops or any other natural material on-site or in areas adjacent to the sites.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to prohibit site staff from hunting of birds and animals on-site a or in areas adjacent to the sites.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to immediately re-vegetate stripped areas and remove aliens species by weeding. This significantly reduces the amount of time and money that must be spent on alien plant management during rehabilitation.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure, where possible,	DSC Environment	As the work front

[19] Water quality is affected by the incorrect handling of substances and materials. Soil erosion and sediment is also detrimental to water quality. Mismanagement of polluted run-off from vehicle and plant washing and wind dispersal of dry materials into rivers and watercourses are detrimental to water quality.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		cleared indigenous vegetation is kept in a nursery for use at a later stage (such as site rehabilitation process).	Specialist	progresses.
9.	Materials Management	Contractor to ensure stockpiles do not obstruct natural water pathways.	DSC Environment Specialist.	As necessary.
		Contractor to ensure stockpiles do not exceed 2m in height unless otherwise permitted by the DSC Environment Specialist.	DSC Environment Specialist	As necessary.
		Contractor to cover stockpiles exposed to windy conditions or heavy rain with vegetation, cloth, or tarps.	DSC Environment Specialist	As necessary.
		Contractor to ensure stockpiles are kept clear of weeds and alien vegetation growth by regular weeding	DSC Environment Specialist	Monthly monitoring
		Contractor to ensure all concrete mixing take place on a designated, impermeable surface.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure vehicles transporting concrete to the site are not washed on-site.	Contractor	Ongoing monitoring.
		Contractor to prohibit mixing of lime and other powders during excessively windy conditions.	DSC Environment Specialist	As necessary
		Contractor to store all substances required for vehicle maintenance and repair in sealed containers until they can be disposed of/removed from the sites.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure hazardous substances/materials are transported in sealed containers or bags	DSC Environment Specialist	Ongoing monitoring
		Contractor to prohibit spraying of herbicides/pesticides during windy condition	DSC Environment Specialist	As necessary.
10.	Waste Management	Contractor to place refuse in designated skips/bins, rubbles in demarcated areas, remove from the site, and transport to the pre-approved disposal sites. Waybills proving disposal at each site shall be provided for the DSC Environment Specialist's inspection.	DSC Environment Specialist	Checked at each site meeting.
		Contractor to prohibit littering on-site and clear the site of litter at the end of each working day.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to encourage recycling by providing separate receptacles for different types of waste and make sure that staffs are aware of their uses.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to clean toilets regularly; and avoid contamination of soils, water, pollution and nuisance to adjoining areas.	DSC Environment Specialist	Weekly monitoring.
11.	Social Impacts[20]	Contractor to restrict activities and movement of staff to designated construction areas.	DSC Environment Specialist	Ongoing.
		Contractor to assist in locating DSC Environment Specialist and/or PMU Environment Coordinator in the event	DSC Environment Specialist	Ongoing monitoring.

[20] Regular communication between the Contractor and the interested and affected parties is important for the duration of the contract.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		a construction staff is approached by members of the public or other stakeholders.		
		Contractor to ensure conduct of construction staff, when dealing with the public or other stakeholders, shall be in a manner that is polite and courteous at all times. Failure to adhere to this requirement may result in the removal of staff from the site.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure disruption of access for local residents is minimized and approved by the DSC Environment Specialist.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to provide walkways and metal sheets where required to maintain access across for people and vehicles.	DSC Environment Specialist	Ongoing monitoring
		Contractor to increase workforce in front of critical areas such as institutions, place of worship, business establishment, hospitals, and schools.	DSC Environment Specialist	Ongoing monitoring
		Contractor to consult businesses and institutions regarding operating hours and factoring this in work schedules.	DSC Environment Specialist	At least 1 week prior to the activity taking place.
		Contractor to inform affected persons in writing of disruptive activities at least 24 hours beforehand. This can take place by way of leaflets giving DSC Environment Specialist and Contractor's details or other method approved by the DSC Environment Specialist.	DSC Environment Specialist	At least 24 hrs prior to the activity taking place.
		Contractor to provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.	DSC Environment Specialist	At least 1 week prior to the activity taking place.
		Contractors to ensure lighting on the construction site is be pointed downwards and away from oncoming traffic and nearby houses.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to ensure machinery and vehicles are in good working order to minimize noise nuisance.	DSC Environment Specialist	Ongoing monitoring.
		Contractor to restrict noisy activities to the daytime.	DSC Environment Specialist	Ongoing monitoring.
		A complaints register (refer to the Grievance Redress Mechanism) shall be housed at the site office. This shall be in carbon copy format, with numbered pages. Any missing pages must be accounted for by the Contractor. This register is to be tabled during monthly site meetings.	DSC Environment Specialist	Monthly monitoring.
		Interested and affected people' need to be made aware of the existence of the complaints book and the methods of communication available to them.	PMU Environment Coordinator and DSC Environment Specialist	Ongoing monitoring.
		Contractor to initially handle and document queries and complaints; submit these for inclusion in complaints register; bring issues to DSC Environment Specialist's	PMU Environment Coordinator and DSC Environment Specialist	As necessary.

	Activity	Management/Mitigation	Responsible for Monitoring	Frequency
		attention immediately; and take remedial action as per DSC Environment Specialist's instruction		
		Contractor to assign staff for formal consultation with the interested and affected people in order to explain and answer questions on the construction process.	DSC Environment Specialist	Ongoing monitoring.
12.	Cultural Environment	Contractor to note possible items of historical or archaeological value include old stone foundations, tools, clayware, jewellery, remains, fossils etc. If something of this nature be uncovered, contractor to stop work immediately and notify the DSC Environment Specialist which in turn inform the PMU and coordinate with ASI or State Department of Archaeology.	DSC Environment Specialist	As required.

Table 46. Site Specific Mitigation Measures for the S&D Subproject

Work Component	Mitigation measures
Micro tunneling along Diamond Harbour road	1. Entry shaft for the micro-tunnels are to be located at places on the road where there are least encroachments on the ROW and least chances inconveniences to pedestrians and people living in the neighborhood. 2. The locations of the entry shafts are to be concurred by Metro railway authorities and Kolkata Police 3. A traffic management plan as approved by the above two authorities should in place before construction work commences 3. Suitable bill boards are to be put up at strategic points on the Diamond Harbour road giving salient information on the work component, time schedule and name & contact numbers of responsible persons of PMU and Contractor 4. Required security fencing is to be in place throughout the construction period of the shafts 5. Excess solid waste is to be disposed at sites pre-approved by PMU 6. First aid boxes is to be available in the construction locations 7. Safety gears are to be provided to workmen
Construction of Churial pumping station within Joka tram depot	1. Construction is to commence only after receiving written land transfer document from the present owner, the Calcutta Tramways Company 2. Excess solid waste from civil constructions is to be disposed at sites pre-approved by PMU 3. Pumps/motors are to comply with the prescribed noise standard and manufacturers' specification of noise level is to be checked when installed. 4. The pumping station is to be provided with fire extinguishers, first aid box and rubber mattings around the control panels and ear muffs for the operators 5. No untreated sewage is to be pumped in to the Churial canal; treated sewage, if any, received in the pumping station and is to be disposed, necessary authority from the WBPCB is to be obtained before hand.
Construction of Begore pumping station	1. Construction is to commence only after receiving written land transfer document from the present owner, the Airport Authority of India 2. Excess solid waste from civil constructions is to be disposed at sites pre-approved by PMU; waste water from dewatering of construction site will be disposed in water bodies/drains pre-approved by PMU 3, Diesel gene set, if used during the construction activities, is to comply with prescribed emission and noise standards 3. Pumps/motors are to comply with the prescribed noise standard and manufacturers' specification of noise level is to be checked when installed. 4. The pumping station is to be provided with fire extinguishers, first aid box, rubber mattings around the control panels and ear muffs for the operators 5. The untreated sewage is to be pumped to the Behala Flying Club P.S. from where it will be pumped to Garden Reach STP for treatment. The treated Sewage will then go to Monikhali Canal.
Construction of Santoshpur-Garden	1. Construction of entry pit at the Garden Reach STP end is to commence only after receiving written land transfer document from the present owner, the KMDA. As he

Work Component	Mitigation measures
Reach STP DWF sewer line by micro-tunneling	micro tunneling will go below the railway line, the construction is to commence only after the receipt of written permission from the Railway authorities. 2. The proposed entry pit at the Garden Reach end is located in a low lying area, water logged as observed on 1 March, 2012. It is reported that the site becomes dry at the peak of summer and is being used as play ground during dry period. Taking this information in to consideration, the site may be free from water logging only during 3 months in a year at the maximum. As it has been estimated that the construction period of the entry pit will not be less than 6 months, pumping out of accumulated water will be required during the construction period. The disposal of the pumped water has been proposed in water logged ditches and/or low-lying areas in and around the STP. Contract clauses are to specifically include that the construction cost of the entry pit will include cost of pumping out of accumulated water by the contractor to water bodies approved in writing by the DSC Engineer. The DSC Engineer will identify the suitable disposal site for pumped water. 3. It has been proposed that part of the pathway on one side of the entry pit at STP end recently widened for a length about 30 m by KEIP, will be used as material storage area leaving space for people to move in to and out of their residences connected to this path way and therefore there is no anticipated impact on access. Space will be left in the pathway by the side of entry pit for movement of residents to gain easy access to their houses 4. As the entry pit at STP end will be within a predominantly residential area construction noise should be kept at a minimum avoiding work during night time 5. Approved security fencing is to be in place throughout the construction period of the shafts 6. Excess solid waste is to be disposed at sites pre-approved by PMU 7. First aid boxes is to be available at the construction sites 8. Safety gears are to be provided to workmen 9. There are no site specific environmental issues connected with construction of entry pit at the Santoshpur PS end.

157. Table 47 outlines the post-construction activities..

Table 47: Post-Construction Activities (Defects Liability Period)

	Activities	Management/Mitigation	Responsible for Monitoring	Frequency
1.	Construction Camp	All structures comprising the construction camp are to be removed from site.	DSC Environment Specialist	Subproject completion
		The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint etc. and these shall be cleaned up.	DSC Environment Specialist	Subproject completion
		All hardened surfaces within the construction camp area shall be ripped, all imported materials removed, and the area shall be top-soiled and re-grassed using the guidelines set out in the revegetation specification that forms part of this document.	DSC Environment Specialist	Subproject completion
		The Contractor must arrange the cancellation of all temporary services.	DSC Environment Specialist	Subproject completion
2.	Vegetation	All areas that have been disturbed by construction activities (including the construction camp area) must be cleared of alien vegetation.	DSC Environment Specialist	Subproject completion
		Open areas are to be re-planted as per the revegetation specification.	DSC Environment Specialist	Subproject completion
		All vegetation that has been cleared during construction is to be removed from site or used as much as per the revegetation specification, (except for seeding alien vegetation).	DSC Environment Specialist	Subproject completion
		The Contractor is to water and maintain	DSC Environment	Subproject

	Activities	Management/Mitigation	Responsible for Monitoring	Frequency
		all planted vegetation until the end of the defects liability period and is to submit a method statement regarding this to the DSC Environment Specialist.	Specialist	completion
3.	Land Rehabilitation	All surfaces hardened due to construction activities are to be ripped and imported materials thereon removed.	Contractor	Subproject completion
		All rubble is to be removed from the site to an approved disposal site. Burying of rubble on site is prohibited.	Contractor	Subproject completion
		The site is to be cleared of all litter.	Contractor	Subproject completion
		Surfaces are to be checked for waste products from activities such as concreting or asphalting and cleared in a manner approved by the DSC Environment Specialist.	Contractor	Subproject completion
		All embankments are to be trimmed, shaped and replanted to the satisfaction of the DSC Environment Specialist.	DSC Environment Specialist and Contractor	Subproject completion
		Borrow pits are to be closed and rehabilitated in accordance with the pre-approved management plan for each borrow pit. The Contractor shall liase with the DSC Environment Specialist regarding these requirements.	DSC Environment Specialist	Subproject completion
		The Contractor is to check that all watercourses are free from building rubble, spoil materials and waste materials.	Contractor	Subproject completion
4.	Materials and Infrastructure	Fences, barriers and demarcations associated with the construction phase are to be removed from the site unless stipulated otherwise by the DSC Environment Specialist.	DSC Environment Specialist	Subproject completion
		All residual stockpiles must be removed to spoil or spread on site as directed by the DSC Environment Specialist.	DSC Environment Specialist	Subproject completion
		All leftover building materials must be returned to the depot or removed from the site.	Contractor	Subproject completion
		The Contractor must repair any damage that the construction works has caused to neighboring properties.	Contractors	As directed by the DSC Environment Specialist.
	General	A meeting is to be held on site between the DSC Environment Specialist, PMU Environment Coordinator and the Contractor to approve all remediation activities and to ensure that the site has been restored to a condition approved by the DSC Environment Specialist.	DSC Environment Specialist and PMU Environment Coordinator	On completion of the construction and maintenance phases
		Temporary roads must be closed and access across these blocked.	DSC Environment Specialist and PMU Environment Coordinator	On completion of construction
		Access or haulage roads that were built across watercourses must be rehabilitated by removing temporary bridges and any other materials placed in/or near to watercourses. Revegetation of banks or streambeds must be as necessary to stabilize these	DSC Environment Specialist and Contractor	On completion of construction

	Activities	Management/Mitigation	Responsible for Monitoring	Frequency
		and must be approved by the DSC Environment Specialist.		
		All areas where temporary services were installed are to be rehabilitated to the satisfaction of the DSC Environment Specialist	DSC Environment Specialist and Contractor	On completion of construction

Table 48: Operation and Maintenance Activities

	Activities	Management/Mitigation	Responsible for Monitoring	Frequency
1.	Pollution monitoring	Monitor the environmental quality in terms of Pumps' discharge, sludge, ambient air and noise levels.	KMC	As specified in the CTO to be issued by WBPCB.
2.	Leaks detection and repairs	Conduct pipe repairs the soonest time possible to avoid disruption of service and disturbance to users/sensitive receptors.	KMC	As necessary.
3.	Sludge disposal	Analyse for hazardous elements and accomplish safe disposal at pre-approved sites	KMC	As necessary
4.	Trees and landscaping maintenance	Young trees require sufficient water until their roots are able to tap available groundwater. Make every effort to water existing trees during periods of drought. When pruning cut as close as possible to the branch collar. Do not injure or remove the collar.	KMC	

C. Environmental Monitoring Program

158. Table 49 outlines the environmental monitoring program to ensure implementation of the management and mitigation measures specified in the EMP. The table shall be read within the context of the body of the entire EMP.

Table 49: Environmental Monitoring Program

Aspect	Parameter	Standards	location	duration / frequency	Implementation	Supervision
1. Site establishment and preliminary activities						
Legislation, Permits and Agreements	CTE and CTO for the hot mix, stone crushers, and diesel generators)	Air (Prevention and Control of Pollution) Act of 1981, Rules of 1982 and amendments.	-	prior to moving onto site and during construction	Contractor	PMU / DSC
	CTE and CTO for the WTPs	Water (Prevention and Control of Pollution) Act of 1974, Rules of 1975, and amendments	-	prior to moving onto site	DSC	PMU
	Cutting Permit for Scheduled Trees	West Bengal Trees (Protection and Conservation in Non-Forest	-	prior to moving onto site	DSC	PMU

Aspect	Parameter	Standards	location	duration / frequency	Implementation	Supervision
		Areas) Act, 2006				
	Copy of EMP	ADB SPS	subproject site, offices, website, library, etc.	At all times	Contractor	PMU/DSC
Access to site	Existing conditions	EMP	all access and haul roads	prior to moving onto site	DSC Environment Specialist	PMU
	Road closures and traffic rerouting	Traffic Management Plan and EMP	all affected roads	one week in advance of the activity	DSC Environment Specialist Contractor	PMU
	Notifications and road signages	Traffic Management Plan and EMP	all affected roads	one week in advance of the activity	DSC Environment Specialist Contractor	PMU
Construction camp	Approval of location and facilities	EMP	as identified	prior to moving onto site	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Equipment Lay-down and Storage Area	Approval of location and facilities	EMP	as identified	prior to moving onto site and during site set-up	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Materials management – sourcing	Approval of sources and suppliers	EMP	as identified	prior to procurement of materials	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Education of site staff	Awareness Level Training - Environment - Health and Safety	EMP and records	-	during staff induction, followed by scheduled as determined	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Social impacts	Public Consultations, Information Disclosure, Communication Strategy	EARF, ADB SPS and EMP	subproject site	prior to moving onto site and ongoing	Contractor with the DSC Environment Specialist, PMU Environment Coordinator, PMU/DSC	Implementing Agency (KMC)
	GRM Register	EMP	subproject site	prior to moving onto site and ongoing	Contractor with the DSC Environment Specialist, PMU Environment Coordinator, PMU/DSC	Implementing Agency (KMC)
Noise	Baseline Data for noise level in	National Noise	two locations	prior to site set-up	DSC Environment	PMU/DSC

Aspect	Parameter	Standards	location	duration / frequency	Implementation	Supervision
	dB(A) L_{eq}	Standards	near construction sites as specified by the engineer		Specialist and PMU Environment Coordinator in coordination with the Environmental Monitoring Laboratory of KMC	
Air quality	Baseline ambient data for particulate matters 10 and 2.5 (PM_{10}, $PM_{2.5}$), sulfur dioxides (SO_2), nitrogen dioxide (NO_2), and hydrocarbons (HC)	National Ambient Air Quality Standards	two locations near construction sites as specified by the engineer	prior to site set-up	DSC Environment Specialist and PMU Environment Coordinator in coordination with the Environmental Monitoring Laboratory of KMC	PMU/DSC
Soil erosion	Soil erosion management measures	EMP	as identified by the engineer	during site set-up and throughout the duration of the subproject	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Stormwater	Stormwater management measures	EMP	as identified by the engineer	during site set-up and throughout the duration of the subproject	Contractor with the DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Water quality	Baseline qualitative characteristics	EMP	subproject sites[21]	prior to site set-up	Contractor with DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Conservation of Natural Environment	Existing conditions	EMP	subproject sites	prior to site set-up	Contrator with DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Waste management procedure	Disposal sites	EMP	as determined	prior to site set-up and ongoing throughout the subproject	Contrator with DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
Cultural environment	Chance finds	ASI Act and EMP	as determined	prior to site set-up and ongoing	Contrator with DSC Environment	PMU/DSC

[21] Subproject sites include approved construction site, equipment lay-down and storage area, watercources along the subproject site, open drainages

Aspect	Parameter	Standards	location	duration / frequency	Implementation	Supervision
				throughout the subproject	Specialist and PMU Environment Coordinator	
2. Construction phase						
Access to Site	Qualitative characteristics	Pre-subproject condition and EMP	all access and haul roads	refer to EMP (table on management of construction and workforce activities	Contractor	DSC Environment Specialist
Construction camp	Qualitative characteristics	Pre-subproject condition and EMP	all access and haul roads	refer to EMP (table on management of construction and workforce activities	Contractor	DSC Environment Specialist
Staff conduct	Site Records (Accidents, Complaints)	EMP	subproject sites	Ongoing	Contractor	DSC Environment Specialist
Air quality	PM_{10}, $PM_{2.5}$, SO_2, NO_2 and HC	National Ambient Air Quality Standards	two locations near construction sites as specified by the engineer (dsc).	once in four months (three times in an year)	Contractor with close coordination with the DSC Environment Specialist and Environmental Monitoring Laboratory of KMC	PMU/DSC
Soil erosion	Soil erosion management measures	EMP	subproject sites	Ongoing	Contractor	DSC Environment Specialist
Stormwater	Soil erosion management measures	EMP	subproject sites	Ongoing	Contractor	DSC Environment Specialist
Water quality	Qualitative characteristics	EMP and pre-existing conditions	subproject sites	Ongoing	Contractor	DSC Environment Specialist
Conservation of Natural Resources	Number of scheduled trees	Tree-cutting permit and EMP	subproject sites	Ongoing	Contractor	DSC Environment Specialist
	Vegetation conditions	EMP	subproject sites	Ongoing	Contractor	DSC Environment Specialist
Materials management	Qualitative characteristics	EMP	subproject sites	Ongoing	Contractor	DSC Environment Specialist
Waste management	Qualitative characteristics	EMP	subproject sites	Ongoing	Contractor	DSC Environment Specialist
	Disposal manifests	EMP	subproject sites	Ongoing	Contractor	DSC Environment Specialist
Social impacts	Public Consultations, Information Disclosure, Communication Strategy	EARF, ADB SPS and EMP	subproject sites	Ongoing	Contractor with the DSC Environment Specialist, PMU Environment	Implementing Agency (KMC)

Aspect	Parameter	Standards	location	duration / frequency	Implementation	Supervision
					Coordinator, PMU/DSC	
	GRM Register	EMP	subproject sites	Ongoing	Contractor with the DSC Environment Specialist, PMU Environment Coordinator, PMU/DSC	Implementing Agency (KMC)
Cultural environment	Chance finds	ASI Act and EMP	subproject sites	Ongoing	Contractor	DSC Environment Specialist
Noise quality	Noise Level in dB(A) L_{eq}	National Noise standards	two locations near construction sites as specified by the engineer (dsc).	once in four months (three times in an year)	Environmental Monitoring Laboratory of KMC	PMU/DSC
C. Post-construction activities						
Construction camp	Pre-existing conditions	EMP	construction camp	subproject completion	Contractor	DSC Environment Specialist
Vegetation	Pre-existing conditions	Tree-cutting Permit and EMP	subproject sites	subproject completion	Contractor	DSC Environment Specialist
Land rehabilitation	Pre-existing conditions	EMP	subproject sites	subproject completion	Contractor	DSC Environment Specialist
Materials and infrastructure	Pre-existing conditions	EMP	subproject sites	subproject completion	Contractor	DSC Environment Specialist
General	Records	EMP	subproject sites	subproject completion	Contractor with DSC Environment Specialist and PMU Environment Coordinator	PMU/DSC
D. Operation and maintenance (defect liability period)						
Air quality	PM_{10}, $PM_{2.5}$, SO_2, NO_2	National Ambient Air Quality Standards	two locations as specified by the era.	once in 6 months (defect liability period)	Environmental Monitoring Laboratory of KMC	PMU/DSC
Noise quality	Noise Level in dB(A) L_{eq}	As per National Noise standards	two locations as specified by the era	once in 6 months (defect liability period)	Environmental Monitoring Laboratory of KMC	PMU/DSC

159. A training program has been developed to build the capability of KMC and PMU in implementing the EMP. The suggested outline of the training program is presented in Table 50.

Table 50: Training Programme on environmental safeguards and its implementation

Module	Frequency of sessions	Target participants	Conducting agency
Environmental Safeguards Requirements comprising (i) ADB's Safeguards Policy	Once in Pre-construction	Senior Construction Supervisors of DSC,	DSC and PMU with assistance

Module	Frequency of sessions	Target participants	Conducting agency
Statement of 2009, (ii) environmental documentation requirements and (iii) Environmental requirements of India particularly those applicable to KEIP subprojects, international obligations (common for all subprojects)	stage	Safety Officers of Contractors, KEIP Senior Engineers	from INRM, ADB, New Delhi and WBPCB
IEE and EMP of S&D subproject	Once during Pre-construction stage	Safety officers of Contractors and Construction supervisors of DSC	DSC and PMU
Workshop on implementation of EMP of S&D subproject of KEIP: lessons learnt and way forward	Once during Construction stage	Senior Construction Supervisors of DSC, PMC Engineers, Safety Officers of Contractors, KEIP Senior Engineers	DSC with assistance from PMU

D. Environmental Management and Monitoring Cost

160. The Contractor's cost for site establishment, preliminary, construction, and defect liability activities will be incorporated into the contractual agreements, which will be binding on him for implementation. The air quality, surface water quality, and noise level monitoring of construction and defect liability phases will be conducted by the contractor.

161. The operation phase mitigation measures are again of good operating practices, which will be the responsibility of implementing agency (KMC). The air quality and noise level monitoring during the operation and maintenance phase will be organized by the operating offices of KMC as part of their routine office expenses.

162. The activities identified in environmental monitoring programme mainly includes site inspections and informal discussions with workers and local people and this will be the responsibility of PMU and DSC, costs of which are part of project management. Table 51 summarizes the indicative cost to implement the EMP.

Table 51: Indicative Costs for EMP Implementation.

Item	Parameters	Project Phase	Sampling Station	Duration and Frequency	Quantity	Unit cost (INR)	Total cost INR)	Source of funds
1. Survey and monitoring							1,500,000	Survey and Investigation /Contingency
Ambient air	PM10, PM2.5, SO2, NO2 and CO	Construction	1 station at Joka 1 station at Garden Reach	2 years per station: 26 weeks in a year (once in two weeks) i	312 eight-hourly samples	1,500	468,000	DSC
Water (waste)	SWF – Total Coliform Organism, pH, Dissolved Oxygen, Biochemical Oxygen Demand DWF –as per effluent standard	Construction	SWF from Begore PS DWF from Begore PS SWF from Churial PS DWF from Churial PS	2 years per station 12 months in a year (once a month)	96	3,500	336,000	DSC
Sludge/solid waste	Heavy metals – Arsenic, Chromium (VI), Lead, Nickel and Cadmium	Construction	4 working sites (location vary from month to month depending upon opened up work fronts)	2 years 4 measurements in each months for 24 months	96	2,000	384,000	DSC
Noise	Leq in dBA	Construction	Active construction sites	2 years 50 measurements in each month for 24 months	1200 measurements	200	240,000	DSC
Ground water	As per Drinking water standard	Construction	4 existing tube wells		88 (4 stations for 2 years)	3,000	72,000	DSC
3. Capacity building/ Training/ workshop expenses							600,000	Survey and Investigation /Contingency
		Pre-construction	Common with water supply subproject					
		Construction			2	200,000	400,000	
4. Environmental Permits							100,000	Government Counterpart

Item	Parameters	Project Phase	Sampling Station	Duration and Frequency	Quantity	Unit cost (INR)	Total cost INR)	Source of funds
								funds
Consent to Establish		Pre-construction	2		2	25,000	50,000	
Consent to Operate		Construction	2		2	25,000	50,000	
Total (INR)							2,100,000	
Total (US$)							46,667 (approx)	
Note/s: INR 45 = US$ 1								

E. Monitoring and Reporting

163. Prior to commencement of any civil work, the contractor will submit a compliance report to DSC ensuring that all identified pre-construction environmental impact mitigation measures as detailed in the EMP will be undertaken. DSC will review the report and thereafter PMU will allow commencement of civil works.

164. DSC will organize an induction course for the training of contractors preparing them on:

(i). EMP implementation including environmental monitoring requirements related to identified mitigation measures; and
(ii). taking immediate actions to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of implementation.

165. During the construction phase, results from internal monitoring by the contractor will be reflected in their weekly EMP implementation reports to the DSC Construction Supervisors. These weekly report will be retained in DSC office for reference.

166. Monthly report will be prepared by DSC summarizing compliance with monitoring requirements, details on any noncompliance, remedial actions taken and additional environmental mitigation measures if necessary. The format of the monthly report is given in Appendix 8.

167. Environmental monitoring activities involving measurements will require engagement of external agencies and will be organized by DSC. Based on monthly reports and measurements, DSC will draft a 6-monthly EMP implementation report. The suggested six-monthly monitoring report format will be as follows:

(i) Introduction
(ii) Construction activities
(iii) Report on EMP implementation
(iv) Environmental conditions
(v) Measurement or sampling undertaken and monitoring results
(vi) Findings on compliance status
(vii) Summary of any non-compliance and remedial actions taken
(viii) Recommendations for improvement/revision of the mitigation measures and/or implementation, if any.

168. The PMU will review, approve and submit to ADB the 6 monthly EMP implementation progress report. Once concurrence from the ADB is received the report will be uploaded in the Project website.

169. Based on review of environmental monitoring results, future modifications in the EMP could be undertaken with the concurrence of the ADB. These will be generally undertaken, if required, upon review of the 6-monthly EMP progress reports submitted by the PMU to ADB following agreed procedures and mechanisms.

170. For Projects likely to have anticipated adverse environmental impacts during operation, monitoring may continue at the minimum on an annual basis during the operation phase. Monitoring reports will be posted in a location accessible to the public.

171. For projects likely to have significant adverse environmental impacts, the KMC will retain qualified and experienced external experts to verify its monitoring information. The KMC external auditor will document significant monitoring results, identify the necessary

corrective actions, and reflect them in a corrective action plan. The KMC, in each quarter, will study the compliance with the action plan developed in the previous quarter. Compliance with loan covenants will be screened by the KMC.

172. ADB will review project performance against the KMC's commitments as agreed in the legal documents. The extent of ADB's monitoring and supervision activities will be commensurate with the subproject's risks and impacts. Monitoring and supervising of social and environmental safeguards will be integrated into the project performance management system

IX. CONCLUSION AND RECOMMENDATIONS

173. The process described in this document has assessed the environmental impacts of all elements of the sewerage and drainage subproject in Kolkata City. Potential negative impacts were identified in relation to pre- , construction and operation of the improved infrastructure, but no environmental impacts were identified as being due to either the subproject design or location. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the designs for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design.

174. The public participation processes undertaken during project design ensure stakeholders are engaged during the preparation of the IEE. The planned information disclosure measures and process for carrying out consultation with affected people will facilitate their participation during project implementation.

175. The subproject's Grievance Redress Mechanism will provide the citizens with a platform for redress of their grievances and describes the informal and formal channels, time frame and mechanisms for resolving complaints about environmental performance.

176. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between KMC, PMU, DSC and the contractors. The EMP will (i) ensure that the activities are undertaken in a responsible non-detrimental manner; (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (ii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (iv) ensure that safety recommendations are complied with.

177. A copy of the EMP will be kept on site during the construction period at all times. The EMP will be made binding on all contractors operating on the site and will be included within the Contractual Clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

178. The subproject is unlikely to cause significant adverse impacts because: (i) most of the individual components involve straightforward construction and operation, so impacts will be mainly localized; (ii) in most cases the predicted impacts are likely to be associated with the construction process and are produced because the process is invasive, involving excavation, obstruction at specific construction locations, and earth movements; and (iii) being located mainly in the already constructed S&D facilities and built-up area will not cause direct impact on terrestrial biodiversity values. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels

without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures.

179. Therefore per ADB SPS, the subproject is classified as environmental Category B and does not require further Environmental Impact Assessment.

Appendix 1. Standards Ambient Air, air emission, effluents, receiving water bodies, drinking *water at consumer end*

A) Notification by Ministry of Environment & Forests, Government of India
Environment (Protection) Seventh Amendment Rules, 2009
Ambient Air Quality Standards

Pollutant	Time Weighted Average	Industrial, Residential, Rural and Other Areas	Sensitive Area (Notified by Central Govt)	Method of Measurement
Sulphur Dioxide (SO_2), µg/m^3	Annual* 24 hours**	50 80	20 80	Improved West & Gaeke method Ultraviolet Fluorescence
Nitrogen Oxide (NO_2), µg/m^3	Annual* 24 hours**	40 80	30 80	Jacobs & Hochheiser modified (NaOH – $NaAsO_2$) method Gas Chemiluminiscence
Particulate Matter (PM_{10}) (Size <10 µm) µg/m^3	Annual* 24 hours**	60 100	60 100	 Gravimetric TOEM Beta Attenuation
Particulate Matter ($PM_{2.5}$) (Size <2.5 µm) µg/m^3	Annual8 24 hours**	40 60	40 60	 Gravimetric TOEM Beta Attenuation
Ozone (O_3) µg/m^3	8 hours** 1 hour**	100 180	100 180	 UV photometric Chemiluminiscence Chemical method
Lead (Pb) µg/m^3	Annual* 24 hours**	0.5 1.0	0.5 1.0	 AAS method after sampling using EPM 2000 or equivalent filter paper
Carbon Monoxide (CO), mg/m^3	8 hours** 1 hour**	2.0 4.0	2.0 4.0	 Non Dispersive Infrared Spectroscopy
Ammonia (NH_3),	Annual* 24 hours**	100 400	100 400	 Chemiluminiscence Indophenol blue method
Benzene (C_6H_6) µg/m^3	Annual*	5	5	 Gas Chromatography continuous analyzer Adsorption & desorption followed by GC analysis
Benzo(o)pyrene (BaP) particulate phase only ng/m^3	Annual*	1	1	 Solvent extraction followed by GC/HPLC analysis
Arsenic (As), ng/m^3	Annual*	6	6	 AAS/ICP method after sampling using EPM 2000 or equivalent filter paper
Nickel (Ni) ng/m^3	Annual*	20	20	 AAS/ICP method after sampling using EPM 2000 or equivalent filter paper

Source: Central Pollution Control Board, New Delhi, Notification dated 18th November 2009
Notes:
* Indicates Annual Arithmetic Mean of Minimum 104 measurement in a year measured twice a week, 24 hourly at uniform intervals
** 24 hourly/8 hourly/1 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed by not on two consecutive days

B) Emission standards for diesel generator sets

1) CPCB emission regulations, Part IV, COINDS/26/1986-87

Stack Height

The minimum height of stack to be provided with each generator set can be worked out using the following formula:

$$H = h + 0.2x\ (KVA)^{0.5}$$

where

H = Total height of stack in metre
h = Height of the building in metres where the generator set is installed
KVA = Total generator capacity of the set in KVA

Based on the above formula the minimum stack height to be provided with different range of generator sets may be as follows:

For Generator Sets	Total Height of stack in metre
50 KVA	Height of the building + 1.5 metre
50-100 KVA	Height of the building + 2.0 metre
100-150 KVA	Height of the building + 2.5 metre
150-200 KVA	Height of the building + 3.0 metre
200-250 KVA	Height of the building + 3.5 metre
250-300 KVA	Height of the building + 3.5 metre

Similarly for higher KVA ratings a stack height can be worked out using the above formula.

2) GSR 371(E) 17 May 2002, amendment to Environment (Protection) Rules 2002 and

(The Emission Limits for new diesel engines (up to 800 KW) for Generator Sets (GENSETS) were notified by the Environment (Protection) Amendment Rules 2002 vide GSR 371(E), dated 17th May 2002 at Sl. No. 95 and as amended vide GSR 520(E), dated 1st July 2003, GSR 448 (E) dated 12th July, 2004, GSR 520(E) dated 12th August 2004 and GSR 280(E) dated 11th April, 2008 under Environment (Protection) Act, 1986)

Para 95. Emission limits for new diesel engines (up to 800 W) for gen set application

The emission limits for new diesel engines up to 800 kw, for gen set applications shall be as follows:

Capacity of diesel engine	Date of implementation	Emission limits (g/kw-hr) for				Smoke limit (light absorption coefficient, m-1) (at full load)	Test cycle	
1	2	3				4	5	
		NO_x	HC	CO	PM		Torque %	Weight-ing factors
Up to 19 KW	1.7.2005	9.2	1.3	3.5	0.3	0.7	100 75	0.05 0.25
> 19 KW up to 176 KW	1.1.2004 1.7.2004	9.2 9.2	1.3 1.3	5.0 3.5	0.5 0.3	0.7 0.7	50 25	0.30 0.30
> 176 KW up to 800 KW	1.11.2004	9.2	1.3	3.5	0.3	0.7	10	0.10

3) Environment Protect third amendment rules 2002 vide 489(E) 9 July, 2002

Para 96. Emission standards for diesel engines (engine rating more than 0.8 Mw (800 Kw) for power plant, generator set applications and other requirements

Parameter		Area Category	Total engine rating of the plant (includes existing as well as new generator sets)	Gerator sets commissioning date		
				Before 1/7/2003	Between 1/7/2003 and 1/7/2005	On or after 1/7/2005
NO_x (as NO_2) (AT 15% O_2), dry basis, in ppmv		A	Up to 75MW	1100	970	710
		B	Up to 150MW			
		A	More than 75MW	1100	710	360
		B	More than 150MW			
NMHC (as C) (at 15% O_2), mg/Nm^3		Both A and B		150	100	
PM (at 15% O_2), mg/Nm^3	Diesel Fuels - HSD & LDO	Both A and B		75	75	
	Furnace Oils - LSHS & FO	Both A and B		150	100	
CO (at 15% O_2), mg/Nm		Both A and B		150	150	
Sulphur content in fuel		A		<2%		
		B		<4%		
Fuel specification		For A only	Up to 5MW	Only Diesel Fuels (HSD, LDO) shall be used.		
Stack height (for generator sets commissioned after 1/7/2003)		Stack height shall be maximum of the following, in meter: (i) 14 $Q^{0.3}$, Q = Total SO_2 emission from the plant in kg/hr (ii) Minimum 6 m above the building where generator set is installed. (iii) 30 m.				

Note:

1. Acronyms used: MW : Mega (106) Watt, FO : Furnace Oil, NO_x : Oxides of Nitrogen: HSD : High Speed Diesel, NO2 : Nitrogen Dioxide, LDO : Light Diesel Oil; O_2 : Oxygen, LSHS : Low Sulphur Heavy Stock, NMHC : Non-Methane Hydrocarbon kPa : Kilo Pascal, C : Carbon, mm : Milli (10^{-3}) metre, PM : Particulate Matter kg/hr : Kilo (10^3) gram per hour, CO : Carbon Monoxide, mg/Nm^3 : Milli (10^{-3}) gram per ; SO_2 : Sulphur Dioxide Normal metre cubic, ppmv : part per million (106) by volume
2. Area categories A and B are defined as follows:

Category A: Areas within the municipal limits of towns/cities having population more than 1million and also up to 5 km beyond the municipal limits of such towns/cities.
Category B: Areas not covered by category A.
4. Individual units with engine ratings less than or equal to 800 KW are not covered by this notification.
5. Only following liquid fuels viz. High Speed Diesel, Light Diesel Oil, Low Sulphur Heavy Stock and Furnace Oil or liquid fuels with equivalent specifications shall be used in these power plants and generator sets.
6. For expansion Project, stack height of new generator sets shall be as per total Sulphur Dioxide emission (including existing as well as additional load).
7. For multi engine plants, fuels shall be grouped in cluster to get better plume rise and dispersion. Provision for any future expansion should be made in planning stage itself.
8. Particulate Matter, Non-Methane Hydrocarbon and percent moisture (dry basis). Carbon Monoxide results -are to be normalized to 25^0C, 1.01 Kilo Pascal (760 mm of mercury) pressure and zero
9. Measurement shall be performed at steady load conditions of more than 85% of the rated load.
10. Continuous monitoring of Oxides of Nitrogen shall be done by the plants whose total engine capacity is more than 50 Mega Waft. However, minimum once in six month monitoring for other parameters shall be adopted by the plants.

ii) Effluent

A) Schedule VI of Environment (Protection) Rules, 1986

General standards for discharge of environmental pollutants: Effluents

Sl no	**Parameter**	**Standards**			
		Inland surface water	Public sewers	Land of Irrigation	Marine/ coastal areas
		(a)	(b)	(c)	(d)

Sl no	Parameter	Standards			
1.	Colour and odour	remove as far as practicable			
2.	Suspended solids, mg/l. max.	100	600	200	(a) For process waste water100 (b) For cooling water effluent 10% above total suspended matter of influent.
3.	Particle size of suspended solids	shall pass 850 micron IS Sieve			(a)Floatable solids, max. 3mm. (b)Settable solids (max 850 micron)
4.	pH value	5.5. to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
5.	Temperature	shall not exceed 50°C above the receiving water temperature			shall not exceed 50°C above the receiving water temperature
6.	Oil and grease, mg./l, max.	10	20	10	20
7.	Total residual chlorine, mg/l. max.	1.0			1.0
8.	Ammonical nitrogen (as N.) mg/l max	50	50		50
9.	Total Kjeldahl Nitrogen (as NH_3) mg/l. max	100			100
10.	Free ammonia (as NH_3), mg/l.max	5.0			5.0
11.	Biochemical oxygen demand (3 days at 27^0C), mg/l. max.	30	350	100	100
12.	Chemical oxygen demand, mg/l, max.	250			250
13.	Arsenic (as As) mg/l, max.	0.2	0.2	0.2	0.2
14.	Mercury (as Hg), mg/l, max.	0.1	0.1	0.1	0.1
15.	Lead (as Pb) mg/l, max	0.1	1.0		2.0
16.	Cadmium (as Cd) mg/l. max	2.0	1.0		2.0
17.	Hexavalent chromium (as Cr. +6). Mg/l, max	0.1	2.0		1.0
18.	Total Chromium (as Cr) mg/l, max	2.0	2.0		2.0
19.	Copper (as Cu) mg/l, max	3.0	3.0		3.0
20.	Zinc (as Zn) mg/l, max	5.0	15		15
21.	Selenium (as Se) mg/l, max	0.05	0.05		0.05
22.	Nickel (as Ni)	3.0	3.0		5.0

Sl no	Parameter	Standards			
	mg/l, max				
23.	Cyanide (as CN) mg/l, max	0.2	2.0	0.2	0.2
24.	Fluoride (as F) mg/l, max	2.0	15		15
25.	Dissolved phosphates (as P) mg/l, max	5.0			
26.	Sulfide (as S) mg/l, max	2.0			5.0
27.	Phenolic compounds (as C_6H_5OH) mg/l, max	1.0	5.0		5.0
28.	Radioactive materials: (a)Alfa emitters microcurie/ml, max. (b)Beta emitters micro curie/ml, max.	10^{-7} 10^{-6}	10^{-7} 10^{-6}	10^{-8} 10^{-7}	10^{-7} 10^{-6}
29.	Bio-assay test	90% Survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
30.	Manganese (as Mn)	2 mg/l	2 mg/l		2 mg/l
31.	Iron (as Fe)	3 mg/l	3 mg/l		3 mg/l
32.	Vanadium (as V)	0.2 mg/l	0.2 mg/l		0.2 mg/l
33.	Nitrate Nitrogen	10 mg/l			20 mg/l

These standards shall be applicable for industries, operations or process other than those industries operations or process for which standards have been specified in schedule of the Environment Protection Rules, 1989

B) CPCB Primary Water Quality Criteria

The Central Pollution Control Board (CPCB), an apex body in the field of water quality management, has developed a concept of "designated best use". According to which, out of several uses a particular water body is put to, the use which demands highest quality of water is called its "designated best use", and accordingly the water body is designated. The CPCB has identified 5 such "designated best uses". All those water bodies, which are used for drinking without any treatment, but with disinfection (chlorination), are termed as "A" Class Water, those which are used for outdoor bathing are termed as "B" Class Water, those which are used for drinking after conventional treatment are termed as "C" Class Water, those which are used for propagation of wildlife and fisheries are termed as "D" Class Water and those which are used for irrigation, cooling and controlled waste disposal are termed as "E" Class Water. For each of these five "designated best uses", the CPCB has identified water quality requirements in terms of few chemical characteristics, known as primary water quality criteria. The "designated best uses" along with respective water quality criteria is given in Table below.

Table. Best use based classification of surface waters in India

S.No.	Designated-Best-Use	Class of Water	Criteria

S.No.	Designated-Best-Use	Class of Water	Criteria
1	Drinking Water Source without conventional treatment but after disinfection	A	1. Total Coliform Organism MPN/100 ml: 50 or less
			2. pH: between 6.5 and 8.
			3. Dissolved Oxygen: 6mg/1 or more
			4. Biochemical Oxygen Demand 5 days 20°C: 2mg/1 or less
2	Outdoor bathing (Organised)	B	1. Total Coliform Organism MPN/100 ml: 500 or less
			2. pH: between 6.5 and 8.5
			3. Dissolved Oxygen: 5mg/1 or more
			4. Biochemical Oxygen Demand 5 days 20°C: 3mg/1 or less
3	Drinking water source after conventional treatment and disinfection	C	1. Total Coliform Organism MPN/100 ml: 5000 or less
			2. pH: between 6 to 9
			3. Dissolved Oxygen: 4mg/1 or more
			4. Biochemical Oxygen Demand 5 days 20°C: 3mg/1 or less
4	Propagation of Wild life and Fisheries	D	1. pH: between 6.5 to 8.5
			2. Dissolved Oxygen: 4mg/1 or more
5	Irrigation, Industrial Cooling, Controlled waste disposal	E	1. pH: between 6.0 to 8.5
			2. Electrical Conductivity at 25OC micro mhos/cm: Max 2250
			3. Sodium Absorption Ratio Max.: 26
			4. Boron Max.: 2mg/1

C) Drinking water standard at consumer end is under revision and the draft version is given in the following Table

Indian Standards for Drinking Water - Specification (BIS 10500: 1991) revised draft 2009

Sl. No	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of Test (Ref to IS)	Remarks
1. Organoleptic and physical parameters						
i)	Colour, Hazen units, Max	5	Above 5 consumer acceptance drcreases	15	3025 (Part 5)	
ii).	Odour	Agreeable	-	Agreeable	3025 (Part 5)	a)Test cold when heated b)Test at several dilutions
iii)	Taste	Agreeable	-	Agreeable	3025 (Part 7 & 8)	Test to be conducted only after safety has been established
iv)	Turbidity, NTU, Max	1	Above 5 consumer acceptance decreases	5	3025 (Part 10)	-
v)	Dissolved solids, mg/l, Max	500	Beyond this palatability decreases and may cause gastrointestinal irritation	2000	3025 (Part 16)	-

Sl. No	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of Test (Ref to IS)	Remarks
vi)	pH Value	6.5 to 8.5	Beyond this range the water will affect the mucous membrane and/or water supply system	No Relaxation	3025 (Part 11)	-
vii)	Total hardness (as $CaCO_3$), mg/l., Max	200	Encrustation in water supply structure and adverse effects on domestic use	600	3025 (Part 21)	
Note 1: It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under the water not acceptable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under permissible limit in the absence of alternate source in col (5), above which the sources will have to be rejected.						
General parameters concerning substances undesirable in excessive amounts						
i)	Iron (as Fe) mg/l, Max	0.3	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures, and promotes iron bacteria	No relaxation	3025 (Part 53)	Total concentration of Manganese (as Mn) and Iron (as Fe) shall not exceed 0.3 mg/l
ii)	Aluminium (as Al), mg/l, Max	0.1	Beyond this limit taste/ appearance are affected, has adverse effect on domestic uses and water supply structures	0.3	IS 3025 (Part 59)	-
iii)	Copper (as Cu), mg/l, Max	0.05	Astringent taste, discoloration and corrosion of pipes, fittings and utensils will be caused beyond this	1.5	IS 3025 (Part 42)	-
iv)	Manganese (as Mn), mg/l ,Max	0.1	Beyond this limit taste/ appearance are affected, has adverse effect on domestic uses and water supply structures	0.3	IS 3025 (Part 59)	Total concentration of Manganese (as Mn) and Iron (as Fe) shall not exceed 0.3 mg/l
v)	Zinc (as Zn), mg/l, Max	5	Beyond this limit it can cause astringent taste and an opalescence in water	15	IS 3025 (Part 49)	-
vi)	Magnesium (as Mg), mg/l, Max.	30	Encrustation in water supply structure and adverse effects on domestic use	No relaxation	IS 3025 (Part 46)	-
vii)	Barium (as Ba), mg/l, Max	0.7	May lead to cardiovascular problem	No relaxation	Annex F of IS 13428*/ S 15302	-

Sl. No	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of Test (Ref to IS)	Remarks
viii)	Calcium (as Ca) mg/l, Max	75	Encrustation in water supply structure and adverse effects on domestic use	200	3025 (Part 40)	-
ix)	Silver (as Ag), mg/l, Max	0.1	-	No relaxation	Annex J of IS 13428	-
x)	Selenium (as Se), mg/l, Max	0.01	Beyond this the water becomes toxic	No relaxation	3025 (Part 56) or IS 15303*	-
xi)	Molybdenum (as Mo), mg/l, Max	0.07	Beyond this it may cause osteoporosis/bone disorders	No relaxation	3025 (Part 2; 2002)/ ISO 11885: 1996	-
xii)	Boron (as B), mg/l, Max	0.5	-	1.0	3025 (Part 57)	-
xiii)	Nitrate (as NO_3) mg/l, Max	45	Beyond this methaemoglobinamia takes place/may be indicative of pollution	No relaxation	3025 (Part 34)	
xiv)	Sulfate (as SO_4) mg/l, Max	200	Beyond this causes gastro intestinal irritation when magnesium or sodium is present	400	3025 (Part 24)	May be extended to 400 provided that Mg does not exceed 30
xv)	Sulphide (as H_2S), mg/l, Max	Below detectable limit	Beyond this it may cause objectionable taste and odour	No relaxation	3025 (Part 29)	-
xvi)	Fluoride (as F) mg/l, Max	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	3025 (Part 60)	-
xvii)	Chlorides (as Cl) mg/l, Max.	250	Beyond this taste corrosion and palatability are affected	1000	3025 (Part 32)	-
xviii)	Ammonia (as total ammonia – N), mg/l, Max	0.5	Toxicological effect about 200 mg per kg of body weight	No relaxation	3025 (Part 34)	-
xix)	Chloramines (as Cl_2), mg/l, Max	0.2	Eyes, nose irritation, anaemia, stomach discomfort	No relaxation	3025 (Part 26) or APHA 4500-ClG	-
xx)	Residual, Free chlorine, mg/l, Min	0.2	-	-	3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it

Sl. No	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of Test (Ref to IS)	Remarks
						should be minimum 0.5 mg/l.
xxi)	Total alkalinity in Calcium carbonate, mg/l, Max	200	Beyond this limit taste becomes unpleasant	600	3025 (Part 23)	-
xxii)	Phenolic Compounds (as C_6H_5OH) mg/l, Max.	0.001	Beyond this may cause objectionable taste and odour	0.002	3025 (Part 43)	-
xxiii)	Mineral Oil mg/l, Max	Below detectable limit	Beyond this limit undesirable taste and odour after chlorination takes place	No relaxation	3025 (Part 39) Infra red partition method	-
xxiv)	Anionic detergents (as MBAS) mg/l, Max	0.2	Beyond this limit it can cause a light froth in water	1.0	Annex K to IS 13428-	-
Note 2: in case of dispute, the method by '*' shall be referee method. Note 3: It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under Acceptable render the water not acceptable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under permissible limit in the absence of alternate source in col (5), above which the sources will have to be rejected.						
Parameters concerning toxic substances						
i)	Total Chromium (as Cr_{6+}), mg/l, Max	0.05	May be carcinogenic above this limit	No relaxation	3025 (part 52)	-
ii)	Total Arsenic (as As) mg/l, Max	0.01	Beyond this the water becomes toxic	0.05	3025 (part 37)	
iii)	Mercury (as Hg) mg/l, Max	0.001	Beyond this the water becomes toxic	No relaxation	3025 (part 48)/Mercury Analyser	-
iv)	Cadmiun (as Cd) mg/lit, Max	0.003	Beyond this the water becomes toxic	No relaxation	3025 (part 41)	
v)	Lead (as Pb) mg/l, Max	0.01	Beyond this the water becomes toxic	No relaxation	3025 (part 47)	
vi)	Nickel (as Ni), mg/l, Max	0.02	Beyond this the water becomes toxic	No relaxation	3025 (part 54)	
vii)	Cyanide (CN), mg/l, Max	0.05	Beyond this the water becomes toxic	No relaxation	3025 (part 27)	
viii)	Polynuclear Aromatic Hydrocarbons (as PAH), mg/l, Max	0.0001	May be carcinogenic	No relaxation	APHA 6440	-
ix)	Polychlorinated biphenyls, mg/l. Max	0.0005	May be carcinogenic	No relaxation	ASTM 5175/APHA 6630	-

Bacteriological quality of drinking water	
Organisms	Guidelines
E. coli or thermotolerent	Must not be detectable in any 100 ml sample

coliform bacteria	
Total coliform bacteria	Must not be detectable in any 100 ml sample

Appendix 2. Noise standards

A). Noise Pollution (Regulation and Control) Rules, 2002 as amended up to 2010

Rule 3. Ambient air guality standards in respect of noise for different areas/zones

(1) The ambient air quality standards in respect of noise for different areas/zones shall be such as specified below
(2) The State Government shall categorize the areas into industrial, commercial, residential or silence areas/zones for the purpose of implementation of noise standards for different areas.
(5) An area comprising not less than 100 metres around hospitals, educational institutions and courts may be declared as silence area/zone for the purpose of these rules.

Area Code	Category of Area	Limit in dB(A) Leqa	
		Day Time	Night Time
A.	Industrial area	75	70
B.	Commercial area	65	55
C.	Residential area	55	45
D.	Silence zone	50	40

Notes:
1. Day time is reckoned in between 6 a.m. and 10 p.m.
2. Night time is reckoned in between 10 PM and 6 AM.
3. Silence zone is an area comprising not less than 100 m around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.
** dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing. A "decibel" is a unit in which noise is measured.*
"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.
Leq is an energy mean of the noise level over a specified period.

Rule 5. Restrictions on the use of Loud Speakers/Public Address system and sound producing instruments

(2) Any sound producing instrument shall not be used at night time except in closed premises for communication within, like auditoria, conference rooms, community halls, banquet halls or during a public emergency;
(4) The noise level at the boundary of the public place, where any noise source is being used shall not exceed 10 dB (A) above the ambient noise standards for the area or 75 dB (A) whichever is lower;

Rule 5A. Restrictions on the use of sound emitting construction equipments.

(3) Sound emitting construction equipments shall not be used or operated during night time in residential areas and silence zones.

B) Noise limit for generator sets run with petrol or kerosene

The noise limit for generator sets run with petrol or kerosene notified by Environment (Protection) (Amendment) Rules, 2000, vide G.S.R. 742 (E), dated 25th September, 2000, at serial no. 91, and as amended by Environment (Protection) (Amendment) Rules, 2001, vide G.S.R. 628 (E), dated 30th August, 2001 and Environment (Protection) (Amendment) Rules, 2011, vide G.S.R. 215 (E), dated 15th March, 2011, under the Environment (Protection) Act, 1986 is as follows:

	Noise Limit from September 1, 2002	September 1, 2003
Sound Power Level LWA	90 dBA	86 dBA

C) Noise limit for generator sets run with diesel

Noise limit for Generator Sets run with Diesel notified by Environment (Protection) second Amendment Rules vide GSR 371(E), dated 17th May 2002 at serial no.94 and its amendments vide GSR No 520(E) dated 1st July 2003; GSR 448(E), dated 12th July 2004; GSR 315(E) dated 16th May 2005; GSR 464(E) dated 7th August 2006; GSR 566(E) dated 29th August 2007 and GSR 752(E) dated 24th October 2008; G.S.R. 215 (E), dated 15th March, 2011 under the Environment (Protection) Act, 1986) is as follows:

Para 50. Noise limit for diesel generator sets (up to 1000 KVA) manufactured on or after the 1st January, 2005

The maximum permissible sound pressure level for new diesel generator (DG) sets with rated capacity up to 1000 KVA, manufactured on or after the 1st January, 2005 shall be 75 dB(A) at 1 metre from the enclosure surface. The diesel generator sets should be provided with integral acoustic enclosure at the manufacturing stage itself.
The implementation of noise limit for these diesel generator sets shall be regulated as given in paragraph 3 below.

2. Noise limit for DG sets not covered by paragraph 1.

Noise limits for diesel generator sets not covered by paragraph 1, shall be as follows:-

2.1 Noise from DG set shall be controlled by providing an acoustic enclosure or by treating the room acoustically, at the users end.
2.2 The acoustic enclosure or acoustic treatment of the room shall be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/acoustic treatment. Under such circumstances the performance may be checked for noise reduction up to actual ambient noise level, preferably, in the night time). The measurement for Insertion Loss may be done at different points at 0.5 m from the acoustic enclosure/ room, then averaged.
2.3 The DG set shall be provided with proper exhaust muffler with insertion loss of minimum 25 dB (A).
2.5 Guidelines for the manufacturers/ users of Diesel Generator sets shall be as under:-
01. The manufacturer shall offer to the user a standard acoustic enclosure of 25 dB (A) insertion loss and also a suitable exhaust muffler with insertion loss of 25 dB(A).
02. The user shall make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise requirements by proper citing and control measures.
03. Installation of DG set must be strictly in compliance with the recommendations of the DG set manufacturer.
04. A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

GSR.7 dated 22 December 1998 amendment to Environment Protection Rules 1986

83. Standards/guidelines for control of Noise Pollution from Stationary Diesel Generator (DG) Sets.

(i) Noise Standards for DG Sets (15-500 KVA)

The total sound power level, Lw, of a DG set should be less than, 94+10 log10 (KVA), dB(A), at the manufacturing stage, where, KVA is the nominal power rating of a DG set.

This level should fall by 5 dB(A) every five years, till 2007, i.e. in 2002 and then in 2007.

(ii) Mandatory acoustic enclosure/acoustic treatment of room for stationary DG sets (5 KVA and above)

Noise from the DG set should be controlled by providing an acoustic enclosure or by treating the room acoustically.

The acoustic enclosure/acoustic treatment of the room should be designed for minimum 25 dB(A) Insertion Loss or for meeting the ambient noise standards, which ever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/acoustic treatment. Under such circumstances the performance may be checked for noise reduction up to actual ambient noise level, preferably, in the night time). The measurement for Insertion Loss may be done at different points at 0.5m from the acoustic enclosure/room, and then averaged.

The DG set should also be provide with proper exhaust muffler with Insertion Loss of minimum 25 dB(A).

(iii) Guidelines for the manufacturers/users of DG sets (5KVA and above)

01 The manufacturer should offer to the user a standard acoustic enclosure of 25 dB(A) insertion Loss and also a suitable exhaust muffler, with insertion loss of 25dB(A).

02. The user should make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise

03 The manufacturer should furnish noise power levels of the unsilenced DG sets as per standards prescribed under (A).

04. The total sound power level of a DG set, at the user's end, shall be within2 dB(a) of the total sound power level of the DG set, at the manufacturing stage as prescribed under (A).

05. Installation of a DG set must be strictly in compliance with the recommendations of the DG set manufacturer.

06. A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

D) GSR 742(E) dated 30.08.1990 amended GSR 422 (E) dated 19 May, 1993

Noise limits for domestic appliances and construction equipments at the manufacturing stage in dB(A)

Window air conditioners of 1 -1.5 tonne	68
Air coolers	60
Refrigerators	46
Compactors (rollers), front loaders, concentrate mixers, cranes (movable), vibrators and saws	75

Appendix 3. Occupational noise exposure

National Institute of Occupational Safety and Health
Criteria for a recommended standard: occupational noise exposure
NIOSH Publication no. 98-126

Combination of noise exposure levels and duration that no worker exposure shall equal or exceed

Exposure Level (dBA)	Duration		
	Hours	Minutes	Seconds
80	25	24	-
81	20	10	-
82	16	-	-
83	12	42	-
84	10	5	-
85	8	-	-
86	6	21	
87	5	2	-
88	4	-	-
89	3	10	-
90	2	31	-
91	2	-	-
92	1	35	-
93	1	16	
94	1	-	-
95	-	47	37
96	-	37	48
97	-	30	-
98	-	23	49
99	-	18	59
100	-	15	-
103	-	7	30
105	-	4	43
110	-	1	29

Appendix 4. Hazardous Wastes (Management Handling and Transboundary Movement) Rules, 2008

S.O. 2265 (E) dated 24 September, 2008
Rule 3. Hazardous waste means waste which by reasons of any of its physical, chemical, reactive, toxic, inflammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances, and shall include wastes having constituents specified in Schedule II if their concentration is equal to or more than the limit indicated in the said schedule.

5. Grant of authorization for handling hazardous wastes
(a) Every person who is engaged in generation, processing, treatment, packaging, storage, transportation, use, collection, destruction, conversion offering for sale, transfer or the like of the hazardous waste shall require to obtain an authorization from the WBPCB.
(b) The hazardous waste shall be collected, treated, re-cycled, re-processed, stored or disposed of only in only in such facilities as may be authorized by the WBPCB for the purpose.

Schedule 2

List of Waste Constituents with Concentration Limits*

Class A

Concentration limit: □ 50 mg/kg

A1 Antimony and antimony compounds
A2 Arsenic and arsenic compounds
A3 Beryllium and beryllium compounds
A4 Cadmium and cadmium compounds
A5 Chromium (VI) compounds
A6 Mercury and mercury compounds
A7 Selenium and selenium compounds
A8 Tellurium and tellurium compounds
A9 Thallium and thallium compounds
A10 Inorganic cyanide compounds
A11 Metal carbonyls
A12 Napthalene
A13 Anthracene
A14 Phenanthrene
A15 Chrysene, benzo (a) anthracene, fluoranthene, benzo (a) pyrene, benzo (K) fluoranthene, indeno (1, 2, 3-cd) pyrene and benzo (ghi) perylene
A16 halogenated compounds of aromatic rings, e.g. polychlorinated biphenyls, polychloroterphenyls and their derivatives
A17 Halogenated aromatic compounds
A18 Benzene
A19 Organo-chlorine pesticides
A20 Organo-tin Compounds

Class B

Concentration limit: □ 5, 000 mg/kg

B1 Chromium (III) compounds
B2 Cobalt compounds
B3 Copper compounds
B4 Lead and lead compounds
B5 Molybdenum compounds
B6 Nickel compounds
B7 Inorganic Tin compounds
B8 Vanadium compounds
B9 Tungsten compounds
B10 Silver compounds
B11 Halogenated aliphatic compounds
B12 Organo phosphorus compounds

B13 Organic peroxides
B14 Organic nitro-and nitroso-compounds
B15 Organic azo-and azooxy compounds
B16 Nitriles
B17 Amines
B18 (Iso-and thio-) cyanates
B19 Phenol and phenolic compounds
B20 Mercaptans
B21 Asbestos
B22 Halogen-silanes
B23 Hydrazine (s)
B24 Flourine
B25 Chlorine
B26 Bromine
B27 White and red phosphorus
B28 Ferro-silicate and alloys
B29 Manganese-silicate
B30 Halogen-containing compounds which produce acidic vapours on contact with humid air or water, e.g. silicon tetrachloride, aluminium chloride, titanium tetrachloride

Class C
Concentration limit; □ 20, 000 mg/kg

C1 Ammonia and ammonium compounds
C2 Inorganic peroxides
C3 Barium compounds except barium sulphate
C4 Fluorine compounds
C5 Phosphate compounds except phosphates of aluminium, calcium and iron
C6 Bromates, (hypo-bromites)
C7 Chlorates, (hypo-chlorites)
C8 Aromatic compounds other than those listed under A12 to A18
C9 Organic silicone compounds
C10 Organic sulphur compounds
C11 Iodates
C12 Nitrates, nitrites
C13 Sulphides
C14 Zinc compounds
C15 Salts of per-acids
C16 Acid amides
C17 Acid anhydrides

Class D
Concentration limit: □ 50, 000 mg/kg

D1 Total Sulphur
D2 Inorganic acids

D3 Metal hydrogen sulphates
D4 Oxides and hydroxides except those of hydrogen, carbon, silicon, iron, aluminum, titanium, manganese, magnesium, calcium
D5 Total hydrocarbons other than those listed under A12 to A18
D6 Organic oxygen compounds
D7 Organic nitrogen compounds expressed as nitrogen
D8 Nitrides
D9 Hydrides

Class E

Regardless of concentration limit, Classified as hazardous wastes if the waste exhibits any of the following Characteristics.

E1 Flammable
Flammable wastes with flash point 65.6°c or below.

E2 Explosive
Wastes which may explode under the effect of flame, heat or photochemical conditions. Any other waste of explosive materials included in the Indian Explosive Act.

E3 Corrosive
Wastes which may be corrosive, by chemical action, will cause severe damage when in contact with living tissue.

E4 Toxic
Wastes containing or contaminated with established toxic and or eco- toxic constituents.

E5 Carcinogenicity, Mutagenecity and Endocrine disruptivity
Wastes contaminated or containing established carcinogens, mutagens and endocrine disruptors.

---

*Waste constituents and their concentration limits given in this list are based on erstwhile BAGA (the Netherlands Environment Protection Agency) List of Hazardous Substances. In order to decide whether specific wastes listed above is hazardous or not, following points be taken into consideration:

(i) If a component of the waste appears in one of the five risk classes listed above (A,B,C,D or E) and the concentration of the component is equal to or more than the limit for the relevant risks class, the material is then classified as hazardous waste.
(ii) If a chemical compound containing a hazardous constituent is present in the waste, the concentration limit does not apply to the compound, but only to the hazardous constituent itself.
(iii) If multiple hazardous constituents from the same class are present in the waste, the concentrations are added together.
(iv) If multiple hazardous constituents from different classes are present in the waste, the lowest concentration limit corresponding to the constituent(s) applies.
(v) For determining the concentration of the hazardous constituents in the waste "Toxicity Characteristics Leaching Procedure (TCLP) as per ASTM-D5233-92 should be adopted.

Appendix 5 Rapid Environmental Assessment (REA) Checklist
Sewerage and Drainage Subproject (Pumping stations)

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting			
Is the project area…			
Densely populated?	+		As per the census 2011, the urban population of Kolkata is 4.45 million and population density is 24783 persons/sq.km. in 2011; the subproject is coming up in a densely populated area.
Heavy with development activities?	+		
Adjacent to or within any environmentally sensitive areas?		+	
Cultural heritage site		+	
Protected Area		+	
Wetland		+	
Mangrove		+	
Estuarine		+	
Buffer zone of protected area		+	
Special area for protecting biodiversity		+	
Bay		+	
B. Potential Environmental Impacts			
Will the Project cause…			
• Impacts on the sustainability of associated sanitation systems and their interactions with other urban services?		+	The pumping stations will pump DWF to STP and allow gravity flow and part pumping of SWF in to the drainage canals. These receptors have adequate capacity to receive the designed flows
• Deterioration of surrounding environmental conditions due rapid urban population growth commercial and industrial activity and increased waste generation to the point that both manmade and natural systems are overloaded and the capacities to mange these systems are overwhelmed?		+	As per census of 2011 KMC has registered a negative population growth; design of the pumping station has taken in to account the flows from this stabilized population
• Degradation of land and eco systems (e.g. loss of wetlands and wild zones, coastal zones, watersheds and forests)?		+	The pumping stations will be located in built up areas
• dislocation or involuntary resettlement of people		+	Not expected
• impairment of historical/cultural monuments / areas and loss/damage to these sites? Loss of tourism revenues?		+	Not expected
• occupation of low lying lands, flood plains and steep hill sides by squatters and low income groups and their exposure to increased health hazards and risks due to pollutive industries?		+	Not expected
•			
• social conflicts arising from displacement of communities?		+	Displacement of communities will not be required. Small scale dislocation of business may be expected from water transmission pipe laying works for which RP will be in place
• conflicts in abstraction of raw water for Water supply with other beneficial water uses for surface and ground waters?		+	No new water intake arrangement is contemplated. There is no proposal to draw ground water. Present drawal of raw water from Hooghly river is small compared to the discharge
• unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?		+	The raw water is treatable to national standard
• delivery of unsafe Water to distribution system?		+	-

• inadequate protection of intake works or wells, leading to pollution of water supply?		+	The intake will be refurbished to make them secure
• over pumping of ground water, leading to salinization and ground subsidence?		+	Raw water is being sourced from river water
• excessive algal growth in storage reservoir?		+	Not anticipated although there are reports of algal growths in filter beds during winter months
• increase in production of sewage beyond capabilities of community facilities?		+	Sewage system development is a part of the Investment Program
• inadequate disposal of sludge from water treatment plants?		+	Sludge management is being refurbished under the subproject
• inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		+	No new pumping stations are being established; pumps are being replaced with sets conforming to noise standards
• -. impairments associated with transmission lines and access roads?	+		Expected only during the construction stage; mitigation measures will be in place
• health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.		+	Chlorine dosing through chlorinator will be continued; separate storing areas exist for the chemicals
• health and safety hazards to workers from the management of chlorine used for disinfection and other contaminants?		+	Personal Protective Equipments will continue to be provided to workers; a standard O & M procedure will be introduced
• water resources problems (e.g. depletion/ degradation of available water supply deterioration for surface and ground water quality and pollution of receiving water		+	Not expected
• Air pollution due to urban emission?		+	Not expected
• Road blocking and temporary flooding due to land excavation during rainy season?		+	Pumping stations are located in secured places
• noise and dust from construction activities?	+		During construction stage only; will be suitably mitigated
• traffic disturbance due to construction material transport and wastes?	+		Only intermittently; to be mitigated through traffic management
• temporary silt run-off due to construction?		+	Construction areas are flat lands
• hazards to public health due to ambient household and occupational pollution thermal inversion and smog formation?		+	Not expected
•			
• social conflicts between construction workers from other areas and community workers?		+	Not expected
• water depletion and/or degradation?		+	No activity leading to water depletion and/or degradation during any stage
• overpaying of ground water leading to land subsidence lowered ground water table and salinization?		+	No extraction of ground water during any stage
• contamination of surface and ground water due to improper waste disposal?		+	Sound construction and O & M procedure will eliminate such chances
• pollution of receiving waters resulting in amenity losses fisheries and marine resource depletion and health problems?		+	Pumped sewage will be delivered to STP for proper treatment before discharge to canals
• interference with other utilities and blocking of access to buildings nuisance to neighbouring araeas due to noise smell and influx of insects rodents etc?		+	Some effect in construction stage only to be suitably mitigated by the sound construction protocol
• impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?		+	STPs will be adequately operated
• overflows and flooding of neighbouring properties		+	DWF pumps are adequately designed

with raw sewage?			
• environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?f		+	Sludges will be disposed in approved places
• noise and vibration due to blasting and other civil works?		+	No blasting is planned; construction noises will be monitored for compliance
• discharge of hazardous materials in to sewers resulting in damage to sewer system and danger to workers?		+	The pumped DWF and SWF will be monitored regularly to detect presence of hazardous substances; Regulatory authorities will be informed in case of any adverse detection
• inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities		+	All legally required stipulations to alleviate noise and other nuisances will be followed
• Social conflicts between construction workers from other areas and community workers?		+	Only local people will be employed by the contractor
• Hazards to public health due to overflow flooding and ground water pollution due to failure of sewerage system?		+	The pumping stations will be adequately designed and operated to prevent such contingencies
• Deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?		+	Sludges will disposed in approved places in approved manner; DWF pumps will be adequately operated
• Contamination of surface and ground water due to sludge disposal on land?		+	Sludge will be chemically analysed for hazardous substances before disposal; in case of hazardous sludge, disposal will be as per rules
• Hazards to workers from toxic gases and hazardous materials which may be contained in sewage flow and exposure to pathogens in sewage and sludge?Health and safety		+	Personal Protective gears to workers for use and training to workmen for safe practices will be provided

Climate Change and Disaster Risk Questions The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.	**Yes**	**No**	**Remarks**
Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes (see Annex I)?	**+**		Project area is subject to flooding during monsoon especially in low lying areas
Could changes in temperature, precipitation, or extreme events patterns over the Project lifespan affect technical or financial sustainability (e.g., changes in rainfall patterns disrupt reliability of water supply; sea level rise creates salinity intrusion into proposed water supply source)?		**+**	Short term changes are not expected
Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g.,high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?	**+**		Canal bank dwellers are vulnerable during flooding
Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., by using water from a vulnerable source that is relied upon by many user groups, or encouraging settlement in earthquake zones)?		**+**	On the other hand treatment surface water will negate the increased salinity of raw water from Hooghly river

Appendix 6. Consultation and participation plan of Sewerage and Drainage Subproject

C&P Activity	Target Stakeholders	Type of Participation	Objectives of the C&P Activity	Responsible Unit/Persons	Time Frame	Cost Estimate INR
1 **Project Orientation Workshop** for government officials (especially KMC & WBPCB officials, officers, and staff on the Investment program (half day)	50 government officials and staff per Project orientation workshop consisting of representatives from the officials and staff, especially the Municipal Corporations; and private contractors	Information sharing Consultation Shared responsibility Shared decision making	To introduce the Project To demonstrate the link between improved S&D and sewerage infrastructure and good health, women's empowerment, and environmental conservation (Note: Seminar topics and contents to be gender-sensitive, socially inclusive, and raise environmental & social awareness). To present Safeguards and Social Frameworks and Plans and disclosure requirements. To discuss roles and accountabilities of various government units. To discuss issues related to use of government lands /property for the Project, environmental risks. To mitigate potential problems e.g., citizens' use of government lands and property that will be lost to the Project such as hawking rights on streets, temporary occupation of public facilities, construction material storage on public facilities, environmental risks especially aquatic ecology of Hooghly river, Compilation and agreement on recommendations	PMU with assistance from Project Team	Year 1: One Project orientation workshop	Project Orientation Workshop for officials = 50, 000
1 **Project Orientation Seminar** for household heads on the investment program	100 community members, preferably, household heads, with at least 30 women	Information sharing Consultation Shared decision making .	To introduce the Project, highlighting its importance and benefits to the community To demonstrate the link between improved S&D and sewerage infrastructure and good health, women's empowerment and environmental	PMU with assistance from Project Team	Years 1:	Project Orientation Seminar households = 50,000

C&P Activity	Target Stakeholders	Type of Participation	Objectives of the C&P Activity	Responsible Unit/Persons	Time Frame	Cost Estimate INR
(half day) 1 **Project Orientation Seminar** for women only on the investment program (half day)	participating At least 50 women community members per Project Orientation Seminar		conservation. (Note: Seminar topics and contents to be gender-sensitive, socially inclusive, and raise environmental/ social awareness). To present safeguards and social frameworks and plans. Compilation of concerns and views related to S&D and sewerage. Compilation and agreements on recommendations			Project Orientation Seminar for women = 25000
One Consultation workshop (half day) with temporarily affected persons	50 hawkers/ vendors, and small shopkeepers affected per subproject	Information sharing Consultation	To introduce the Project. To demonstrate the link between improved water supply and sewerage infrastructure and good health, women's empowerment and environmental conservation & social protection. To show possible livelihood/business opportunities/alternatives. (Note: Seminar topics and contents to be gender-sensitive, socially inclusive, and raise environmental awareness). To present social and resettlement framework and draft social and resettlement plans. To mitigate potential resistance to the	PMU with assistance from Project Team	Year 1: One consultation workshop	Consultation Workshop = 75,000

C&P Activity	Target Stakeholders	Type of Participation	Objectives of the C&P Activity	Responsible Unit/Persons	Time Frame	Cost Estimate INR
			Project Compilation of recommendations & agreements on remedial measures			
One Consultation workshop with the academe, NGOs, and other civil society organizations (1 whole day)	50 representatives of the academic field, NGOs, and other civil society organizations	Information sharing/knowledge generation. Consultation Shared responsibility	To introduce the Project. To demonstrate the link between improved S&D and sewerage infrastructure and good health, women's empowerment, and environmental conservation and social protection. To show possible livelihood/business opportunities/alternatives. (Note: Seminar topics and contents to be gender-sensitive, socially inclusive, and raise environmental awareness) Compilation of views on proposed conservation and mitigation measures. To mitigate potential resistance to the Project. To discuss possible roles as watchdogs of the Project's implementation. To gather other relevant recommendation	PMU with assistance from Project Team	Year 1: One consultation workshop	Consultation Workshop = 50,000 Travel of participants = 25,000
Strategic and Action Planning Workshop 1 half day for Councillors and KMC officials &	Councillors, KMC and KMC officials & engineers	Information sharing Shared responsibility. Shared decision making control	To develop strategic and action plans in accordance with the Project road map. To review compliance with social safeguards, environment, and gender frame works and plans.	PMU with assistance from Project Team	Annually	Councillors meetings 50,000 X 5 years = 250,000 Project Team

C&P Activity	Target Stakeholders	Type of Participation	Objectives of the C&P Activity	Responsible Unit/Persons	Time Frame	Cost Estimate INR
engineers 1 half day for ADB Project Team			To discuss progress in implementation, including problems encountered and means to mitigate/address them. To regularly report on the progress of implementation.			monitoring meetings: 15000 X 4 years = 60,000
Participatory Monitoring Meetings (half day) (for community watchdogs)	20 representatives (50% women) from the community and civil society (representatives of CBOs, NGOs, ward committees, poor/slum communities, private sector)	Information sharing. Shared responsibility	Discussion of issues and concerns during Project implementation. To discuss and recommend measures to mitigate/ address the problems. To monitor progress of Project implementation	PMU with assistance from Project Team	Participatory Monitoring Meetings: Semi-annually	15000 X 2 meetings X 4 years = 120,000
TOTAL COST OF CONSULTATION AND PARTICIPATION - INR ~ 705,000						

Appendix 7. Sample Grievance Registration Form ()
(To be available also in Bengali, Hindi and Urdu)

The _____Project welcomes complaints, suggestions, queries and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.
Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

Date		Place of registration			
Contact Information/Personal Details					
Name		Gender	* Male * Female	Age	
Home Address					
Village / Town					
District					
Phone no.					
E-mail					
Complaint/Suggestion/Comment/Question Please provide the details (who, what, where and how) of your grievance below: If included as attachment/note/letter, please tick here:					
How do you want us to reach you for feedback or update on your comment/grievance?					

FOR OFFICIAL USE ONLY

Registered by: (Name of Official registering grievance)	
Mode of communication: Note/Letter E-mail Verbal/Telephonic	
Reviewed by: (Names/Positions of Official(s) reviewing grievance)	
Action Taken:	
Whether Action Taken Disclosed:	Yes No
Means of Disclosure:	

Appendix 8. Environmental Monitoring Format

A. Work Progress

Location	Work package	Work components	Physical progress

B. Status of environmental clearance

Work Package	Type of clearance	Agency applied for	Date of application	Date of receipt of clearance	Clearance reference number	Validity date

C. Compliance with EMP (Pre-construction/Construction/Operation stage

Package	Impact description	Mitigation measures undertaken	Period	Date or Frequency	Monitoring remarks	Monitored by

D Measurement of pollutants

Components	Package/Location	Parameters/Pollutants	Sate of sampling	Monitoring result
Air quality				
Water quality				
Sludge quality				
Noise level				

Index Map for Sewerage and Drainage Works (Tranche I)