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Dhaka Water Supply and Sanitation Project

Environmental Management Framework Implementation Manual

Dhaka Water & Sanitation Authority
Government of Bangladesh
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IMPLEMENTATION MANUAL

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List of Acronyms and Abbreviations

CETP	Central Effluent Treatment Plant
DOE	Department of Environment
DS	Dhaka Sanitation
DWASA	Dhaka Water Supply and Sewerage Authority
DCC	Dhaka City Corporation
DMP	Dhaka Metropolitan Police
GOB	Government of the People's Republic of Bangladesh
IDA	International Development Association
MLGRDC	Ministry of Local Government, Rural development & Cooperatives
MODS	Maintenance, Operation, Distribution & Services
NGO	Non Government Organization
O&M	Operation and Maintenance
PPF	Project Preparatory Fund
PPR'03	Public Procurement Regulations, 2003
PAP	Project Affected Person
STP	Sewage Treatment Plant
SLS	Sewage Lifting Station
SPM	Suspended Particle Matter
TOR	Terms of Reference
WSS	Water Supply and Sanitation
WTP	Water Treatment Plant

1. Introduction

1.1. Background

Dhaka Water Supply and Sewerage Authority (DWASA) intends to undertake the project named **"Environmental Management Framework (Package # DS-5)" under Dhaka Chittagong Drainage and Sewerage Sector Project** to be financed by the World Bank (IDA : PPF Study Project - **Credit # Q 4780)** to improve water supply and sanitation (WSS) to low-income communities, sewage disposal, sanitation and storm water drainage facilities under metropolis Dhaka. The project plans to rehabilitate the existing sewer systems, storm water drainage system and natural retention reservoirs. DWASA also intends to update the waste water management and preparation of sewerage master plan for more efficient planning and management of these facilities, to provide services for the above work-expanse. For the successful implementation of the sub-projects, Consultant has been engaged for preparation of Environmental Management Framework and it is one of the tasks of the Consultant to prepare a Project Implementation Manual.

1.2. Structure of the Manual

The Project Implementation Manual is structured in a sequential manner to assist the reader to understand the background of preparing the document, purpose, objectives and basis for developing the manual and thorough understanding what components makeup the manual and how these components are integrated during the implementation/rehabilitation and O&M stage of all sub-projects and future new projects. The chapter-wise descriptions are stated briefly as under :

Chapter 1 provides background information to the need for preparation of this manual under the project of Environmental Management Framework (DS -5) and information about the project, objectives of the manual, and some background of the project.

Chapter 2 provides information about the environmental management and safeguard issues during implementation of development works related to Storm Water Drainage system within Dhaka City with respect to installation of pumping stations, development of existing drainage canals and construction / rehabilitation of drainage networks

Chapter 3 provides information about the environmental management and safeguard issues during implementation of development works related to Sewerage system within Dhaka City with respect to construction / rehabilitation of Sewage Treatment Plant (STP), sewer networks, sewage lifting stations, CETP, Wetland, etc.

Chapter 4 provides information about the environmental management and safeguard issues during implementation of development works related to the responsibilities of the concerned personnel dealing with the implementation activities such as contractors, supervising personnel, senior officials, executing agency, consultant, NGO, concerned ministry, etc.

Chapter 5 provides O&M of different components such as pipelines, sewer networks, drainage networks, sewage treatment plant, CETP, Wetland and also O&M of WSS programme to low income communities, pumping stations galleries at Rampura Bridge point and Janapath galleries, etc.
Chapter 6 provides information about Electro-mechanical works.

Chapter 7 provides summary of monitoring and maintenance.

1.3. Objectives of the Manual

This Project Implementation Manual is intended to assist in considering alternatives and reducing the negative environmental impacts DS 1A to DS 10 and other WSS projects. The Manual aims to improve skills and knowledge of DWASA officials and staffs on environmental assessment and management issues during planning, construction supervision and operation phases of the projects. The Manual aims to provide details of how to implement the sub-projects & WSS projects. It can be used as a stand-alone document.

In preparing this Manual a review has been carried out of existing domestic and overseas documents that have been developed by organizations dealing with WSS sectors, both in Bangladesh and elsewhere.

This Project Implementation Manual will be a guideline for the project managers / implementers to implement projects remaining fully aware of the environment. cautionary measures shall have to be explicitly spelled out in the manual for prevention of damages to environment such as use of modern techniques of construction methods that do little damage to environment (replacing in-practice crude methods), backfilling the excavated trench as early as possible to prevent ingress of pollution to sub-surface water, use of environment-friendly construction materials, noise pollution and air pollution should be kept minimal, etc. The World Bank study emphasized the target of introducing environmentally sound non-polluting vehicles and also of reducing air pollution from the industrial sources, the air pollution from its present figure of 500 spm to 200 spm in the year 2010 and less than 200 spm by the year 2020. It is expected to consider all relevant aspects of environmental safeguard issues and incorporate adequately in the Manual.

2. Storm Water Drainage System

2.1. Installation of Pumping Stations

In most cases Storm Water Drainage Networks are designed under gravity flow condition, but especially in the flat region like Dhaka City, some pumping station is needed to pump out the collected storm water though the drainage pipelines to the ultimate outfall. Sometimes intermediate boosting or lifting stations may be needed. At present there are 3(three) drainage pumping stations two are operated by DWASA and one by the BWDB. During installation / construction of such pumping or boosting station all probable environmental degradation aspects such as air pollution, noise pollution, water pollution, land acquisition, health & safety issues, resettlement, etc should be considered very carefully avoiding all negative environmental impacts. In order to achieve these targets following aspects should be considered :

- Generally drainage pumping stations are located at the downstream leading to the ultimate outfall to facilitate pumping of the storm water,
- Land acquisition should be carefully dealt to avoid resettlement for the residents, squatters, slum people, houses, buildings, shops, small shops, even mobile shops and all other affected people,
- Adequate compensations should be given to the project affected persons (PAP), as per Resettlement Policy Framework,
- During construction stage, especially during the winter dust may cause serious air pollution, which should be controlled in a planned manner by spreading water over the area at certain interval,
- Normally the pumping / boosting stations are constructed for deep excavation and sufficient care must be taken to avoid accidents among the workers due to side collapse, land sliding, etc,
- There should not be any compromise with the health and safety issues of the workers / supervising personnel, officials and nearby public,
- During installation of any equipment sufficient precaution should be undertaken, so that by any means surface or groundwater is not polluted,
- Pumps and machineries are to be installed which will produce minimum noise. Similarly during excavation excessive noise should be avoided, even if any cutter make excessive noise, it should not be used during night after 10:00 pm so that nearby public do not feel disturbance for their sleeping,
- Trucks carrying excavated materials or any other dumping materials, sufficient care should be taken so that roads are not damaged and solid wastes are not thrown here and there which will create environmental pollution,
- Sufficient care should be taken so that all workers use helmets, gum boots, and other protective clothing during removing wastes / sludge, &/or excavated materials from the trenches, which may cause health risks to the workers,
- All excavated materials &/or sludge should be dumped carefully to a safe and planned dumping places, so that these do not create health hazards or environmental pollution to the surrounding areas,
- Use of modern techniques of construction methods that do little damage to environment (replacing in-practice crude methods). To reduce environmental pollution.

2.2 Development of Existing Drainage Canals

In order to remove water logging and maintain the drainage flow in working condition, all natural canals, open drains and existing box culverts, etc should always needs to be cleaned or re-excavated frequently. There are about 65 Km of open drainage channel within DWASA. Water logging will always create environmental degradation including damage of roads & other infrastructure. Besides, stagnant water will assist mosquito' growth and thereby spread water related diseases, causing human health hazards. Therefore, during developing, cleaning, excavating new canal &/or re-excavating the drainage canals, sufficient care must be taken in order not to create environmental pollution, as stated below ;

- Many slums & squatters are located on the embankment of the natural drainage canals and as such sufficient care must be taken so that temporary inhabitants, hawkers, and temporary mobile shop owners including mobile shops whether legal or illegal should not be disturbed, or adequately compensated as per Resettlement Policy Framework,
- Trucks carrying excavated materials or any other dumping materials, sufficient care should be taken so that roads are not damaged and solid wastes / sludge are not thrown here and there which will create environmental pollution.
- Pumps and machineries which are used for cleaning, excavation and re-excavation should not produce excessive noise. During excavation of canals and removing the sludge excessive noise should be avoided, even if any cutter make excessive noise, it should not be used during night after 10:00 pm so that nearby public do not feel disturbance for their sleeping,
- There should not be any compromise with the health and safety issues of the workers / supervising personnel, officials and nearby public,
- Sufficient care should be taken so that all workers use helmets, gum boots, and other protective clothing during removing wastes / sludge, which may cause health risks to the workers,
- All excavated sludge should be dumped carefully to a safe and planned dumping places, so that these do not create health hazards or environmental pollution to the surrounding areas,
- Use of modern techniques of construction methods such as excavator, covered dump truck, use of steel sheets for pedestrian crossing, vehicular movement, etc that do little damage to environment (replacing in-practice crude methods) to reduce environmental pollution.

2.2. Construction / Rehabilitation of Drainage Networks

One of the major activities of DWASA is for the construction / rehabilitation works of underground drainage networks. At present there are about 233 Km of conduit primary storm water drains within the jurisdiction of DWASA, and about 8 Km of box culverts. Most of these drainage networks are located beneath the city roads along with other underground utility services. Major environmental degradation will occur and sufficient precautionary measures needs to be undertaken during the construction / rehabilitation of the storm water drainage networks, although there is no land acquisition cases occur, which are as under:

- Vehicular traffic and pedestrian shall always be disturbed during the construction / rehabilitation of storm water drainage networks, because

of the location of the drains beneath the city roads, so extra precaution should be taken to keep the disturbance as minimum as possible,

- Before excavation all road surface should be cut by using modern cutter to avoid damage of the existing road surface,
- Trial holes should be done very carefully to locate the existing underground utility services before finalization of the alignment for the new construction of the storm water drainage pipelines;
- Use of modern techniques of construction methods such as trench less technology, tunneling, use of excavator, working at night, using heavy steel sheets over the open trench and allow vehicular traffic or pedestrian that do little damage to environment (replacing in-practice crude methods), to reduce environmental pollution.
- Excavated earth / materials should be removed from the site simultaneously by using covered dump truck, so that existing roads are not damaged during removing the excavated materials, and this will reduce the blockage of roads by the excavated materials and will not cause traffic congestion near the construction area,
- During new construction / rehabilitation of pipelines care should be taken so that mobile shop owners and nearby temporary or permanent shops and residents are not disturbed beyond the tolerable limits &/or sufficient compensation is given as per Resettlement Policy Framework,
- During construction stage, especially during the winter dust may cause serious air pollution, which should be controlled in a planned manner by spreading water over the working area at certain interval,
- There should not be any compromise with the health and safety issues of the workers / supervising personnel, officials and nearby public,
- Sufficient care should be taken so that all workers use helmets, gum boots, and other protective clothing during excavation in trench and removing excavated materials, which may cause health risks to the workers,
- Dewatering from the excavated trench and discharging the water to the open road other than the existing alternate drainage channel will cause water stagnation, damaging the roads, and thereby will cause water related diseases causing human health risk,
- Better planning for cutting the road surface, trench cutting, removing excavated earth, providing sight rails, providing heavy steel sheets over the trench for vehicular and pedestrian crossing, installing pipes, and timely backfilling the trench for section by section will reduce the public sufferings to a great extent,
- In the busy & narrow roads works should not be executed during the day time, which will not create unnecessary traffic congestions,
- Traffic signals, Red signals, especially during night and other protective measures should be undertaken both day and night in order to avoid unpleasant /unwanted accidents near the construction site (s),
- All storm water drainage pipelines are installed properly by maintaining the gradient /slope using the leveling instrument &/or with the help of sight rails above the ground with pre-leveled based on cut-sheet,
- Manhole construction should be executed by providing temporary fencing around it,
- First-aid kits should always be kept ready at the construction site,
- Safe drinking water for the workers should be available at site, and proper sanitation arrangement must be made properly at the site or near the site within the walking distance,

- The World Bank study emphasized the target of introducing environmentally sound non-polluting vehicles and also of reducing air pollution from the industrial or any other sources.
- All underground utility services should be protected properly and in case of any accidental damage, it should be repaired as quickly as possible as per recommendation / suggestion of the concerned agency.

3. Sewerage System

3.1. Construction / Rehabilitation of Sewage Treatment Plant

There is only one Sewage Treatment Plant (STP) located at Pagla, operated and maintained by DWASA, but it is serving about 20% of the existing population of Dhaka City more or less moderately, not so efficiently, which need expansion, modernization or new STP has to be constructed within a short period based on the Master Plan yet to be prepared. During construction of new STP &/or rehabilitation of the existing STP, especially during cleaning of sludge from the facultative lagoons following precautionary measures are to be taken to avoid environmental degradation:

- Land acquisition for the new STP should be carefully dealt to avoid resettlement of the residents, squatters, slum people, houses, buildings, shops, small shops, even mobile shops and all other affected people,
- Adequate compensations should be given to the project affected persons, as per Resettlement Policy Framework,
- During construction stage, especially during the winter dust may cause serious air pollution, which should be controlled in a planned manner by spreading water over the area at certain interval,
- Normally the STP are constructed for deep excavation and sufficient care must be taken to avoid accidents among the workers due to side collapse, land sliding, etc,
- There should not be any compromise with the health and safety issues of the workers / supervising personnel, officials and nearby public,
- During construction of installation of any equipment sufficient precaution should be made, so that by any means surface or groundwater is not polluted,
- Pumps and machineries are to be installed which will produce minimum noise. Similarly during excavation of earth excessive noise should be avoided, even if any cutter make excessive noise, it should not be used during night after 10:00 pm so that nearby public do not feel disturbance for their sleeping,
- Trucks carrying excavated materials or any other dumping materials, sufficient care should be taken so that roads are not damaged and solid wastes are not thrown here and there which will create environmental pollution,
- Sufficient care should be taken so that all workers use helmets, gum boots, and other protective clothing during removing wastes / sludge, &/or excavated materials from the trenches, which may cause health risks to the workers,
- All excavated materials &/or sludge should be dumped carefully to a safe and planned dumping places, so that these do not create health hazards or environmental pollution to the surrounding areas,
- Use of modern techniques of construction methods e.g. use of excavator, covered dump truck, vibrating machine, rod cutter, welding machine, etc that do little damage to environment (replacing in-practice crude methods). To reduce environmental pollution.

- First-aid kits should always be kept ready at the construction site,
- Safe drinking water for the workers should be available at site, and proper sanitation arrangement must be made properly at the site or near the site within the walking distance,

3.2. Construction / Rehabilitation of Sewer Networks

One of the major activities of DWASA is for the construction / rehabilitation works of underground sewer networks. At present there are about 881 Km of sewer within the jurisdiction of DWASA, covering about 20% of the present population. Most of these sewer networks are located beneath the city roads along with other underground utility services. Major environmental degradation will occur and sufficient precautionary measures needs to be undertaken during the construction / rehabilitation of the sewer networks, although there is no land acquisition cases occur, which are as under:

- Vehicular traffic and pedestrian shall always be disturbed during the construction / rehabilitation of sewer networks, because of the location of the sewer beneath the city roads, so extra precaution should be taken to keep the disturbance as minimum as possible,
- Before excavation all road surface should be cut by using modern cutter to avoid damage of the existing road surface,
- Trial holes should be done very carefully to locate the existing underground utility services before finalization of the alignment for the new construction of the sewer pipelines;
- Use of modern techniques of construction methods such as trench less technology, tunneling, use of excavator, working at night, using heavy steel sheets over the open trench and allow vehicular traffic or pedestrian that do little damage to environment (replacing in-practice crude methods), to reduce environmental pollution.
- Excavated earth / materials should be removed from the site simultaneously by using covered dump truck, so that existing roads are not damaged during removing the excavated materials, and this will reduce the blockage of roads by the excavated materials and will not cause traffic congestion near the construction area,
- During new construction / rehabilitation of sewer pipelines care should be taken so that mobile shop owners and nearby temporary or permanent shops and residents are not disturbed beyond the tolerable limits &/or adequate compensation is given as per Resettlement Policy Framework,
- During construction stage, especially during the winter dust may cause serious air pollution, which should be controlled in a planned manner by spreading water over the working area at certain interval,
- There should not be any compromise with the health and safety issues of the workers / supervising personnel, officials and nearby public,
- Sufficient care should be taken so that all workers use helmets, gum boots, and other protective clothing during excavation in trench and removing excavated materials, which may cause health risks to the workers,
- Dewatering from the excavated trench and discharging water to the open road other than the existing alternate drainage channel will cause temporary water logging, damaging the roads, and thereby will cause water related diseases causing human health risk,
- Better planning for cutting the road surface, trench cutting, removing excavated earth, providing sight rails, providing heavy steel sheets over the trench for vehicular and pedestrian crossing, installing pipes, and

timely backfilling the trench for section by section will reduce the public sufferings to a great extent,

- In the busy & narrow roads works should not be executed during the day time, which will not create unnecessary traffic congestions,
- Traffic signals, Red signals, especially during night and other protective measures should be undertaken both day and night in order to avoid unpleasant /unwanted accidents near the construction site (s),
- All sewer pipelines are installed properly by maintaining the gradient /slope using the leveling instrument &/or with the help of sight rails above the ground with pre-leveled based on cut-sheet,
- Manhole construction should be executed by providing temporary fencing around it,
- First-aid kits should always be kept ready at the construction site,
- Safe drinking water for the workers should be available at site, and proper sanitation arrangement must be made properly at the site or near the site within the walking distance,
- The World Bank study emphasized the target of introducing environmentally sound non-polluting vehicles and also of reducing air pollution from the industrial or any other sources.
- All underground utility services should be protected properly and in case of any accidental damage, it should be repaired as quickly as possible as per recommendation / suggestion of the concerned agency.

3.3. Construction / Rehabilitation of Sewage Lifting Station

Sewer Networks are designed under gravity flow condition, but especially in the flat region like Dhaka City, some sewage lifting station (SLS) is needed to pump out the collected sewage though the sewer pipelines towards the next STP i.e. the ultimate outfall. At present there are 29(twenty nine) SLS operated and maintained by DWASA. During installation / construction of such SLS or boosting station all probable environmental degradation aspects such as air pollution, noise pollution, water pollution, land acquisition, health & safety issues, resettlement, etc should be considered very carefully avoiding all negative environmental impacts. In order to achieve these targets following aspects should be considered :

- Generally SLS are located at the lowest level of incoming sewer and pumped to the outlet sewer leading to the STP i.e. ultimate outfall,
- Land acquisition should be carefully dealt to avoid resettlement of the residents, squatters, slum people, houses, buildings, shops, small shops, even mobile shops and all other affected people,
- Adequate compensations should be given to the project affected persons, as per Resettlement Policy Framework,
- During construction stage, especially during the winter dust may cause serious air pollution, which should be controlled in a planned manner by spreading water over the area at certain interval,
- Normally the SLS are constructed for deep excavation and sufficient care must be taken to avoid accidents among the workers due to side collapse, land sliding, etc,
- There should not be any compromise with the health and safety issues of the workers / supervising personnel, officials and nearby public,
- During construction of installation of pump sufficient precaution should be made, so that by any means surface or groundwater is not polluted,
- Pumps and electrical equipment are to be installed which will produce minimum noise. Similarly during excavation of earth excessive noise should be avoided, even if any cutter make excessive noise, it should not

be used during night after 10:00 pm so that nearby public do not feel disturbance for their sleeping,

- Trucks carrying excavated materials or any other dumping materials, sufficient care should be taken so that roads are not damaged and solid wastes are not thrown here and there which will create environmental pollution,
- Sufficient care should be taken so that all workers use helmets, gum boots, and other protective clothing during removing wastes / sludge, &/or excavated materials from the trenches, which may cause health risks to the workers,
- All excavated materials &/or sludge should be dumped carefully to a safe and planned dumping places, so that these do not create health hazards or environmental pollution to the surrounding areas,
- Use of modern techniques of construction methods i.e. use of excavator, cover dump truck etc that do little damage to environment (replacing in-practice crude methods). To reduce the environmental pollution.

3.4. Construction of CETP

Central Effluent Treatment Plant (CETP) has been planned to be constructed at the low lying area of Tejgaon Industrial Area under the sub-project DS – 2, so that Dhaka city can be made free from pollution arising from unhygienic disposal of sewage either from domestic or industrial and also to build up a common effluent treatment plant (CETP) at Tejgaon Industrial Area to improve the health hazard of the community. Construction of the CETP will be like a modern STP. Land acquisition criteria should be followed very carefully so that excessive Resettlement can be avoided. However if the Resettlement cannot be avoided, adequate compensation should be given to the affected persons as per Resettlement Policy Framework. During construction of CETP all probable environmental degradation aspects such as air pollution, noise pollution, water pollution, land acquisition, health & safety issues, resettlement, etc should be considered very carefully avoiding all negative environmental impacts. In order to achieve these targets following aspects should be considered :

- Land acquisition for the new CETP should be carefully dealt to avoid resettlement of the residents, squatters, slum people, houses, buildings, shops, small shops, even mobile shops and all other affected people,
- Adequate compensations should be given to the project affected persons, as per Resettlement Policy Framework,
- During construction stage, especially during the winter dust may cause serious air pollution, which should be controlled in a planned manner by spreading water over the area at certain interval,
- Normally the CETP are constructed for deep excavation and sufficient care must be taken to avoid accidents among the workers due to side collapse, land sliding, etc,
- There should not be any compromise with the health and safety issues of the workers / supervising personnel, officials and nearby public,
- During installation of any equipment sufficient precaution should be undertaken, so that by any means surface or groundwater is not polluted,
- Pumps and machineries are to be installed which will produce minimum noise. Similarly during excavation of earth excessive noise should be avoided, even if any cutter make excessive noise, it should not be used during night after 10:00 pm so that nearby public do not feel disturbance for their sleeping,

- Trucks carrying excavated materials or any other dumping materials, sufficient care should be taken so that roads are not damaged and solid wastes are not thrown here and there which will create environmental pollution,
- Sufficient care should be taken so that all workers use helmets, gum boots, and other protective clothing during removing wastes / sludge, &/or excavated material from the trenches, which may cause health risks to the workers,
- All excavated materials &/or sludge should be dumped carefully to a safe and planned dumping places, so that these do not create health hazards or environmental pollution to the surrounding areas,
- Use of modern techniques of construction methods e.g. use of excavator, covered dump truck, vibrating machine, rod cutter, welding machine, etc that do little damage to environment (replacing in-practice crude methods). To reduce environmental pollution.
- First-aid kits should always be kept ready at the construction site,
- Safe drinking water for the workers should be available at site, and proper sanitation arrangement must be made properly at the site or near the site within the walking distance.

GENERIC ENVIRONMENTAL MANAGEMENT PLAN FOR SEWAGE AND SANITATION COMPONENT

Sub-Project	Impacts	Mitigation Measures	Project Phase	Responsibility
Sewage Treatment Plant and Sewage Pumping Stations	Acquisition of Private Agricultural land or forest land	• Avoid or minimize the area of acquisition • Preparation of adequate land acquisition plans before implementation	Planning / design	
	Loss of trees and vegetation	• Compensatory planting should be done. • Plant double the number of trees cut	Construction	
	Disruption to vegetation and eco-system	• Avoidance of disruption to grasslands, wetlands and other riparian areas	Construction	
	Accumulation of excavated earth in the areas of operation causing inconvenience to public	• Transportation and disposal of excess earth to a designated disposal site	Construction	
	Increased dust levels due to earth work excavation and construction activities	• Immediate shifting of excavated earth • Frequent sprinkling of water on excavated earth • Washing of construction site to control dust	Construction	
	Disturbance to other Utilities	• Scheduling activities in consultation with the other utility agencies and public and ensuring minimum disturbance to the utilities	Construction	
	Increased air pollution and Noise Levels during Construction	• Preventive maintenance of equipment and vehicles to meet emission standards and noise control, • Provision of Personal Protective equipment, ear muffs, etc. for the construction labor • Avoiding construction activities during nights	Construction	
	Disturbance to eco-system and bio-diversity	• Avoidance of eco-sensitive areas • Protective measures for Bio-diversity	Construction	
	Surface water /groundwater pollution due to discharge of sludge and effluent	• Treatment units should operated regularly to produce effluent to meet the effluent standards	Operation	
	Hazards due to storage of chemicals	• Training to operators on storage and usage of chemicals	Operation	
	Air pollution through ventilating shaft	• Ventilating shafts are located in such a way not causing pollution in to the nearby houses	Construction Operation	

Sub-Project	Impacts	Mitigation Measures	Project Phase	Responsibility
Public	Loss of trees and vegetation	▪ Compensatory planting should be done.	Construction	

Conveniences		▪ Plant double the number of trees cut		
	Nuisance to public	▪ Regular collection and disposal of waste ▪ Grow trees around the facility	Planning / design	
	Contamination by human waste/ excreta	▪ Regular cleaning of toilets ▪ Connection to sewerage system ▪ Provision for hand washing and toilets	Operation	
	Accumulation of excavated earth at site in causing inconvenience to public	▪ Transportation and disposal of excess earth to a designated disposal site	Construction	
	Increased dust levels due to earth work excavation and construction activities	▪ Immediate shifting of excavated earth ▪ Frequent sprinkling of water on excavated earth ▪ Washing of construction site to control dust	Construction	
	Disturbance to other Utilities	▪ Scheduling activities in consultation with the other utility agencies and public and ensuring minimum disturbance to the utilities	Construction	
	Increased air pollution and smell	▪ Ventilating shafts are located in such a way not causing pollution in to the nearby houses Regular cleaning and maintenance of facility ▪ Grow fragrance bearing plants around the facility	Construction Operation	

Sub-Project	**Impacts**	**Mitigation Measures**	**Project Phase**	**Responsibility**
Storm Water Drainage	Land Acquisition of Private Agricultural land for laying the transmission main	▪ Preparation of adequate land acquisition plans before implementation with disturbance of minimum area	Planning / design	
	Disturbance to eco-system and bio-diversity	▪ Avoidance of eco-sensitive areas ▪ Protective measures for Bio-diversity	Planning / design Construction	
	Ecological impacts due to cutting of trees	▪ Compensatory tree planting of trees double the number of trees cut	Planning / design Construction	
	Loss of fertile top soil of the Agriculture Lands along the alignment	▪ Preserve the topsoil removed and replace the topsoil back after completion of construction activity.	Construction	
	Temporary Disruption of natural drainage pattern	▪ Provision of appropriate by-pass arrangements for natural drainage during construction	Construction	
	Stagnation of water on the road	▪ Proper design of grade for the edge drains and lateral drains and size of inlets	Planning / design	
	Stagnation leading to mosquito breeding and public health problems and surface water pollution	▪ Providing proper section and grades to drains ▪ Covering the drains	Planning / design	

	Lowering of groundwater table due to pumping of water during excavation	▪ Scheduling construction activities of deeper sections in summer months to avoid huge pumping	Construction	
	Stagnation of sewage, odor problem Overflow causes water pollution in channels and water bodies Ugly and unsightly conditions	▪ Strict adherence of pumping schedule	Operation	
	Cross contamination of water supply pipeline	▪ Sewer line should be laid below water supply line with vertical clearance of 45cm and horizontal separation of joints by 3m on both sides	Construction	
	Disturbance to the general public and vehicle movements	▪ Actions to divert and regulate traffic in consultation with citizens in advance through citizen's meeting ▪ While planning alternate route care should be taken to minimize impact at sensitive locations such as schools and hospitals ▪ Signals and signs of diversion should be provided	Planning / design Construction	
	Disruption of Utilities such as electricity, telephone and other services	▪ Preparation of Plan for shifting or safe guarding of utilities and getting appropriate approvals / permissions in advance from the concern agencies ▪ Carrying out shifting or safe guarding arrangements at the earliest possible time	Planning / design	
	Storage of materials causing disturbance to public and traffic	▪ Suitable sites should be identified for storage of materials	Planning / design	
	Excavated earth on the road causing inconvenience to public	▪ Disposal of unused / excess earth at an environmentally suitable disposal site	Construction	
	Disturbance to traffic and general public	▪ Actions to divert and regulate traffic in consultation with citizens in advance through citizen's meeting ▪ While planning alternate route care should be taken to minimize impact at sensitive locations such as schools and hospitals ▪ Signals and signs of diversion should be provided	Construction	
	Damage to road surface /other utilities	▪ Reinstatement of Road Surface in earliest possible time	Construction	
	Risk of accidents	▪ Effective safety and warning measures ▪ Temporary crossings across the pipeline trench	Construction	

		wherever necessary		
	Cultural relics	▪ Fossils, coins, articles of value and other remains of geologic or archeological interests if found shall be informed to the authorized institution and excavation shall be stopped	Construction	
	Cultural relics	▪ Fossils, coins, articles of value and other remains of geologic or archeological interests if found shall be informed to the authorized institution and excavation shall be stopped	Construction	
	Increase in Air pollution and dust levels due to construction activities	▪ Sprinkling water /washing of construction site to control dust	Construction	
	Increased Noise level	▪ Preventive maintenance of equipment and vehicles to reduce noise ▪ Sound barriers in inhibited areas shall be provided ▪ Safety devices such as ear plugs are provided to workers	Construction	
	Air pollution through ventilating shaft	▪ Ventilating shafts are located in such a way not causing pollution in to the nearby houses	Planning / design Construction	
	Increase in dust levels to due to earth work and other construction activities	▪ Take suitable measures to control dust through sprinkling/washing of construction site	Construction	
	Dust, Noise due to movement of vehicles	▪ Preventive maintenance of equipment and vehicles to reduce noise ▪ Sound barriers in inhibited areas shall be provided ▪ Safety devices such as ear plugs are provided to workers	Construction	
	Projection/depression of Manhole covers on the road surface causing inconvenience to public; leading to accident	▪ Proper planning of road construction with fixing the formation level ▪ Strict quality control in road construction	Construction	
	Social disruption	▪ Preference to local labour	Construction	Contractor
	Leakage causes nuisance	▪ Leaks should be identifies and rectified then and there	Operation	ULB/ Operator

3.5. Construction of Wetland

Construction of Wetland has been planned to be constructed at the low lying area east of Tejgaon Industrial area under the sub-project DS – 2 where feasibility study is being conducted for Construction of Wetland at north east of Trimohoni/Narai Khal. Wetland will be used for secondary and tertiary treatment of waste water, but it will require larger area than the stabilization ponds. Land acquisition criteria should be followed very carefully so that excessive Resettlement can be avoided. However if the Resettlement cannot be avoided, adequate compensation should be given to the affected persons as per Resettlement Policy Framework. During construction of Wetland all probable environmental degradation aspects such as air pollution, noise pollution, water pollution, land acquisition, health & safety issues, resettlement, etc should be considered very carefully avoiding all negative environmental impacts. In order to achieve these targets following aspects should be considered :

- Land acquisition for the Wetland should be carefully dealt to avoid resettlement of the residents, squatters, slum people, houses, buildings, shops, small shops, even mobile shops and all other affected people,
- Adequate compensations should be given to the project affected persons, as per Resettlement Policy Framework,
- During construction stage, especially during the winter dust may cause serious air pollution, which should be controlled in a planned manner by spreading water over the area at certain interval,
- Normally the Wetland are constructed in a marshy land and sufficient care must be taken to avoid accidents among the workers due to side collapse, land sliding, etc,
- There should not be any compromise with the health and safety issues of the workers / supervising personnel, officials and nearby public,
- During construction of Wetland sufficient precaution should be undertaken, so that by any means surface or groundwater is not polluted,
- Trucks carrying excavated materials or any other dumping materials, sufficient care should be taken so that roads are not damaged and solid wastes are not thrown here and there which will create environmental pollution,
- Sufficient care should be taken so that all workers use helmets, gum boots, and other protective clothing during removing wastes / sludge, &/or excavated material from the trenches, which may cause health risks to the workers,
- All excavated materials &/or sludge should be dumped carefully to a safe and planned dumping places, so that these do not create health hazards or environmental pollution to the surrounding areas,
- Use of modern techniques of construction methods e.g. use of excavator, covered dump truck, vibrating machine, rod cutter, welding machine, etc that do little damage to environment (replacing in-practice crude methods). To reduce environmental pollution.
- First-aid kits should always be kept ready at the construction site,
- Safe drinking water for the workers should be available at site, and proper sanitation arrangement must be made properly at the site or near the site within the walking distance,

4. Responsibilities of Personnel engaged for Implementation

4.1. Responsibilities of Working Contractors

Normally all contractors would be selected as per procedure outlined in the PPR'03 who would play vital role during the construction period of any contract to maintain all possible precautionary measures to improve the environmental degradation. Therefore, contractors should be provided sufficient knowledge about the merit and demerits of environmental pollution, especially about the negative environmental impacts. If the contractor is well educated, experienced and well conversant about the environmental degradation many environmental improvement can be achieved without mitigation measures. In order to execute any development works smoothly, efficiently and successfully the working contractors should undertake the following responsibilities :

- First and foremost responsibility of the working contractor to provide safety tools e.g. helmets, gum boots, protective cloths, gloves, rain coats, to all workers engaged in the working site,
- They are responsible for looking into the health and safety procedure throughout the construction period,
- They are responsible to arrange safe drinking water and sanitation facilities for their workers close to the site,
- All traffic signals and red signals should be arranged for the safety of others to avoid unwanted & unpleasant accidents,
- They are responsible to give proper compensation to the workers if there be any accidents at site,
- They are responsible to give proper compensation to the affected persons whose properties would be damaged at site due to his negligence in obtaining precautionary measures,
- Dust pollution and air pollution can be controlled and minimized by the contractors, if they are vigilant and spread water at site at frequent interval,
- Provided sufficient precautionary measures are taken at site, all possible accidents related to trench collapse, damaging road surface, surface and groundwater pollution, air pollution, noise pollution, and other environmental pollutions can be avoided,
- Most of the mitigation measures to be taken at site, are the responsibilities of the working contractors,
- By using the modern construction techniques / methods e.g. use of road cutters, excavators, cover dump trucks, trench less technologies, tunneling, providing steel sheets over the open trench, mixer machine, vibratos, etc. would minimize all possible environmental degradation,
- Site clearance after completion of all development works are the responsibility of the working contractors,
- Traffic congestion can also be avoided if the contractor takes all possible precautionary measures at site including well planning of the construction method.

Best-Practice for Environmental Management and Mitigation Measures

Environmental Issues	Actions Required by the Contractor
Construction Wastes	Dispose solid and liquid wastes in a safe place. Monitor water quality around site activities.
Water logging	Avoid water logging, scour and erosion through enabling continued piped water/sewerage flow in project sites.
Spoil or debris	Remove spoils, debris and silt deposited on and around the site and restore the affected area to its original state.
Chemical and fuel	Chemical and fuel storage shall be sited on an impervious base within a secured area. This shall be located away from any commercial, residential establishments. The contents of any drum / container shall be clearly marked.
Air quality	Use working methods that minimize gaseous, dust or other air-borne emissions and carry out the works in ways that minimize adverse air quality. Avoid work during high wind, no dust generating operations shall be allowed, equipment and vehicles shall be kept in good working order.
Control site operations within noise limits	Necessary measures should be taken to ensure operation of mechanical equipment and machinery and works do not cause any excessive noise. Suspend activities during prayer time.
Water Quality	All liquid waste products arising on the sites shall be collected and disposed off at location onsite or offsite and in a manner that shall not cause pollution.
Welfare on Site	Provide safe drinking water to all employees. Sanitary facilities shall be properly arranged for male and female workers. Encourage employees to wash frequently, particularly those exposed to chemicals, dust or pathogens. Pre-employment and periodic medical examinations shall be conducted for all workers.
Traffic Management	Manage traffic to ensure the safety of all road users, construction workers and general public. When digging/repairing the site, provide appropriate traffic management and calming measures (e.g. traffic signs - stop/go, speed limit, men-at-work, road narrowing or lane closure) and use traffic cones to control traffic flow.

4.2. Responsibilities of Construction Supervising Personnel

The supervising personnel shall play an active role during implementation process of any development works. They will monitor the actions taken by the contractors at site for and on behalf of the executing agency. They may be appointed by the executing agency himself or directly employed by the supervisory consultants (as the case may be). Their role is to ensure that the working contracts follow their instructions as per conditions of contract documented in the tender documents, specifications, drawings and other written or verbal instructions of the Engineer in charge. Normally they maintain a site instruction book with them, where the Engineer in charge or any other senior officials of the executing agency or the consultants (if any) give written instructions about the improvement of site condition, working method or procedure, quality of materials, maintaining proper construction environment,

etc. In order to execute any development works smoothly, efficiently and successfully the supervising personnel should undertake the following responsibilities :

- Continuously check to ensure that the environmental parameters are well maintained by the working contractors,
- Dust control, air pollution, noise pollution, water pollution, or any other environmental degradations at site should be controlled,
- Traffic congestion at site should be kept as minimum as possible,
- Walkways for the neighboring houses and other pedestrian should be provided along with normal vehicular movement near the construction site with least disturbances,
- Health and safety issues of the workers including ensuring availability of safe drinking water and proper sanitation facilities should be checked.
- There should not be any compromise regarding health and safety issues,
- The Excavated materials should be removed from site side by side and adjoining roads should not be damaged during carrying of excavated materials from site,
- Noise pollution should be kept at reasonable limit at all time, especially while working at night after 10:00 pm,
- Proper signaling, use of red signals at night, precautionary measures are to be ensured at site to avoid accidents,
- Ensure that the working contractors are providing safety tools e.g. helmets, gum boots, protective cloths, gloves, rain coats, etc to all workers engaged in the working site,
- Ensure that all excavated materials &/or sludge should be dumped carefully to a safe and planned dumping places, so that these do not create health hazards or environmental pollution to the surrounding areas,
- Ensure Use of modern techniques of construction methods e.g. use of excavator, covered dump truck, vibrating machine, rod cutter, welding machine, etc that do little damage to environment (replacing in-practice crude methods). To reduce environmental pollution.
- Ensure that the first-aid kits are kept ready at the construction site,
- Ensure that especial precautionary measures are taken during use of toxic chemicals at site by the workers,
- All underground utility services should be protected properly and in case of any accidental damage, it should be repaired as quickly as possible as per recommendation / suggestion of the concerned agency.

4.3. Responsibilities of Executing Agency

The overall responsibility of the executing agency is to ensure that the tender documents are well documented to ensure that all related environmental aspects are covered, which are mandatory to be followed during execution or implementation of the sub-projects or new projects. During the pre-bid meeting all environmental aspects should be highlighted in details so that the bidders submit their offer with due considerations of the construction related environmental parameters. Again during the **"kick of meeting"** all the construction related environmental aspects should be highlighted, so that the working contractor realize the importance of the environmental degradation, negative impacts or any other important features. In order to execute any development works smoothly, efficiently and successfully the executing agency should undertake the following responsibilities :

- Ensure that application and precautionary measures with respect to the environmental aspects are well understood by the contractor, supervising personnel, senior officials of the department those who are directly or indirectly responsible for implementation of the project, consultant, NGO (if any),
- Ensure punitive action against the defaulter (s) violating the environmental aspects at any time during the construction stage,
- Create public awareness campaign (by using the media, website, or by engaging NGO, etc) regarding the negative environmental impacts, likely to occur during and after implementation of the project.
- Coordinate with the underground utility service providing agencies and assist to obtain necessary permission (if required) from the respective agency including road cutting permission from DCC and DMP.

4.4. Responsibilities of the Consultant

The consultant responsible for the detailed engineering design should ensure that the recommendations of all environmental aspects, which are laid down during approval of the project based on the feasibility study. Those who are engaged for preparing the tender document including preparing the technical specifications, special terms and conditions, should include the construction related environmental aspects, which are mandatory to be followed strictly during execution of implementation of the project. During pre-bid meeting the consultant (if present) should highlight the importance about the environmental degradation, negative impacts and all precautionary measures to be taken during implementation of the project. Again during the **"kick of meeting"** the consultant (if present) should highlight the importance of all the construction related environmental aspects, so that the working contractor realize the importance of the environmental degradation, negative impacts or any other important features including possible precautionary measures to be undertaken during implementation of the project. In order to execute any development works smoothly, efficiently and successfully the consultant should undertake the following responsibilities :

- Environmentalist (s) should be included in the consultant's team (both for study, design & supervision) who are well acquainted with the prevailing rules, regulations and legislation available in the country and conditions given by the donor agency with respect to the environmental aspects,
- All supervising personnel and senior consultants engaged by the consultant and responsible for the supervision works in the project should also be well trained, experienced and well acquainted with respect to environmental aspects in detail,
- While the consultant is engaged for full time supervision of the project, then the consultant should undertake 100% responsibilities to implement all environmental management aspects, and other precautionary measures during implementation of the project,
- Ensure punitive action against the defaulter (s) violating the environmental aspects at any time during the construction stage,
- Ensure proper clearance of site at the end of the project, so that no environmental degradation is occurred with the surplus materials of the contractor.

4.5. Responsibilities of the NGO

The NGO can play a vital role to build up public awareness campaign, especially among the inhabitants of slums & fringe areas of the Dhaka City with respect to the services rendered for the water supply and sanitation and thereby for the

improvement of public health, social and natural environment. In order to provide services by the NGO when engaged by the department, they should undertake the following responsibilities :

- The NGO must provide firm commitment that they have no vested interest in the proposed development activities, other than ensuring compliance to their responsibilities as per specified terms of reference set forth by DWASA,
- They should motivate the public to participate in the development process including operation and maintenance of the services rendered to them, which is the national assets,
- They should motivate and create awareness amongst the public regarding the positive and negative environmental impacts of the development process,
- They should motivate the public to change their personal habits for the improvement of their personal hygiene, health of family members and social environment as well as community environment,
- During the construction and implementation of the development process there may be some temporary disturbances, hazards and environmental degradation, but upon successful completion of the projects it will provide immense benefits to the community. NGO should inform the stakeholders about such benefits in advance so that they realize and support the ongoing development process.

4.6. Responsibilities of the Ministry

DWASA is under the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC), Local Government Division, Government of the People's Republic of Bangladesh. Local Government Division, will be responsible for overall planning, identification of investment projects and coordination of activities of agencies under it. MLGRDC shall accord the greatest possible degree of autonomy to DWASA in decision-making at the operational level. The MLGRDC discharges its functions for monitoring the DWASA's overall performances. The MLGRDC shall monitor, evaluate periodically the physical and financial performances of DWASA for the purposes ensuring that both the objectives for execution of plans and programme are being effectively implemented in accordance with the approved performance targets.

The ministry's activities can be compared like an umbrella and the proponent or the executing agency should work under the same umbrella. The ministry will provide necessary guidance, approval and arrange funding for all development activities to be undertaken by the executing agency. The ministry will constitute the inter-ministerial steering committee to resolve the issues (viz the environmental policy), which is beyond the competency of the ministry.

5. Operation & Maintenance (O&M)

5.1. O&M of Sewer Network

At present there are about 881 Km of Sewer Networks within the jurisdiction of DWASA of different diameters including the bigger diameter trunk sewers and 29 Sewage Lifting Stations (SLS). All sewers are designed to operate under gravity flow that is the reason for constructing large numbers of SLS. Provided the gradient / slope of the sewer is maintained properly and self cleansing velocities are attained, which is critical at night, sewer should work smoothly. Otherwise, sludge accumulates at the bottom of the sewer, which ultimately obstacles the normal sewage flow and thereby blockage of sewer is encountered. Operation and Maintenance (O&M) of the sewer networks are briefly stated as under :

- Cast Iron manhole covers are often stolen very frequently, and the sweepers &/or nearby residents used to dump the solid wastes inside the sewer, which often causes hindrance of the normal sewage flow, and accidents are observed frequently causing human health risk,
- During construction period sufficient care must be taken to maintain the gradient / slope of the sewer as per design, otherwise the sewer may not function properly,
- Sewer should be cleaned properly upon completion of the construction works and before inter-connection to the main sewer,
- Sludge is accumulated at the bottom of the sewer and thereby reduces the diameter of the sewer and cause hindrance of normal sewage flow, and overflowing the sewage through the manhole cover causing environmental pollution to the surrounding areas,
- Unless and until the sewer is cleaned periodically either manually or by mechanically through the sewer cleaning vehicle or by other means, normal function of sewer cannot be ensured,
- If there is large leakage or breakage in the sewer, infiltration volume is increased tremendously and thereby excessive load for pumping in the SLS, especially during rainy season or flood,

5.2. O&M of Storm Water Drainage Network

At present there are about 233 Km of Storm Water Primary Drainage Networks, 65 Km of open drainage channel and about 8 Km of box culverts within the jurisdiction of DWASA of different sizes including the bigger diameter trunk mains and 3 Pumping Stations. All storm water conduit drains are designed to operate under gravity flow. Provided the gradient / slope of the conduit drains are maintained properly and self cleansing velocities are attained, which is critical during the dry season, all drains should work properly. Otherwise, sludge accumulates at the bottom of the drain, which ultimately obstacles the normal flow and thereby blockage of drains are encountered. Operation and Maintenance (O&M) of Storm Water Drainage networks are briefly stated as under :

- Cast Iron manhole covers are often stolen very frequently, and the sweepers &/or nearby residents used to dump the solid wastes inside the drains, which often causes hindrance of the normal flow, and accidents are observed frequently causing human health risk,
- During construction period sufficient care must be taken to maintain the gradient /slope of the drains as per design, otherwise, the drain may not function properly,

- Drains should be cleaned properly upon completion of the construction works and before inter-connection to the main drainage networks,
- Sludge is accumulated at the bottom of the drain and thereby reduces the diameter of the conduit and cause hindrance of normal flow, and overflowing through the manhole cover causing environmental pollution to the surrounding areas,
- Unless and until the sewer is cleaned periodically either manually or by mechanically, normal function of the drain cannot be ensured,
- If there is large leakage or breakage in the drain, infiltration volume is increased tremendously, and thereby drainage will not function properly and thereby water logging causing environmental degradation.
- Catch pits should be cleaned frequently, especially before the rainy season starts, otherwise, temporary water logging may occur. Removal and disposal of the sludge &/or solid wastes from the catch pits may cause environmental pollution,
- Open channel and the box culverts should be cleaned frequently to maintain the normal flow.

5.3. O&M of Sewage Treatment Plant

The facultative lagoon located at Pagla which is the only Sewage Treatment Plant (STP), operated and maintained by DWASA, serving about 20% of the present population of Dhaka city. O&M of the STP is almost a daily routine work to be undertaken by the staffs engaged for the STP. One of the most important parameter of the O&M is to discharge or dispose of the sludge obtained during cleaning operation from the lagoon, may be once in a year . If these sludge is not disposed of properly in a planned way it will create human health hazard and causes environmental pollution to the surroundings. Similarly if the effluent of the STP is discharged to the river without proper treatment, it will create river pollution causing ecological risk, mortality of fish & aquatic plant. In addition to those stated above another daily routine task is to clean and dispose of the solid wastes collected from the grit chamber. These sludge to be disposed of properly in a hygienic way, otherwise, it will create environmental degradation causing human health hazards.

5.4. O&M of CETP

At present the CETP is under the feasibility study &/or under the design & planning stage. When it will be constructed and operated it needs several routine O&M activities like the STP, where there are possibilities of environmental degradation. If the sludge is not disposed of properly in a hygienic way, it will create human health hazards. Routine O&M activities would be spelled out properly during preparing the operation manual for the CETP.

5.5. O&M of Wetland

Wetland is also under the feasibility study &/or under the design & planning stage. When it will be constructed and operated it needs several routine O&M activities like the STP, where there are possibilities of environmental degradation, if the sludge is not disposed of properly in a hygienic way. Routine O&M activities would be spelled out properly during preparing the operation manual for the Wetland.

5.6. O&M of WSS Programme

Water Supply and Sanitation (WSS) programme to the low income communities of Dhaka city includes providing the services for water supply, sanitary sewage and drainage components. O&M of sanitary sewage & drainage components

have been discussed earlier in details and as such it will not be repeated, hence only the O&M for the water supply networks shall be discussed below :

- Water supply distribution networks are designed for pressure flow. Here maintenance of proper gradient is not so important, but leakage in pipeline is important, because more is the system pressure more is the wastage of water through the leakage in pipeline,
- Gate Valves, Pressure Reducing Valves, Washout Valves are installed in the water pipelines some times found leaking, where again the more is the system pressure more is the wastage of water through the leakage of valves,
- Due to power failure or any other reasons, if the supply of water is disrupted for several hours, dirty water or polluted water may enter into the system through these leakages and ultimately these polluted water are supplied to the consumer when the water supply is restored,
- Public awareness to be created so that the consumers should not use the supplied water for the domestic purposes unless it is boiled properly (at least 10 minutes of continuous boiling after the boiling point starts).
- Public awareness should be created so that the consumer inform to the MODS Zone office or any other offices of DWASA about any leakages noticed within the locality, so that the leakage can be repaired as quickly as possible to save national wealth,
- Public awareness should also be created to save water, even if it is metered & the consumers are willing to pay for their excess consumption, by changing the personal habits of the consumer,
- All underground utility services should be protected properly and in case of any accidental damage, it should be repaired as quickly as possible as per recommendation / suggestion of the concerned agency.

5.7. O&M of Sewage Lifting Station

Generally sewer is designed under the gravity flow by maintaining the slopes properly. Since Dhaka city is more or less flat and as such many Sewage Lifting Stations (SLS) have been designed and operated for intermediate boosting of sewage flow. O&M of the SLS is important, which are briefly summarized as under :

- Overall maintenances of the pumps of the SLS is an important task,
- Regular removal of solid wastes and its safe disposal is an important task, which may cause human health hazards and environmental pollution to the surrounding areas,
- When upstream sewer is found leaking and if it is connected with the neighboring surface drain or storm water drain, excess pumping is required for the SLS and the situation is more aggravated during rainy season and flood,

5.8. O&M of Pump Galleries at Rampura Bridge Point and Janapath

DWASA has installed multiple pumps galleries at Rampura Bridge point and Janapath for pumping out the flood water from the city side to the river side to improve the flood situation. During the rainy season when the surrounding area is about to inundate, then these pumps are operated by the DWASA employees engaged for the respective station. O&M of the pump galleries are important, which are briefly summarized as under :

- All pumps should be checked and keep operative before the monsoon,

- Inlet points of pipes are to be checked and all solid wastes are removed and disposed of properly, otherwise it will create human health hazards risks and thereby environmental pollution to the surrounding areas,
- Supply of fuel for the pumps should be stocked in sufficient quantity,
- Operators should be well equipped with some emergency tools,
- Care should be taken so that flood water does not come into contact for the operators as well as for the pedestrian, which may cause skin diseases to the victims,
- First aid and safety kits should always be made available at the site to tackle the emergency situation,
- All staffs should be well equipped with the health and safety equipment e.g. gum boots, helmet, protective clothing, rain coats, etc.

6. Electro Mechanical Works

The electro mechanical equipments are the key components of any plant, which needs routine operation and maintenance and these are summarized as under :

- Electric supply should always be ensured and checked with the desired voltage, otherwise machineries and equipment may be damaged,
- There should not be any open electric connections without proper tapping, which may cause serious accidents to the staffs or other persons,
- All electrical units should always be functional efficiently, kept clean and rated voltage should always be attained,
- Emergency tool like tester, voltmeter, insulated screw drivers, pliers, etc should be kept at site to tackle the emergency situation,
- All staffs should be well equipped with the health and safety equipment e.g. gum boots, helmet, protective clothing, rain coats, etc.
- First aid and safety kits should always be made available at the site to tackle the emergency situation,
- Major motor failures occurs due to the presence of dirt, moisture, friction and vibration and as such routine cleaning is always essential,
- Proper oil and grease should be used and checked as a routine O&M programme,
- All switches including the starter switches are to be checked frequently and maintained properly,
- All fuses are to be checked frequently and spare fuses are always be kept ready at site to tackle the emergency situation,
- Lubricant is another important aspects for proper functioning of all moving parts, which need to be checked regularly and frequently,
- Bearings of pumps may create over heat and noise, which should be checked minutely and replace the same as and when required,
- Motor operating speed should also be checked and take remedial action if anything goes wrong,
- Cleanliness of the control equipment is another important O&M practice,
- Vibration and noise of pump should be checked, take appropriate remedial action and controlled to avoid noise pollution,
- Packing glands should be checked frequently,
- Over greasing should always be avoided as because too much greasing will cause damages as fast as lack of greasing,
- Sometimes over greasing of the bearing may damage the equipment,
- Manufacture's recommendation should always be followed as per their operating manual,
- Packing should be well lubricated because it increases the efficiency of the pump by reducing air leakage and prolong the life of packing and shaft by reducing the friction,
- If the packing box leaks excessively, remove the packing and repack with fresh packing,
- If the shaft is scored, the shaft should be replaced or the life of the packing would be shortened,
- Use of proper oil around the packing will prolong the life of the packing and will prevent leakage,
- Good maintenance depends on the availability of proper tools and recommended spare parts at site and should always be used by the trained staffs,
- Training and refresher's training should always be done at regular interval.

7. Summary of Monitoring and Maintenance

Monitoring and maintenance of machineries and equipment should always be attempted by the experienced and well trained personnel. In addition all other staffs should be given some sorts of preliminary training to tackle the emergency situation, even for shut down the equipment, switched off the electrical equipment, etc. Monitoring and maintenances for all components have been stated in details in the respective sections and as such no need to repeat these here. Major parameters are stated below :

- There should not be any compromise with the health and safety issues of the employees &/or workers,
- Safety equipment and tools should always be ensured and practiced by all employees &/or workers,
- Environmental degradation, especially the negative environmental impacts must not be allowed at any instance,
- Proper care should always be taken for the safe disposal of sludge, solid wastes and other toxic substances, so that these do not create human health hazards or risk, ecological risks,
- Public awareness to be created among the inhabitants to reduce water consumption, boil water properly before the domestic use, change personal habits to prevent wastage of water, use safe water for all purposes of domestic use and drinking,
- Keep clean the surroundings of the individual premises as well as communities, use sanitary latrine by all members of the family, keep the drain clean as far as practical,
- Always wash hands before & after eating and after using the latrine,
- Inform DWASA as quickly as possible, if any leakage in waterline, sewer & drainage is noticed within the locality,
- Health and safety issues including the improvement of the environmental degradation should be given top most priority.