



KOLKATA ENVIRONMENTAL IMPROVEMENT PROJECT

PROJECT MANAGEMENT UNIT

**PROGRESS REPORT ON EMP IMPLEMENTATION OF
KOLKATA ENVIRONMENTAL IMPROVEMENT PROJECT
FOR THE PERIOD JANUARY TO JUNE, 2008**

(Loan Nos. 1813-IND & 2293-IND)

July, 2008



KOLKATA MUNICIPAL CORPORATION

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List of Abbreviations

Asian Development Bank	ADB
Department for International Development	DFID
Design and Supervision Consultants	DSC
Dry Weather Flow	DWF
East Kolkata Wetlands	EKW
EKW Management Authority	EKWMA
Environmental Impact Assessment	EIA
Environmental Management Cell	EMP
Executing Agency	EA
Government of West Bengal	GoWB
Initial Environmental Examination	IEE
Irrigation and Waterways Department	I & W D
Kolkata Environmental Improvement Project	KEIP
Kolkata Municipal Corporation	KMC
Million litres per day	MLD
Occupational Health and Safety Plans	OHSP
Project Affected Persons	PAP
Project Director	PD
Project Management Consultant	PMC
Project Management Unit	PMU
Project Preparatory Technical Assistance	PPTA
Project Specific Study	PSS
Pumping Station	PS
Report and Recommendation of the President, Asian Development Bank	RRP
Sewerage and Drainage	S & D
Sewage Treatment Plant	STP
Solid Waste Management	SWM
Storm Weather Flow	SWF
Team Leader	TL
Tollygunj Panchannagram canal	T P canal

PROGRESS REPORT ON EMP IMPLEMENTATION OF KEIP FOR THE PERIOD JANUARY TO JUNE, 2008

I. INTRODUCTION

1. Kolkata Municipal Corporation (KMC) is the Executing Agency (EA) for implementing the Kolkata Environmental Improvement Project (KEIP or the Project) with financial assistance from Asian Development Bank (ADB) since 2002. The Project consists of the following six parts or components (RRP, 2000):

Part A: Stakeholder Consultation Process

Part B: Sewerage and Drainage Improvement

Part C: Solid Waste Management

Part D: Slum Improvements

Part E: Canal Improvements

Part F: Implementation Assistance and Capacity Building

2. The Project Preparatory Technical Assistance (PPTA) had prepared an Initial Environmental Examination (IEE) report in 2000 that designated the Project as Category B. During detailed design and implementation of the Project over last 5 years, the physical scope and design of the Project have been modified, and approved by the ADB. These include construction of new sewerage and drainage (S & D) network in borough VII and discharge of untreated sewage from S & D works under the Project in boroughs VII, XI and XII into the existing Dry Weather Flow (DWF) channel for eventual natural treatment in the fisheries of the East Kolkata Wetlands (EKW), an ecologically sensitive area listed as a Ramsar site. Accordingly, the original IEE of 2000 has been revised and updated to screen and assess potential environmental impacts and appropriate mitigation measures have been proposed. The overall IEE shows that the Project will have a positive impact on the environment of the project area particularly on terrestrial habitats, through improved sewage and drainage facilities, reducing flood damage due to water logging during monsoon, improving the local environment and enhancing institutional capacity for providing improved civic services in the targeted areas of Kolkata and especially in the selected slum areas. The potential adverse impacts on the environment are perceived to be localized, short-term, non-significant, and can generally be mitigated. The mitigation measures have been adequately spelt out in the revised IEE and component-wise IEEs. The summary IEE developed for the Project was publicly disclosed on ADB website in August 2006.

3. Since a part of the Project extends into the environmentally sensitive EKW area, the revised KEIP has now been categorized as B sensitive. As such an interim environmental management plan (EMP), as per requirements of Environment Policy of ADB, 2002, ADB's

Environmental Guideline, 2003 and ADB's Environmental Operation Manual, 2006, has been developed. This interim EMP of the Project will be finalized upon receipt of the final report of the Project Specific Study (PSS) by Dr Tim Wrigley and Dr Asis Mazumdar of School of Water Resources Engineering, Jadavpur University. The PSS is being carried out as part of TA 4814-IND (component TA for capacity building for the protection of EKW). Findings as per draft report specifically indicate that no additional STP is required to be constructed due to the additional sewage to be generated by KEIP that is proposed to be conveyed and naturally treated in the EKW.

4. The present EMP implementation report relates to the progress of implementation of the provisions of EMP of KEIP during the first six months (January-June) of 2008 in respect of various work components of Part B, Part C, Part D and Part E in which civil constructions are involved. However, construction activities related to involuntary resettlement, their impacts and monitoring of mitigation measures including socio-economic benefits to the project affected persons (PAPs) in accordance with agreed revised Resettlement Plan are not reported in this write-up. The Stake Holder Consultation Process (Part A) is an important component of the Project in all phases of implementation of components of KEIP involving civil construction. Such consultations, during the design stage, have provided important inputs for addressing environmental concerns of the stakeholders and have been duly considered. During the construction phase, more frequent stakeholder consultations at work site levels have been carried out. These consultations were to confirm that the implementation of the EMP to overcome the perceived adverse environmental impacts, identified during the design stage, are being adequately and effectively addressed. The Implementation Assistance and Capacity Building of KMC (Part F) is another important component of the Project that is being implemented through various studies and consultations with DFID, UK funds. Implementation of the EMP will be facilitated by such capacity building of the KMC during the operation and maintenance phase.

II. CONSTRUCTION ACTIVITIES

A. Sewerage and Drainage Improvement

5. Sewerage and Drainage components of KEIP have the following four sub-components.
- (i) construction of combined S&D network**
6. Table 1 summarizes construction activities during January to June, 2008.

Table 1. Borough-wise details of construction of S & D network works, January – June, 2008

Component	Borough I		Borough VII		Borough XI (part)	Borough XII & XI (part)	Borough XIII		Borough XIV			Borough XV
	SDD1	SDD2	SDF 1	SDF 2	SDA1	SDC	SDA2	SDA3	SDB1	SDB2	SDB3	SDE
Estimated approximate volume of soil excavated from new and replaced pipes and manholes (m ³)	14382.54	15087.88	4182.02	16900.85	7957.16	83269.80	12741.24	77673.98	13183.07	12739.46	14807.50	14807.5
Estimated approximate volume of excess excavated soil disposed (m ³)	-	-	-	-	9412.625	-	11513.97	13525.89	30761.51	10059.90	-	-
Estimated approximate quantity of silt removed and disposed from cleaning of existing pipes	-	-	-	-	3211.35	-	3257.68	764.99	-	8418.78	40.63	40.63
Estimated approximate quantity of precipitate removed from cleaning of existing drainage channels	1527.48	60.13	-	-	100.45	678.5	3399.25	3472.9	780.75	-	-	-
Estimated approximate volume of road crust removed (m ³)	1815.31	-	-	-	3322.66	-	2009.15	264.5	-	-	-	-
Approximate Length of new drainage and sewerage line (m) constructed– up to 450 mm diameter	618.45	200.82	161.29	336.89	1281.27	7489.87	354.66	1711.50	133.87	125.79	989.27	989.27
Approximate Length of proposed new drainage and sewerage line (m) constructed – above 450 mm diameter	2292.68	2516.77	736.42	2688.83	1708.28	13832.45	3763.60	2908.81	2610.35	1562.10	2735.66	2735.66

ii) construction and augmentation of pumping stations

7. The progress of work in the construction of pumping stations (PS) during January to June, 2008 under KEIP is given in Table 2.

Table 2. Progress of work of construction of pumping stations, January – June, 2008

Package	Identification of PS	Type DWF / SWF	Status (Augmentation/New)	Status of Construction	Progress of work	
					Well sinking (m)	RCC (cu.m)
SD 23	Borough XII, XIII & XIV	DWF	New	Work in progress	28.3	1272.67
SD24R1	LS1A-2B, Behala Node-C, Kamdahari, LS-5	DWF	Augmentation	Work in progress	-	22.91
SD24R2		DWF	Augmentation	Work in progress	-	-
SD26	Borough I	DWF+SWF	New	Work in progress	11.92	185.91
SD27	Borough VII	DWF + SWF	New	Work in progress	10.03	253.45
SD32	Borough XV	DWF + SWF	New	Work in progress	-	-

(iii) disposal of wastewater into DWF channel

8. The findings from the draft report of PSS of Dr Tim Wrigley and Prof Asis Majumdar indicate that the fisheries of EKW are capable of naturally treating the additional sewage from KEIP works that will reach the EKW fisheries via the DWF channel.

(iv) construction of augmented/refurbished sewage treatment plants (STPs) for discharge of treated effluents into the drainage canals.

9. Construction activities during January to June, 2008 related to this sub-component has commenced after pre-construction studies and the progress made is summarized in Table 3.

B. Solid Waste Management

10. There was no activity to report with respect to solid waste management component of KEIP during January-June, 2008.

Table 3. Progress of work in the refurbishment of Sewage Treatment Plants under KEIP from January to June, 2008

Name of Sewage Treatment Plant	Refurbished Treatment Capacity (2021) in MLD	Progress of work					
		Work elements					
		Topographical survey of the total area of the STP	Dewatering of existing ponds (m ³)	Earth work in excavation of existing ponds (m ³)	Earth work in filling of embankments (m ³)	Laying of outlet DI pipeline (m)	Laying NP3 pipe line (m)
		1	2	3	4		5
South Suburban East	45	15.93	542139.28	248177.26	16124.24	462	419.57
Bangur	52	Preparatory work commenced					
Garden Reach	57						

C. Slum Improvement

11. Construction work undertaken in Slum Improvement Packages in KEIP during January - June 2008 is summarized in Table 4.

Table 4. Construction work undertaken in Slum Improvement Packages in KEIP, January – June 2008

Package	IXA	XA	XB	XC	XI	Total
Pavement area (sq.m)	8050	6	2615	6983	2407	20060
Toilet (no)	15	103	0	4	0	122
Bath (no)	6	4		150	0	160
Urinal (no)	6			0		6
Total renovation/new line 150 to 450	143	218	813	426	2138	3738
Inspection pit, Manhole and gully pit (no)	117	122	267	285	347	1138
100 to 250 C.I/D.I main (m)	-	-	-	-	6	6
15 to 80 dia G.I. pipe	206	-	-	0	372	578

D. Canal Improvement Works

12. Progress in construction activities in canal improvement works of KEIP from January to June, 2008 is given in Table 5.

III. REPORT ON EMP IMPLEMENTATION

Induction of contractors on implementation & monitoring requirements

13. Consequent upon the award of any contract and during the construction activities, contractors are made aware of the basic provisions of EMP as related to their works. These were accomplished through instructions by the site engineers and Senior Construction Supervisors of Design and Supervision Consultants (DSC), KEIP.

Compliance reports of contractors prior to commencement of works

14. Works related to refurbishment of South Suburban STP commenced after the design parameters were established so as to prevent any flooding of the facility due to inadequate space, capacity and pumping requirements.

15. Works related to canal improvements commenced only when the relocation of canal bank dwellers for the selected stretches is completed. Where felling of trees is involved, tree survey along the stretch to be excavated has been carried out so that re-plantation after completion of work could be taken up vigorously.

Weekly construction reports of contractors and DSC

16. Weekly reviews of all construction activities with emphasis on mitigation measures of potential environmental impacts being undertaken by the Contractors have been taken by the respective Senior Construction Supervisors. Spot flying checks on the construction sites to ensure overall quality control including environmental and social requirements are being made by Team Leader (TL), DSC.

Training of contractors on mitigation of unexpected adverse impacts

17. Mitigation measures for any unexpected adverse impacts being faced are formulated by DSC and implemented by Contractors under the supervision of site engineers of DSC as soon as they crop up and reviewed about their efficacies weekly by the Senior Construction Supervisors of DSC.

Monthly monitoring report of contractors

18. Site wise monthly reports are being prepared by Senior Construction Supervisors of DSC in consultation with Environment Specialist of DSC. These reports are available in the office of DSC.

Table 5. Basin wise details of progress in construction activities from January to June, 2008 of rehabilitation of different canal systems under KEIP

	T P main canal CW -05	T P main canal CW -08	T P main canal CW -09	Manikhali U/S CW -10	Monikhali downstream CW 11	Keorapukur CW 12A	Churial extension CW 12B	Churial Main CW 13	Churial Main CW 14	Churial Main CW 15
1. Earth work in excavation in cubic m	78430	28000	33115	19945	16900	2291	10522	Not yet commenced		
2. Geotextile filter in sq. M	4739	Nil	Nil	6992	3150	Nil	Nil			
3. Precast concrete block lining in sq. m	4739	Nil	Nil	9689	5850	Nil	Nil			
4. M-30 grade concrete in structures in cu. m	Nil	Nil	Nil	622	Nil	330	1704			
5. Reinforcement in M. T.	Nil	Nil	Nil	40	Nil	31	133			
6. Disposal of excavated material	78000	23000	32000	19500	16500	Nil	10500			
7. Topographic survey (km)	Nil	4.341	5.857	Nil	Nil	Nil	Nil			
8. Clearing and grubbing of canal banks including disposal (km)	2.87	1.241	3.737	0.60	4.75	1.12	2.043			
9. Clearing and removal of water hyacinth including disposal in sq.m.	51124	11430	11113	57401	11046	18211	14996			
10. Clearing of sludge and slush including floating debris and removal (km)	1.165	1.241	3.737	0.60	1.5	0.087	1.33			

Six monthly progress report of EMP implementation

19. Six monthly review and report of EMP implementation is being developed by Environment Specialist of DSC based on the feed back from and in consultation with Senior Construction Supervisors of DSC incorporating the results of the required sampling, laboratory analysis and measurements. The third six monthly report (January-June, 2008) has become due after 30 June, 2007.

Institutional Strengthening and Training

20. The recently established EKWMA of Government of West Bengal has engaged M/S Wetland International for the development of an EKW EMP. In order to safeguard the interests of KEIP while formulating the EKW EMP, Dr Stuart Bunting and Dr P Edwards, International Specialists of Wetland issues, have been engaged by ADB to provide inputs to EKWMA for finalising the EKW EMP.

21. KMC has already established an environment management cell (EMC). The EMC is to play an advisory and overall coordination role for KMC and the KEIP to ensure that agreed mitigation measures and monitoring are being carried out. Environment has been formally introduced as a subject in the portfolio of Sri Sushil Sharma; Member - Mayor-in-Council (Policy making Body in KMC). Sri Anindya Karforma, (a Chief Engineer Rank Officer) is the Nodal Officer of the EMC. Suitable staffing has been made in the EMC. There is a fully functional Central Water Testing Laboratory in KMC now. There is also a dedicated water testing facility at Palta Water Treatment Plant. Further the ponds and water bodies in KMC area are being cleansed and preserved in keeping with the Inland Fisheries Act and the West Bengal Town and Country Planning Act. The EMC is looking into all this.

Statutory Clearances/Approval Status

22. The proposal to build 89 blocks of housing for canal bank dwellers at Nonadanga covering a built-up area of about 70,000 m² will only require prior environmental clearance from WBPCB. Necessary application in prescribed Form 1 and Form 1A has been made to the Board in September, 2007. Comments in the form of minor clarifications were received in December, 2007 and necessary clarifications have been provided on 12.1.2008. A presentation was made to the members of Expert Appraisal Committee on 31.1.2008. Provisional environmental clearance has been granted by the WBPCB on 26.03.2008. Additional administrative documents as requested are being provided for the final clearance.

23. For continued operation of the three Sewage Treatment Plants (South Suburban East, Bangur and Garden Reach) after refurbishment by KEIP, necessary permission has been sought from WBPCB on 25.2.2008 that has been followed up by a reminder dated 15 April, 2008.

IV. ENVIRONMENTAL CONDITIONS

A. Sewerage and Drainage Improvement

(i) construction of combined S & D network

24. Construction activities have impacted the local environment in some sites, especially with the onset of monsoon in later part of the six monthly period from January to June, 2008, mainly in the nature of inconveniences to the residents. These inconveniences are transient in nature and will disappear once the construction phase is over. Many of the inconveniences have been mitigated to the extent practicable so that their intensities are minimized and/or shortened in time and there is no adverse permanent impact on the environment. These inconveniences are to be accepted (for which public awareness campaign has been taken up) for a short period of time for bringing in a permanent improved environment once the construction phase is completed.

(ii) construction and augmentation of pumping stations

25. Construction work of new pumping stations during the period has commenced in KMC lands with activities being restricted to preparatory work for installation of new pumps in some cases and well sinking in some other cases. Environmental conditions at the construction works remained unchanged due to low intensity construction activities. On the other hand, better drainage in the catchments of the pumping stations is likely to bring in improvement in environmental conditions.

(iii) disposal of wastewater into DWF channel

26. Disposal of additional wastewater into DWF channel will commence when pipe laying works, house connections and construction and commissioning of pumping stations in the designated catchments under the KEIP are completed. Environmental condition around the DWF channel therefore was not impacted during the period due to the Project.

(iv) construction of new and augmented/refurbished sewerage treatment plants (STPs) for discharge of treated effluents into the drainage canals.

27. Construction activities related to refurbishment of South Suburban East Sewage Treatment Plant was limited to cleaning of the existing facilities including excavations and raising and strengthening of peripheral embankments of the existing ponds. These activities did not lead to any perceptible change in the environmental conditions in the STP area. Excess soil

and silt were used in the strengthening of embankments of the ponds without any change in environmental conditions in and around the embankments. Only preparatory activities related to refurbishment of the other two STPs (Bangur and Garden Reach) have commenced.

B. Solid Waste Management

28. No activity is to be reported under this component during the period under review.

C. Slum Improvement

29. The environmental conditions of selected slums have improved wherever the planned constructions of infra-structural facilities are complete. As the improvement works are all in the nature of small scale isolated spot development of basic civic amenities within the slums, construction stage adverse impacts are minimal and as such there are no change in environmental conditions at the sites during construction activities.

D. Canal Improvement Works

30. With the relocation of canal bank dwellers, re-excavations of canals and bridge constructions, the canal bank areas and their surroundings are poised for an improvement in environmental conditions with relatively unpolluted canal water, elimination of foul odour, elimination of cause of solid waste dumping, better conveyance of storm weather flows, improvement of drainage in catchments and elimination of ugly shanties along canal banks. The canal bank dwellers are being rehabilitated with housings having basic civic amenities for a healthy and dignified living. The excavated silts are non-hazardous and are being disposed at pre arranged approved sites where no adverse impacts on environment are expected.

V. MEASUREMENT OR SAMPLING UNDERTAKEN AND MONITORING RESULTS

Canal Silt Analysis

31. Sampling and analysis of canal silts from 36 points of 18 different locations were carried out during May, 2008 of Churial main canal. The summarized results of canal silt analysis are given in Table 6 and the detailed analysis report is given in Appendix 1 and 2. It is to be noted from the silt analysis report that concentrations of metals in the silt samples, collected from the Churial main canal are non-hazardous when compared with limits set in Hazardous Wastes (M&H) Amendment Rules 2003.

Table 6. Summarised results of analysis of silt of Churial main canal January-June, 2008

Parameters	Churial main canal	
	Range	Mean
pH(1:5)	6.81-8.02	-
Bulk Density (gm/cc)	0.94-1.17	1.05
Sand (%)	71.0-92.5	82.4

Parameters	Churial main canal	
	Range	Mean
Silt (%)	1.0-23.0	10.0
Clay (%)	3.0-16.5	7.6
Total Kjeldahl Nitrogen (%)	0.15-0.42	0.28
Potassium (ppm)	16.25-93.4	41.6
Phenolic Compound (ppm)	<0.5-27.49	1.73
Arsenic(ppm)	<0.50	
Mercury(ppm)	<0.50-18.73	1.13
Lead(ppm)	5.81-29.15	18.15
Cadmium(ppm)	<1.0	
Total Chromium(ppm)	10.85-68.95	42.78
Chromium +6(ppm)	<1.0	
Zinc(ppm)	23.61-118.49	65.07
Nickel(ppm)	8.97-33.43	24.22
Copper(ppm)	7.36-66.76	24.46

Similar analysis of canal silt in respect of physico-chemical properties and heavy metal concentration has been carried from representative samples of T P main canal system (under Package 3 of KEIP) and of T.P main canal, Intercepting channel and various Lead channels (under Package 2 of KEIP). The results of the analysis are presented in Appendices 3, 4, 5 and 6. The results indicate that concentrations of metals in the silt samples, collected from the mentioned canals are non-hazardous when compared with limits set in Hazardous Wastes (M&H) Amendment Rules 2003.

Sewage Silt Analysis

32. Sampling and analysis of sewage silt recovered due to dismantling of previous sewage lines or cleaning of old lines from 10 different locations were carried out once during January-June, 2008. The results of sewage silt analysis are given in Appendix 7. It is to be noted from the silt analysis report that concentrations of phenolic compounds and metals like cadmium, nickel, chromium⁺⁶, mercury and arsenics in the silt samples are below the detection limits of determination. Concentrations of other metals like lead, copper, chromium⁺³ and zinc are relatively low. They are all non-hazardous when compared with limits set in Hazardous Wastes (M&H) Amendment Rules 2003.

STP Silt Analysis

33. Sampling and analysis of silt excavated of existing ponds of SSE STP as part of refurbishment programme of the STP from one location were carried out during the period January-June, 2008. The results of STP silt analysis are given in Appendix 7. It is to be noted

from the silt analysis report that concentrations of phenolic compounds and metals like cadmium, nickel, chromium⁺⁶, mercury and arsenic in the silt samples are below the detection limits of determination. Concentrations of other metals like lead, copper, chromium⁺³ and zinc are relatively low. They are all non-hazardous when compared with limits set in Hazardous Wastes (M&H) Amendment Rules 2003.

Waste Water Analysis

34. Waste water was sampled from the following six sites in the Project Specific Study (PSS) that has been carried out by Dr Wrigley and Prof Asis Majumdar:

1. Topsia Point A that receives pumped “settled” sewage from the city of Kolkata,
2. Ambedkar Bridge that is 4 km downstream of Topsia Point A,
3. Bantala Weir, a major off-take point of DWF to the fisheries and is 6 km downstream of Topsia Point A,
4. Bamunghata where DWF channel flow enters a series of fish ponds,
5. Karaidanga that is 15 km downstream of Topsia Point A having only residual DWF,
6. Ghusighata that is 36 km downstream of Topsia Point A represents the final discharge point of DWF to Kulti river.

35. BOD concentrations at Topsia are 150 mg/L. At Bantala measured BOD concentrations are in the range of 100 to 110 mg/L. Measured BOD loadings in the studied three fish pond systems were between 11 and 30 kg/ha/day with residence time ranging from 28 to 74 days. Measured BOD concentrations at the outlets of the studied fish ponds are in the order of 20 mg/L with input BOD concentrations in the fish ponds varying between 35 and 90 mg/L indicating that ponds act efficiently in removing BOD. The inflowing BOD organic matter is converted into algae.

36. The inflow “settled sewage” has concentrations of suspended solid in the range of 200 mg/L that are generally reduced to around 100 mg/L. The settled sewage is broken down into key nutrients which in turn are converted to algal matter in passage through the fish ponds. Consequently chlorophyll a concentrations increase from 10 microgram/L in the feeder channel to as high as 300 microgram/L towards the outlet of the fisheries. Dissolved oxygen concentrations increase from 0-2 mg/L in the fish feeder channel to 4-6 mg/L in the ponds. Ammonia concentrations in the order of 3-4 mg/L were measured in the feeder channel and lower values of between 1-3 mg/L were measured in the pond outlets. The above trends persisted during a seven day intensive study undertaken.

37. Removal of both total and faecal coliform was extremely high in the fish pond system. Typical inflow numbers as measured in the DWF channel to the ponds were $10\text{-}20 \times 10^5$. These numbers were reduced to between 1000 and 4000 MPN per 100 ml in the fish ponds.

38. It has been calculated that an additional fifteen per cent of flow from several boroughs of the Kolkata city at a BOD concentration of 180 mg/L can be treated in the studied EKW ponds to meet water quality discharge criteria and enhance the fishery. It will also irrigation facility in the farm lands within the EKW thus improving rural livelihoods and enhancing the values of wise use for EKW, a Ramsar wetland.

Noise Level Measurement

39. Noise level in dBA has been measured at several work sites for each component of the KEIP where civil construction is going on. The results of the measurements are tabulated in Appendix 8 and 9. All measurements were carried out during day time as all major construction activities were restricted during the day time. It could be seen from the data that at all work sites where manual operations are being carried out during the construction activities the time averaged noise level in dB(A) is around 65. Considering that ambient noise level is relatively high in typical congested mixed residential-commercial areas of Kolkata with high multi-modal traffic noise, the measured noise level is to be accepted as a temporary situation. However, where diesel pump sets were used for dewatering trenches/ponds and/or JCP/Hydra was used, the noise level has reached in excess of 80 dB (A) often reaching values above 90 dB (A). Such elevated noise levels can not be avoided at work sites but were of short and/or intermittent duration and during the day time only. Highest work zone noise level in excess of 100 dBA was recorded at sites where compressor with jack hammer was in operation connection with laying of sewage pipes below the concreted road. Necessary protection measures to the work men and those who are working near the site as per rule have been enforced.

VI. FINDINGS ON THE COMPLIANCE STATUS

40. The implementation including monitoring as planned in the EMP has been carried out at all work sites of the KEIP. Most of the works are related to construction phase only. The daily observations that are required to be made as per list of monitoring agenda were noted each day by the site engineers of the Contractors and DSC in their Construction records. These were summarized on a weekly basis and were reviewed by the respective Senior Construction Supervisors of DSC and extra remedial measures if required were implemented. The extra remedial measures are listed in Chapter VII vide paras 51, 53 and 55. A site wise monthly

report was prepared by the respective Senior Construction Supervisors that have been used by the Environment Specialist of DSC to develop the six-monthly report of EMP implementation of KEIP.

41. The above structured approach for the period January to June, 2008 has ensured that the provisions of the EMP have been enforced and complied with. The potential adverse impacts have been mitigated by continuous and timely measures as provided in the EMP. In a few cases unexpected and unavoidable situations (like water logging due to high intensity rains, difficulty faced for movement and access to houses in narrow streets with no alternate pathways, etc) have developed leading to temporary inconveniences that have been mitigated to the extent possible by taking timely appropriate measures.

Sewerage & Drainage network

Construction Phase

42. Summary observations of monitoring carried out during the Construction Phase during January to June, 2008 are given below item-wise:

i. Soil erosion & surface run-off prevention

Daily visual inspections have been carried out by DSC site supervisors at all running work sites to ensure exposed surfaces are resurfaced and stabilized rapidly by the Contractors. There was no case of delayed action by the Contractors. Timely precautionary measures were taken to prevent soil erosion and landslide in a few cases where such measures were necessary. Consequent minor damages to boundary walls and walls of individual properties have been noted in some areas due to pipe laying work apparently because these were having very shallow foundations. Remedial action taken is given in Chapter VII para 51.

ii. Prevention of dust nuisance

There was no dust nuisance during the wet periods. Daily visual inspections have been carried out by DSC site supervisors at all running work sites to ensure (a) light water spraying on loose and fine debris whenever necessary during dry periods, (b) use of masks / goggles by workmen whenever necessary & (c) covered transport of excess material whenever necessary. There was no record of heavy fugitive dust emission in the work sites. It is to be noted that site conditions did not allow use of much of heavy equipment. Generation of dust was, therefore, on the low side.

iii. Disposal of silt and excess soil

Monthly visual inspection of sites and delivery records of the Contractors have been carried out by DSC site supervisors to ensure that timely and adequate disposal of silt and excess soil has

been undertaken by the Contractors at pre-agreed and pre-approved sites. There was no case of unnecessary silt / soil accumulation at work sites.

iv. Prevention of soil, ground and/or surface water contamination from contaminated silt

No contaminated silt arising out of cleaning/dismantling of existing sewage lines has been excavated out during the present construction phase (Appendix 7).

v. Vehicular and Construction noise pollution mitigation

Sound level monitoring has been carried out at running work sites. The data given in Appendix 8 bring out that the noise levels due to increased construction activities were elevated a few decibals over the ambient noise where works were carried out manually. Dewatering of trenches by pumps and employment of Hydra/JCP/ Air Compressors/Jack Hammer were persistent sources of relatively high noise level at the work sites. Necessary steps through provision of preventive gears to the workmen were taken as per rule. No night operations were carried out.

vii. Relocation of utility services

Intersection of major utility lines during trenching/excavation for drainage network was avoided in most cases. Diversions of water supply lines and electrical lines have been carried out observing the required formalities and with the consent of affected people.

viii. Prevention of water logging / flooding during trenching

Daily inspection at all running work sites has been carried out by DSC and PMU site supervisors to check water levels in the trenches. Timely dewatering was carried out as required. However, during wet periods some areas experienced temporary water-logging due to high intensity rainfall and due to impaired and insufficient drainage. Necessary draining and pumping of water logged areas were taken up to the extent feasible by deploying additional pumps.

ix. Traffic management

Partial/full closure of any public road including temporary diversion was done in co-ordination with the police authorities. The situation was reviewed daily by DSC site supervisors with the Contractors to minimize inconveniences to the local people. Safe passage for bicycles and pedestrian traffic was always maintained. Cases of major traffic closures/diversions were in the places as mentioned in Table 7.

Table 7. Details of major traffic diversions/closures due to construction of S & D network under KEIP from January to June, 2008

Package	Ward	Road	Duration of diversion/ closure		Description of the closure/diversion and remedial measures provided
			From	To	
SDA 2	120	James Long Sarani	Dec 07	April 08	One way traffic. Other way diverted through D.H. Road
SDA2	119	S N Roy Road (J L Sarani to DH Road)	March 08	Continuing	Traffic diverted through Roy Bahadur Road
SDA2	117	Jyotish Roy Road	Jan 08	May 08	Traffic diverted through Kailash Pandit Lane
SDA3	115	B L Saha Road (Surity to Karunamoyee)	March 08	Continuing	Traffic diverted through Karunamoyee Ghat Road
SDB1	128	Biren Roy Road (W)	January 08	June 08	Full closure. Traffic has been diverted through wards 126 & 127 and partially through internal roads of ward 128
SDB2	129	R K Sarani	November 07	Continuing	Islamia-Polar Fan Factory, Traffic diverted through Brahma Samaj Rd and Goalapara Road
SDB2	129	M B Road (2000)	November,07	Continuing	Polar Fan Factory-Goragacha; Traffic diverted through MID Rd
SDB2	129	M B Road (1400)	March, 07	3.7.08	Goragacha-13B Bus Terminus (KB Road); Traffic diverted through MID Rd
SDB2	129	K B Road	January, 08	3.7.08	13B Bus Terminus-MID Rd junction; Traffic diverted through M B Road & AD Garden Road
SDB2	130	Royed Park	November, 07	January, 08	Brahma Samaj Road-B C Rd; Traffic diverted through S N Chatterjee Rd & Dhalipara
SDB2	131	N S Road	February, 08	May, 08	Bhutnath Park – K D Mukherjee Road
SDB3	128	B C Road	February 08	Continuing	No. 8 Rickshaw Stand – 149 B C Road; Traffic diverted through Housing Board Bye Road
SDB3	129	May Road	Novemeber, 06	April, 08	Traffic diverted through Sukanta Sarani
SDB3	129	Satyajit Roy Sarani	November, 07	Continuing	Traffic diverted through M B Road
SDD2	5	Manmatha Dutt Road	March, 07	Continuing	One flank of the road kept open; road work in

Package	Ward	Road	Duration of diversion/ closure		Description of the closure/diversion and remedial measures provided
			From	To	
					progress
SDD2	5	Raja Manindra Road	March 08	May 08	Traffic movement facilitated by deputing volunteers
SDD2	5	Seven Tank Road	July 07	Continuing	One flank of the road kept open for traffic movement
SDD2	2	Kali Charan Ghosh Road	January08	Continuing	Road totally closed; traffic diverted through adjacent bye-lanes
SDD2	4	Raja Manindra Road	May, 08	Continuing	Traffic volunteers deputed to manage traffic movement
SDD1	S. Dum Dum Municipality	Jessore Road	February 08	Continuing	Traffic diverted through one flank by deputing volunteers
SDD1	3	Khudiram Bose Road	May 08	Continuing	Traffic diverted through one flank by deputing volunteers
SDD1	3	Indra Biswas Road	March 08	Continuing	Traffic movement is slightly restricted as the work is going on at one side of the road
SDD1	6	Lock Gate Road	February, 08	Continuing	Traffic movement is slightly restricted as the work is going on at one side of the road
SDE	134	Garden Reach road from CESC gate to Paharpur Road Junction (Length 800 m approx)	February, 08	Continuing	Heavy vehicles are diverted through Paharpur Road; Light vehicles are allowed to pass through Garden Reach Road
SDF1	56	Motijil Lane	January 2008	Continuing	Partial closure
SDF1	56	Convent Lane	January 2008	Continuing	Partial closure
SDF1	56	Kamardanga Road	June 2008	Continuing	Partial closure
SDF1	56	Pottery Road	June 2008	Continuing	Partial closure
SDF1	59	Christopher Road	January 2008		Partial closure
SDF2	57	Pagladanga 1 st Lane	November 2007	Continuing	Partial closure
SDF2	57	South Canal Road	December 2007	Continuing	Partial closure
SDF2	57	Kulia Tangra 2 nd Lane	January 2008	Continuing	Partial closure
SDF2	57	Rani Rashmoni Garden Lane	January 2008	Continuing	Partial closure
SDF2	58	New Tangra Road	December 2007	Continuing	Partial closure
SDF2	58	Paymental Garden Road	March 2008	Continuing	Partial closure

Package	Ward	Road	Duration of diversion/ closure		Description of the closure/diversion and remedial measures provided
			From	To	
SDF2	58	Dhapa Road	May 2008		Partial closure
SDF2	66	G J Khan Raod	December 2007	Continuing	Partial closure
SDF2	66	Raicharan Ghosh Road	Aoril 2008	Continuing	Partial closure
SDF2	67	Dr G S Bose Road	March 2008	Continuing	Partial closure
SDF2	67	Dharmatala Road	March 2008	Continuing	Partial closure
SDF2	67	Swinhoe Lanr	March 2008	Continuing	Partial closure

x. Health and safety of work force

Daily visual inspection was carried out by DSC site supervisors to ensure that Occupational Health & Safety standards were followed by the Contractors.

xi. Environmental health & safety at construction camp sites

A safety, health and environmental plan were submitted by each Contractor on acceptance of the work order detailing the provisions being made under the Plan. The Plan in each case provided for, amongst other things, temporary labour camps with flush latrines. In addition available pay and use toilets came handy for the camp sites in some places. On the whole the camp sites did not pose any threat to environmental health and safety in the area. DSC site supervisors made daily visual inspections.

xii. Conservation of places of cultural importance

There was no case involving places of cultural importance falling along S&D network excavations.

Pumping Stations

Construction Phase

43. Summary observations of monitoring carried out in the Construction Phase during January to June, 2008 are given below item-wise:

i. Soil erosion & surface run-off prevention

Daily visual inspections have been carried out by DSC site supervisors at all running work sites to ensure working surfaces do not remain exposed and unstable after completion of the construction work.

ii. Prevention of dust nuisance

There was no dust emission during the wet periods. Daily visual inspections have been carried out by DSC site supervisors at all running work sites to ensure (a) light water spraying on loose and fine debris whenever necessary during dry periods, (b) use of masks / goggles by workmen whenever necessary & (c) covered transport of excess material whenever necessary. There was no record of fugitive dust emission in the work sites. It is to be noted that site conditions did not allow use of much heavy equipment. Generation of dust was, therefore, on the low side.

iii. Prevention of soil, ground and/or surface water contamination from contaminated silt

No contaminated silt was excavated out during the present construction phase.

Sewage Treatment Plant

Pre-construction Phase

44. Monitoring for pre-construction phase included only situations related to possible flooding of STP sites.

i. Flooding of STP sites

- Flooding of sites are not expected because of provision of improved drainage in the design
- Flooding of sites are not expected because of provision of adequate treatment & pumping capacity and stand by pumps in the design

Construction Phase

45. Summary observations of monitoring carried out during the Construction Phase in the South Suburban East STP are given below item-wise:

i. Soil erosion & surface run-off prevention

Daily visual inspections have been carried out by DSC site supervisors at all running work sites to ensure exposed surfaces are stabilized rapidly by the Constructors. The embankments are being strengthened to accidental bank erosion and/or failure. There was no case of delayed action by the Contractors.

ii. Prevention of dust nuisance

There was no dust emission during the wet periods. Daily visual inspections have been carried out by DSC site supervisors at all running work sites to ensure (a) light water spraying on loose and fine debris whenever necessary during the dry periods, (b) use of masks / goggles by workmen whenever necessary & (c) covered transport of excess material whenever necessary. There was no record of fugitive dust emission from the work sites. No piling was also done. Generation of dust was, therefore, on the low side.

iii. Prevention of soil, ground and/or surface water contamination from contaminated silt

Silts from excavations of ponds of the existing SSE STP are non-hazardous (Appendix 7). On the contrary they are rich in nutrients. Current disposal of silts from the existing ponds of SSE STP at pre-approved sites will not contaminate soil, ground and/or surface water.

iv. Vehicular and Construction noise pollution mitigation

The SSE STP site is away from residential areas. Construction activity was limited to dewatering and manual & machine excavation during dry periods. There was no major vehicle movement in the area. There was minimum addition to the ambient noise level due to vehicular activities during this period although the work place noise level is high (Appendix 9).

v. Relocation of utility services

There was no record of any intersection of major utility lines during construction work.

vi. Prevention of water logging / flooding during trenching/excavation of ponds

Daily inspection at all running work sites has been carried out by DSC site supervisors to prevent water-logging/flooding due to excavation activities. However, the surrounding areas outside the STP boundary are low-lying and partially covered with water especially during the wet periods.

vii. Traffic management

There was no partial / full closure of any public road including temporary diversion for construction activities under this sub-component.

viii. Health and safety of work force

Daily visual inspection was carried out by DSC site supervisors to ensure that Occupational Health Safety standards were followed by the Contractors.

Slum Improvements

Construction Phase

46. Summary observations of monitoring carried out during the Construction Phase in the boroughs are given below item-wise:

i. Prevention of Soil erosion & surface run-off

Slum improvement works are in the nature of small spot improvements of infrastructure. Therefore significant soil erosion and undesirable surface run-off have not been encountered. Daily checks by the Contractors and DSC site supervisors were carried out.

ii. Prevention of dust nuisance

There was no dust nuisance during the wet periods. Non-significant dust nuisance has been mitigated by light water spraying whenever required under supervision of DSC site supervisors. It is to be noted that low intensity construction activity for slum improvements did not generate adverse fugitive dust.

iii. Disposal of silt and excess soil

Small quantities of silt and excess soil generated during spot improvement of facilities in the selected slums have been disposed adequately and in time. Monthly review was made by the Contractors and DSC site supervisors.

iv. Prevention of soil, ground and/or surface water contamination

Slum improvement works did not pose any significant soil, ground and/or surface water contamination.

v. Mitigation of noise pollution

The nature of construction activities involved only manual work with no significant additional noise generation.

vi. Relocation of utility services

There was no occasion for relocation of utility services during the construction phase of slum improvement works in various Boroughs.

vii. Prevention of water logging / flooding

There was some water logging / flooding during the construction phase of slum improvement works in various Boroughs during wet periods. Site supervisors of the Contractors and DSC made daily inspections and took necessary emergency measures.

viii. Traffic management

There was no occasion of temporary / partial traffic diversion during the construction phase.

ix. Health and safety of work force

Daily visual inspection was carried out by DSC site supervisors to ensure occupational health and safety standards are strictly followed by the Contractors. There were no violations.

Operation Phase

47. Summary observation of monitoring carried out during the Operation Phase in boroughs I to XI is given below item-wise:

i. Regular emptying of septic tanks

Quarterly cleaning of septic tanks has been routinely carried out by KMC.

ii. Regular cleaning and maintenance of drains

Boroughs of KMC have a running programme of regular cleaning and maintenance of drains in the slums.

iii. Water quality of stand posts

Stand posts in the slum areas receive water from KMC's filtered water supply and are free from any metal, organic and pathogenic contamination as revealed by regular analysis of water carried out in KMC water testing laboratory.

iv. Cleaning and disinfection of urinals

KMC through its respective Boroughs carried out cleaning and disinfection of urinals continuously. Only visual inspection of urinals was undertaken to ensure cleanliness.

Canal Improvements

Pre-construction Phase

48. Summary observations of monitoring carried out during the Pre-construction Phase are given below item-wise:

i. Tree replanting

A large number of trees has been planned to be planted along the canal banks once excavation work is completed. Tender specifications for carrying out such planting along with extensive beautification of the canal banks have been drafted.

ii. Relocation of canal bank dwellers

Two hundred fifty families from different canal banks have relocated in the flats newly constructed under KEIP during the current six-monthly period (January – June, 2008).

The relocated sites/housings have improved environmental conditions with adequate sanitation and other facilities compared to the abominable environmental conditions in the canal bank shanties.

Construction Phase

49. Summary observations of monitoring carried out in the Construction Phase during January to June 2008 are given below item-wise:

i. Prevention of soil erosion & surface run-off

Daily visual inspections have been carried out by DSC site supervisors at all running canal excavation sites to ensure that the slopes of excavated banks were stabilized rapidly by the contractor. There were minimum excavation works with on-set of monsoon. Timely precautionary measures were taken to prevent any bank failure in case of development of any adverse situation. DSC site supervisors ensured that there was no case of delayed action by the contractors.

ii. Prevention of dust nuisance

It is to be noted that canal silt was wet when excavated. Daily visual inspections were carried out by DSC site supervisors at all canal stretches under excavation to ensure (a) light water spraying on loose dried canal silt if necessary, (b) use of hand gloves / masks / goggles by workmen whenever necessary & (c) covered transport of dewatered and semi-dry canal silt.

iii. Disposal of excavated silt

Daily visual inspection of excavation sites and monthly checking of delivery records of the contractor have been carried out by DSC site supervisors to ensure that timely and adequate disposal of excavated silt at pre-agreed and pre-approved sites have been undertaken by the contractor after dewatering of the excavated silts at the canal banks. There was no case of unnecessary silt accumulation at work sites. Dry silt was transported under cover. The excavated silt is non-hazardous in nature for the analysed parameters (Appendices 1, 2, 3, 4, 5 and 6) with respect to limits set in Hazardous Wastes (M&H) Amendment Rules 2003.

iv. Prevention of soil, ground and/or surface water contamination from contaminated soil

The silt excavated from the canal was temporarily stacked by the side of the same canal. The filtrate is therefore going back to where the water charged silt came from. This is to prevent any possible pollution of other water bodies and spilling of interstitial water during transportation to disposal sites. No statutory clearance is required for this operation more so because the silt itself is non-hazardous.

v. Mitigation of noise pollution

Sound level monitoring has been carried out at running work sites. The data given in Appendix 9 bring out that the noise levels due to canal improvement activities are relatively high where machineries like excavators were in operation. Construction noise generation due to manual excavation work was on comparatively low side. It is to be noted that construction sites are in general away from residential areas (excluding the informal shanties of the canal bank dwellers).

vi. Traffic Management

There was no necessity of temporary/partial diversion/closure of roads during the construction phase. Traffic situation was regularly reviewed by the Contractors and DSC site supervisors.

vii. Health and Safety of work force

Daily visual inspection was carried out by DSC site supervisors to ensure occupational health and safety standards are strictly followed by the Contractors. There were no violations. Temporary labour camps have primary sanitary facilities

VII. SUMMARY OF ANY NON-COMPLIANCE AND REMEDIAL ACTIONS TAKEN

S & D network construction

50. There were minor threats of deterioration of local environmental quality, mainly in terms of inconveniences to residents in some of the work fronts opened for the construction of S & D network temporarily due to the following reasons:

- Difficulty in ingress and egress into some houses for their respective residents due to electric cable shifting work and due to pipe laying works
- Bad conditions of the roads due to time lag between laying of pipe lines and road restoration work
- Complete or partial closure of roads with restricted traffic movements
- Short-term water-logging in trenches especially after heavy monsoon showers
- Flooding of streets and low-lying houses after heavy monsoon showers because of impaired drainage arrangements
- Short term disruption of electricity and water supply to some households during diversion of underground electric and sewer lines falling along the alignment of S & D lines being laid at some sites.
- Elevated noise levels in some sites due to
 1. use of air compressors and jack hammers for breaking of ground/road and/or existing sewers
 2. working of Hydra machines
 3. use of noisy diesel pumps for dewatering of trenches
 4. use of hammering technology in sheet piling to support walls of trenches
 5. plying of trucks in the night especially for removing excess silt and movement of construction materials
- Minor and major damages to boundary walls and residential buildings especially in wards 128, 129 and 132 due to pipe laying works.

51. The following remedial actions were taken expeditiously mitigating the inconveniences to a large extent.

- Ingress and egress to affected houses were provided as far as practicable although in some cases there were temporary restrictions on full accessibility due to non-availability of alternate space. These restrictions were withdrawn expeditiously through suitable engineering and administrative actions.

- Alternate routes were always provided for temporary closure or part closure of roads with provisions of pathways for pedestrians and two-wheelers.
- Accumulated water was pumped out as and when required to the extent possible
- Flooding after heavy rain was mitigated by continuous pumping to the extent feasible/possible
- Restoration of accidental disruption of electricity and water supply was arranged expeditiously by pursuing the CESC and KMC water supply department to undertake diversion/repair expeditiously.
- Elevated noise levels at work sites are to be accepted, in the cases mentioned, as these are work related noise that can not be avoided. However, proper maintenance of the equipments was enforced on the contractors so that the noise levels of the used equipments remained at manufacturers' specifications. Workmen also used proper gears so that the occupational health norms were not violated.
- Suitable repairs to the boundary walls and buildings are being carried out. Further repair works are in progress.

Refurbishment of STP

52. (i) The existing ponds of SSE STP are being excavated and the embankments of the ponds are being strengthened by increasing their heights and widths. As a consequence some surrounding built-up areas were water-logged during wet periods due to drainage congestion.

(ii) Due to movements of heavy vehicles, the roads around the STP site are damaged inconveniencing the local people who use these roads.

53. Remedial measures that have been taken are as follows:

- (i) pumping and draining of water from the built-up areas
- (ii) roads are being repaired as and when required.

Canal Excavation work

54. Environmental problems related to stability of canal banks to be excavated were faced at few sites. They are as follows:

- Threat of soil erosion and landslide due to bank instability along a few vulnerable stretches during excavation posing dangers to stability of the excavated canal banks and in some cases close by hutments/building and road.

55. The following remedial measures were taken expeditiously mitigating the adverse situation to a large extent.

- Extensive Eucalyptus *ballah* piling to prevent soil collapse and soil erosion along vulnerable stretches of the canals under excavation were taken up expeditiously. In cases where the design requirement is for permanent protection of canal sections, concrete lining has been provided. The details are given in Table 8.

Table 8. Details of bank protection measures carried out to prevent bank/slope failure along stretches canals from January to June, 2008

Serial No	Name of the canal	Chainage (m)		Piling work carried (m)		Remarks
		From	To	From	To	
Eucalyptus ballah piling						
1	Intercepting Canal	2280	2310	2280	2310	150 mm dia 6 m long
2	Intercepting Canal	2310	2370	2310	2370	
3	Intercepting Canal	2370	2430	2370	2430	
4	Intercepting Canal	2220	2280	2220	2280	
5	Intercepting Canal	2400	2670	2400	2670	200 mm dia 6 m long
6	Intercepting Canal	2430	2610	2430	2610	
7	Intercepting Canal	3030	3100	3030	3100	
8	Intercepting Canal	2760	2910	2760	2910	150 mm dia 6 m long
9	Begore khal	2520	2650	2520	2650	150 mm dia 6 m long
10	Parnashree khal	410	430	410	430	
11	Keorapukur canal	70	124	70	90	
12	Manikhali (D/S)	3157	3457	3347	3457	
13	Manikhali (D/S)	6380	6395	Not yet done		
PCC lining						
1	Intercepting canal	2220	2400	2220	2400	Both banks
2	Intercepting canal	2740	2910	2740	2910	Both banks
3	Intercepting canal	2970	3100	2970	3030	Right bank

Serial No	Name of the canal	Chainage (m)		Piling work carried (m)		Remarks
		From	To	From	To	
4	Intercepting canal	2970	3100	2970	3100	Left bank
5	Begore khal	2900	3345	2900	3345	Bed and side
6	Manikhali (d/s)	1650	3066	About 350 m in isolated stretches		

VIII. RECOMMENDATIONS FOR IMPROVEMENT/ REVISION OF THE MITIGATION MEASURES AND/ OR THE EMP IF ANY

56. At this stage on the implementation of interim EMP of the revised KEIP, no improvements/revisions of the mitigation measures of the interim EMP are suggested/recommended. Progressive strict enforcement of the provisions of the interim EMP has been planned in the next six months.

APPENDICES

Appendix 1. Physico chemical properties of silt of Churial main canal system Package VIII (8)

Sr. No.	Sampling Site	Sample No.	Sampling point (chainage in m)	pH (1:5)	Bulk Density (gm/cc)	Sand (%)	Silt (%)	Clay (%)	Total Kjeldahl Nitrogen (%)	Potassium (ppm)	Phenolic Compound (ppm)
1	Churial main canal	1A: at slush level	6400	7.23	1.15	72.5	11.0	16.5	0.32	32.50	<0.50
		1B: 1 m below slush level		7.23	0.99	79.5	15.0	5.5	0.30	53.34	<0.50
2	Churial main canal	2A: at slush level	6900	7.25	0.98	78.5	17.0	4.5	0.31	62.39	<0.50
		2B: 1 m below slush level		7.32	1.11	84.5	10.0	5.5	0.39	53.47	<0.50
3	Churial main canal	3A: at slush level	7400	7.13	1.09	81.5	8.0	10.5	0.29	81.31	<0.50
		3B: 1 m below slush level		7.11	0.89	92.5	1.0	6.5	0.33	93.40	<0.50
4	Churial main canal	4A: Slush level	7900	6.81	1.06	85.0	6.0	9.0	0.17	26.59	<0.50
		4B: 1 m below slush level		7.44	1.04	79.0	14.0	7.0	0.34	36.71	<0.50

Sr. No.	Sampling Site	Sample No.	Sampling point (chainage in m)	pH (1:5)	Bulk Density (gm/cc)	Sand (%)	Silt (%)	Clay (%)	Total Kjeldahl Nitrogen (%)	Potassium (ppm)	Phenolic Compound (ppm)
5	Churial main canal	5A: at slush level	8400	7.09	1.09	77.0	14.0	9.0	0.35	40.18	<0.50
		5B: 1 m below slush level		7.54	1.06	85.0	7.0	8.0	0.23	27.12	<0.50
6	Churial main canal	6A: at slush level	8900	7.35	1.06	71.0	21.0	8.0	0.30	44.56	13.99
		6B: 1 m below slush level		7.43	1.04	72.0	23.0	5.0	0.31	32.32	<0.50
7	Churial main canal	7A: at slush level	9400	7.41	1.02	83.0	11.0	6.0	0.33	38.44	<0.50
		7B: 1 m below slush level		7.30	1.08	78.0	9.0	13.0	0.36	46.36	27.49
8	Churial main canal	8A: at slush level	9900	7.43	1.09	85.0	5.0	10.0	0.27	40.78	<0.50
		8B: 1 m below slush level		7.33	1.04	80.0	12.0	8.0	0.38	34.70	<0.50

Sr. No.	Sampling Site	Sample No.	Sampling point (chainage in m)	pH (1:5)	Bulk Density (gm/cc)	Sand (%)	Silt (%)	Clay (%)	Total Kjeldahl Nitrogen (%)	Potassium (ppm)	Phenolic Compound (ppm)
9	Churial main canal	9A: at slush level	10400	7.45	1.12	81.0	11.0	8.0	0.35	40.40	<0.50
		9B: 1 m below slush level		7.18	1.00	80.0	15.0	5.0	0.31	57.32	<0.50
10	Churial main canal	10A: at slush level	10900	7.31	1.02	83.0	14.0	3.0	0.27	45.66	<0.50
		10B: 1 m below slush level		7.33	1.03	82.0	15.0	3.0	0.27	33.29	<0.50
11	Churial main canal	11A: at slush level	11400	7.42	1.04	86.0	10.0	4.0	0.21	45.26	<0.50
		11B: 1 m below slush level		7.26	0.95	85.0	9.0	6.0	0.42	49.50	<0.50
12	Churial main canal	12A: at slush level	11900	7.54	1.10	85.0	8.0	7.0	0.23	21.87	<0.50
		12B: 1 m below slush level		7.19	1.03	80.0	16.0	4.0	0.34	61.70	<0.50

Sr. No.	Sampling Site	Sample No.	Sampling point (chainage in m)	pH (1:5)	Bulk Density (gm/cc)	Sand (%)	Silt (%)	Clay (%)	Total Kjeldahl Nitrogen (%)	Potassium (ppm)	Phenolic Compound (ppm)
13	Churial main canal	13A: at slush level	12400	7.69	1.08	83.0	7.0	10.0	0.17	28.19	<0.50
		13B: 1 m below slush level		7.51	1.10	85.0	6.0	9.0	0.18	16.25	<0.50
14	Churial main canal	14A: at slush level	12900	7.61	0.96	85.0	6.0	9.0	0.32	34.17	<0.50
		14B: 1 m below slush level		7.52	1.11	84.0	6.0	10.0	0.16	22.47	<0.50
15	Churial main canal	15A: at slush level	13400	7.56	1.01	84.0	7.0	9.0	0.15	32.26	<0.50
		15B: 1 m below slush level		7.51	1.04	86.0	6.0	8.0	0.19	29.80	<0.50
16	Churial main canal	16A: at slush level	13900	8.02	1.17	88.0	5.0	7.0	0.16	27.87	<0.50
		16B: 1 m below slush level		7.88	1.16	87.0	5.0	8.0	0.15	26.40	<0.50

Sr. No.	Sampling Site	Sample No.	Sampling point (chainage in m)	pH (1:5)	Bulk Density (gm/cc)	Sand (%)	Silt (%)	Clay (%)	Total Kjeldahl Nitrogen (%)	Potassium (ppm)	Phenolic Compound (ppm)
17	Churial main canal	17A: at slush level	14400	7.45	1.05	82.0	8.0	10.0	0.26	41.34	<0.50
		17B: 1 m below slush level		7.44	0.94	84.0	8.0	8.0	0.37	25.82	<0.50
18	Churial main canal	18A: at slush level	14695	7.52	1.08	86.0	6.0	8.0	0.24	77.66	<0.50
		18B: 1 m below slush level		7.47	1.02	85.0	9.0	6.0	0.34	36.54	<0.50

Appendix 2. Heavy metals in canal silt of Churial main canal Package VIII (8)

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel	Copper
				(ppm)								
1	Churial Main canal	1A: Slush level	6400	<0.50	<0.50	20.86	<1.00	48.24	<1.0	69.57	33.42	25.52
		1B: 1 m below slush level		<0.50	<0.50	26.04	<1.00	53.52	<1.0	97.30	33.43	34.82

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel	Copper
				(ppm)								
2	Churial main canal	2A:Slush level	6900	<0.50	1.14	21.88	<1.0	42.16	<1.0	68.79	27.04	25.65
		2B: 1 m below slush level		<0.50	5.28	29.15	<1.0	51.74	<1.0	89.42	32.01	30.11
3	Churial main canal	3A:Slush level	7400	<0.50	7.13	20.77	<1.00	43.40	<1.00	75.30	31.55	25.83
		3B: 1 m below slush level		<0.50	0.50	19.52	<1.00	39.54	<1.00	74.19	24.29	25.29
4	Churial main canal	4A:Slush level	7900	<0.50	<0.50	23.20	<1.00	42.78	<1.00	77.86	28.91	30.0
		4B: 1 m below slush level		<0.50	<0.50	24.78	<1.00	43.90	<1.00	74.18	28.27	26.70
5	Churial main canal	5A:Slush level	8400	<0.50	<0.50	21.20	<1.00	42.26	<1.00	58.53	29.72	26.54
		5B: 1 m below slush level		<0.50	<0.50	21.18	<1.00	41.04	<1.00	70.55	25.50	23.14

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel	Copper
				(ppm)								
6	Churial main canal	6A:Slush level	8900	<0.50	<0.50	22.77	<1.00	41.54	<1.00	82.52	25.88	28.76
		6B: 1 m below slush level		<0.50	<0.50	21.10	<1.00	49.19	<1.00	72.74	29.89	27.63
7	Churial main canal	7A:Slush level	9400	<0.50	18.73	24.98	<1.00	46.56	<1.00	77.69	28.80	32.15
		7B: 1 m below slush level		<0.50	1.49	24.15	<1.00	39.88	<1.00	74.94	24.40	25.89
8	Churial main canal	8A:Slush level	9900	<0.50	<0.50	19.35	<1.00	54.39	<1.00	62.34	26.43	24.81
		8B: 1 m below slush level		<0.50	<0.50	16.50	<1.00	57.90	<1.00	60.29	25.89	23.14
9	Churial main canal	9A:Slush level	10400	<0.50	<0.50	15.98	<1.00	35.83	<1.00	63.55	23.08	22.32
		9B: 1 m below slush level		<0.50	<0.50	16.50	<1.00	64.71	<1.00	71.12	22.43	25.06

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel	Copper
				(ppm)								
10	Churial main canal	10A:Slush level	10900	<0.50	<0.50	18.31	<1.00	62.21	<1.00	71.56	24.48	27.55
		10B: 1 m below slush level		<0.50	<0.50	16.50	<1.00	59.06	<1.00	70.40	25.17	23.22
11	Churial main canal	11A:Slush level	11400	<0.50	<0.50	16.57	<1.00	48.28	<1.00	63.28	23.15	24.52
		11B: 1 m below slush level		<0.50	<0.50	18.23	<1.00	35.42	<1.00	61.30	22.64	22.75
12		12A:Slush level	11900	<0.50	1.98	25.83	<1.00	39.75	<1.00	118.49	23.51	66.76
		12B: 1 m below slush level		<0.50	<0.50	18.49	<1.00	58.50	<1.00	70.29	27.67	28.53

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel	Copper
				(ppm)								
13	Churial main canal	13A:Slush level	12400	<0.50	<0.50	13.92	<1.00	24.33	<1.00	53.73	17.38	18.82
		13B: 1 m below slush level		<0.50	<0.50	13.40	<1.00	22.61	<1.00	43.42	14.05	16.67
14	Churial main canal	14A:Slush level	12900	<0.50	<0.50	13.94	<1.00	68.95	<1.00	53.94	26.03	21.27
		14B: 1 m below slush level		<0.50	<0.50	13.88	<1.00	40.25	<1.00	54.70	21.53	18.26
15	Churial main canal	15A:Slush level	13400	<0.50	<0.50	13.61	<1.00	46.08	<1.00	54.56	24.32	19.83
		15B: 1 m below slush level		<0.50	<0.50	12.29	<1.00	38.96	<1.00	49.99	21.62	17.84
16	Churial main canal	16A:Slush level	13900	<0.50	<0.50	13.22	<1.00	47.11	<1.00	46.61	23.98	16.85
		16B: 1 m below slush level		<0.50	<0.50	11.28	<1.00	21.97	<1.00	37.91	15.96	14.35

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel	Copper
				(ppm)								
17	Churial main canal	17A:Slush level	14400	<0.50	<0.50	12.63	<1.00	32.86	<1.00	52.07	19.92	17.52
		17B: 1 m below slush level		<0.50	<0.50	11.84	<1.00	10.95	<1.00	33.84	10.35	13.28
18	Churial main canal	18A:Slush level	14695	<0.50	<0.50	5.81	<1.00	10.85	<1.00	23.61	8.97	7.36
		18B: 1 m below slush level		<0.50	1.50	13.72	<1.00	37.06	<1.00	62.10	20.33	21.95

Appendix 3. Physico chemical properties of silt of T P main canal system Package 3 of KEIP

Sr. No.	Sampling Site	Sample No.	Sampling point (chainage in m)	pH (1:2.5)	Bulk Density (gm/cc)	Sand (%)	Silt (%)	Clay (%)	Total Kjeldahl Nitrogen (mg/kg)	Potassium (ppm)	Phenolic Compound (ppm)
1	T-P main canal	S-A: at slush level	200	7.10	1.30	40	28	32	63777.77	202.5	1.37
		S-B: 1 m below slush level		7.12	1.20	36	32	32	54444.44	212.2	0.87

Sr. No.	Sampling Site	Sample No.	Sampling point (chainage in m)	pH (1:2.5)	Bulk Density (gm/cc)	Sand (%)	Silt (%)	Clay (%)	Total Kjeldahl Nitrogen (mg/kg)	Potassium (ppm)	Phenolic Compound (ppm)
2	T-P main canal	S-C: at slush level	800	7.14	1.50	64	16	20	63000.0	211.3	0.27
		S-D: 1 m below slush level		7.48	1.25	42	30	28	25200.0	217.7	0.22
3	T-P main canal	S-E: at slush level	1300	7.53	1.32	44.0	26.0	30	22400.0	215.3	7.62
		S-F: 1 m below slush level		7.66	1.50	54.0	16.0	30	33600.0	218.2	0.96
4	Lead channel A0-A1	S-G: Slush level	800	7.04	1.35	46.0	24.0	30.0	36400.0	235.12	0.62
		S-H: 1 m below slush level		7.51	1.25	30.0	32.0	38.0	46200.0	215.4	0.57
5	Lead channel AA	S-I: at slush level	150	7.24	1.49	50.0	10	40.0	51333.33	235.7	2.25
		S-J: 1 m below slush level		7.61	1.48	58.0	20	22.0	27066.66	237.12	0.52
6	Lead channel A0-A1	S-K: at slush level	300	7.27	1.51	61.0	5	34.0	49000.0	235.28	1.92
		S-L: 1 m below slush level		7.66	1.35	30.0	20	30.0	25000.0	241.3	1.44

Sr. No.	Sampling Site	Sample No.	Sampling point (chainage in m)	pH (1:2.5)	Bulk Density (gm/cc)	Sand (%)	Silt (%)	Clay (%)	Total Kjeldahl Nitrogen (mg/kg)	Potassium (ppm)	Phenolic Compound (ppm)
7	A5-A6 canal	S-A:Slush level	300	7.36	1.39	50.0	24.0	26.0			BDL
		S-B: 1 m below slush level		7.21	1.37	52.0	18.0	30.0			BDL
8	A5-A6 canal	S-C:Slush level	1300	6.91	1.40	62.0	10.0	28.0			BDL
		S-D: 1 m below slush level		7.33	1.36	48.0	22.0	30.0			BDL
9	A5-A6 canal	S-E:Slush level	800	7.51	1.34	42.0	26.0	32.0			BDL
		S-F: 1 m below slush level		7.49	1.35	46.0	22.0	32.0			BDL
10	ba2 canal	S-G:Slush level	200	7.41	1.40	58.0	16.0	26.0			BDL
		S-H: 1 m below slush level		7.36	1.36	60.0	4.0	36.0			BDL

Appendix 4. Heavy metals in canal silt of T-P main canal system under Package- 3 of KEIP

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel
				(ppm)							
1	T-P main canal	S-A: at slush level	200	BDL	BDL	BDL	BDL	66.10	<1.00	138.69	BDL
		S-B: 1 m below slush level		BDL	BDL	60.0	BDL	76.27	<1.00	181.38	BDL
2	T-P main canal	S-C: at slush level	800	BDL	BDL	BDL	BDL	66.10	<1.00	162.46	BDL
		S-D: 1 m below slush level		BDL	BDL	65.21	BDL	127.11	<1.00	186.46	BDL
3	T-P main canal	S-E: at slush level	1300	BDL	BDL	BDL	BDL	86.44	<1.00	18.69	BDL
		S-F: 1 m below slush level		BDL	BDL	44.34	BDL	86.44	<1.00	216.46	BDL
4	Lead channel A0-A1	S-G: Slush level	800	BDL	BDL	39.13	BDL	71.18	<1.00	216.92	BDL
		S-H: 1 m below slush level		BDL	BDL	39.13	BDL	91.52	<1.00	469.70	BDL

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel
				(ppm)							
5	Lead channel AA	S-I: at slush level	150	BDL	BDL	60.0	BDL	76.27	<1.00	192.0	BDL
		S-J: 1 m below slush level		BDL	BDL	54.78	BDL	76.27	<1.00	219.69	BDL
6	Lead channel A0-A1	S-K: at slush level	300	BDL	BDL	44.34	BDL	66.10	<1.00	169.38	BDL
		S-L: 1 m below slush level		BDL	BDL	44.34	BDL	127.11	<1.00	76.15	BDL
7	A5-A6 canal	S-A: Slush level	300	BDL	BDL	30.3	BDL	44.6	BDL	96.05	BDL
		S-B: 1 m below slush level		BDL	BDL	18.2	BDL	74.3	BDL	86.1	BDL
8	A5-A6 canal	S-C: Slush level	1300	BDL	BDL	32.45	BDL	64.8	BDL	101.65	BDL
		S-D: 1 m below slush level		BDL	BDL	13.5	BDL	64.8	BDL	48.0	BDL
9	A5-A6 canal	S-E: Slush level	800	BDL	BDL	40.5	BDL	76.05	BDL	103.25	BDL
		S-F: 1 m below slush level		BDL	BDL	22.95	BDL	88.75	BDL	69.7	BDL

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel
				(ppm)							
10	ba2 canal	S-G:Slush level	200	BDL	BDL	37.85	BDL	65.15	BDL	60.15	BDL
		S-H: 1 m below slush level		BDL	BDL	37.7	BDL	83.1	BDL	72.75	BDL

Appendix 5. Physico chemical properties of silt of T.P main canal, Intercepting channel and various Lead channels under Package 2 of KEIP

Sr. No.	Sampling Site	Sample No.	Sampling point (chainage in m)	pH (1:2.5)	Bulk Density (gm/cc)	Sand (%)	Silt (%)	Clay (%)	Phenolic Compound (ppm)
1	BB1(east)	S-A: at slush level	1750	6.57	1.56	63.0	9.0	28.0	BDL
		S-B: 1 m below slush level		7.09	1.59	66.8	10.0	23.2	BDL
2	Intercepting Channel	S-C: at slush level	700	7.4	1.53	61.0	10.0	29.0	BDL
		S-D: 1 m below slush level		7.1	1.51	56.8	16.0	27.2	BDL
3	BB1 (west)	S-E: at slush level	400	6.99	1.58	67.0	5.0	28.0	BDL
		S-F: 1 m below slush level		7.11	1.45	48.8	14.0	37.2	BDL

Sr. No.	Sampling Site	Sample No.	Sampling point (chainage in m)	pH (1:2.5)	Bulk Density (gm/cc)	Sand (%)	Silt (%)	Clay (%)	Phenolic Compound (ppm)
4	CC1 (west)	S-G: Slush level	400	6.94	1.59	67.0	10.0	23.0	BDL
		S-H: 1 m below slush level		7.2	1.61	74.8	8.0	17.2	BDL
5	T-P main channel	S-I: at slush level	2650	7.09	1.61	57.0	10.0	33.0	BDL
		S-J: 1 m below slush level		7.18	1.51	60.8	10.0	29.2	BDL
6	T-P main channel	S-K: at slush level	3350	7.16	1.62	75.0	8.0	17.0	BDL
		S-L: 1 m below slush level		7.24	1.53	60.8	12.0	27.2	BDL
7	CC1(east)	S-M: Slush level	1750	7.1	1.52	58.0	13.0	29.0	BDL
		S-N: 1 m below slush level		7.13	1.52	60.0	12.0	28.0	BDL

Appendix 6. Heavy metals in canal silt of T.P main canal, Intercepting channel and various Lead channels under Package 2 of KEIP

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel	Copper
1	BB1(east)	S-A: at slush level	1750	BDL	BDL	124.8	1.88	64.94	BDL	615.38	89.41	232.25
		S-B: 1 m below slush level		BDL	BDL	96.48	2.34	50.11	BDL	576.92	69.86	203.22
2	Intercepting Channel	S-C: at slush level	700	BDL	BDL	102.72	2.0	57.17	BDL	669.23	124.70	222.58
		S-D: 1 m below slush level		BDL	BDL	91.2	2.17	70.58	BDL	535.89	100.0	232.25

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel	Copper
				(ppm)								
3	BB1 (west)	S-E: at slush level	400	BDL	BDL	132.48	1.65	68.47	BDL	617.94	89.01	222.58
		S-F: 1 m below slush level		BDL	BDL	115.68	2.74	58.58	BDL	782.05	82.35	387.09
4	CC1 (west)	S-G: Slush level	400	BDL	BDL	111.84	1.65	70.58	BDL	648.71	92.15	280.64
		S-H: 1 m below slush level		BDL	BDL	102.24	1.42	65.64	BDL	584.61	100.39	241.93
5	T-P main channel	S-I: at slush level	2650	BDL	BDL	126.24	1.48	71.29	BDL	576.92	95.68	241.93
		S-J: 1 m below slush level		BDL	BDL	88.8	1.54	58.58	BDL	402.56	65.49	174.19

Sr. No.	Sampling Site	Sample No.	Sampling point	Arsenic	Mercury	Lead	Cadmium	Total Chromium	Hexavalent chromium	Zinc	Nickel	Copper
				(ppm)								
6	T-P main channel	S-K: at slush level	3350	BDL	BDL	122.4	2.17	67.07	BDL	525.64	59.60	203.22
		S-L: 1 m below slush level		BDL	BDL	107.52	2.74	67.05	BDL	641.02	78.82	261.29
7	CC1(east)	S-M :Slush level	1750	BDL	BDL	101.76	2.0	74.29	BDL	602.56	81.56	232.25
		S-N: 1 m below slush level		BDL	BDL	99.84	2.45	36.70	BDL	679.48	92.94	203.22

Appendix 7. Physico chemical Properties and heavy metal concentrations of Sewage silt from different S & D works and STP silt

Parameters	Box drain along Dum Dum Road (SDD-2)	Lala Babu Nikashi D/S (SDD-2)	S- 1 R K Sarani, M.H. no G125/3/BM, Ward 130	Chittaranjan Colony (Zone 67) 900 Ward 102	Purba Pally Haltu Ward 107 (SDC)	New Tangra 1400 dia pipeline (Ward 58)	Rashmani Garden Lane (Ward 57)	New Tangra	DrNG Saha Road, SDB 1	1450 to 1452, Kalachand Para	South Suburban East STP	Minimum Detection Limit ppm
Sand (%)	54.0	62.0	62.0	40.0	62.0	42.0	58.0	50.0	50.0	40.0	36.0	-
Clay (%)	28.0	30.0	24.0	48.0	28.0	34.0	28.0	32.0	36.0	34.0	44.0	-
Silt (%)	18.0	8.0	14.0	12.0	10.0	24.0	14.0	18.0	14.0	26.0	20.0	-
pH (1:2.5)	7.56	7.23	7.12	7.16	7.31	7.20	7.21	6.76	7.43	7.56	7.16	-
Bulk Density (gm/cc)	1.38	1.39	1.42	1.28	1.40	1.33	1.39	1.36	1.34	1.30	1.28	
Phenolic Compound (mg./kg)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.1
Lead (mg/kg)	135.75	98.2	19.8	12.0	56.45	10.35	31.7	7.35	31.70	11.10	1.30	0.03
Cadmium (mg/kg)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.04
Copper (mg/kg)	136.8	141.7	25.1	40.65	48.70	16.75	45.05	18.2	65.05	35.60	20.2	0.09
Chromium(III) (mg/kg)	67.85	68.2	59.1	81.9	41.10	130.20	71.0	49.75	75.20	65.40	88.25	0.20
Zinc (mg/kg)	108.55	106.6	55.15	68.7	71.5	58.20	116.6	53.25	75.65	66.60	39.7	0.07
Nickel (mg/kg)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.24
Chromium(VI) (mg/kg)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.1

Parameters	Box drain along Dum Dum Road (SDD-2)	Lala Babu Nikashi D/S (SDD-2)	S- 1 R K Sarani, M.H. no G125/3/BM, Ward 130	Chittaranjan Colony (Zone 67) 900 Ward 102	Purba Pally Haltu Ward 107 (SDC)	New Tangra 1400 dia pipeline (Ward 58)	Rashmani Garden Lane (Ward 57)	New Tangra	DrNG Saha Road, SDB 1	1450 to 1452, Kalachand Para	South Suburban East STP	Minimum Detection Limit ppm
Mercury (mg/kg)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001
Arsenic (mg/kg)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01

*BDL Stands for Below Detection Limit

** Minimum Detection Limit of Metal in Liquid Phase.

Appendix 8. Noise level monitoring at different S& D work sites of KEIP during January-June, 2008
(average of 32 readings at each site within 15 minutes taken in four cardinal directions at a distance of 2 metres from the working site)

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
1	SDC		XII	109	Purbaloke	4.1.2008	69.1	Laying of pipe lines was going on manually; one water pump was in operation; no road noise; road totally closed.
2	SDC		XI	101	Robindra Pally	4.1.2008	66.26	Road was closed and no traffic movement was visible; workers were engaged in earth cutting manually.
3	SDC		XI	101	Robindra Pally	4.1.2008	77.0	One heavy roller was running; no traffic movement was noticed.

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
4	SDC		XI	110	Birji West Road	4.1.2008	67.4	Road was closed and no traffic movement was visible; workers were engaged in earth cutting manually.
5	SDC		XI	102	Jadavpur (Upendra Biswas Sarani)	4.1.2008	78.8	One roller machine was in operation; one surface train line was beside the road but no train was running during observation; traffic movement was low
6	SDC		XI	102	Jadavpur near Station Road	4.1.2008	92.1	One mixing machine was in operation for road preparation; road was busy due to traffic movement
7	SDC		XII	104	Vivek Nagar	4.1.2008	91.7	Two hot mixing machines & one roller machine were in operation for road preparation; two wheelers were moving and four wheeler cars were also observed plying.
8	SDC		XII	103	DWF Canal side (Station road) Santoshpur	4.1.2008	58.9	Road was closed and no traffic movement was visible; workers were engaged in earth cutting manually.
9	SDC		XII	106	Avisikta Area	4.1.2008	67.8	Workers were engaged in earth cutting manually; the area was just beside E.M.Bypass
10	SDC		XII	107	Panchanan Gram	4.1.2008	69.9	One water pump (5 HP) was in operation; earth cutting was in operation manually
11	SDA	2	XIII	118	S N Roy Road (in front of Jabakusum) 900 dia pipe works	5.1.2008	77.2	Earth cutting was going on manually; some light vehicles were plying during monitoring
12	SDA	2	XIII	118	S N Roy Road (600 dia)	5.1.2008	69.0	Earth cutting operation was going on manually; road was closed and no traffic movement was noticed.

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
13	SDA	3	XIII	120	22/2A Roy Bahadur Road (James Long Sarani)	5.1.2008	72.9	Pipe laying was being done manually; road was open and light vehicles were moving.
14	SDA	3	XIII	120	James Long Sarani (near UCO Bank)	5.1.2008	94.6	Work for pipe laying and setting of manhole set was going on manually; vehicles were moving.
15	SDD	1	I	6	Lock Gate road (near 7/G)	7.1.2008	104	One compressor with two Jack Hammer were in operation; traffic noise was low; Jack hammer was in operation for cutting concrete road
16	SDD	2	I	5	Tara Sankar Sarani (near Tala Park)	7.1.2008	74.4	Laying of pipe lines was going on; manual excavation was going on; light traffic noise; no pumping.
17	SDB	3	XIV	129	Joyrampur Jota Road (1800 dia)	7.1.2008	66.2	Workers are laying underground pipelines manually; road was closed and no traffic was visible
18	SDB	3	XIV	128/129	P K Road (1000 dia)	7.1.2008	67.0	Workers were laying underground pipelines manually; road was closed and no traffic was visible
19	SDB	2	XIV	129	M B Road (2000 dia)	7.1.2008	81.5	JCB excavator machine was in operation and workers were involved in digging; road was closed and no traffic movement was noticed
20	SDB	2	XIV	129	M B Road (2000 dia)	7.1.2008	76.5	One water suction pump was in operation to clear the accumulated water in the underground part; workers were working manually and road was closed for traffic

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
21	SDB	2	XIV	129	R K Sarani (1800 dia)	7.1.2008	84.6	One J C B excavator was in operation; road was closed for traffic.
22	SDB	2	XIV	129	R K Sarani (1800 dia)	7.1.2008	72.9	Work is in operation for digging the underground soil manually
23	SDB	1	XIV	132	Pathak Para	7.1.2008	64.6	Workers were digging in the road manually and traffic was low; some light vehicles were plying
24	SDB	1	XIV	132	Banerjee Para	7.1.2008	62.3	Workers were digging in the road manually and traffic was low; some light vehicles were plying.
25	SDB	1	XIV	128	Biren Roy Road (W) near East India Pharmeceutucals (1800 dia)	7.1.2008	73.2	One water suction pump was in operation; traffic density was low.
26	SDB	1	XIV	128	Dr N G Saha Road (800 dia pipeline) near Roy dighi Sitala Mandir	7.1.2008	72.2	One bitumen mixture machine was in operation for road preparation; road was closed and no traffic was visible.
27	SDF	2	VII	57	South Canal Road	24.3.2008	93.6	5 H.P. pump was running; some small cars were moving
28	SDF	2	VII	57	South Canal Road	24.3.2008	59.3	Small vehicles were moving; no construction was going on.
29	SDF	2	VII	57	Rani Rashmani Garden Lane	24.3.2008	89.4	14 H P pump was running and the road was closed.
30	SDF	2	VII	57	Rani Rashmani Garden Lane	24.3.2008	87.5	4 H P pump was running; manual work was going on and the road was closed

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
31	SDF	2	VII	57	Pagladanga Road	24.3.2008	60.4	Manual work was going on and the road was closed.
32	SDF	1	VII	59	Christofer Road	24.3.2008	92.4	12 H P pump was running; manual work was going on and the road was closed.
33	SDC		XII	104	Bank Plot	25.3.2008	74.8	Roller machine was in operation and the road was closed. Manual work was going on.
34	SDC		XII	107	Haltu Purba Para	25.3.2008	80.7	One pump was running; road was closed and manual work was going on
35	SDC		XI	110	Briji	25.3.2008	72.3	Sheer driving machine was in operation; road was closed ; manual work is going on
36	SDC		XI	101	DWF Roypur Road	25.3.2008	87.3	Hydra crane was running and labourers were engaged with other manual operations; road was closed.
37	SDC		XI	102	Balika Vidyaniketan	25.3.2008	89.2	One H P pump was in operation; road was open for small vehicles; manual work was going on.
38	SDC		XI	102	Jadavpur Rail station	25.3.2008	60.2	Road was near rail line; no work is going on then.
39	SDC		XII	109	Mukundapur (Mukunda Bhavan)	25.3.2008	89.7	One 7.5 H P pump was running; manual work was going on; road was closed
40	SDC		XII	103	Bagha Jatin Station	25.3.2008	91.4	One 5 H P pump was running; manual work was going on; road was closed
41	SDC		XII	109	53 Purba Diganta (Nandan Kanan)	25.3.2008	86.2	5 H P pump and mixture machine were in operation; manual work was going on and road was closed.
42	SDC		XII	106	Purbachal (n)	25.3.2008	89.8	10 H P mixture machine was in operation; manual work was going on; road was closed

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
43	SDC		XII	107	Meghnath Saha Road	25.3.2008	80.9	Road was open but no work was going on.
44	SDC		XII	107	Panchannagram	25.3.2008	85.4	7.5 H P was in operation; manual work in progress; small cars were moving
45	SDC		XII	108	Martin para	25.3.2008	84.8	7.5 H P pump was running; other manual work was in operation; road was closed
46	SDB	1	XIV	128	Dr N G Saha Road (Roy Dighi)	27.3.2008	97.2	Concrete mixture machine was in operation. Other manual work was going on; road was closed
47	SDB	1	XIV	128	Biren Roy Road (W)	27.3.2008	93.3	Hydra machine and a 5 H P pump was in operation; other manual work was going on; road was closed.
48	SDB	1	XIV	128	Basudevpur Road	27.3.2008	81.7	5 H P pump was in operation; other manual work was going on; road was closed
49	SDB	2	XIII	118	S N Roy Road	27.3.2008	93.5	10 H P pump was in operation; other manual work was going on; small cars were plying
50	SDA	3	XIII	115	B L Saha Road	27.3.2008	86.8	15 KVA D G and one winch machine were in operation; other manual work was going on; road was closed
51	SDB	2	XIV	130	N S Road	28.3.2008	88.1	3 H P pump was in operation; other manual work was going on; road was closed
52	SDB	2	XIV	131	N S Road	28.3.2008	85.6	3 H P and 5 H P pumps were in operation; other manual work was going on; road was closed.
53	SDB	2	XIV	131	MID Road	28.3.2008	81.5	3 H P pump was in operation; other manual work was going on; road was closed.

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
54	SDB	2	XIV	129	M B Road	28.3.2008	86.7	6 H P pump and 2.3 KVA D G were in operation; other manual work was going on; road was closed.
55	SDB	2	XIV	129	M B Road	28.3.2008	94.6	20 H P pump was in operation; small/medium vehicles were plying
56	SDB	2	XIV	129	M B Road	28.3.2008	83.7	6 H P pump was in operation; other manual work was going on; road was closed.
57	SDB	3	XIV	129	S Roy Sarani	28.3.2008	99.0	14 H P pump was in operation; road was closed
58	SDB	3	XIV	129	Sukanta Sarani	28.3.2008	94.7	17 H P pump was in operation; road was closed
59	SDB	3	XIV	129	Sukanta Sarani	28.3.2008	94.7	6 H P pump was running and the road was closed.
60	SDE				Karbala Road	29.3.2008	91.1.	# H P and 5 H P pumps were in operation; other manual work was going on; small vehicles were plying
61	SDE				Near Baghjatin Station	29.3.2008	96.2	2.5 H P pump was running; other manual work was going on; small vehicles were plying
62	SDE		XV	134	Ram Nagar	29.3.2008	82.2	3 H P pump was running; other manual work was going on; small cars were plying
63	SDD	2	I	2	Seven Tank	30.3.2008	81.7	6 H P pump was running; manual work was going and small cars were plying.
64	SDD	2	I	2	Raja Bagan Lane	30.3.2008	48.1	No work was going.
62	SDD	2	I	5	Tara Shankar Road	30.3.2008	56.4	No work was going.
63	SDD	2	I	5	Paikpara	30.3.2008	97.4	Compressor machine was running; manual work is in progress and the road was busy.

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
65	SDD	2	I	5	Paikpara	30.3.2008	86.5	Hydra machine was working; manual work was going on and road was busy.
66	SDD	4	I	2	Sinthee Road	30.3.2008	62.9	Manual was in operation and the road was closed.
67	SDD	2	I		Roy para Road	30.3.2008	86.5	6 H P pump was in operation, manual work was going on and the road was closed.
68	SDD	2	I	2	Roy para Road	30.3.2008	90.4	6 H P mixture machine was working and the road was closed.
69	SDD	2	I	2	K C Ghosh Road	30.3.2008	91.4	2 nos 6 H P pumps were running; manual work was going on and the road was closed.
70	SDD	1	I	6	Lock Gate	30.3.2008	86.8	J C B machine was in operation; manual work was going on and the road was closed.
71	SDD	2	I		Jessore Road	30.3.2008	94.9	Tata Hitachi machine was in operation; manual work was going on and the road was closed
72	SDC		XII	109	Purbalok	15.5.2008	51.2	No work was going on; road was closed
73	SDC		XII	108	Martin Para	15.5.2008	65.4	Road was closed; only manual work
74	SDC		XII	106	Gitanjali Park	15.5.2008	97.2	12 H P Miller Machine working; road was closed
75	SDC		XI	101	Rabindra Palli	15.5.2008	54.9	No work was going on, road was closed
76	SDC		XII	107	Rajdanga	15.5.2008	52.2	No work was going on; road was closed
77	SDC		XI	102	Jadavpur Rly Stn	15.5.2008	50.6	No work was going on; road was closed
78	SDC		XI	102	Bani Niketan Balika Vidyalaya	15.5.2008	49.7	No work was going on; road was closed
79	SDC		XI	101	DWF-Raipur Road	15.5.2008	50.6	No work was going on; road was closed
80	SDC		XI	110	Birji	15.5.2008	50.9	No work was going on; road was closed

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
81	SDC		XII	107	Haltu Purba Pally	15.5.2008	48.3	No work was going on; road was closed
82	SDC		XI	103	Bagha Jatin Rly Stn	15.5.2008	58.8	No work was going on; road was closed
83	SDC		XII	109	DWF Nandan Kanan	15.5.2008	49.8	No work was going on; road was closed
84	SDC		XII	107	Panchanna gram	15.5.2008	47.9	No work was going on; road was closed
	SDF		VII	57	South canal	19.5.2008	96.1	Only 12 H P pump was in operation and the road was closed
	SDF		VII	57	South canal	27.5.2008	92.8	Only mixture machine was in operation and road was closed
	SDF		VII	57	Dhapa road II	27.5.2008	87.7	One H P pump was running; other manual work was going on; road was closed
	SDF		VII	57	Pagladanga road	27.5.2008	84.9	One H P pump was running; other manual work was going on; road was closed
85	SDF	2	VII	57	Kulia Tangra	27.5.2008	97.7	One 12 HP pump was in operation; manual work was in operation and road was closed
86	SDF	1	VII	59	Christopher Road	27.5.2008	99.3	One 4 H P pump was in operation; manual work was in operation and road was closed.
87	SDB	1	XIV	128	P Das para	29.5.2008	83.8	Roller machine was in operation; manual work was in operation and road was closed
88	SDB	1	XIV	128	A K Paul Road	29.5.2008	73.0	5 H P pump was in operation; manual work was in operation and road was closed
89	SDB	2	XIV	130	B C Road	29.5.2008	52.5	No work was in progress and road was closed
90	SDB	2	XIV	129	M B Road	29.5.2008	53.2	No work was in progress and road was closed
91	SDB	2	Xiv	131	M.I.D. Road	29.5.2008	53.8	No work was in progress and road was closed
92	SDA	2	XIII	81	T C Road	29.5.2008	91.6	J C B was running and the road was closed
93	SDA	2	XIII	119	D H Road	29.5.2008	95.2	20 H P pump was in operation; manual work was in progress and road was closed

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
94	SDB	3	XIV	129	Joy Rampurjala Road	29.5.2008	86.0	5 H P pump was running; manual work was in progress and road was closed
95	SDB	3	XIV	129	S R Sarani	29.5.2008	73.6	5 H P pump was running; manual work was in progress and road was closed
96	SDA	3	XIII	121	Raja Rammohan Roy Road	29.5.2008	51.3	No work was in progress and road was closed
97	SDD	1	I		Jessore Road	30.5.2008	90.1	No work was in progress; road was busy and heavy vehicles were running.
98	SDD	2	I	2	K C Ghosh Road	30.5.2008	71.2	No work was in progress but road was busy and small cars were plying.
99	SDD	2	I	5	Kelat Babu Lane	30.5.2008	52.9	No work was in progress and road was closed
100	SDD	2	I	2	Raja Bazar Lane	30.5.2008	93.0	5 H P pump was running; manual work was in progress but road was closed.
101	SDD	2	I	2	Roy para Road	30.5.2008	53.5	No work was in progress and road was closed
102	SDD	2	I	2	South Sinthee Road	30.5.2008	52.7	No work was in progress and road was closed
103	SDD	2		2	Seven Tank	30.5.2008	72.0	No work was in progress and road was closed
104	SDD	2	I	2	Subakhan Road	30.5.2008	88.4	6 H P pump was running; manual work was in progress and the road was busy.
105	SDD	2	I	4	Paikpara 1 st Road	30.5.2008	89.9	6 H P pump was running; manual work was in progress and the road was busy

Appendix 9. Noise level monitoring at different work sites of Canal works, STP and Pump house under KEIP during January-June, 2008
(average of 32 readings at each site within 15 minutes taken in four cardinal directions at a distance of 2 metres from the working site)

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
1	CW10				New Monikhali	5.1.2008	89.4	Two JCB pay loader machines were working for lifting silt from the canal.
2	CW10				Ketopole, Begore khal	5.1.2008	70.2	Piling of wooden log was going on
3	CW12A				Keorapukur canal (Kudghat Metro station)	7.1.2008	86.4	Two water pumps (5 HP & 10 HP) were running. Traffic noise was also perceptible. IS210 excavator was in operation in the canal.
4	CW12A				Keorapukur canal (Kudghat Metro station)	7.1.2008	81.5	Canal excavation by TATA Hitachi machine (EX-210LC) was going on. Some road noise was also picked up
5	CW5		XII	107	Raj Danga (T-P canal)	24.3.2008	83.6	6 H P Tata-Hitachi machine was running; other manual work was going on and road was closed
6	CW5		XII		T P Main canal	24.3.2008	54.3	No work was in progress
7	CW9		XII	109	AOA1 canal	24.3.2008	83.5	12 H P pump was running; other manual work was going on and road was closed
8	CW8		XII	106	BB1 west canal	24.3.2008	85.7	12 H P pump was running; other manual work was going on and road was closed
9	CW 12A			114	Keorapukur canal	26.3.2008	95.4	Vibrator machine was in operation; other manual work was going on.
10	CW12A			114	Keorapukur canal	26.3.2008	91.1.	JCB machine was engaged in earth cutting
11	CW12A			114	Keorapukur canal	26.3.2008	90.8	One 5 H P pump and one mixture machine was in operation; other manual work was going on

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
12	CW12A			114	Keorapukur canal	26.3.2008	83.7	10 H P (7.5 KVA) D G was running beside the road; small cars was plying
13	CW12B		XIII	124	Ramkrishna Nagar	26.3.2008	94.9	One H P pump and one mixture machine were in operation; other manual work was going on
14	CW12B		XIII	124	Barisha Purba para, Churial extension canal	26.3.2008	90.4	Concrete machine was in operation; other manual work was going on; small cars were plying
15	CW11				Rampur Quarter. Manikhali D/S	26.3.2008	93.6	Concrete machine was running; other manual work was going on; road was closed
16	CW11				Khalpole, Monikhali D/S	26.3.2008	82.4	JCB machine was in operation; the site was beside a canal and there was no road
17	CW11				Khalpole (near BBT road)	26.3.2008	76.9	JCB machine was in operation; earth lifting from canal was going on
	CW11				KEIP Housing, New Manikhali	19.5.2008	91	JCB machine was engaged in arth cutting
	CW11				Rampur	19.5.2008	88.4	One 6 H P pump was in operation
	CW10				Baghajatin station	19.5.2008	55.3	Labourers were engaged in earth cutting
	CW10				Ketopol, Begore khal (Chainage 145)	19.5.2008	58.6	Only balla work was going on
	CW8			107	Rajdanga	27.5.2008	86.0	Only 8 H P pump was in operation
	CW8			107	Rajdanga	27.5.2008	99.0	Only winch machine was in operation
	CW5		XII	107	Rajdanga	27.5.2008	83.8	Only excavator was in operation
	CW9		XII	102	T P main canal	27.5.2008	92.8	Only excavator was in running
	CW9			102	BA2 canal	27.5,2008	89.5	Only excavator was in operation
	CW12A		XI	114	Kudghat	28.5.2008	91.9	10 H P pump was in operation; other manual work was going on

Serial no	Package no	Lot no	Borough no	Ward no	Monitoring site	Date	Mean sound level in dBA	Remarks
	CW12A		XI	114	Kudghat	28.5.2008	94.3	Tata Hitachi machine was in operation beside the road
	SD 27		VII	67	Pumping Station	25.3.2008	93.0	One 5 H P pump was running; other manual work was going on and road was closed
	SD23		XIII	117	Pumping at Canal road	28.5.2008	94.7	JCB was in operation and the road was closed
	SD23		XIII	117	Pumping at Canal road	28.5.2008	90.5	Mixture machine in operation and road was closed
	SD25		XIII	124	SSE STP	29.3.2008	96.6	Tata Hitachi machine was running; other manual work was going on; road was closed
	SD 25		XIII	124	SSE STP	28.5.2008	100.0	Tata Hitachi machine was in operation; manual work was going on and road was closed
	SD 25		XIII	124	SSE STP	28.5.2008	96.3	Volvo machine was in operation; manual work was going on and road was closed
	SD 25		XIII	124	SSE STP	28.5.2008	52.9	Residential area far from the STP
	SD 25		XIII	124	SSE STP	29.5.2008	86.8	5 H P pump was running; manual work was going on and road was closed